(RESEARCH ARTICLE)

Analysis of Factors contributing to Warehousing Risk Management and operations: A quantitative Assessment

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Abstract

This study presents a comprehensive analysis of factors influencing warehousing risk management. Critical components such as warehousing management, staff quality, safety practices, inventory, theft, and government policies pose a serious risk to warehouse management which likely affect the operational supply chain of warehouse effectiveness. The research employed a quantitative approach using a structured questionnaire distributed among the warehouse personnel, and data collated from 71 responses were tested for reliability and level of significance using Cronbach's Alpha and analysis of variance (ANOVA). Horizontal bar graphs categorizing various risk components labeled A to E. The graph illustrates the percentage of agreement from respondents regarding the validity of each, highlighting A3:83% of warehouse management and E1:83% of warehouse theft as the most critical contributors to warehousing management risk, while A10:49.3% of warehouse management demonstrates lower consensus. The findings underscore the importance of comprehensive risk management for improving warehouse efficiency, balancing supply and demand, and enhancing competitiveness in dynamic industrial environments.

1. Introduction

A warehouse is a large commercial building used for the storage, handling, and management of goods and inventory. Its primary purpose is to support the supply chain by providing a central location where products can be stored before they are distributed to customers or other supply chain partners. Warehouses play a critical role in logistics and inventory management, enabling businesses to balance supply and demand, manage stock levels, and streamline distribution processes. According to Smith et al. (2022), warehousing is defined as a "systematic process of storing goods and materials in a designated space to facilitate efficient inventory management, order fulfillment, and logistical operations.

The warehousing sector is fundamental to the logistics and supply chain industries, acting as a critical node for the storage and distribution of goods. Warehousing plays a pivotal role in supply chain operations, and effective risk management is essential for safeguarding personnel, inventory, and overall business continuity. As highlighted by Hani K. Alzahrani (2022), the complexity of warehouse environments necessitates a proactive approach to identify potential hazards and implement mitigation strategies. Regular risk assessments are vital for recognizing risks associated with equipment failures, inventory discrepancies, and safety violations, which can lead to operational disruptions if left unaddressed.

Smith et al. (2022) emphasize that integrating technology, such as Warehouse Management Systems (WMS), can enhance the effectiveness of risk assessments by providing real-time data and analytics to monitor operations

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continuously. However, reliance solely on technology without regular human oversight can lead to gaps in risk management.

The research work aims to categorize and examine the different risks in warehousing into various segments such as Operational risks, Safety risks, Theft, Environmental risks, Technological risks, and Supply chain risks to determine an appropriate approach to warehouse risk management.

2. Methodology

The materials employed in this research include, Survey Questionnaire, Government publications on manufacturing Standards and logistics, and relevant Industry Whitepapers

The survey included socio-demographic segments labeled from letter (a) to (f) and a 25-item self-administered questionnaire designed to assess warehousing management risk assessment among participants and warehouse users (Hedge. A., et al., 1999). The items of the questionnaires were segmented into six mothers factors such as warehouse management, staff quality, safety, inventory, theft, and government policy as shown in Figure 1. While Cronbach's Alpha criteria and ANOVA are used to analyze the integrity of the collected dataset.

Figure 1 Warehousing Risk Management Mother Factors of the Items of Risk assessment

3. Results

3.1. Warehousing Management

Ten items were used to assess warehousing management with seventy-one (71) responses as shown in Table 1, the case summary and reliability level of the responses from questionnaires were determined. The revealed Cronbach's alpha value of 0.953 indicates an excellent internal consistency and reliability of the set items to analyze warehousing management, the differences between the groups are statistically significant for the F-value of 3.9551, and the P-value is 0.00000086. The items were labeled from A1 to A10 respectively as listed below.

- A1: Supply chain risks are regularly monitored and evaluated.
- A2: Communications with suppliers are efficient and effective in preventing delays.
- A3: The warehouse maintains a buffer stock to mitigate the impact of supply chain disruptions.
- A4: Regular maintenance schedules are followed for all warehouse equipment.
- A5: Backup equipment is available to ensure operations during equipment failures.
- A6: Equipment failure incidents are documented and reviewed to prevent recurrence.
- A7: Investment in new or advanced technology reduces the likelihood of equipment failure.
- A8: Feedback systems are necessary for better service delivery in the warehouse.
- A9: There is a feedback system to cater to customers' suggestions and complaints in the warehouse.
- A10: The warehouse has a robust plan in place to handle supply chain disruptions.

As shown in Figure 2, the validation for strongly agreed for item A1 is 42.3%, A2 35.2%, A3 49.3%, A4 43.7%, A5 47.9%, A6 31.0%, A7 49.3%, A8 36.6%, A9 45.1%, A10 49.3%. This indicate that if warehousing management strongly adhere to items A3, A7and A10 respectively there will be less risk on warehousing management, also reported by (Wu, D. and Olson, D.L. 2008) and (Hani K.et al., 2022), other items (A1, A2, A4, A5, A6, A8, A9) were also germane in warehousing management, but according to this study the most critical items were A3, A7 and A10.

Table 1 Case Summaries, Test for Data Reliability, and Analysis of Variance (ANOVA) of Responses to Warehousing Management.

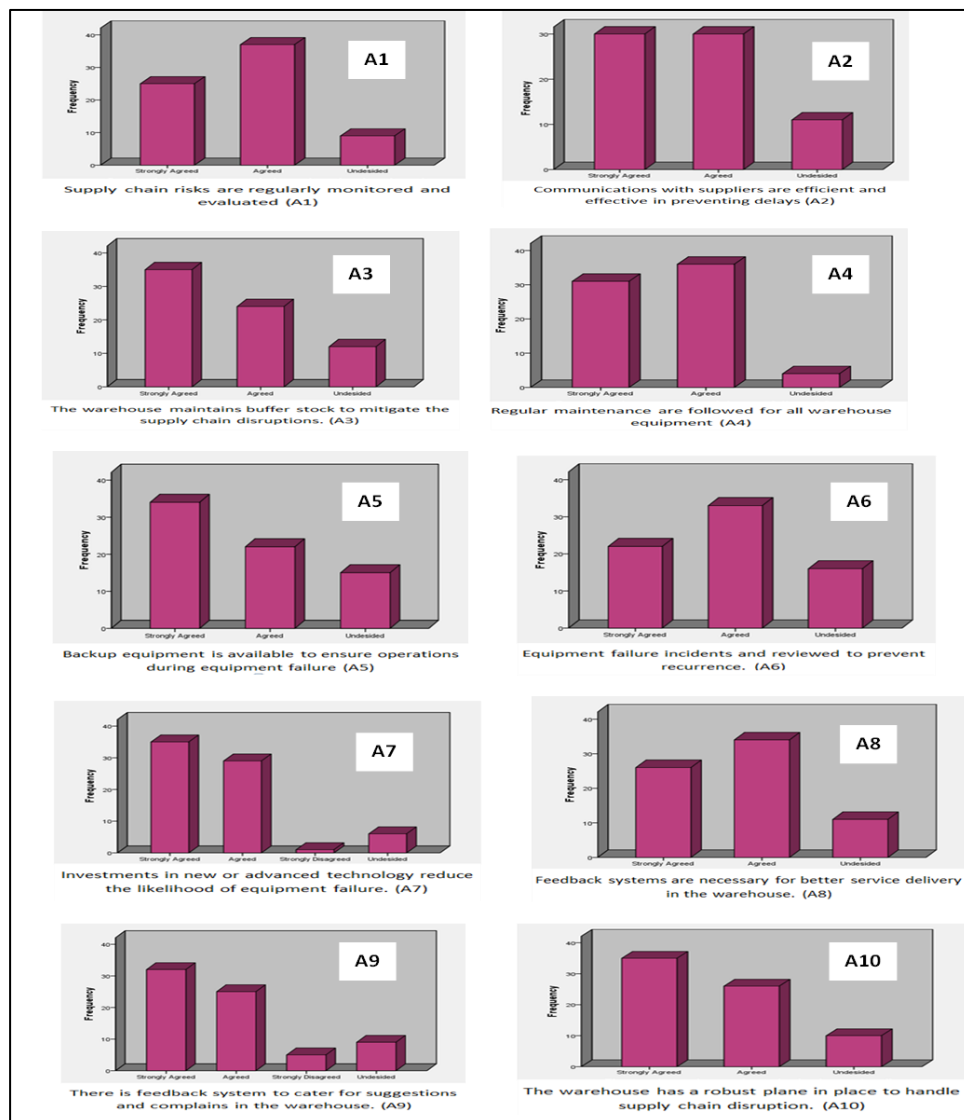| Case Summary					
Total cases analyzed		**Valid cases**		**Excluded cases**	
71	100%	42	71%	29	29%
Cronbach's Alpha		0.953			
F-value:		p-value			
3.951		0.0000086			

Figure 2 Bar chart presentation of the ten items (A1 to A10) on risk assessment on warehousing Management responses

3.2. Staff Quality

The staff quality of warehousing management risk assessment was analyzed with four (4) items, the responses summary, data reliability, and analysis of variance are detailed in Table 2.

Seventy-one (71) responses with twenty-one (21) excluded cases were examined, 0.956 Cronbach's alpha criteria indicated good data set reliability and the F-value of 6.355 with P-value of 0.000383 indicated the differences between the data groups were statistically significant.

Table 2 Case Summaries, Test for Data Reliability and Analysis of Variance (ANOVA) of Responses to Staff Quality

Case Summary					
Total cases analyzed		**Valid cases**		**Excluded cases**	
71	100%	71	71%	29	29%
Cronbach's Alpha			0.956		
F-value			p-value		
6.355			0.000383		

The items in the group were denoted with B1 to B4 in the questionnaire to examine the staff quality in the warehousing operation.

- B1: Employees should be cross-trained to ensure operational continuity during staff shortages.
- B2: Untrained staff can ruin warehousing management.
- B3: Temporary staffing options are readily available to manage peak periods or emergencies
- B4: Staff are trained to identify early warning signs of equipment malfunction.

This study revealed that 35.2% strongly agreed with B1, 49.3% .56.3 %, 62.3% with B2, B3, B4 respectively, as shown in Figure 3, which means item B4 with 62.3% has the highest validated case, if staff is trained to identify early warning signs of equipment malfunction will drastically reduce operation down time due consistence human error and increase warehousing operations efficiently as found by (Sri et al., 2017). Generally staff training is paramount to staff quality which serves as a tool to mitigate the risk of handling in operations and warehousing management.
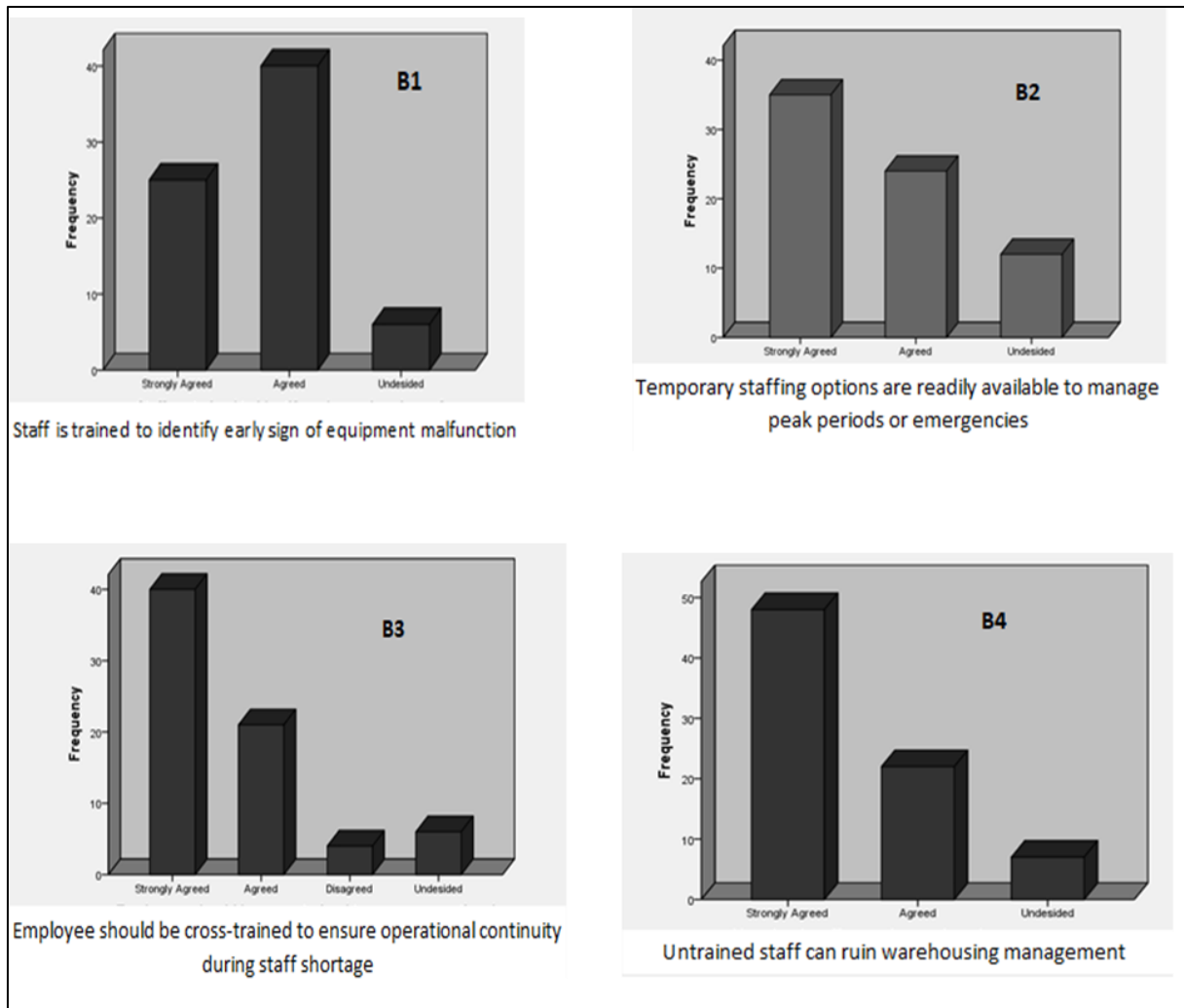
Figure 3 Bar chart presentation of the 4 items (B1 to B4) on risk assessment of warehousing staff quality

3.3. Safety in the Warehouse

Warehousing safety was determined with 71% case summary and 29 % excluded cases due to outliers, the cronbach's alpha test for reliability of 0.944 shows that there is high consistency and reliability of the grouped items, also the f-value, P-value of 19.516 and 0.000945 respectively means the results from these data set are statistically significant as shown in Table 3

Table 3 Is Case Summaries, Test for Data Reliability, and Analysis of Variance (ANOVA) of Responses to Safety in Warehousing

Case Summary					
Total cases analyzed		**Valid cases**		**Excluded cases**	
71	100%	71	71%	29	29%
Cronbach's Alpha			0.944		
F-value			P-value		
19.516			0.000945		

The items outlined for the analysis of safety in the warehousing were tagged with C1 to C6 as stated below.

- C1: The warehouse is kept clean and free from obstructions to ensure safe movement.
- C2: Potential hazards in the warehouse are promptly identified and addressed.
- C3: Equipment and tools are regularly inspected and maintained to ensure safe usage.
- C4: Safety signs and warnings are visible and effectively placed throughout the warehouse.
- C5: All workers are provided with and consistently use appropriate PPE during operations.
- C6: Management is proactive in enforcing safety standards and addressing employee safety concerns.

The result from the analysis shows that C1 was 45.1% strongly agreed with, C2 68.7%, C3 38%, C4 50.7%, C5 43.7%, C6 66.2%, as in Figure 4, item C2 has the highest value which proves that, if potential hazards in the warehouse are promptly identified and addressed (Stanesmervyn and Anugeetha Shine 2022), the risk due to safety management in the warehouse will be reduced drastically and other items will makes major elements to support the implementation of item C2 for successful safety practice in the warehouse operations.
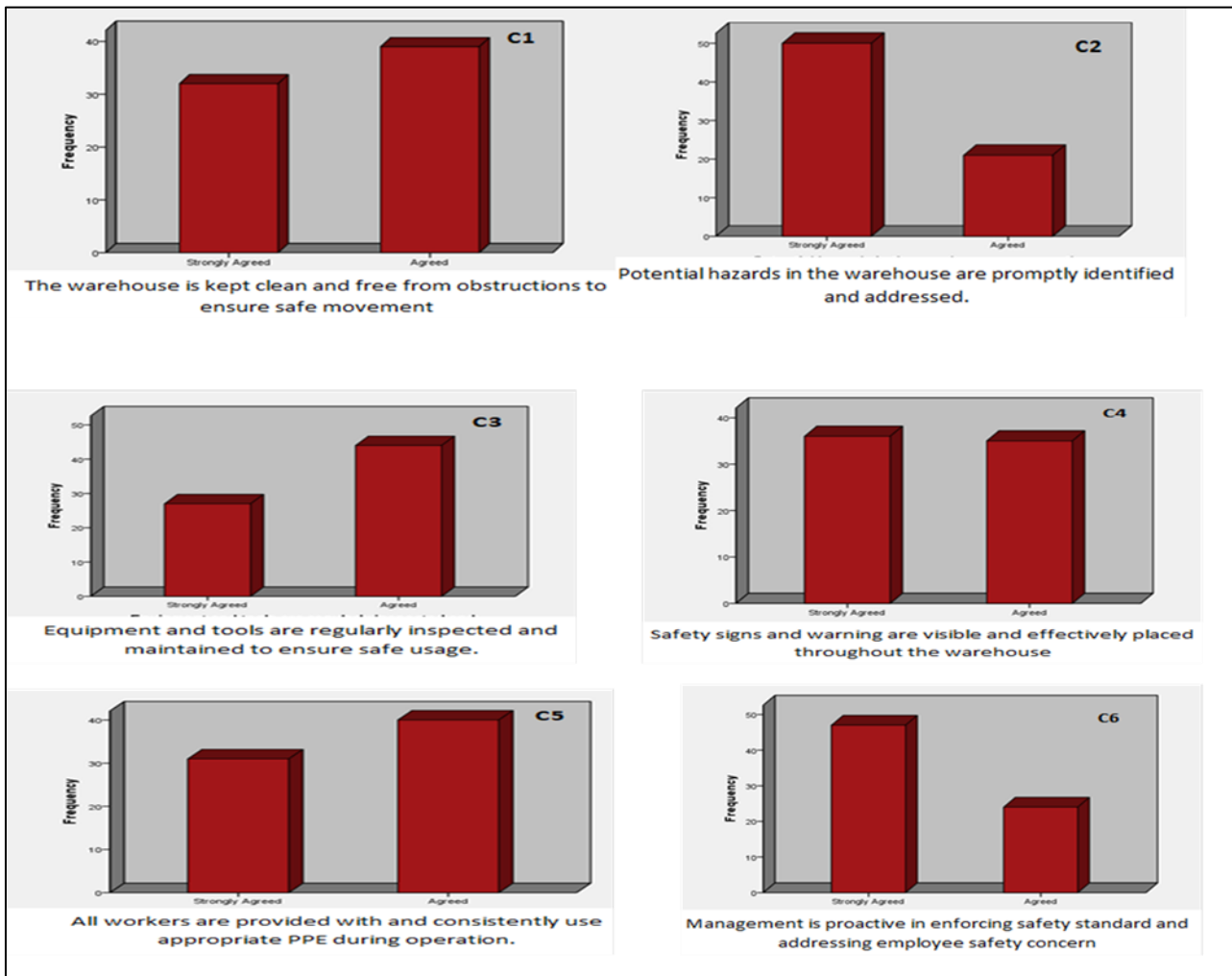

Figure 4 Bar chart presentation of the 6 items (C1 to C6) on responses of risk assessment of Safety in warehousing operations

3.4. Warehouse Inventory

The warehouse inventory risk assessment was determined using four (4) factors and seventy one case studies, twenty nine (29) were excluded due to outliers as shown in Table 4., the cronbach alpha of 0,441 indicates a low reliability of the data set (Nurhafizah, A et, al., 2024), which might be as result of lesser number of factors in the data set., although the F-value and P-value of 4.035 and 0.003 shows a good statistical significant of the data set.

Table 4 Is Case Summaries, Test for Data Reliability and Analysis of Variance (ANOVA) of Responses to Warehouse Inventory Risk Assessment in Warehousing Operation

Case Summary					
Total cases analyzed		**Valid cases**		**Excluded cases**	
71	100%	71	71%	29	29%
Cronbach's Alpha		0.441			
Cronbach's Alpha Based on Standardized Items		0.708			
F-value		p-value			
4.035		0.003			

The risk assessment of the inventory of the warehousing operations was presented with four (4) items denoted with the alphabet D1 to D4 and the meanings were stated below

- D1: Errors in inventory records are promptly detected and corrected.
- D2: Technology (e.g., barcode scanners, RFID) is effectively utilized to minimize inventory errors.
- D3: Periodic stock audits are conducted to ensure inventory accuracy
- D4: Inventory tracking systems in the warehouse are accurate and reliable.

The feedback from the questionnaire shows low percentages of decisions attributed to "strongly agreed" across the four factors (D1 to D4), while the decision attributed to "agreed" is higher across the factors as shown in Figure 5, hence the final decision will be based on responses from "agreed" decisions collated from the questionnaires. 78.9% agreed with item D1, while 60.6%, 54.9%, and 40.8% agreed with items D2, D3, and D4 respectively. Item E1 has the highest percentage of 78.9% meaning that if immediate error detection in inventory records is corrected it will reduce the risk of inventory errors in the warehousing management. (Peck, H. 2006), Other items can also be considered like D2 with 60.6% technology can be used to detect prompt errors in inventory records to mitigate the risk of inventory errors in the warehousing management.
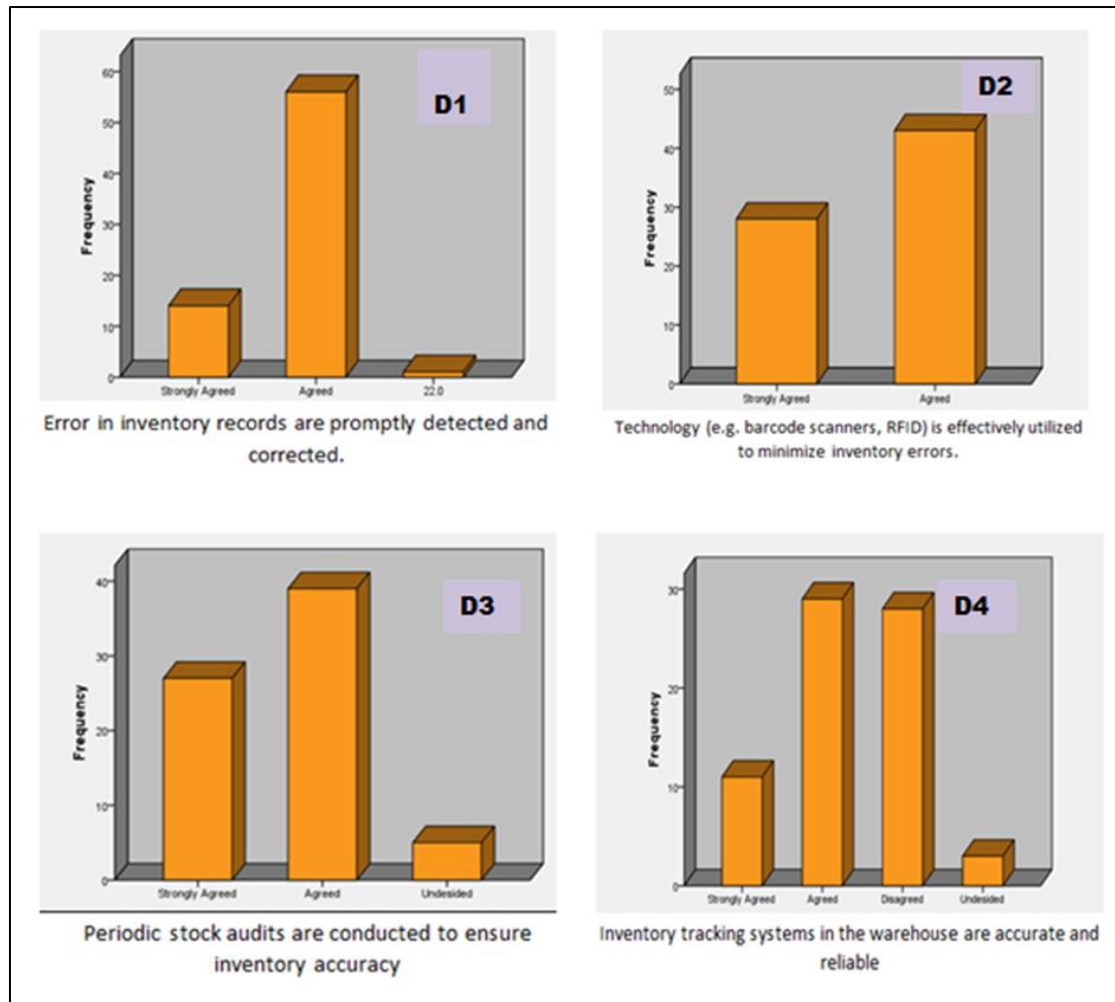
Figure 5 Bar chart presentation of the 4 Factors (E1 to E4) responses of risk assessment of inventory in the warehousing operations

3.5.   Warehouse Theft

The warehouse theft was analyzed from seventy-one (71) cases with twenty-nine (29) excluded cases, the Cronbach's alpha of reliability value was 0.881 for five (5) factors, this indicates that the data set has a good reliability level of acceptance. The F-value of 18.019 and P-value of 0.00000434 show that the outcome is statistically significant. As summarized in Table 5.

Table 5 Case Summaries, Test of Data Reliability, and Analysis of Variance (ANOVA) of Responses of Warehouse Theft Risk Assessment

Case Summary					
Total cases analyzed		**Valid cases**		**Excluded cases**	
71	100%	71	71%	29	29%
Cronbach's Alpha		0.881			
F-value		p-value			
18.019		0.00000434			

This study uses five variables labeled from E1 to E5 as stated in the questionnaires.

- E1: Adequate security measures are put in place to prevent theft in the warehouse.
- E2: Surveillance systems (e.g., cameras) should be consistently monitored to detect unauthorized access.
- E3: Access to restricted areas in the warehouse should be effectively controlled.
- E4: Staff members should be required to undergo background checks to minimize internal theft risks.
- E5: Regular audits are conducted to identify and address discrepancies related to theft.

The analysis revealed the percentage outcome of "strongly agreed" with variable E1 as 50.7%, E2:83.1%, E3:69.0%, E4:63.4%, and E5: 43.7%. Based on the outcome, factor E3 with 83.1% has the highest valid case as shown in Figure 6, meaning that if surveillance systems are consistently monitored to detect unauthorized access it will reduce the localized and on-transit cargo theft in the warehouse as also mentioned by (Xinrui Liang a, et., al. 2022). Although on-transit forced stops and hijacks must also be considered, Ekwall and Lantz (2012) find that hijacks constitute less than 2% of all cargo theft, to enhance security against cargo theft due to hijack, the characteristics of these types of incidents can be examined in further research work.
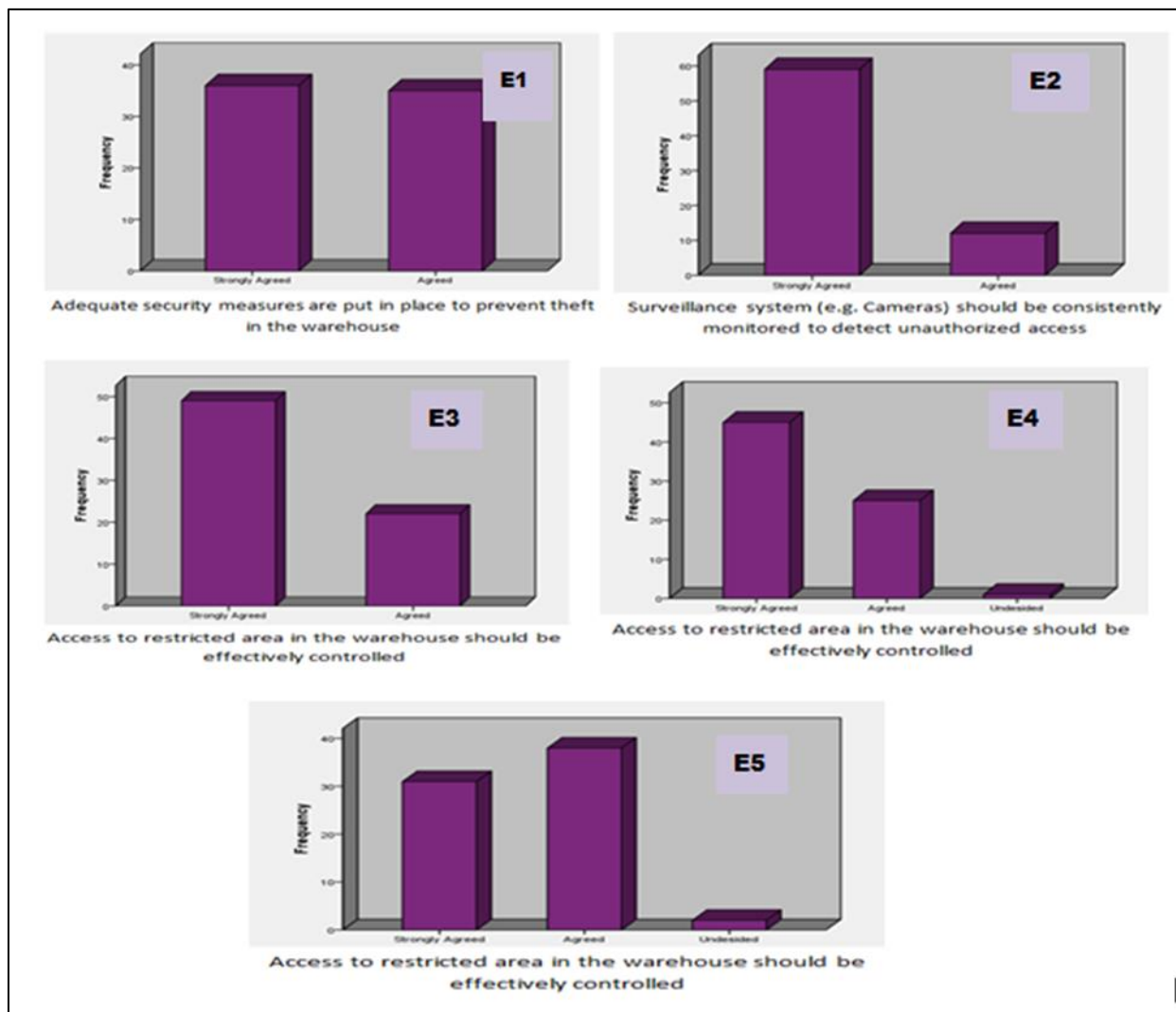
Figure 6 Bar chart presentation of the 5 Factors (F1 to F5) responses of risk assessment of warehouse theft

3.6. Government Policies

The government policies in terms of taxation which seriously affect warehousing management are administered in the questionnaire, seventy cases were valid and twenty-nine were missing as shown in Table 6, 43% strongly agreed while 28% only agreed and the pie chart presentation in Figure 7, revealed the percentage responses. According to the valid

result in this study, it shows 60.0% a strong conviction that the government policies of taxation greatly affect the warehousing management.

Table 6 Summary of the statistical results

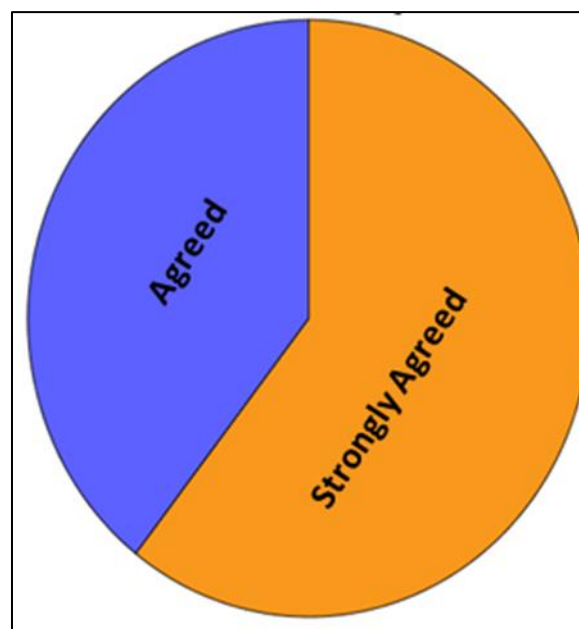| Case validity		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly Agreed	43	43.0	60.6	60.6
	Agreed	28	28.0	39.4	100.0
	Total	71	71.0	100.0	
Missing	System	29	29.0		
Total		100	100.0		

Figure 7 Pie Chart Presentation of Responses for Unfriendly Government Policies and Taxes Affecting Warehousing Management

4. Conclusion

This research underscores the critical nature of warehousing risk management as a dependent variable affected by several identifiable factors. The analysis revealed that the highest influencing factors are represented by F3 (Access to restricted areas in the warehouse should be effectively controlled), which recorded an impressive 83.1% of respondents expressing strong agreement regarding its significance. In contrast, factors A3 (The warehouse maintains buffer stock to mitigate the impact of supply chain disruptions), A7 (Investment in new or advanced technology reduces the likelihood of equipment failure), and A10 (The warehouse has a robust plan in place to handle supply chain disruptions), with a notable but relatively lower agreement percentage of 49.3%, indicate variability in their perceived importance. These findings highlight the imperative for management within warehousing operations to prioritize risk identification, particularly in the realms associated with F3. Effective risk management is essential not only for mitigating uncertainty but also for fostering a culture of proactive decision-making that enhances overall business resilience. By concentrating efforts on these key risk areas, warehousing management can strengthen its operational framework, reduce potential disruptions, and ultimately enhance its competitive advantage in a dynamic market.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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