Comparative analysis of outsourcing and in house warehouse management system to improve productivity and stock accuracy

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Article Info

ABSTRACT

This study compares the impact of outsourced and in-house Warehouse Management Systems (WMS) on productivity and stock accuracy in the fast-moving consumer goods (FMCG) sector. Data was collected from a logistics services company in Palembang using quantitative methods, including measurements of productivity per person per hour and stock accuracy per SKU. Productivity was assessed based on items processed per unit time, while stock accuracy compared physical stock with system records. Additional data was gathered through a Google Form survey targeting operational staff and warehouse managers to understand the implementation of both WMS models. The survey covered critical processes such as putaway, picking, and inventory, providing insights into operational efficiency and challenges associated with each model. Dummy variable multiple regression was applied to evaluate the performance impact of each WMS model, supplemented by qualitative insights from structured interviews. Findings reveal that WMS in-house is better than outsourcing WMS. While 12.5% of respondents rated the outsourced WMS as inefficient, none reported inefficiencies in the in-house system. Additionally, 62.5% of respondents found the in-house WMS highly effective, citing smoother implementation and higher reliability. The in-house WMS also demonstrated superior operational efficiency, storage accuracy, and responsiveness. It provided better storage location guidance (33.3%) and faster, more accurate operator navigation (26.5%) compared to the outsourced system. Moreover, only 33.3% of respondents noted delays in resolving technical issues with the in-house system, versus 68.8% for the outsourced system. Statistical analysis further supported these findings, showing significant advantages for the in-house WMS in productivity (p=0.068) and stock accuracy (p=0.000). These results highlight the strategic advantages of adopting an in-house WMS, underscoring its role in enhancing operational efficiency and maintaining competitiveness in the dynamic FMCG market.

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Introduction

Warehouse management plays a crucial role in ensuring the smooth distribution of goods, especially in the Fast-Moving Consumer Goods (FMCG) sector which has very dynamic stock management needs (Chauhan, 2023; Dinçer & Turgay, 2023; Ogbeyemi et al., 2024). In the FMCG industry, warehouse management must be able to anticipate frequent fluctuations in demand, ensure goods are available on time, and maintain product quality

until it reaches consumers (Malema, 2019). The main challenges faced by FMCG companies in warehouse management include controlling the quality of goods, as products such as food and beverages require more attention related to proper storage (Avci, 2019). In addition, fast-changing stock management requires an efficient system to monitor and manage inventory in real-time, thus avoiding overstocks or shortages that could impact smooth distribution and customer satisfaction (Richards, 2021).

The development of technology has brought significant changes in the warehouse management system, which used to be done manually, now shifting to the use of advanced technology (Attaran, 2020; Custodio & Machado, 2020). One of the major innovations in warehouse management is the implementation of Warehouse Management System (WMS), a software system that helps automate and optimise inventory management and distribution processes (Madamidola et al., 2024); (Odeyinka & Omoegun, 2023). WMS allows companies to monitor the flow of goods in real-time, manage stock more efficiently, and improve accuracy in recording and shipping goods (Baruffaldi et al., 2019); (Andiyappillai, 2020).

One of the main benefits of implementing WMS is increasing stock accuracy (Andiyappillai, 2020). Warehouses are equipped with equipment and labor that can add value to the supply chain by storing or adjusting inventory amounts (Tien et al., 2019). With this system, real-time monitoring of goods availability and stock movement in the warehouse can be carried out. The integration of Real Time Location System (RTLS) and WMS not only provides real time warehouse visualization but also avoids mistakes in utilizing warehouse space (Halawa et al., 2020). In addition to its primary functions, a WMS helps optimize productivity by efficiently allocating warehouse resources, which increases productivity and reduces operating costs (Abdul Rahman et al., 2023). It achieves this by minimizing time and expenses associated with stock management (Muller, 2019). For instance, a WMS can organize pickup routes to reduce travel distance (Shetty et al., 2020).

A WMS enhances efficiency through optimal placement or put-away strategies, ensuring that goods are stored in the correct locations and preventing losses. This leads to cost savings and improved operational efficiency. Effective support for picking systems is achieved by adhering to controlled storage principles and optimizing storage assignments and picking routes (Liang et al., 2023; Ozden et al., 2021). Implementing WMS can also improve stock accuracy in the warehouse. WMS will continue to monitor the amount of stock available in the warehouse and provide notifications if there is a difference between the amount of stock registered with the company and the amount of stock available in the warehouse (Deepali et al., 2024; Shanmugamani & Mohamad, 2023). This will help reduce errors in picking goods, improve stock accuracy, and avoid overstock and understock. Productivity and stock accuracy are two important factors in warehouse management. High productivity in the warehouse can reduce operating costs and increase speed in processing goods, while high stock accuracy can ensure the availability of the right goods at the right time, thereby minimizing the risk of loss (Istiqomah et al., 2020).

Warehouse management systems can be divided into two main models, namely outsourcing and in-house. An outsourced system involves a third party managing the warehouse, so that the company does not need to handle warehouse management directly (Deptova, 2024); (Vatumalae et al., 2020). Whereas the in-house system involves the management of the warehouse by the company's internal team using more advanced technology and management systems, giving full control of the warehouse operations (Changarampat, 2022); (Ruthramathi & Sivakumar, 2023).

Each system has different advantages and disadvantages, especially in the FMCG sector. Outsourcing systems offer advantages in terms of operational cost efficiency as companies do not need to invest in warehouse infrastructure, but companies lose some control over quality and operational flexibility, which can be a constraint when there are rapid changes in demand. In-house systems provide full control over quality management and operational flexibility, but require a large initial investment in infrastructure and technology, as well as higher operational costs. In the FMCG sector, where speed and accuracy of distribution are critical, the decision on the warehouse management system model should consider cost, quality control, and flexibility to deal with rapid demand changes (Richards, 2021).

The challenges in improving productivity and stock accuracy in warehouse management vary depending on the system used. Outsourcing systems often face challenges in terms of quality and cost control, where companies have to rely on third parties who may not have the same level of flexibility and oversight, which can risk stock accuracy and unexpected costs (Koponen, 2023). Meanwhile, with in-house systems, while providing full control, there is often a waste of resources, both in terms of manpower and the technology needed to manage the warehouse efficiently (Minashkina & Happonen, 2020). All these challenges affect productivity and accuracy, which are crucial in the FMCG sector that requires speed and accuracy in stock management.

While some previous research on outsourced WMS suggests that it can reduce operational costs and allow companies to focus on core business, this model often faces challenges in quality control and operational control

(Maheshwari et al., 2023). Research on in-house systems mostly emphasises the advantages of full control over warehouse management and operational flexibility, but also indicates the need for greater investment in infrastructure and technology (Amini & Jahanbakhsh Javid, 2023). This literature provides an important basis for analysing how each system contributes to productivity and stock accuracy in the FMCG sector, and helps identify the most effective system according to company characteristics.

Previous research on warehouse management systems has discussed various approaches to stock management and distribution, but few have directly compared outsourced and in-house systems in the context of the FMCG sector. Some previous studies focus on the efficiencies of technology-based warehouse management systems, such as the use of Warehouse Management System (WMS) to improve accuracy and productivity, while others explore the advantages and challenges of warehouse outsourcing in reducing operational costs. However, research on the direct comparison between the two warehouse management systems in the context of the FMCG sector, especially in terms of their impact on operational efficiency and stock accuracy, is limited. This research will deepen the gap by analysing the advantages and disadvantages of each system in improving productivity and accuracy of stock management in FMCG companies.

Research into warehouse management systems is essential in Palembang, given the rapid development of the FMCG sector in the region in recent years. The growth of the FMCG industry has fuelled increased demand for distribution efficiency and accurate stock management, yet many local companies still face challenges in effectively managing their warehouses. Some companies in Palembang may not have utilised advanced technology or optimised warehouse management systems, potentially hindering productivity and stock accuracy. By comparing outsourced and in-house warehouse management systems, this research can provide relevant insights for local companies in choosing the right model to improve operational efficiency. The results of this study can help companies in Palembang address issues related to cost, quality control, and operational flexibility, which in turn will support their competitiveness and business sustainability in an increasingly competitive FMCG market.

The purpose of this study is to analyse and compare the impact of outsourced warehouse management systems and in-house WMS on productivity and stock accuracy in the FMCG sector. This research aims to understand how each system affects operational performance, especially in terms of inventory management efficiency and accuracy of goods distribution. By comparing the advantages and disadvantages of each system, this research is expected to provide deeper insights into the factors that contribute to improving productivity and stock accuracy in the FMCG sector, as well as provide recommendations for companies in this sector to choose the warehouse management system that best suits their needs and challenges.

Method

The research design employed in this study is quantitative research with a descriptive analytical approach. Descriptive analytical research involves describing or measuring the characteristics of a phenomenon or population through systematic and structured data collection methods. In the context of this study, this design was chosen to evaluate the relationship between different warehouse management system (WMS) models outsourcing and in-house, and dependent variables such as productivity and stock accuracy. This approach enables researchers not only to describe the characteristics of each system but also to analyze how these models contribute to operational efficiency in stock management. The study will collect data on the patterns of WMS implementation, productivity, and stock accuracy in the warehouse of an FMCG logistics service company in Palembang, Indonesia, and analyze the effects using Dummy Variables Multiple Regression.

This research was conducted systematically through several main steps. First, at the planning stage, the researcher determined the research objectives, formulated the problem, and developed a theoretical framework and research hypothesis. Next, the researcher determined the research method, including the research design, data collection techniques, and sample selection criteria using purposive sampling. Second, in the data collection stage, quantitative data such as productivity per person per hour and stock accuracy per SKU were collected from the operational reports of FMCG logistics companies that met the inclusion criteria, while qualitative data were obtained through semi-structured interviews with warehouse managers and operational staff. Third, the collected data were analysed using multiple linear regression with dummy variables to evaluate the relationship between outsourced and in-house warehouse management system models with productivity and stock accuracy. Finally, the results of the data analysis were interpreted to answer the research questions, draw conclusions, and provide relevant strategic recommendations for FMCG logistics companies in Palembang.

Research Population and Sample
The population in this research are all FMCG logistics service companies located in Palembang, Indonesia that have implemented a Warehouse Management System for several years. The sampling technique in this study used purposive sampling method, which is the selection of samples based on certain criteria relevant to the research objectives. Samples were taken from the population of FMCG sector logistics companies in Palembang that met the inclusion criteria, such as having a warehouse that has been actively operating for at least five years and using one of the three warehouse management system models-manual, outsourced, or in-house. Exclusion criteria were applied for companies that did not have structured operational data related to productivity and stock accuracy. Purposive sampling was chosen as it allows researchers to focus on companies that are considered representative and have relevant experience to provide accurate and in-depth data. This technique also ensured that the sample was appropriate for analysing the relationship between warehouse management systems and performance variables, such as productivity and stock accuracy.

Data collection technique
The data collection techniques in this study use a quantitative approach with a focus on measuring productivity per person per hour and stock accuracy per SKU (Stock Keeping Unit). Productivity is calculated based on the number of items processed in a certain unit of time, while stock accuracy is measured by comparing physical stock data with records contained in the system. This quantitative data is collected directly from the warehouse management system and operational reports of the FMCG logistics company that is the subject of the study. In addition, Google Form surveys were used to gather additional information from operational staff and warehouse managers regarding the implementation of WMS models, both outsourced and in-house. The questions in the survey covered key aspects such as the process of placing goods, picking goods, and conducting stock-taking, designed to dig deeper into the operational efficiency and constraints faced in each WMS model. This combination of quantitative and qualitative data provides a strong foundation to comprehensively analyse the relationship between WMS models and productivity and stock accuracy.

Data analysis technique
The data analysis technique used in this research is multiple regression analysis. Multiple regression is a statistical method used to analyze the relationship between one dependent variable and two or more independent variables. Independent variables can be numeric variables or dummy variables. Dummy variables, or also called indicator variables, are categorical variables represented in binary form (0 or 1) to describe membership in a category or group. Multiple regression analysis is used to analyze the relationship between the independent variable, namely the implementation of the Warehouse Management System, and the dependent variable, namely productivity and stock accuracy. The results of interviews conducted through Google Form surveys were used as supporting data to provide context to the quantitative results and enrich the interpretation of the findings. This approach ensures that the analysis is not only descriptive but also explains the significant influence of each WMS model on the measured performance variables.

Results and Discussions

Comparative Analysis of Outsourced WMS and In House WMS Based on Respondents' Perceptions
The results showed significant differences between the implementation of outsourced WMS and in-house WMS based on respondents' perceptions collected through structured interviews using Google Form. In the outsourced WMS implementation, key activities such as putaway, picking, replenishment (pick face), and stock taking showed that 12.5% of respondents felt the system was not running smoothly, 27.5% felt smoothly, 25% felt very smoothly, and only 25% felt very smoothly. In contrast, the implementation of an in-house WMS received a more positive response, with no respondents stating that the system was not running smoothly. A total of 6.3% stated that the system ran smoothly, 31.3% felt it was very smooth, and 62.5% felt it was very smooth. This shows that an in-house WMS is more accepted by respondents as it provides a smoother experience in its implementation compared to an outsourced WMS.

In addition, a comparison of the effectiveness of the putaway process shows that the in-house WMS offers greater convenience for operators than the outsourced WMS. A total of 33.3% of respondents stated that the in-house WMS provides a better order of putaway locations, compared to 25% in the outsourced WMS. Additionally, 26.5% of respondents mentioned that the in-house WMS is faster and more accurate in directing operators to recommended storage locations, compared to 25% in the outsourced WMS. However, challenges such as slow vendor response on outsourced WMS (68.8%) is one of the major drawbacks compared to in-house WMS, which only recorded 33.3% of similar complaints. Overall, in-house WMS is not only smoother in implementation, but also more effective in improving productivity and stock accuracy, reinforcing respondents' preference for in-house developed systems.

Regression Test of the Application of WMS Alternatives to Productivity

In this test step, a regression analysis was carried out to assess how much influence the implementation of two types of warehousing management systems (WMS), namely D1 WMS developed by a third party (Outsource) and D2 WMS developed in-house (Inhouse), on productivity and accuracy stock. The testing process involves using an Excel application to process data through data analysis and regression features.

This regeresion test measures three parameters of the influence of the choice of WMS application on productivity and accuracy stock, namely the T-test to see the influence of each WMS on productivity, the F-test to see the significance of the simultaneous implementation of WMS, and the R coefficient to see how much the influence of the implementation of each WMS has productivity.

Table 1 <T Test Result>

Model	Coefficient	T Statistic	Sig
1 (Constant)	175.04	11.577	.000
WMS Outsourcing (D1)	-22.194	-1.038	.307
WMS In-House (D2)	40.316	1.886	.068
Dependent Variable: Productivity			

Source: Data Processed (2024)

A partial test using the T-test showed that D1 had no significant influence on productivity, as reflected by the p-value of 0.307. The expected p-value for high significance is <0.01, for medium significance is <0.05, and for moderate significance is <0.1. On the other hand, D2 has a significant positive influence on productivity, indicated by a p-value of 0.068 which is smaller than 0.1.

In statistical analysis, p-value is used to determine the level of significance of the relationship between variables. Generally, the smaller the p-value, the more significant the relationship. In this case, with a p-value of 0.307, it suggests that the relationship between D1 and productivity is not statistically significant.

Meanwhile, for the D2 variable, different results were obtained where this variable had a significant positive influence on productivity. This can be seen from the p-value of 0.068, which is smaller than the limit of <0.1. Although this value does not meet the stricter significance criteria (<0.01 or <0.05), it still shows a significant relationship between the D2 variable and productivity.

Thus, it can be concluded that in the context of this test, D1 has no significant effect on productivity while D2 has a positive effect with a sufficient level of significance, based on the analysis of the p-value obtained for each variable. This means that, there is a real positive influence, although the level of confidence is not high enough to be considered very statistically significant. However, this positive trend still shows the important potential of WMS Inhouse in increasing productivity and operational efficiency, and indicates opportunities for further improvement and optimization in the use of warehouse management systems.

The implementation of Inhouse WMS shows better results in increasing productivity compared to Outsource WMS, but these results are at a moderate level of significance. More research may be needed to reinforce these findings to identify additional factors that affect productivity.

Testing simultaneously with F-significance

Table 2. F Test Result

		ANOVAᵇ				
	Model	Sum of Squares	df	Mean Square	F	Sig.
1	Regression	24101.545	2	12050.773	4.393	.020a
	Residual	90523.093	33	2743.124		
	Total	114624.638	35			
	a. Predictors: (Constant), WMS Outsourcing, WMS In-House					
	b. Dependent Variable: Productivity					

Source: Data Processed (2024)

In a scenario without prior WMS implementation, the gradual adoption of WMS outsourcing (D1) and WMS insourcing (D2) significantly enhances productivity. This is evidenced by an F-significance value of 0.020, indicating that both types of WMS contribute substantially to productivity improvement.

The study shows that when WMS outsourcing and insourcing are implemented sequentially in a context where no WMS was previously in place, there is a notable increase in productivity with a high level of

significance. WMS outsourcing enables companies to benefit from the expertise and technology of external service providers, while WMS insourcing allows for direct control and system adjustments tailored to the company's specific needs. The combination of these approaches improves item retrieval speed, reduces operational errors, and decreases the time required for warehouse management processes.

These findings suggest that the phased implementation of both WMS outsourcing and insourcing can lead to tangible and sustainable productivity improvements. By leveraging external expertise and technology through outsourcing while maintaining control and customization through insourcing, companies can achieve significant operational efficiencies and enhance overall productivity.

Coefficient of Determination (R2)

Table 3. Coefficient Determination Result

Model Summary				
Model	**Multiple R**	**R Square**	**Adjusted R Square**	**Std. Error Of The Estimate**
1	.459	.210	.162	52.375
a. Predictors: (Constant), WMS Outsourcing, WMS In-House				

Source: Data Processed (2024)

The F test is used to determine whether the regression model as a whole has a significant effect on the dependent variables. In this context, the F test is used to evaluate whether the model that includes the simultaneous deployment of WMS Outsource and WMS Inhouse has a significant effect on productivity. The results of the significant F test showed that at least one of the independent variables incorporated into the model had a significant influence on the dependent variables.

Meanwhile, the R^2 (R-squared) value is a measure of how well the variability of dependent variables can be explained by the regression model. An R^2 value in Table-6 of 0.21 or 21% indicates that about 21% of the variation in productivity can be explained by a model that includes the implementation of both WMS systems. This means that the combination of Outsource WMS and Inhouse WMS contributes significantly to productivity variation.

Although 21% of the variation is explained by the model, there are still about 79% other variations in productivity that are not explained by the model. This suggests that there are still other factors affecting productivity that are not included in the model that require further research.

Overall, the results from Table-6 show that the combined implementation of WMS Outsource and WMS Inhouse simultaneously contributes significantly to the company's productivity. With this statistical evidence, companies can be more confident that investing in the implementation of these two WMS systems is the right step to achieve increased productivity.

Regression Test of *WMS* Application to Accuracy Stock

Next is the regression test of the application of *WMS* to the accuracy stock which measures three parameters, namely the T-test to partially test the effect of the application of *WMS* on the accuracy stock, the F-test to see the significance level of the simultaneous application of *WMS* alternatives to the accuracy stock and the coefficient R (R2) to measure how much variability in the accuracy stock can be explained by the *application of WMS in-house* and *WMS outsource*.

Table 4. T Test Result

Model		Coefficient	T Statistic	Sig
1	(Constant)	0.840	46.868	.000
	WMS Outsourcing	0.159	6.267	.000
	WMS In-House	0.160	6.327	.000
Dependent Variable: Accuracy Stock				

Source: Data Processed (2024)

The results of the analysis in Table-7 show that D1 (*WMS Outsource*) has a very positive and significant impact on Stock Accuracy. This is reinforced by a very low p-value, which is 0.000, which clearly indicates very high significance. Likewise, with D2 (*WMS Inhouse*), which also has a positive and significant impact on Stock Accuracy, as indicated by a very low p-value, which is 0.000, smaller than 0.01.

Thus, the implementation of *WMS* with the outsourcing pattern shows a very significant improvement in Stock Accuracy, however, *the inhouse* application pattern shows an even more significant improvement. This is reflected in the higher regression coefficient of D2 than D1, which is 0.16 compared to 0.15, as well as the lower

p-value value for D2 (0.000000037) compared to D1 (0.000000044), confirming the greater significance of the impact of D2 on Stock Accuracy.

Testing simultaneously with F-significance

Table 5. F Test Result

	Model	Sum of Squares	df	Mean Square	F	Sig.
	ANOVA^b					
1	Regression	0.204	2	0.102	26.433	.000a
	Residual	0.127	33	.004		
	Total	0.331	35			
	a. Predictors: (Constant), WMS Outsourcing, WMS In-House					
	b. Dependent Variable: Accuracy Stock					

Source: Data Processed (2024)

In situations where no *WMS system* is deployed, the continuous use of *outsource* (D1) and *in-house WMS* (D2) shows a very significant impact. This is evident from the very low significance value of F, which is 0.000, or even less than 0.01. This very low value indicates that the influence of the implementation of the two *WMS* application patterns is very statistically strong. Thus, it can be concluded that the implementation stages of the two *WMS* application patterns as a whole have provided an excellent improvement in stock accuracy.

Assessing the Determination Coefficient (R2)

Table 6. Coefficient Determination Result

Model	Multiple R	R Square	Adjusted R Square	Std. Error Of The Estimate
Model Summary				
1	.785	.616	.592	0.062
a. Predictors: (Constant), WMS Outsourcing, WMS In-House				

Source: Data Processed (2024)

How much influence the two *outsourced WMS* and *inhouse WMS* systems together contribute to the accuracy stock can be seen in the following R-square table, the R-square figure of 0.61 or 61% indicates that the contribution is very large. The higher the R-square value, the greater the proportion of variability described by the model, indicating that the model has a good fit

A high R-square value (61%) indicates that *WMS Outsource* and *WMS Inhouse* are very effective in improving stock accuracy. This means that the simultaneous implementation of these two systems plays an important role in ensuring more accurate and efficient stock management, reducing errors, and improving the reliability of stock data.

In an operational context, these figures show that organizations that implement these two systems simultaneously can expect significant improvements in stock management accuracy, aiding in better decision-making and more efficient inventory management.

In other words, the implementation of these two systems effectively improves the accuracy of stock management in warehousing operations. A high R-square number indicates that there is a strong relationship between the use of *WMS* and the improvement of stock accuracy, so it can be concluded that the increase in stock accuracy is not the result of a chance factor.

However, there are still 39% of other factors that cannot be explained by this model. Other factors that may affect the accuracy of stock can include aspects such as the difficulties faced by operators in the process of *putaway*, picking, replenishment in addition to other factors such as operator training and skills, quality of input data, physical condition of the warehouse, and additional technologies used in the stock management process.

Overall, this significant R-square value confirms that the use of *WMS*, both *Outsource* and *Inhouse*, has a substantial impact on improving stock accuracy. While there is room for improvement and exploration of other factors that can contribute, these results demonstrate the real effectiveness of WMS systems in managing inventory more accurately.

Comparative Analysis of Outsourced WMS and In House WMS Based on Respondents' Perceptions

An in-house WMS is proven to have significant advantages over an outsourced WMS in terms of smooth implementation and operational effectiveness. Based on the survey results, the majority of respondents stated that the implementation of an in-house WMS was very smooth, with no significant obstacles during the implementation process. This is supported by the in-house system's ability to accommodate the specific needs of company operations more flexibly, thus minimizing disruptions during the integration process. In contrast, outsourced WMS tends to face challenges in adapting to operational needs, which is evident from the proportion of respondents who complained about the mismatch between the system and operational needs.

The effectiveness of an in-house WMS is also reflected in improved productivity and better stock accuracy compared to an outsourced WMS. The in-house system was designed with specific warehouse workflows in mind, providing more accurate and efficient guidance in the process of placing and picking goods. Respondents noted that an in-house WMS offers more optimized placement location recommendations as well as faster and more accurate picking route management than an outsourced system. As such, this in-house system directly contributes to time savings and error reduction, ultimately improving the productivity of warehouse operations.

The strong preference for an in-house WMS is also influenced by the ability of the in-house IT team to respond to technical issues more quickly and effectively. Most respondents mentioned that complaints or technical glitches on an in-house WMS are handled more swiftly compared to outsourced WMS vendors. In addition, in-house system development allows companies to manage system updates or customizations independently, without relying on third parties. These advantages further strengthen the position of in-house WMS as a more reliable and adaptive solution to support the company's operational needs in the long term.

Previous research by (Shivam & Gupta, 2024), shows that an in-house WMS is superior in terms of flexibility, as the system can be designed to suit the company's specific needs, including workflow and goods storage processes. In contrast, WMS built by third parties often face obstacles in customizing to the company's unique needs, thus reducing operational efficiency. Another study by (Minashkina & Happonen, 2020) mentioned that the speed of response to technical issues is one of the key factors influencing preference for an in-house WMS, where in-house IT teams have a deeper understanding of the system and are able to resolve glitches faster than external vendors.

Effect of WMS Outsourcing on Productivity

The results show that the use of outsourced warehouse management systems (WMS) has no significant effect on productivity in the FMCG sector. One of the main reasons is the company's lack of direct control over warehouse operations. In the outsourcing model, most of the warehouse management responsibilities are in the hands of a third party, so companies often face challenges in ensuring consistent operational standards. Reliance on third parties can also result in delays in decision-making that impact daily productivity, especially when technical or logistical issues occur. This finding is in line with the results of a study from (Ali Syed & Siddiqui, 2019) which states that outsourcing has no significance on warehouse performance in Pakistan's FMCG sector. However, these findings contradict the results of a study from (Buzu, 2021) which reveals that receiving, storage, put away, order picking and shipping significantly influence warehouse performance of the organization.

In addition, outsourced WMSs are often designed to handle a wide range of general client needs, lacking the flexibility to meet the specific needs of FMCG companies that have a high degree of operational complexity. For example, sudden changes in demand patterns or the need to manage large amounts of stock quickly may not be optimally handled by outsourced service providers. This becomes an obstacle for the company in achieving maximum operational efficiency, as outsourcing service providers need time to adapt their systems to the company's specific needs.

The lack of significant influence may also be due to the potential additional costs associated with outsourcing services, such as the costs of training external staff, system integration, and communication between the company and the service provider. These costs may reduce the benefits gained from increased productivity. On the other hand, limitations in the company's ability to directly monitor the outsourcer's performance also reduce the effectiveness of the system. Therefore, although outsourced WMS provides benefits in terms of reducing internal managerial burden, the results of this study suggest that this approach is less than optimal for improving productivity in the FMCG sector, especially in companies that require high flexibility and speed in their warehouse operations.

Effect of In-House WMS on Productivity

The results show that the use of an in-house warehouse management system (WMS) has a positive and significant influence on productivity in the FMCG sector. One of the main factors that support this finding is

the full control that the company has over the entire warehouse operation. With an in-house WMS, a company can directly set up, monitor, and customize the warehouse management system according to its specific needs. This flexibility allows the company to respond quickly to changes in market demand, which is crucial in the dynamic and competitive FMCG industry. This finding supports the study results from (Marzouk et al., 2022), who stated the automation of DRP using ERP systems has a positive and significant impact on supply chain functions including supply and demand planning, procurement, production, warehouses, and logistics in the Egyptian FMCG industry, improving data accuracy and efficiency.

In addition, an in-house WMS provides better integration capabilities with other systems within the company, such as supply chain management systems and enterprise resource planning (ERP) systems. This integration ensures more efficient and accurate data flow, thereby reducing operational errors that are often the cause of low productivity. With centralized management, companies can also implement more consistent work policies and ensure that all operational teams understand the set work standards. This not only improves efficiency, but also minimizes time wasted due to discrepancies in work processes.

Another factor that makes an in-house WMS contribute positively to productivity is the opportunity for continuous development and optimization of the system. The company can adjust the technology and operational procedures based on historical data and productivity trends obtained from the warehouse. Full control over the system also allows the company to conduct specific training for its employees, so that they are more competent in operating the system. Therefore, investing in an in-house WMS proves to deliver significant gains in terms of efficiency and productivity, making it an excellent choice for FMCG companies that prioritize complete control and operational flexibility.

Effect of WMS Outsourcing on Stock Accuracy

The results show that an outsourced warehouse management system (WMS) has a positive and significant influence on stock accuracy in the FMCG sector. One of the main reasons is the specialized expertise that outsourced service providers have in managing warehouse systems. Service providers usually use advanced technologies such as barcode scanning, RFID, or even the Internet of Things (IoT) to track stock in real-time. With these technologies, inventory data becomes more accurate, minimizes the risk of human error, and ensures that stock information is always updated automatically. This finding is in line with the findings of (Kmiecik, 2024) which states that 3PL (third party logistic) providers have the potential to implement better inventory management systems based on location management and automated storage processes built on the knowledge of logistics service providers..

Another advantage of outsourced WMS is the professional focus on stock management. Outsourced service providers often have extensive experience and specially trained teams to manage different types of goods in the warehouse. In the context of the FMCG sector, which requires high-precision stock management due to large volumes and fast turnaround, outsourcing can ensure that every unit of stock is recorded correctly, from receipt of goods to delivery to the customer. This standardized process helps reduce stock data discrepancies, such as overstocking or understocking, which can disrupt a company's operations.

In addition, outsourced WMS systems are usually equipped with automated reports and in-depth data analyses. This feature allows companies to monitor stock movement patterns more easily, identify errors faster, and make more informed decisions based on accurate data. By providing more reliable data, companies can improve supply chain efficiency and ensure uninterrupted availability of products in the market. Therefore, the significant impact of outsourced WMS on stock accuracy makes it an attractive option, especially for FMCG companies looking to reduce the risk of errors and improve customer satisfaction through optimized inventory management.

Effect of In-House WMS on Stock Accuracy

Research shows that the implementation of an in-house warehouse management system (WMS) has a positive and significant influence on stock accuracy in the FMCG sector. One of the main reasons is the full control that companies have over all warehouse management activities. With an internally managed system, a company can customize its stock recording and tracking processes according to its specific needs. This flexibility allows companies to ensure that every unit of stock is recorded precisely, from receipt to distribution of goods, thus minimizing stock data errors. This finding supports the study results from (Marzouk et al., 2022), who stated the automation of DRP using ERP systems has a positive and significant impact on supply chain functions including supply and demand planning, procurement, production, warehouses, and logistics in the Egyptian FMCG industry, improving data accuracy and efficiency.

The advantage of an in-house WMS in improving stock accuracy also lies in its ability to integrate advanced technologies, such as barcode scanning or RFID systems, with the company's existing systems. This integration creates a more coordinated workflow between various departments, such as production, marketing, and

logistics. As a result, stock data can be updated in real-time, enabling companies to detect discrepancies faster and take corrective measures before problems escalate. With consolidated processes, an in-house WMS helps companies maintain a high level of stock accuracy, which is essential in meeting dynamic market demands.

In addition, the use of an in-house WMS provides an opportunity for companies to continuously improve the system through evaluation and learning from historical data. The company can identify error patterns or areas that require improvement, and then optimize work procedures to prevent recurrence of the same mistakes. This capability, coupled with more in-depth employee training on the use of the system, creates more consistent and reliable stock management. Therefore, an in-house WMS is not just a tool to ensure stock accuracy, but also a long-term strategy to improve operational reliability in the competitive FMCG sector.

Conclusions

The conclusion of this study show that in-house WMS shows a number of significant advantages over the outsourced WMS, especially in terms of implementation stability and reliability, with none of the respondents stating that the system was not running smoothly, while the outsourced WMS recorded 12.5% of such complaints. In addition, the in-house WMS provides a smoother operational experience, especially in key activities such as putaway, picking, replenishment, and stock taking, with 62.5% of respondents finding the system very smooth, far surpassing the outsourced WMS. In terms of the ease and accuracy of the storage process, the in-house WMS is also superior, with 33.3% of respondents citing it as providing a better order of placement locations and 26.5% stating that it is faster and more accurate in directing operators to storage locations. Responsiveness to technical issues is also an advantage of in-house WMS, with only 33.3% of complaints related to slow response, compared to 68.8% for outsourced WMS.

In addition, the result shows that there is a significant difference between outsourced and in-house warehouse management systems in influencing productivity and stock accuracy in the FMCG sector. This is evidenced by the test results that the In-House WMS obtained a significance value of 0.068 for the test on Productivity and obtained a significance value of 0.000 for the test on stock accuracy. An in-house WMS system is proven to have a stronger positive impact on productivity than an outsourced system, mainly due to the full control the company has over the warehouse management process. With the flexibility to customize the system as needed, better integration between departments, and the ability to train employees specifically, an in-house WMS allows companies to optimize operational efficiency on an ongoing basis. Meanwhile, outsourced WMS has a significant positive influence on stock accuracy thanks to the use of advanced technology and specialized expertise from the service provider, although its effect on productivity is more limited compared to in-house WMS.

Overall, this research highlights the importance of choosing a warehouse management system that suits the company's strategic needs. For the FMCG sector, where market demands are highly dynamic and stock accuracy is a key element in maintaining supply chain sustainability, both models have their respective advantages. Companies that prioritize efficiency and long-term flexibility can consider an in-house WMS, while companies that want to reduce the risk of stock errors more quickly can utilize an outsourced WMS. The findings provide important insights for FMCG companies in Palembang and other regions to evaluate their warehouse management strategies to improve competitiveness in the market.

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