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Intervening Role of Cargo Control in Relation with Warehouse Management System Influence Freight Stations Efficiency

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Abstract: Container Freight Stations (CFS) are buildings or fields located in the Customs Area to temporarily store goods before loading and unloading. The aim of this research is to find out how strong the role of cargo control as an intervening variable along with the WMS influence the container freight stations efficiency. This research was carried out in CFS belonging to Pesaka Loka Kirana Ltd. located in the Line 2 of Tanjung Priok Port area. The research methods used are qualitative and quantitative approaches (mixed methods), using SmartPLS 4 with PLS-SEM analysis method. Data was obtained from 56 workers at the CFS, using questionnaire with a 5-Point Likert scale. Preliminary research led to a total of 11 new indicators that can be applied for both WMS and cargo control. The result reveal that cargo control as an intervening variable along with WMS significantly and positively influence container freight stations efficiency.
Keywords: *Warehouse Management System*, *Cargo Control, Container Freight Stations, Structural Equation Modeling, Pesaka Loka Kirana*

1. Introduction

Container terminals is a configuration to deal with storage, stacking or unloading cargo into and out of containers. Also where the container can be picked up, unloaded, stored, stacked or emptied using various means of transport such as ships, trucks, and railways. Container terminals are orchestrated into five characterizatioins relying upon the proprietorships including public terminals, operator built terminals, carrier built terminals, leased dedicated terminals and joint venture. The ongoing expansion of global trade has resulted in a significant need for transportation infrastructure to facilitate international trade and bridge the geographical gap between areas of high demand and supply centers or locations with limited use to areas with more utility. Water transportation has been suggested as a viable mode of transportation for the movement of large quantities of goods between countries, particularly in light of the growing issue of port congestion (Koech, 2018).

According to the World Bank (2023), Indonesia scored the Logistics Performance Index (LPI) by 3 points in 2023. The present score shows an annualized decrease of 4.76% in comparison to the previous year, which had a value of 3.15 points. According to the LPI score,

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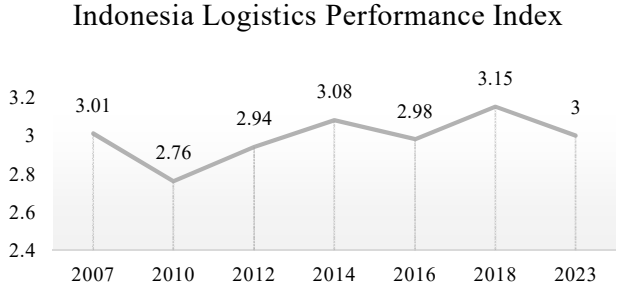
Indonesia is ranked 63rd out of 139 countries. The LPI scores are derived on six distinct characteristics, specifically customs, infrastructure, international shipping, quality and logistical competence, tracking and tracing of goods, and timing accuracy. In the year 2023, Indonesia achieved a score of 2.8 points in the customs dimension. The dimensions pertaining to infrastructure and international shipments are measured at 2.9 points and 3 points, respectively. Furthermore, Indonesia's quality dimension and logistics competency score have been rated around 2.9. A detailed overview of the LPI condition can be seen in **Figure 1**.



Source: World Bank 2023

Fig. 1. Logistics Performance Index

Improving the LPI is necessary because it can illustrate the logistics performance of a country and its comparison between countries. Logistics efficiency must also be improved with integrated planning across ministries or related institutions, especially from the cost aspect. This condition needs to engage the stakeholders, especially those involved (Setijadi, 2023).

Provisions regarding customs areas and container freight stations have been regulated in Minister of Finance Regulation No. 23/PMK.04/2015 concerning Customs Areas and Container Freight Stations to improve the performance of the national logistics system, fixing the investment climate, and increase the competitiveness of the national economy. Customs area is a certain limitation in seaports, airports, or other places designated for the traffic of goods which are fully under the supervision of the Directorate General of Customs and Excise. Meanwhile, container freight stations are buildings or fields located in the customs area to temporarily store goods before loading and unloading (Ministry of Finance, 2020).

Container Freight Stations (CFS) is a designated facility which assists in decreasing port congestion by relocating goods to a location situated outside the port premises where customs-related operations can be accomplished. The operational protocols of customs authorities and the spatial limitations encountered at ports have given rise to the concept of CFS. Logistics companies establish CFS in close proximity to ports subsequent to obtaining the necessary licensure from governmental authorities. The adoption of CFS is a fundamental requirement for any organization engaged in import and export activities. The role of CFS has crucial significance in facilitating the transportation of goods via import and export processes. The

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primary duty of the entity in question is to ensure the safety of the cargo until it is transported or acquired. In addition to safety, the cargo requires to be sorted properly for the next phase of movement (Preetha & Subhashini, 2018).

Warehouse is a highly dynamic environment and every process requires a system that can control all the operations that exist in it. WMS is one of the effective strategies to accelerate the development of an organization by giving priorities on the reliability of its supply chain (Pane, 2018). WMS helps the businesses to communicate and collaborate with all the logistics partners effectively and also real-time when it is integrated with all the necessary external systems or partners. Here comes the systems integration into place for communicating the right data, at the right time and to the right business partner (Andiyappillai, 2020).

Pesaka Loka Kirana Ltd (2023) implements a warehouse management system (WMS) to simplify and speed up loading-unloading activities during the process and help them communicate and collaborate with all the logistics partners effectively and real-time. This system encompasses many stages, starting from active (a sign that the container from the terminal is ready to be transported to the CFS), incoming, arrived, stripping, stored, behandle, and outgoing (cargo released after completed all the administrative procedures).

Moreover, cargo control is a cohesive way to smoothly manage an organization's operations while ensuring that warehouse capacity is adequate, goods are delivered on time, and losses are minimized. Unlike a warehouse or factory that runs a production, the cargo control system in a CFS focuses solely on supervision and utilization, to ensure that the number and volume of incoming goods match the available warehouse capacity (Sidharta, 2023).

The performance of CFS affected by three key aspects, including storage capacity, customs clearance speed, and cost considerations. CFS storage space is affected by the capacity of the stacking yards at the CFS. Capacity utilization at this facility is regulated by the operator or port authority. The storage space provided at these facilities helps decongest the port while allowing other cargo from other vessels to be discharged. The speed of customs clearance is improved by the availability of sufficient customs verification areas provided, allowing multiple containers to be simultaneously inspected by various customs officers. The primary objective of the CFS is to optimize savings in the handling process, while immediately improving the capabilities of importers within the supply chain to effectively trade internationally. The terminal efficiency and effectiveness are closely related to its profitability and operational performance, as proven by the charges applied on importers and exporters, cargo dwell-time, and the number of vessel arrives at the terminal during a specific timeframe (Musyoka, 2018).

Pesaka Loka Kirana Ltd. is a fast-growing company engaged in warehousing and freight forwarding, located in line 2 of Tanjung Priok Port area. This CFS center includes businesses that temporarily store goods before they are sent to their final destination for commercial purposes. There are multiple issues that frequently arise in this stack yard, such as poor connection, the unavailability of relocation menu, inability for users to retrieve data directly

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from the database, and slower barcoding process compared to manual input.

In addition, the existing body of literature pertaining to the selected research factors, which is container freight station (fast moving warehouse) and cargo control is limited, as there is a dearth of studies that have specifically examined the interplay among these variables. Scholarly reviews pertaining to warehouses mainly revolve around production-oriented and slow-moving warehouse operations. Therefore, it is imperative to clarify the gap and establish a coherent trajectory for future progress.

2. Literature Review

Warehouse Management System

Warehouse Management System (WMS) is an Information Technology (IT) solution employed to enhance warehouse productivity by effectively managing and monitoring warehouse operations, ensuring precision by systematically capturing and documenting warehouse transactions through data collecting. The utilization of a WMS in a proficient and efficient way has the potential to significantly increase the overall productivity of a warehouse facility (Herdianzah, 2022).

By adopting Warehouse Management Systems (WMS), companies have effective control over the import and export of commodities, also enabling firms to overcome the drawbacks associated with traditional warehousing, such as slowdowns, disorder, and poor performance. One of the advantages of Warehouse Management Systems (WMS) is their ability to facilitate the storage of warehouse information using databases. This feature enables the efficient sharing of information that helps organizations in achieving refined management practices. Consequently, the use of WMS leads to enhanced warehouse operation efficiency and increased enterprise revenue (Zhang & Zheng, 2021).

Pesaka Loka Kirana Ltd (2023) implements a warehouse management system (WMS) to simplify and speed up loading-unloading activities during the process and help them communicate and collaborate with all the logistics partners effectively and real-time. This system encompasses many stages, starting from active (a sign that the container from the terminal is ready to be transported to the CFS), incoming, arrived, stripping, stored, behandle, and outgoing (cargo released after completed all the administrative procedures).

Cargo Control

Cargo transportation include products of mining and processing industries, construction, trade and other organizations, as well as household goods. Objects that are accepted and transported for the purpose of delivery to the owner are called cargo. Cargo can consist of the same items and packages. All transported cargo must be measured in tons, other sizes (liters, units, cubes, meters) needs to be converted (Erkinjonov & Erkinov, 2022).

Cargo control is a cohesive way to smoothly manage an organization's operations while ensuring that the warehouse capacity is adequate, goods are delivered on time, and losses are

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minimized. Unlike a warehouse or factory that runs a production, the cargo control system in a CFS focuses solely on supervision and utilization, to ensure that the number and volume of incoming goods match the available warehouse capacity (Sidharta, 2023).

Container Freight Stations Efficiency

Regarding to the Minister of Finance Regulation, Container Freight Stations (CFS) are buildings or fields located in the Customs Area to temporarily store goods before loading and unloading (Ministry of Finance, 2020). Container Freight Stations (CFS) is a designated facility to assists in decreasing port congestion by relocating goods to a location situated outside the port premises where customs-related operations can be accomplished. CFS plays a crucial role to keep the cargo safe and until they are transported and acquired (Preetha & Subhashini, 2018).

CFS storage space is affected by the capacity of the stacking yards at the CFS. Capacity utilization at this facility is regulated by the operator or port authority. The storage space provided at these facilities helps decongest the port while allowing other cargo from other vessels to be discharged. The speed of customs clearance is improved by the availability of sufficient customs verification areas provided, allowing multiple containers to be simultaneously inspected by various customs officers. The primary objective of the CFS is to optimize savings in the handling process, while immediately improving the capabilities of importers within the supply chain to effectively trade internationally. The terminal efficiency and effectiveness are closely related to its profitability and operational performance, as proven by the charges applied on importers and exporters, cargo dwell-time, and the number of vessel arrives at the terminal during a specific timeframe (Musyoka, 2018).

3. Research Method

This research utilizes qualitative and quantitative approaches. Qualitative research methodologies are employed to address inquiries pertaining to subjective experiences, interpretations, and viewpoints, primarily from the perspective of the individuals involved in the study. Typically, this approach entails participating in small-group discussions to explore individual's beliefs, attitudes, and conceptualizations of normative behavior. Semi-structured interviews are employed as an opportunity to gather insights from key informants regarding a particular topic, to obtain background information or an institutional point of view. (Hammarberg et al, 2016).

On the other hand, quantitative methods are used to compute on a particular population or sample, which consist of 56 employees who work at Pesaka Loka Kirana Ltd. Data collection using instruments and statistical data analysis, with the aim of testing predetermined hypothesis. The determination of focus in quantitative approaches is based on the level of novelty that has been obtained from the situation in the field (Sugiyono, 2022). All of the measures for each construct as shown in **Table 1** were validated by the previous studies and small-group discussions with the assessment using the 5-Point Likert Scale.

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Table 1. Measurement of Variables

Variable	Operational definition	Source
Warehouse Management System (*applied on slow moving warehouse*)	The operational efficiency of WMS is accurate as it covers almost all logistics activities in a typical warehouse, such as receiving, put-away, storage, picking, packing and shipping.	(Adawiyah, 2022)
Warehouse Management System (*applied on fast moving warehouse*)	WMS helps businesses to communicate and collaborate with all the logistics partners effectively and also real-time starting from active, incoming, arrived, stripping, stored, behandle, and outgoing.	(Pesaka Loka Kirana Ltd, 2023)
Inventory Control (*applied on slow moving warehouse*)	Inventory control consists of several aspects, including safety stock (anticipation of high demand), optimal inventory quantity (inventory cost efficiency), accuracy in order fulfillment (types and lead time) as well as customer satisfaction.	(Ramadhanty & Evitha, 2021)
Cargo Control (*applied on fast moving warehouse*)	Cargo control system in a container freight stations focuses solely on supervision and utilization, to ensure that the number and volume of incoming goods match the availability of warehouse capacity.	(Sidharta, 2023)
Container Freight Stations Efficiency	Container Freight Stations efficiency influenced by se veral things including storage, customs clearance speed, and costs incurred.	Musyoka (2018)

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a set of observed variables, by examining the intercorrelations among these variables. Latent variables are denoted as new variables that are derived from a combination of many variables. On the other side, path analysis is a graphical depiction that illustrates the relationship between variables using arrows to display the correlation Both primary and secondary sources were used in this research. Primary data received directly from the first source for the purpose of doing research or analysis by distributing questionnaires, conducting interviews, or making observations. The term of secondary data refers to information that is gathered through the processes of finding, processing, analyzing, and comparing specific materials with a variety of library sources, including academic publications, government reports, statistical data, public databases, and other online sources (Sugiyono, 2022).

This research employed Structural Equation Modeling (SEM) as the chosen data analysis methodology. SEM is a statistical technique that integrates two distinct methodologies, specifically factor analysis and path analysis. Factor analysis refers to statistical method used to derive latent variables from coefficient. The visual representation of the connection between two or more variables is shown by an arrow, which includes a correlation coefficient. The representation of correlation in the form of an arrow as shown in **Figure 2** has the ability to express intricate interactions between variables, including indirect or mediation relationships (Wingdes, 2019).

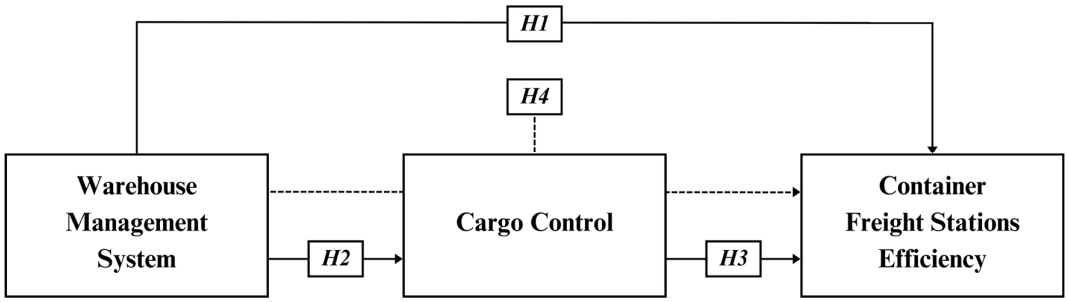

Fig. 2. Research Model

The following hypotheses are proposed as a result of this study, which draws upon the findings of previous studies and the development of the research model:

H1: Warehouse Management System significantly and positively affects the Container Freight Stations Efficiency
H2: Warehouse Management System significantly and positively affects Cargo Control
H3: Cargo Control significantly and positively affects the Container Freight Stations Efficiency

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H4: Warehouse Management System through Cargo Control significantly and positively affects the Container Freight Stations Efficiency.

4. Results and Discussion

As there is a lack of studies that have specifically examined the impact of warehouse management system and cargo control on container freight stations, it becomes difficult to identify indicators for these two variables that align accurately with the operation of CFS. Therefore, it is necessary to start preliminary research by doing semi-structured interviews in order to find the right indicators as presented in **Table 2**.

Table 2. Preliminary Result Findings

Variables	Dimensions	Indicators
Warehouse Management System	Inbound Process	Active
		Incoming
		Arrived
	Cargo Handling	Stripping
		Stored (Less Container Load)
		Behandle
		Outgoing
Cargo Control	Monitoring	Quantity of Items
		Volume of Goods
	Utilization	Warehouse Capacity
		Flow of Goods

Confirmatory Composite Analysis (CCA) conducted in order to assess the validity and reliability of the measurements (Hair et al, 2020). It is necessary to establish the composite reliability (CR) of the constructs with the threshold value is equal to or greater than 0.7. This study demonstrates that all constructs have composite reliability (CR) values exceeding 0.7, indicating high internal consistency. Additionally, the Cronbach's Alpha (α) values for all constructs are above 0.7, further confirming their reliability. Hence, the reliability metrics of the construct have surpassed the predetermined threshold levels.

Convergent validity is a method used to evaluate the degree of positive connection among various indicators that belong to the same dimension (Sarstedt et al, 2020). An appropriate loading factor of 0.7 and an Average Variance Extracted (AVE) of 0.5 have been achieved. According to the data displayed in **Table 3**, it can be observed that all the items used to measure each construct exhibited a loading factor greater than 0.7. Additionally, the average variance extracted (AVE) for all constructs surpassed the threshold of 0.5. These findings provide evidence supporting the presence of convergent validity.

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Table 3. Result of Confirmatory Composite Analysis

Construct or Item	Loading	α	rho_A	rho_C	AVE	t-stats
Warehouse Management System		0.905	0.906	0.925	0.637	-
WMS1 – Active	0.795	-	-	-	-	9.322
WMS2 – Incoming	0.801	-	-	-	-	12.968
WMS3 – Arrived	0.739	-	-	-	-	6.977
WMS4 – Stripping	0.771	-	-	-	-	9.892
WMS5 – Stored (LCL)	0.849	-	-	-	-	13.291
WMS6 – Behandle	0.845	-	-	-	-	20.236
WMS7 – Outgoing	0.784	-	-	-	-	14.946
Cargo Control		0.862	0.865	0.907	0.709	-
CC1 – Quantity of Items	0.786	-	-	-	-	10.704
CC2 – Volume of Goods	0.874	-	-	-	-	19.872
CC3 – Warehouse Capacity	0.862	-	-	-	-	20.841
CC4 – Flow of Goods	0.843	-	-	-	-	16.784
Container Freight Stations Efficiency		0.925	0.928	0.938	0.626	-
CFSE1 – Stacking Area	0.821	-	-	-	-	14.321
CFSE2 – Capacity Utilization	0.793	-	-	-	-	11.121
CFSE3 – Proximity to Port	0.726	-	-	-	-	8.317
CFSE4 – Storage Security	0.763	-	-	-	-	7.104
CFSE5 – Cargo Control	0.848	-	-	-	-	19.406
CFSE6 – Number of Customs Officers	0.763	-	-	-	-	12.924
CFSE7 – Customs Clearance Speed	0.777	-	-	-	-	16.795
CFSE8 – Handling Cost	0.749	-	-	-	-	8.465
CFSE9 – Storage Cost	0.869	-	-	-	-	20.273

Despite the longstanding recommendation of the Fornell-Larcker criterion for evaluating the discriminant validity of latent variables, its effectiveness is limited when used in conjunction with classical Partial Least Squares Path Modeling (PLS-PM) due to its reliance on constant factor loading estimations. In order to address this limitation, the HTMT (Heterotrait-Monotrait Ratio of Correlations) was devised as a means of evaluating discriminant validity specifically within the context of variance-based estimators. The assessment of the HTMT can be accomplished by constructing a confidence interval to determine if the HTMT is statistically smaller than a predetermined threshold value, which in this case is 1 (Benitez et al, 2020). As shown in **Table 4**, all square root AVE values were less than 1 which indicates that the discriminant validity has been established.

Table 4. Discriminant Validity with HTMT

	Cargo Control	CFS Efficiency	WMS
Cargo Control			
Container Freight Stations Efficiency	0.916		
Warehouse Management System	0.916	0.971	

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The examination of path coefficients, variance, effect sizes, and t-values were conducted to analyze the hypotheses. This analysis used a bootstrapping process consisting of 5000 subsamples. The initial stage consisted of performing an analysis of the interplay between the warehouse management system, cargo control, and container freight stations efficiency. Followed by an analysis of the specific indirect effects of cargo control as an intervening variable along with WMS influence the efficiency of container freight stations.

Subsequently, value of f^2 was conducted, which measures the significant impact generated by the independent variables regardless of the sample size (Benitez et al, 2020). The effect can be classified into three categories, such as small, medium and large. The small effect size falls within the range of 0.02 to 0.15, the medium effect size falls within the range of 0.15 to 0.35, and the large effect size is defined as any value greater than 0.35. The results presented in **Table 5** indicate that the WMS has a substantial effect on both cargo control and CFS efficiency, as shown by the large effect sizes of 1.973 and 0.954 respectively. However, the relationship between cargo control and CFS efficiency is relatively small, which amounted to 0.135.

Table 5. Hypothesis Testing Results

Path	β	SD	t-value	Bias	p-value	f^2	Results
Warehouse Management System – Container Freight Stations Efficiency	0.689	0.078	8.850	-0.001	0.000	0.954	Acc
Warehouse Management System – Cargo Control	0.815	0.063	12.835	-0.004	0.000	1.973	Acc
Cargo Control – Container Freight Stations Efficiency	0.259	0.089	2.900	-0.002	0.004	0.135	Acc
Warehouse Management System – Cargo Control – Container Freight Stations Efficiency	0.211	0.074	2.835	-0.003	0.005	-	Acc

The evaluation of the strength and significance of the path coefficients pertains to the projected connections, specifically the structural paths between the constructs. In a way that's similar to the evaluation of weights for formative indicators, the assessment of significance relies on the utilization of bootstrapping standard errors as a foundation for the computation of t-values and p-values associated with path coefficients (Urreta & Rönkkö, 2018). A path coefficient is considered statistically significant at the 5% level of significance if the value of zero is not included within the 95% confidence interval (Sarstedt et al, 2020).

The results as shown in **Table 5** explain the significant and positive effect of warehouse management system (t-value (8.850) > t-table (2.006), p-value (0.000) < 0.05) and cargo control (t-value (2.900) > t-table (2.006), p-value (0.004) < 0.05) on container freight stations efficiency. On the other hand, WMS also has a significant impact on cargo control (t-value (12.835) > t-table (2.006), p-value (0.000) < 0.05). This result shows that the ability to track

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cargo in real-time allows for better resource allocation and scheduling, resulting in a smoother and more synchronized workflow within the CFS.

Further analysis for indirect effect shows that cargo control as an intervening variable along with warehouse management system significantly and positively influence container freight stations efficiency (t-value (2.835) > t-table (2.006), p-value (0.005) < 0.05). Cargo control serves as a critical role in the efficiency of container freight stations. Cargo control acts as the intermediary by executing the directives and strategies set by the WMS. It ensures that the operations within the CFS align with the optimization goals set by the WMS. This integrated approach allowing real-time inventory tracking, improves space utilization, order processing, streamlines workflows, reducing errors and delays, ultimately leading to a significant improvement in overall CFS operations.

Table 6. Structural Analysis Results

	R^2	Adjusted	Q^2	Model Fit
Warehouse Management System	-	-	-	-
Cargo Control	0.664	0.657	0.674	-
Container Freight Stations Efficiency	0.833	0.826	0.822	-
SRMR	-	-	-	0.086
d_ULS	-	-	-	1.550
NFI	-	-	-	0.642

The following step is the evaluation of the coefficient of determination (R^2). The R^2 statistic quantifies the amount of variance explained by the endogenous constructs, serving as an indicator of the model's explanatory power or in-sample predictive power. The coefficient of determination (R^2) is a statistical measure that varies between 0 and 1. Higher values of R^2 indicate a greater degree of explanatory power (Sarstedt et al, 2020). As a formal guideline, R^2 values of 0.75, 0.50, and 0.25 can be categorized as substantial, moderate, and weak. **Table 6** presents that cargo control (0.664) and container freight stations (0.833) has a moderate and substantial in-sample predictive power respectively.

5. Conclusion

Preliminary research led to a total of 11 new indicators that can be applied for both WMS and cargo control. The results shows that both WMS and cargo control has a positive and significant impact on container freight stations. On the other hand, cargo control is positively and significantly influenced by the WMS. Further analysis for indirect effects also shows that cargo control as an intervening variable along with warehouse management system (WMS) significantly and positively influence the efficiency of container freight stations. This integrated approach allowing real-time inventory tracking, improves space utilization, order processing, streamlines workflows, reducing errors and delays, ultimately leading to a significant improvement in overall CFS operations and throughput.

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6. Implications

The research examining the intervening role of cargo control within the realm of WMS has unveiled a paradigm-shifting perspective on the optimization of container freight stations efficiency. This study offers profound implications for the logistics and supply chain industry, illuminating a critical nexus where technology, control mechanisms, and operational strategies intersect. By identifying cargo control as a pivotal link in the chain, the research underscores its transformative potential in enhancing overall efficiency and productivity within container freight stations. This revelation prompts a reevaluation of established practices and emphasizes the need for a holistic approach to warehouse management. The integration of robust cargo control measures within WMS not only enhance inventory management but also streamlines processes, minimizing bottlenecks and maximizing throughput. Moreover, this study catapults the discourse on operational excellence, advocating for an elevated standard of performance in the freight industry. As a result, stakeholders are now presented with a unique opportunity to restructure their logistics frameworks, leveraging the insights gained from this research to forge more resilient and responsive supply chains. The implications extend far beyond the confines of individual warehouses, resonating across the entire freight ecosystem, ultimately fostering a more agile, adaptable, and efficient industry.

7. Research Limitations

This study was limited to the CFS belongs to Pesaka Loka Kirana Ltd. located in the Line 2 of Tanjung Priok Port area. It should be noted that this study relies solely on the assumption that the 56 respondents, consisting of staff and the management, possess the availability to complete the questionnaires provided and demonstrate genuine commitment in responding to each statement. This is crucial in order to ensure that the data is accurate and reliable for this research. Furthermore, the existing body of literature pertaining to the selected research factors is also limited, as there is a lack of scholarly reviews that have specifically studied the relationship between the variables.

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