

Evaluating Warehouse Management System (WMS) and Inventory Efficiency: Evidence from the Malaysian Automotive Industry

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ABSTRACT

The increasing complexity of operations in the automotive industry has created a strong demand for effective inventory management to ensure operational efficiency and customer satisfaction. Warehouse Management Systems (WMS) are widely used to support inventory control, improve data accuracy, and enhance decision-making processes. However, ineffective WMS implementation may result in problems such as inaccurate inventory records, stockouts, and inefficient warehouse operations. Therefore, this study aims to examine the role of WMS implementation in enhancing inventory management efficiency in the automotive industry. This research adopts a quantitative approach, focusing on key WMS-related factors such as the quality of WMS implementation, real-time data availability, system integration, and inventory efficiency. Data were collected using a structured questionnaire distributed to respondents involved in warehouse and inventory operations within the automotive sector. The collected data were analyzed using statistical techniques including reliability analysis, Pearson's correlation analysis, and regression analysis by SPSS tool. The findings reveal that the quality of WMS implementation has a significant positive impact on inventory management efficiency. In addition, real-time data availability and effective system integration were found to contribute to improved inventory efficiency, reduced stockouts, and better operational performance. Overall, the results confirm that an effective WMS plays a crucial role in enhancing inventory management efficiency. This study provides valuable insights for automotive organizations seeking to improve warehouse operations and strengthen inventory management practices through effective WMS implementation.

Keywords: inventory management, operational efficiency, customer satisfaction, warehouse operations, decision-making

INTRODUCTION

The automotive industry plays a critical role in global economic development and industrial growth. It involves a complex supply chain consisting of manufacturers, suppliers, and logistics providers that collaborate to produce and deliver vehicles. Given the large number of parts required for vehicle assembly, efficient inventory management is essential for ensuring smooth operations, timely production, and high levels of customer satisfaction. The automotive industry is a key player in global economic development, involving a vast network of companies that manufacture and supply vehicle parts, as well as factories responsible for assembling and delivering cars to customers. Efficient inventory management is vital to ensure the smooth operation of these companies. Proper management includes tracking parts and materials, storing them correctly, and ensuring timely deliveries. When inventory management fails, it can lead to delays in production, increased costs, and reduced customer satisfaction.

In the automotive sector, inventory management efficiency is crucial because even small disruptions in the availability of parts can significantly affect production timelines. Companies must ensure that the right parts and materials are available in the right quantity, at the right time, and in the right location. Poor inventory management practices can lead to production delays, increased costs, and diminished competitiveness in the market. These

inefficiencies are often exacerbated by issues such as inaccurate inventory tracking, lack of real-time data, and employee resistance to system changes. Efficient management of inventory is crucial to ensure smooth production and timely delivery of vehicles. However, many companies still struggle with inventory inaccuracies, which cause major disruptions in the supply chain. When there is a mismatch between recorded inventory and the actual stock in the warehouse, it often leads to stockouts, overstocking, or delays in order fulfilment. This can halt production lines and increase operational costs and subsequently reduce profits. Recent studies have emphasized that poor inventory visibility directly impacts warehouse performance, while inaccurate stock levels reduce picking efficiency and increase wasted labour. Youngswaing and Cheunkamon et al. (2024) reported that improving inventory tracking through structured warehouse layouts and automation increased inventory efficiency to over 99%, showing that better systems lead to better outcomes.

To address these challenges, many automotive companies have turned to WMS as a solution to streamline their inventory and warehouse operations. WMS automates critical warehouse functions such as receiving, storage, picking, and dispatching, providing organizations with better control and visibility over their inventory. In recent years, many automotive companies have adopted WMS to enhance their warehouse operations. This adoption is driven by the need to reduce operational costs, meet customer demands more effectively, and address supply chain challenges such as delays or shortages. By implementing a reliable WMS, automotive companies can improve flexibility, operational efficiency, and competitiveness in the market. In addition, WMS has been shown to reduce manual errors, improve inventory efficiency, and enhance overall operational efficiency, particularly in complex supply chains like those in the automotive sector.

As the demand for more efficient and responsive operations grows, the adoption of WMS has accelerated in the automotive industry. However, the success of WMS implementation depends on several factors, including system usability, real-time data availability, employee readiness, and strong management support. These factors play a significant role in determining how well WMS can improve inventory management efficiency. This study aims to examine the impact of WMS implementation on inventory management efficiency in the automotive sector. The findings of this research contribute to both academic literature and industry practice by identifying the key factors that influence the success of WMS in automotive warehouse operations and providing recommendations for improving inventory management practices.

LITERATURE REVIEW

As automotive manufacturing involves complex supply chains and strict production schedules, effective warehouse operations are essential. Several existing researchers studied how WMS could improve inventory efficiency, order processing speed, warehouse space utilization, and decision-making. WMS plays an essential role in streamlining inventory management, particularly in complex sectors like the automotive industry, where managing thousands of parts and components is critical to maintaining production efficiency.

WMS have become indispensable tools in modern warehouse operations, particularly for sectors like automotive manufacturing, where the scale and complexity of inventory management require precision and efficiency. A WMS is designed to automate the management of warehouse processes, which include receiving goods, storing them in the appropriate locations, tracking inventory levels, picking items for orders, packing, and shipping. Chong et al. (2021) highlighted that the key benefit of WMS is its ability to streamline these processes, reduce manual errors and ensure more accurate inventory records. By integrating various warehouse activities into a single system, WMS provides real-time updates on inventory, making it easier for managers to monitor stock levels, track inventory movements, and respond to discrepancies instantly.

In the context of the automotive industry, the role of WMS is even more critical due to the vast number of components involved in vehicle production. A single vehicle can require hundreds or even thousands of parts, and these parts often come from a wide range of suppliers. Davis and Hill (2022) argued that such complexity in the supply chain makes effective inventory management essential to prevent delays in production. Without an efficient system in place, minor disruptions in part deliveries can halt production, resulting in costly delays and increased operational costs. By using WMS, automotive companies can gain greater visibility into their inventory, allowing them to track every part, know its location within the warehouse, and predict when it will be needed on the production line. This visibility is key to avoiding both stockouts and overstocking, ensuring that parts are available

in the right quantity at the right time without tying up unnecessary resources in inventory.

In addition, Noriega et al. (2023) emphasized that another primary benefit of WMS is its ability to improve order fulfillment accuracy. Automotive companies often rely on just-in-time (JIT) inventory systems, which require parts to be delivered to the production line exactly when they are needed. A WMS plays a crucial role in supporting JIT by providing up-to-date, real-time information on stock levels and order status. This data helps warehouse managers to adjust orders, prioritize urgent stock, and coordinate with suppliers to ensure parts are available when needed. For example, WMS can track the precise location of each part, whether it is in transit, in storage, or ready for picking, allowing companies to make faster and more accurate decisions regarding inventory movement. The accuracy of this system reduces lead times, helps avoid overproduction, and ensures that automotive manufacturers can meet tight production schedules, ultimately reduce the costs and improve customer satisfaction.

Overall, the integration of WMS into automotive warehouses not only boosts operational efficiency but also improves supply chain visibility and control. By automating routine warehouse tasks and providing real-time updates, WMS enhances inventory management practices and ensures that parts are delivered to production lines without delay. This makes WMS a critical component in the automotive industry, where precision and efficiency are paramount to maintaining competitiveness and meeting customer demands.

Inaccurate Inventory Tracking

Inaccurate inventory tracking is one of the most pressing issues faced by automotive companies. As Khan et al. (2020) noted, traditional manual inventory systems are prone to human errors, which can lead to discrepancies between recorded stock levels and actual inventory. In the automotive industry, where the assembly of vehicles relies on thousands of parts, even minor discrepancies can halt production lines, causing costly delays. For example, missing parts can delay the entire production process, while overstocking results in the inefficiency of resources. As Hachem et al. (2016) highlighted, inaccurate stock levels can lead to logistical problems, such as incorrect shipments or unnecessary restocking, which disrupt the supply chain.

WMS systems help eliminate these issues by automating inventory tracking. By scanning items upon receipt and throughout their movement within the warehouse, WMS systems provide real-time, accurate data on stock levels. Chong et al. (2021) emphasized that WMS significantly improves the accuracy of inventory records by reducing manual input and automatically updating the database when inventory is moved or adjusted. This automation ensures that the inventory data remains aligned with the actual stock levels, preventing errors and improving decision-making. Furthermore, Davis and Hill (2022) noted that the integration of WMS with advanced technologies such as RFID and IoT has further enhanced inventory tracking capabilities. These technologies allow for more precise tracking of inventory throughout the entire supply chain, from suppliers to the production line. As a result, automotive companies can maintain more accurate stock levels, prevent stockouts, and streamline their operations.

WMS and Real-Time Decision-Making

In the automotive industry, the ability to make real-time decisions is essential for maintaining operational efficiency and avoiding costly delays. Real-time decision-making enables managers to address issues and make adjustments instantly, based on up-to-date information. This capability is particularly important in automotive manufacturing, where the timely delivery of parts to production lines is critical to maintaining production schedules. WMS play a crucial role in facilitating real-time decision-making by providing accurate and current data about inventory levels, part locations, order statuses, and stock movements. By offering real-time visibility into inventory, WMS allows warehouse and production managers to respond swiftly to changes in demand, delays in supply, or disruptions in the production process. This real-time data is invaluable for ensuring that the right parts are available when needed and production timelines are met without unnecessary interruptions.

In the automotive industry, where vehicle assembly involves hundreds or thousands of parts, accurate inventory management is crucial. Chong et al. (2021) explained that WMS systems track the movement of parts in real time, ensuring that managers know exactly where each part is located and in what quantity. If inventory for a specific part runs low, the WMS can immediately alert warehouse staff or procurement teams, prompting them to reorder

or source the part from another supplier. This real-time visibility helps companies avoid stockouts, which can cause production lines to halt and lead to costly delays. Furthermore, WMS systems can provide real-time data on inventory levels across multiple warehouses and distribution centres, ensuring that managers can manage stock effectively and avoid unnecessary overstocking.

In addition to inventory tracking, WMS systems also integrate seamlessly with other enterprise systems, such as Enterprise Resource Planning (ERP) and Supply Chain Management (SCM) systems. Lee et al. (2020) noted that this integration allows for the continuous flow of real-time data across different functions within the organization. For instance, when WMS detects low inventory levels, it can automatically trigger a reorder request through the ERP system, ensuring that parts are reordered promptly and delivered just in time for production. This integration ensures that decision-makers across the organization, from procurement to production to shipping, are all working with the same, up-to-date information. By connecting WMS with other enterprise systems, companies can automate many aspects of their supply chain, reduce the human error and enhance the speed of decision-making processes.

Real-time decision-making is further enhanced using technologies like RFID (Radio Frequency Identification) and IoT (Internet of Things), which are integrated with WMS systems. Davis and Hill (2022) highlighted that RFID tags and IoT sensors provide real-time data about the movement and condition of parts as they move through the warehouse and supply chain. For example, RFID tags can be placed on parts as they are received into the warehouse, allowing warehouse staff to track the exact location of each part as it moves through the system. This enables real-time tracking and helps managers make informed decisions about inventory movement, storage, and order fulfilment. Additionally, IoT sensors can track environmental conditions such as temperature and humidity, ensuring that sensitive parts are stored in optimal conditions, which is particularly important for the automotive sector where the quality of components is critical. These technologies allow for a higher degree of automation in inventory management, reducing the need for manual checks and enabling real-time adjustments based on current data.

Noriega et al. (2023) explained that modern WMS systems often come equipped with predictive analytics tools that analyze historical data and current trends to forecast future demand for parts. This predictive capability allows managers to make proactive decisions about stock levels and reorder points, reducing the likelihood of stockouts or overstocking. In the automotive industry, where parts availability must align precisely with production schedules, predictive analytics help managers ensure that the right parts are available at the right time. This capability allows automotive manufacturers to better manage their supply chains, minimize inventory waste, and avoid production delays caused by the lack of critical parts.

The synergy between WMS and Just-in-Time (JIT) inventory systems is another critical factor in real-time decision-making. JIT systems rely on the availability of parts exactly when they are needed, without excess inventory or delays. Chong et al. (2021) highlighted that WMS is vital to the success of JIT because it provides real-time data on inventory, which enables managers to coordinate part deliveries with production schedules. Real-time information from WMS helps automotive manufacturers ensure that parts arrive just in time for assembly, reducing storage costs and the risk of overstocking while preventing production disruptions. By tracking inventory in real time and making immediate adjustments to supply orders, WMS systems support JIT strategies, helping automotive companies maintain leaner operations and more efficient production processes.

In conclusion, WMS plays an indispensable role in enabling real-time decision-making in the automotive industry. By providing accurate, up-to-date information about inventory, part locations, and stock movements, WMS systems help managers make informed decisions that keep production lines running smoothly. The integration of WMS with other enterprise systems such as ERP and SCM enhances the speed and accuracy of decision-making, while technologies like RFID, IoT, and predictive analytics provide deeper insights into inventory management. As the automotive industry continues to face increasing demands for efficiency and flexibility, the ability to make real-time, data-driven decisions will be crucial to maintaining competitive advantage, and WMS will continue to be a key enabler of this capability.

Research Framework

WMS implementation refers to the adoption and integration of digital systems that help manage warehouse functions such as inventory control, stock allocation, receiving, and dispatching. A WMS typically replaces manual or paper-based processes with automated solutions that provide greater visibility and control over stock movement. When a WMS is effectively implemented, it helps streamline daily operations, reduce human error, and support accurate and timely inventory updates. Research by Sumayah et al. (2023) indicates that the implementation of WMS improves stock efficiency, reduces delays in inventory handling, and increases productivity within warehouse settings. By automating routine tasks and offering real-time inventory tracking, WMS enables warehouse teams to make quicker and better-informed decisions. As such, WMS implementation is viewed as a critical enabler of efficient inventory management.

Real-time data and availability refer to the capability of a warehouse system to reflect inventory status and stock movements instantly as they happen. This means that any item received, picked, packed, or shipped is recorded and updated in the system in real time. Access to real-time inventory data enables warehouse employees and managers to respond quickly to changes, reduce miscommunication, and avoid common inventory issues such as stockouts and overstocking. According to Bhattacharya and Momaya (2021), the availability of real-time data allows companies to improve their inventory efficiency and decision-making speed. With up-to-date and transparent inventory information, companies are better positioned to optimize space utilization, meet customer demands on time, and reduce excess stock. Real-time data thus plays a major role in enhancing the reliability and efficiency of inventory operations.

Inventory Management Efficiency

Inventory management efficiency is the ability of a company to manage its inventory in a way that meets demand while minimizing errors, waste, and operational costs. This variable includes factors such as accurate stock records, quick and complete order fulfilment, minimized stockouts and overstocking, and efficient use of warehouse space. When inventory is managed efficiently, the company can serve customers better, reduce unnecessary costs, and operate with greater predictability. According to Gunasekaran et al. (2020), organizations that implemented WMS solutions achieved higher accuracy in stock management, faster delivery cycles, and better alignment between inventory levels and actual demand. Inventory management efficiency is the ultimate outcome of effective warehouse operations and is influenced by various factors, including the quality of system implementation, the competency of employees, and the level of management support. It serves as the main dependent variable in this study, representing the overall success of WMS in enhancing warehouse performance. The hypothesis of the study is as follows,

H₀: The quality of WMS implementation does not significantly affect inventory management efficiency.

H₁: The quality of WMS implementation significantly affects inventory management efficiency.

H₀: The availability of real-time data does not significantly enhance inventory management efficiency.

H₂: The availability of real-time data significantly enhances inventory management efficiency.

RESEARCH METHODOLOGY

Research Design

This study adopts a quantitative research design to examine the effect of WMS on inventory management performance in the automotive sector. A quantitative approach is appropriate as the study collects numerical data, which allows the researcher to measure variables objectively and analyse the relationships between the factors under investigation.

The research design serves as a structured plan that guides the overall conduct of the study. It assists the researcher in determining how data should be collected, identifying suitable respondents, and selecting appropriate methods for data analysis. By following a clear research design, the study remains systematic, focused, and aligned with its

research objectives.

Data were collected using a structured questionnaire, which was divided into several sections corresponding to each variable in the study. Respondents were asked to indicate their level of agreement using a Likert scale, ranging from “strongly disagree” to “strongly agree”. This method enables the researcher to quantify respondents’ perceptions and facilitates statistical analysis using SPSS. This study is non-experimental in nature, as it does not involve any manipulation of variables or intervention within the organizations. Instead, it focuses on observing and analysing existing conditions to determine whether the implementation of WMS contributes to improved inventory management. Overall, the selected research design provides a clear and appropriate framework for achieving the objectives of the study.

The main instrument used in this study is a structured questionnaire, it is designed to collect quantitative data from employees in the automotive industry who are involved in warehouse, logistics, or inventory management whenever in that line. There are three sections. Section A focuses on collecting background information about the respondents. It includes questions about gender, age group, working experience and job position. These questions help the researcher understand the profile of the respondents and ensure they are relevant to the study. Section B consists of Likert-scale items designed to measure the main independent variables related to WMS implementation. Respondents are asked to indicate their level of agreement with each statement using a five-point Likert scale, where 1 represents “Strongly Disagree” and 5 represents “Strongly Agree.” Section C that assesses the dependent variable, which is inventory management efficiency. This section requires respondents to rate their agreement with statements about the accuracy of inventory records, the reduction of stock losses, improvement in inventory turnaround time, and overall satisfaction with inventory performance since the use of WMS.

Prior to distributing the final version of the questionnaire to the selected respondents, a pilot test was conducted to evaluate the clarity, structure, and overall effectiveness of the research instrument. The purpose of the pilot test was to identify any potential issues with the wording of the questions, the flow of the sections, and the ease of understanding for the target respondents. A small group of 10 individuals who work in warehouse, inventory, or logistics departments within automotive-related companies participated in the pilot test. These participants were selected because they matched the target population and had relevant experience with WMS. They were asked to complete the full questionnaire and then provide feedback on whether the instructions and statements were clear, whether any questions were confusing or repetitive, and how long it took them to complete the survey. Based on the feedback received from the pilot test participants, minor revisions were made to improve the clarity and structure of certain items. Some statements were reworded to be more specific or easier to understand, and the formatting of the response options was adjusted for consistency. The average time taken to complete the questionnaire was found to be reasonable, and no major technical issues were reported. The pilot test helped confirm that the questionnaire was well-structured, relevant, and appropriate for the study. By making small improvements before launching the full data collection, the researcher ensured that the instrument would produce more accurate, reliable, and valid responses from the main group of participants.

Population and Sampling Design

The target population for this study consists of employees working in the automotive industry in Selangor, Malaysia, particularly those involved in warehouse operations, logistics, and inventory management. These individuals are directly or indirectly responsible for handling warehouse systems and processes; and are likely to use or interact with a WMS as part of their job responsibilities. This population includes workers from a variety of automotive-related organizations such as automotive manufacturers, parts suppliers, and third-party logistics providers (3PLs). These companies operate at different levels of the automotive supply chain and typically rely on WMS solutions to manage their stock, track inventory movement, and improve efficiency in warehouse operations. The sample size for this study was determined using G*Power, a widely recognized software tool used in social science research to calculate the minimum number of respondents needed for statistical analysis. The final sample size of 200 respondents was considered adequate to detect statistically significant relationships between the variables.

Data Collection and Analysis

The questionnaire was shared with selected employees from various automotive companies in Malaysia, including manufacturers, parts suppliers, and logistics providers. The questionnaire was distributed both in person and online using platforms such as Google Forms. All respondents were informed about the purpose of the research, and their responses were kept private and confidential.

Akinyode and Khan (2018) stated that in order to correctly evaluate the study's findings, it is essential to have a thorough understanding of the qualitative data analysis methods used. By studying and analyzing data obtained from numerous data sources and utilizing a variety of data analysis tools, the probability of any biases that may have existed in the study was removed (Bowen, 2009). Data analysis needed to be categorized and compared so that it can establish important analysis as stated in the research objectives. There are three objectives in data analysis which are getting a feel for the data, testing the goodness of data and testing the hypothesis developed from the research (Sekaran, 2003).

After confirming that the data collected from the questionnaire was reliable through reliability testing, Pearson correlation analysis was conducted to examine the relationships between the independent variables and the dependent variable. This analysis was employed to determine whether there were statistically significant associations between each independent variable WMS implementation, employee training, system usability, real-time data availability, and management support, and inventory management efficiency. The Pearson correlation coefficient, denoted as r , was used to measure both the strength and direction of these relationships. The value of r ranges from -1 to +1. A coefficient close to +1 indicates a strong positive correlation, suggesting that as one variable increases, the other variable also increases. Conversely, a coefficient near -1 indicates a strong negative correlation, meaning that an increase in one variable corresponds with a decrease in the other. A value close to 0 implies that there is little or no linear relationship between the two variables.

The results of the correlation and regression analysis provided clear insights into how each factor influenced inventory management efficiency. For example, real-time data availability demonstrated a high positive correlation with inventory efficiency, indicating that companies which utilized up-to-date inventory information were able to manage their stock more effectively. The significance of each correlation was tested statistically, and those with p -values less than 0.05 were considered significant, confirming that the relationships were not due to random chance. Overall, the regression analysis provided empirical evidence supporting the hypothesis that these independent variables were associated with improvements in inventory management efficiency.

DATA FINDINGS & DISCUSSION

The analysis of gender in this study shows that out of 200 respondents, 135 (67.5%) are male, while 65 (32.5%) are female. This is clearly illustrated in the pie chart, where the majority of respondents (98%) are male, and only 2% are female. This gender distribution indicates a higher number of males compared to females in the sample, with a male-to-female ratio of about 2:1. The results may reflect specific characteristics of the surveyed population or could be related to the focus of the study itself. There were five age groups, the group by highest percentage were aged 41-50 years (29.5%), 31-40 years (20.5%), 51 years and above (17%), 21-25 years (16.5%), and the 26-30 years (16.5%).

The respondents' working experience were categorized into four groups: 1-3 years, 4-7 years, 8-10 years, and more than 10 years. The majority of sample (31.5%) with 8-10 years of experience, followed those with more than 10 years working experience (26.5%), while both the "1-3 years" and "4-7 years" groups each represent 21% of the participants. In terms of working position, the largest segment was managerial position (40%), followed by Distribution/Logistics Staff (26%), Supervisory (27%), Warehouse/Inventory Staff (7%), and administrative staff (7%).

The average score for Inventory Management Efficiency was 4.10, suggesting that respondents generally believed that WMS had a positive impact on improving inventory management efficiency. The standard deviation for inventory management efficiency was 0.85, indicating a higher level of variability in responses compared to the independent variables. This suggests that there were some differing opinions on the degree of impact WMS had

on inventory management efficiency. Overall, these results indicate that respondents had generally positive views on the effectiveness of WMS, employee training, and system usability in improving inventory management efficiency, but there was some variation in how they viewed the extent of these improvements. The scores for all 200 cases were usable for the analysis, with no data excluded as the Cronbach's Alpha value of 0.917, indicating a high level of internal consistency among the questionnaire items. A Cronbach's Alpha value above 0.80 is considered good, while values above 0.90 reflect excellent reliability.

The Pearson correlation analysis examined the relationships between the independent variables (such as WMS implementation, employee training, system usability) and the dependent variable (inventory management efficiency). The analysis revealed a strong positive relationship between WMS Implementation and Inventory Management Efficiency, with a correlation of 0.68 and a p-value of 0.000. This suggests that improvements in WMS implementation are significantly associated with better inventory management efficiency. In terms of multicollinearity, the tolerance values are above 0.05 and the VIF values are below 10 for most variables, indicating that multicollinearity is generally within an acceptable range. Overall, the findings suggest that WMS Implementation and Management Support and Readiness are the key determinants of inventory management efficiency in this study, while the remaining service quality dimensions (Real Time Data Accuracy, Employee Training Competency, and System Usability) do not significantly influence inventory management efficiency.

Regression Analysis

Regression analysis was employed to test the hypothesis. Based on the Model Summary provided in Table 1, the R value is 0.567, indicating a moderate positive relationship between the independent variables (Management Support and Readiness, Real-Time Data Accuracy, System Usability, WMS Implementation, and Employee Training Competency) and the dependent variable (Inventory Management Efficiency). This paper focuses on examining the relationship between Real-time data accuracy and the Inventory Management Efficiency.

Table 1: Model Summary

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.567 ^a	.321	.303	.27889

a. Predictors: (Constant), Management Support and Readiness, Real Time Data Accuracy, System Usability, WMS Implementation, Employee Training Competency

Source: SPSS output

The R Square value of 0.321 means that 32.1% of the variance in the dependent variable can be explained by the independent variables included in the model. This indicates that while the model explains a portion of the variance, the remaining 67.9% is influenced by other factors not included in the analysis. The Adjusted R Square value is 0.303, which accounts for the number of predictors in the model, indicating that 30.3% of the variance in the dependent variable is explained when adjusting for the number of variables. The Standard Error of the Estimate is 0.27889, which represents the average distance that the observed values fall from the regression line. A smaller value suggests reasonable prediction accuracy, indicating that the regression model provides fairly accurate predictions for the dependent variable, but some variability remains. In conclusion, the model explains 32.1% of the variance in the dependent variable, showing a moderate relationship between the predictors and the outcome, but the unexplained variance suggests that other factors not included in the model are also influencing the dependent variable.

The results show that WMS Implementation has a positive and statistically significant effect on inventory management accuracy ($\beta = 0.482$, $t = 6.906$, $p < 0.001$). This indicates that improvements in WMS implementation significantly enhance inventory management accuracy, making it the strongest predictor among the variables. Similarly, Management Support and Readiness also demonstrate a positive and significant relationship with inventory management accuracy ($\beta = 0.224$, $t = 3.153$, p

= 0.002), suggesting that strong management support and readiness positively influence inventory management accuracy.

On the other hand, Real Time Data Accuracy, Employee Training Competency, and System Usability do not show statistically significant effects on inventory management accuracy, as their significance values exceed the 0.05 threshold ($p > 0.05$). Although Real Time Data Accuracy displays a negative coefficient ($\beta = -0.134$), the effect is not strong enough to be considered significant in this model. Similarly, Employee Training Competency and System Usability have positive coefficients, but their effects are not statistically significant.

Based on the multiple regression analysis, the linear regression equation is expressed as follows:

follows:

$$Y = 2.650 + 0.374X_1 + (-0.107) X_2 + 0.056X_3 + (-0.023) X_4 + 0.180X_5$$

Where:

Y= Inventory Management Accuracy X_1 = WMS Implementation

X_2 = Real Time Data Accuracy

X_3 = Employee Training Competency X_4 = System Usability

X_5 = Management Support and Readiness

The results of the multiple regression analysis indicate that WMS Implementation and Management Support and Readiness have a significant positive effect on inventory management efficiency, as their significance values are less than 0.05. This suggests that improvements in WMS adoption and strong management support are crucial for improving inventory management efficiency. However, Real Time Data Accuracy, Employee Training Competency, and System Usability were found to have no significant influence on inventory management efficiency, as their significance values exceed the acceptable threshold level. This suggests that while these factors are important for service quality, they do not significantly predict inventory management efficiency in this study context.

Table 2: Results for the Hypothesis Testing

Hypothesis	Standardised Coefficient Beta	p-value
H ₁ : The quality of WMS implementation significantly affects inventory management efficiency	0.482	0.001
H ₂ : The availability of real-time data significantly enhances inventory management efficiency.	-0.134	0.084

Table 2 shows that the results indicate that WMS Implementation has a significant positive relationship with Inventory Management Accuracy ($t = 6.906$, $p < 0.001$). Since the t-value is greater than 1.96 and the p-value is less than 0.05, there is statistical evidence to reject the null hypothesis (H_0) and accept H_1 . This suggests that improvements in WMS Implementation significantly enhance Inventory Management Accuracy, making it the strongest predictor among the variables in this study. The results of the hypothesis testing confirmed that the quality of WMS implementation significantly affects inventory management efficiency. This means that organizations with a higher quality of WMS implementation are likely to see improvements in their inventory management efficiency. The evidence from this study supports the idea that effective WMS implementation enhances the overall performance of inventory operations by streamlining processes and reducing errors. Based on the significant results for H_1 , we can conclude that WMS implementation positively impacts inventory management efficiency. The higher the quality of WMS implementation, the more efficient the inventory management processes become, leading to improvements in inventory efficiency, reduced stockouts, and faster order fulfilment.

However, based on the results presented by Table 2, Real-Time Data Accuracy does not have a statistically significant relationship with Inventory Management Accuracy ($t = -1.735$, $p = 0.084$). Since the p -value is greater than 0.05, using 5% confidence level, the null hypothesis (H_0) is not rejected and hence, H_2 is not accepted. The hypothesis testing results showed that real-time data availability does not have a statistically significant impact on inventory management efficiency in this study. This suggests that while real-time data might intuitively seem like an important factor, its actual influence on inventory management efficiency may be limited or affected by other factors not captured in this study.

CONCLUSION AND RECOMMENDATION

The findings of this research have important theoretical implications for understanding the role of WMS in enhancing inventory management efficiency, particularly in the automotive sector. These implications contribute to the body of knowledge in operations management, logistics, and information systems, and offer insights for future research in these fields. The statistical evidence shows that WMS implementation has a significant and positive relationship with inventory management efficiency in the automotive sector. Both Pearson correlation and multiple regression analyses indicate that WMS implementation is the strongest predictor of inventory management efficiency and performance. This study suggests that automotive companies that effectively implement WMS are better able to maintain accurate inventory records, reduce discrepancies, and improve overall warehouse efficiency.

The significant impact of WMS implementation can be attributed to the automation and standardization of warehouse processes. WMS enables systematic control over inventory movements such as receiving, storage, picking, and dispatching. By reducing manual data entry and reliance on human judgment, the system minimizes the likelihood of errors that commonly occur in traditional warehouse operations. In the automotive industry, where inventory complexity is high, this level of control is essential to ensure smooth production and timely order fulfilment. Furthermore, effective WMS implementation enhances visibility and monitoring across warehouse operations. Managers are able to track inventory levels in real time, identify irregularities, and take corrective actions promptly. This improved control contributes directly to higher inventory efficiency and operational reliability. The findings therefore strongly support the research objective of evaluating the impact of WMS on improving inventory management efficiency in the automotive sector.

The results indicate that real-time data availability has a positive relationship with inventory management efficiency based on Pearson correlation analysis. This suggests that access to up-to-date inventory information is associated with better warehouse performance. However, the multiple regression analysis shows that real-time data availability does not have a statistically significant effect when other variables are considered together. One possible explanation for this outcome is that real-time data alone may not be sufficient to improve inventory efficiency if it is not actively utilized in decision-making. In some automotive warehouses, real-time information may be available through the system, but operational decisions may still depend on predefined schedules or managerial approval. As a result, the potential benefits of real-time data may not be fully realized at the operational level.

In addition, the effectiveness of real-time data may depend on the overall quality of WMS implementation and organizational support. Without proper system integration and clear operational procedures, real-time information may remain informative rather than actionable. This finding suggests that real-time data availability plays a supportive role in inventory management but requires strong system implementation and management commitment to have a significant impact.

The findings of this study offer several important implications for both academic research and industry practice. From a theoretical perspective, the study reinforces existing technology adoption and organizational support theories by demonstrating that technological systems alone are insufficient to improve operational performance. Instead, the effectiveness of WMS depends on the integration of technological capability with organizational readiness and managerial commitment. This contributes to a deeper understanding of how information systems function within real operational environments, particularly in the automotive sector.

From a practical perspective, the results provide valuable guidance for automotive companies seeking to enhance

their inventory management practices. Organizations should prioritize effective WMS implementation strategies that focus on process standardization, system integration, and operational discipline. In addition, management support should be emphasized as a critical success factor, as leadership involvement directly influences employee compliance, system usage, and data accuracy. Companies that invest in WMS without ensuring strong managerial commitment may fail to achieve the expected performance improvements.

Furthermore, the findings suggest that organizations should reassess their approach to employee training and system usability. Rather than focusing solely on basic system usage, training programs should be designed to enhance employees' understanding of inventory control principles and the operational impact of their actions. This can help transform training from a compliance activity into a performance-enhancing initiative. Overall, the study highlights the importance of aligning technological, human, and organizational elements to improve inventory management efficiency.

Despite providing valuable insights into the impact of various factors on inventory management efficiency in the automotive sector, this study has several limitations that need to be acknowledged. First, the study only considered a limited set of variables, such as WMS implementation, real-time data availability, employee training, system usability, and management support. While these are important factors, there may be other variables, such as technology adoption rate, organizational culture, or external supply chain factors for example like market volatility or supplier performance, that also play a significant role in influencing inventory management efficiency but were not captured in this study. Second, the study's focus on the automotive industry may limit the generalizability of the findings to other sectors. The nature of inventory management challenges can vary significantly across industries, and factors affecting efficiency in the automotive sector might not be the same in, for example, retail or electronics. Therefore, the findings should be interpreted within the context of the automotive industry.

Another limitation of the study is the sample size and data collection method. While the sample was relevant to the research context, it may not represent the broader population of automotive companies implementing WMS. A larger and more diverse sample could provide more robust and generalizable conclusions. Additionally, the study used a cross-sectional design, which means that data were collected at one point in time. As a result, it is difficult to establish causal relationships between variables and inventory management efficiency. A longitudinal study that tracks changes over time would provide a better understanding of how changes in WMS implementation or employee training might impact efficiency over the long term. Lastly, the study relied on self-reported data to measure inventory management efficiency, which could introduce biases in respondents' perceptions. Self-reported measures can be subjective, and respondents may overestimate or underestimate the effectiveness of WMS systems or their training. Therefore, using more objective performance metrics, such as inventory turnover rates or order fulfilment accuracy, would provide more reliable results.

Based on the limitations mentioned above, there are several avenues for future research can be identified. First, future studies could explore additional factors that might influence inventory management efficiency. For example, examining how organizational culture, leadership style, or external supply chain disruptions (such as supplier delays) impact efficiency would provide a more comprehensive understanding of the issue. Including such variables would allow researchers to build a more robust model of factors influencing inventory management. Second, it would be valuable for future studies to compare the effects of WMS implementation and other related factors across different industries. While this study focused on the automotive industry, other sectors, such as retail, electronics, or pharmaceuticals, may face different challenges and exhibit different relationships between WMS and inventory management efficiency. By comparing these industries, researchers could gain deeper insights into industry-specific factors and improve the generalizability of their findings.

Another important recommendation is to adopt a longitudinal study approach, which tracks the same companies over a longer period. This would enable researchers to better understand the long-term effects of WMS implementation and other variables on inventory management efficiency. Longitudinal studies can also provide insights into the causal relationships between the variables, which cross-sectional studies cannot offer. Moreover, future research could incorporate objective performance metrics for measuring inventory management efficiency. Using measures like inventory turnover rates, stock accuracy, order fulfilment times, or cost reductions would allow researchers to avoid biases associated with self-reported data. Objective data would provide more reliable insights into the actual performance of WMS systems.

Lastly, a multi-method research design that combines both qualitative and quantitative data could offer more depth and context to the study's findings. For example, conducting interviews or case studies with managers and employees could provide rich qualitative insights into the practical challenges of implementing WMS and improving inventory management. These qualitative insights could complement the quantitative findings from surveys and statistical analysis, offering a more holistic view of the factors affecting inventory efficiency. In addition, future studies should consider the impact of new technologies on WMS and inventory management efficiency. With the rise of artificial intelligence (AI), Internet of Things (IoT), and machine learning, it would be valuable to explore how these technologies are transforming warehouse operations and inventory systems. Research into the adoption and effects of emerging technologies would provide timely insights into how WMS can evolve to meet the demands of modern supply chains.

In conclusion, this study was conducted to examine the influence of WMS implementation and related organizational factors on inventory management efficiency in the automotive sector. The research focused on identifying the extent to which WMS implementation, real-time data availability, employee training, system usability, and management support contribute to improved inventory performance. Using Pearson correlation and multiple regression analyses, the study provides empirical evidence on the relationships between the independent variables and the dependent variable.

The findings reveal that WMS implementation and management support are the most significant factors influencing inventory management efficiency. These results indicate that the successful use of WMS goes beyond the mere availability of technology and depends heavily on how well the system is implemented and supported by organizational leadership. Effective WMS implementation enables automation, improves inventory visibility, and reduces manual errors, while strong management support ensures consistent system usage, adequate resources, and employee compliance with standardized procedures.

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