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Procurement Issues in the Indonesian Maintenance, Repair, and Overhaul (MRO) Industry

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ABSTRACT

Objective - This study addresses the escalating challenges in aircraft component procurement within Indonesia's aviation industry.

Methodology/Technique – To achieve this objective, an in-depth literature review was conducted, exploring diverse facets such as geographical challenges, parts availability intricacies, supplier preferences, quality assurance, time and pricing dynamics, customs clearance challenges, and cost management strategies within the realm of Indonesian Aviation Maintenance, Repair, and Overhaul (MRO). The research methodologically involved 30 participants from various MRO companies affiliated with the Indonesia Aircraft Maintenance Services Association (IAMSA). Subsequently, PLS-SEM analysis was employed to establish the robust reliability and validity of the study, revealing significant relationships that underscored the crucial impact of lead time on Preferred Suppliers and Procurement Process Performance.

Finding – The Analysis revealed significant relationships, emphasizing the crucial impact of lead time on Preferred Suppliers and Procurement Process Performance within the Indonesian Aviation MRO sector.

Novelty – This study provides nuanced insights for refining procurement strategies and enhancing operational efficiency within the dynamic Indonesian Aviation MRO sector, contributing to the ongoing discourse and offering a holistic understanding of key factors influencing the procurement landscape.

Type of Paper: Empirical
JEL Classification: L11, L16, L42
Keywords: Aircraft Maintenance, Repair, and Overhaul (MRO), Indonesia, Procurement

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1. Introduction

The aviation industry in Indonesia has witnessed unprecedented growth and transformation over the last two decades. The pivotal deregulation measures implemented in the early 2000s ignited a spectacular surge in aircraft and passenger traffic, solidifying Indonesia's position as Southeast Asia's most prominent airline market (Fahriza & Willey, 2018).

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Table 1 presents a compelling snapshot of this growth, illustrating that 2018 Indonesia boasted 1559 registered aircraft (DGCA, 2019). While the industry experienced a temporary setback during the COVID-19 pandemic, with 1497 (DGCA, 2022) registered aircraft, it has demonstrated remarkable resilience and is now recovering.

Table 1. Number of Aircraft Registered from 2018-2021

Year	Number of Aircraft Registered	Total Valid Certificate	Registered Aircraft under AOC 121	Registered Aircraft under AOC 135	Registered Aircraft under OC 91, 137, 141, and FASI
2018	1559	1227	601	307	315
2019	1505	1128	599	312	218
2020	1583	1199	631	316	245
2021	1497	1119	569	303	243

Source: Airworthiness and Aircraft Operations of DGCA, Ministry of the Transportation Republic of Indonesia.

As the industry embarks on this resurgence, Indonesian airlines strategically position themselves to harness enormous growth opportunities across diverse market segments. Major players like Lion Air and Garuda Indonesia have taken bold steps towards expansion and fleet revitalization. For instance, Lion Air's visionary General Director, Edward Sirait, revealed an ambitious plan to acquire 794 new aircraft to be gradually incorporated into their fleet by 2030 (Natahadibrata, 2015). Similarly, Garuda Indonesia has embarked on a transformational journey, acquiring new and advanced aircraft models, including the Next Generation versions of Boeing 737, 777-300ERs, and 747-400s (Garuda-Indonesia, 2022).

Amidst this extraordinary growth, the aviation industry faces a critical challenge that demands immediate attention - the efficient procurement of aircraft parts and engine components to ensure smooth maintenance, repair, and overhaul (MRO) services. The escalating demand for MRO services, driven by the expanding fleet, has intensified the pressure on airlines and MRO industries to secure vital aircraft components. However, many of these essential parts rely heavily on imports from North America and Europe, warranting a strategic approach to ensure a steady and reliable supply chain.

This research addresses the pressing need to examine the challenges faced by the Indonesian aviation industry in its quest for sustainable and efficient aircraft component procurement. The significance of this study lies not only in its relevance to the current state of the aviation sector but also in its potential to impact the industry's overall safety and operational effectiveness. This paper is divided into six sections. It initiates with the Introduction, followed by the Literature Review, Research Methodology, Results, Discussion, and Conclusion. The Introduction sets the context of the Indonesian aviation industry's growth. The Literature Review covers various challenges in Indonesian Aviation Maintenance, Repair, and Overhaul (MRO) procurement. The Research Methodology explains the study's approach. Results present findings from the Analysis. The Discussion synthesizes the findings. The Conclusion summarizes vital points and suggests future research directions. Ultimately, the paper includes a list of references.

2. Literature Review

This research adopts a systematic approach that spans the three crucial phases of the procurement process—sourcing, purchasing, and payment—to identify challenges within the Indonesian Aviation MRO Procurement. Factors such as supplier location, parts availability, and preferred suppliers are considered during the sourcing stage. The purchasing stage thoroughly examines quality, lead time, price, and customs clearance considerations. In contrast, the payment stage focuses explicitly on costs. This methodology seamlessly aligns with the MRO characteristics discussed in this research, emphasizing the dynamic nature of demand for aircraft parts in the Maintenance, Repair, and Overhaul (MRO) industry, influenced by various factors.

2.1 Geographical Challenges of Aircraft Suppliers

The MRO procurement process commences with a thorough needs assessment led by aircraft engineers who identify crucial components necessary for maintenance and repair operations. However, Indonesian MROs encounter significant challenges from the locations of their suppliers, predominantly in North America and Europe. Importing parts from these distant regions introduces logistical complexities, resulting in extended lead times, elevated costs, and the potential for operational disruptions. It is imperative to address these challenges to streamline the sourcing phase, as such difficulties significantly impact the overall effectiveness of MRO operations.

The proximity issue is further exacerbated by the strategic consideration of warehouse locations, particularly in light of customs challenges. These obstacles contribute to prolonged lead times, complicating the procurement process for Indonesian MROs. The heavy reliance on European and North American suppliers highlights the critical need to optimize the sourcing phase in Indonesian MRO procurement. A comprehensive analysis of the Aviation Supplier Association (ASA) database, the largest global association for aircraft parts suppliers boasting 822 members, underscores the concentration of suppliers, with a substantial 453 members hailing from the United States (ASA, 2022). This data emphasizes the urgency of addressing challenges related to supplier location to enhance efficiency in Indonesian MRO procurement (Goncalves & Kokkolaras, 2017).

Aircraft on ground (AOG) incidents occur due to a paucity of transparency regarding the locations of spare parts in aircraft inventories, so airlines often face substantial expenses when procuring the necessary repair components for AOG situations (Wagner et al., 2005). Streamlining the sourcing phase to relieve these challenges and improve the overall efficiency of MRO operations in Indonesia is imperative.

2.2 Parts Availability Challenges in Indonesian MRO Operations

Effective spare parts inventory management is crucial for maintenance activities, contributing to reduced downtime and improved Availability (Zhang et al., 2021). In Indonesian MRO operations, parts availability challenges are multifaceted. The unpredictability of aircraft availability challenges accurate forecasting, compounded by the extensive range of spare parts in the aviation industry. Developing effective stock control strategies for each spare part becomes a substantial challenge, creating a hurdle for inventory management.

Minimizing inventory to mitigate obsolescence risk leads to maintaining small quantities of stock-keeping units (SKU) (Kenzhevayeva et al., 2021). However, a miscalculated stock strategy may result in penalties or heightened downtime costs. Balancing optimal inventory levels while avoiding surplus expenses remains an ongoing challenge for Indonesian MROs.

The intricacies of spare parts consumption are tied to maintenance activities, necessitating understanding equipment usage patterns and effective maintenance strategies. The challenge is heightened by Indonesia's high dependence on imported aircraft parts and difficulties obtaining spare parts from OEMs. E-marketplaces like ILSMart and Partbase offer accessible avenues for procurement, and Indonesian MROs often opt for PMA as a strategic alternative to overcome challenges associated with OEM availability. The multifaceted nature of these challenges underscores the need for a thorough and strategic approach to address the intricacies of spare parts availability in Indonesian MRO operations.

2.3 Shaping Supplier Preferences in Indonesian MRO Landscape

In Indonesian MROs, the procurement of aircraft parts is intricately shaped by a strategic preference for specific suppliers to optimize value in terms of both price and quality, reduce transaction costs, and minimize lead times (Basak & Guha, 2016). Key practices involve a commitment to approved vendors and selectively engaging non-approved vendors for challenging parts, with the primary determinant being stock Availability.

Decision-making factors include the lowest-priced spare part offers, credit terms, and exploration of exchange sales schemes for supplier selection.

However, challenges emerge due to a limited number of local suppliers, mainly sourcing from the USA and Europe. This has led Indonesian MROs to establish preferred partnerships to ensure quality assurance. However, this strategic approach introduces communication challenges, complexities in building trust, and geographical distances. Despite regional exhibitions, bridging the trust gap remains an ongoing challenge.

The successful navigation of vendors through a rigorous verification process underscores the critical role of vendor approval in safeguarding the quality of aircraft parts. The preference for specific suppliers is rooted in their cost competitiveness and the convenience of flexible credit facilities. Cultivating relationships with preferred suppliers enables MROs to negotiate competitive prices, take advantage of flexible credit terms, streamline purchasing workflows, and enhance overall financial management (Basak, 2016).

Choosing a supplier unconditionally introduces new possibilities for improved resource allocation, risk mitigation in procurement, and cost reduction through savings in time, money, and effort (Taherdoost & Brard, 2019). This holistic approach to supplier selection aligns with the strategic goals of Indonesian MROs, emphasizing the importance of well-managed relationships with suppliers to optimize various aspects of the procurement process.

2.3 Quality Assurance in Aircraft Spare Parts Procurement

Ensuring the airworthiness of aircraft is paramount, requiring maintenance procedures aligned with quality, safety standards, and regulatory compliance (Rosales, 2015). Aircraft spare parts procurement is pivotal for maintaining this commitment.

Strict adherence to top-tier quality standards is crucial in acquiring spare parts. A warranty is imperative, guaranteeing part quality and performance. Documentation or traceability confirms part condition, adding accountability and reliability to the procurement process. The presence of a warranty instills buyer confidence and ensures assurance of part quality and functionality.

Traceability documents provide a comprehensive record of part origin, history, and conformity to industry standards, enhancing transparency and confidence. An Authorized Released Certificate (ARC), like FAA 8130 or EASA Form 1, is crucial as the tangible assurance of adherence to aviation regulations and standards.

Prioritizing spare parts based on categories such as Factory New (FN), New (NE), New Surplus (NS), Overhaul (OH), and Serviceable (SV) underscores the commitment to quality. Each category represents a strategic approach to procurement, balancing cost-effectiveness with an unwavering commitment to top-tier quality and reliability. These considerations collectively contribute to maintaining top-tier quality and safety in the aviation industry, ensuring sustained airworthiness and safety (Rosales, 2015).

2.5 Time Dynamics in Aviation MRO Procurement

Navigating lead time intricacies in Aviation MRO procurement is crucial, especially for swift responses in Aircraft on Ground (AOG) situations. Lead time dynamics are integral, shaped by supplier location, customs clearance, and part availability (Pleumpirom & Amornsawadwatana, 2012) (Zhang et al., 2021).

As urgency diminishes, the procurement strategy adjusts. Ad hoc procurement for Overhaul (OH) and Serviceable (SV) parts allows for an extended lead time, aligning with the definition of balancing efficiency and specific requirements for overhauling and maintaining serviceable components.

Conversely, procuring NEW OEM parts requires a more extensive planning horizon, with a lead time of over one month but less than six months, recognizing the meticulous planning and coordination essential for securing these critical assets (Zhang et al., 2021).

Considering lead time in aviation spare part procurement highlights the dynamic process, emphasizing strategic supplier selection based on lead time for optimizing procurement operations in the aviation industry (Pleumpirom & Amornsawadwatana, 2012) (Zhang et al., 2021).

2.6 Pricing Dynamics in Indonesian MRO Procurement

Indonesian MRO procurement is heavily influenced by price dynamics, compounded by using USD for transactions. The fluctuating Indonesian Rupiah adds complexity, impacting overall aircraft part costs. OEM parts are pricier than PMA, posing a trade-off between brand authenticity and cost-effectiveness (Bosdijk, 2019).

Factory New (FN), New (NE), and New Surplus (NS) parts incur higher costs compared to Overhaul (OH), Serviceable (SV), and Repaired (RP) components, reflecting the premium on their condition and reliability. This pricing hierarchy poses a challenge for Indonesian MROs in maintaining airworthiness standards.

Exporting spare parts contributes to high procurement costs, underscoring local availability and manufacturing challenges. Balancing quality, reliability, and costs, Indonesian MROs strategically navigate the procurement landscape amid currency fluctuations, part condition considerations, and source of origin, optimizing cost-effectiveness while upholding airworthiness standards (Bosdijk, 2019).

2.7 Customs Clearance Challenges

Aviation lead times, encompassing transport, customs clearance, and unforeseen delays, impact MRO procurement efficiency (Pleumpirom & Amornsawadwatana, 2012). Indonesia faces challenges with extended customs clearance lasting three days to 1 month, contributing to operational inefficiencies (Putri, 2019). Reliance on USD in the MRO sector, where 99% of components are imported, compounds challenges, affecting cost structures and industry competitiveness.

Imposed duty fees adversely impacted Indonesian airlines, leading to a decline in imports from late 2014 to early 2016 (Rahmawati et al., 2019). Despite a slight increase in the post-zero percent tariff policy, challenges persist, necessitating a comprehensive review of customs clearance procedures and import duty policies.

MRO firms advocate eliminating customs duties on aircraft spare parts, emphasizing improved policy implementation mechanisms, additional tariff posts for duty exemption, and reevaluating criteria for eligible products. These measures are crucial for streamlining customs clearance, reducing lead times, and enhancing efficiency and competitiveness in Indonesian MRO procurement.

2.8 Cost Challenges

Effective cost management in aircraft spare part procurement is crucial for optimal equipment availability and expense reduction (Hu et al., 2018). Strategies include long-term contracts with suppliers for negotiated pricing and favorable terms, reducing overall costs. Considering Part Manufacture Alternate (PMA) for spare parts proves cost-effective, offering competitive pricing compared to original equipment.

Exploring categories like Overhaul (OH), Serviceable (SV), and Repair (RP) provides economic choices while adhering to quality standards. Local sourcing from in-country suppliers cuts costs, easing import-related expenses. However, challenges arise from high import duty tax fees, VAT, import income tax (PPh), and fluxes in the Rupiah Exchange Rate against the US Dollar, increasing import costs (Rahmawati et al., 2019).

The research delves into these strategies and challenges in cost management, utilizing a questionnaire to gather insights on current practices, challenges, and opportunities in Indonesian MRO spare part

procurement. This exploration sheds light on the intricate dynamics of delivery issues associated with Cost in the procurement process.

3. Research Methodology

This research was carried out in Indonesia to investigate the procurement challenges encountered by the MRO (Maintenance, Repair, and Overhaul) industry. The specifics of the samples can be found in Table 2. The survey participants were chosen through purposive sampling, encompassing experts, staff, and procurement managers from diverse MRO companies. These companies were selected from 31 registered members of the Indonesia Aircraft Maintenance Services Association (IAMSA). A Google Form questionnaire was employed to conduct the survey, featuring multiple-choice questions, open-ended inquiries, and Likert-scale ratings relevant to the research subject. Email, WhatsApp, and LinkedIn channels facilitated the distribution of the questionnaire to the intended respondents. Ultimately, 30 respondents voluntarily completed the questionnaire, becoming part of the study's cohort. Regarding the data analysis methodology, this study employed Partial Least Squares - Structural Equation Modeling (PLS-SEM) to assess and predict the structural relationships among the independent and dependent variables. The conceptual framework of this research is explained in Figure 1.

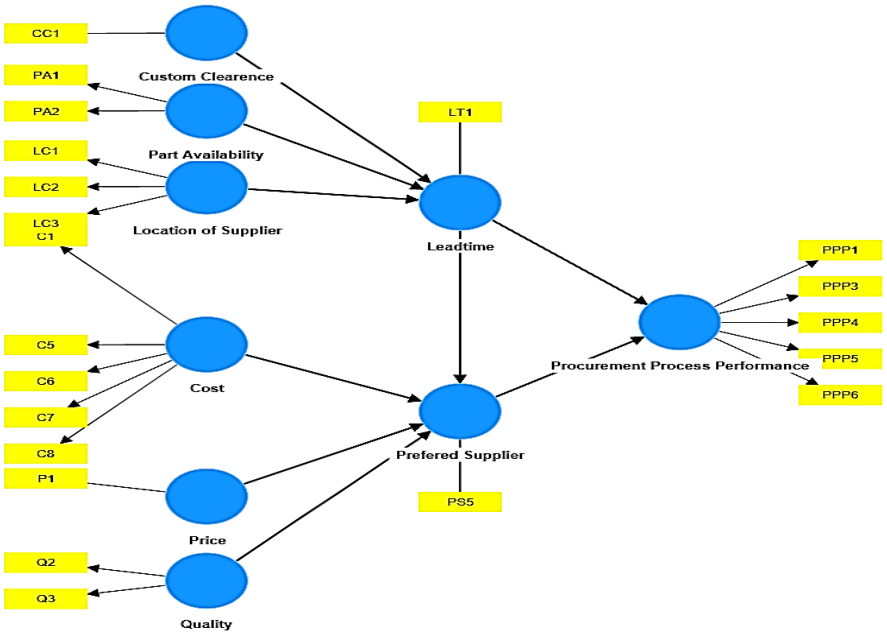

Figure 1. Structural Model

4. Results

This study utilized PLS-SEM analysis to assess the measurement model and evaluate composite reliability (cp), average variance extracted (AVE), and loading values. Figure 1 illustrates the PLS-SEM Measurement Model results. In Table 2, all Composite Reliability coefficients (rho_a and rho_c) exceed the 0.70 threshold, meeting reliability criteria. AVE values surpass 0.50, confirming the measurement model's robustness. Parts Availability exhibits an exceptionally high Cronbach's Alpha of 0.945, reflecting excellent internal consistency. Cost and Quality, with alpha values of 0.891 and 0.877, respectively, demonstrate commendable reliability. Procurement Process Performance (alpha: 0.839) and Supplier Location (alpha: 0.751) also exhibit strong internal consistency, reinforcing the research instrument's accuracy and dependability.

Table 2 Construct reliability and validity

	Cronbach's alpha	Composite reliability (rho_a)	Composite reliability (rho_c)	Average variance extracted (AVE)
Cost	0.891	0.893	0.920	0.699
Location of Supplier	0.751	0.789	0.856	0.665
Part Availability	0.945	1.229	0.971	0.944
Procurement Process Performance	0.839	0.854	0.885	0.608
Quality	0.877	0.881	0.942	0.890

The Heterotrait-Monotrait Ratio (HTMT) test confirms strong discriminant validity, with all values consistently below the 0.90 threshold (Table 3). Even with a conservative approach, the HTMT values in this study remain below 0.85, emphasizing the distinctiveness of each construct (Roemer et al., 2021). The highest recorded HTMT value, 0.777, between Cost and Supplier Location, remains comfortably below the threshold, reinforcing the robustness of the measurement model (Hair et al., 2021).

Table 3 Heterotrait-monotrait ratio (HTMT) – Matrix

	C	CC	LT	LC	PA	PS	P	PPP	Q
Cost (C)									
Custom Clearance (CC)	0.389								
Leadtime (LT)	0.530	0.235							
Location of Supplier (LC)	0.777	0.567	0.658						
Part Availability (PA)	0.725	0.359	0.397	0.561					
Preferred Supplier (PS)	0.563	0.071	0.638	0.500	0.286				
Price (P)	0.680	0.111	0.371	0.718	0.428	0.405			
Procurement Process Performance (PPP)	0.489	0.375	0.527	0.592	0.234	0.330	0.237		
Quality (Q)	0.755	0.399	0.645	0.723	0.661	0.541	0.400	0.441	

Precautionary measures addressed common method bias (CMB) through the linearity test, traditionally employed for detecting predictor-predictor collinearity. This test ensures that variables do not measure the same underlying construct, addressing classic and lateral collinearity. Addressing CMB is crucial to avoid systematic impacts on participants' responses, which may occur when using a comparable measurement approach for all variables. Recognizing the potential distortion of relationships and conclusions, this study emphasizes identifying and mitigating CMB.

Table 4 VIF – Inner Model List

Cost → Preferred Supplier	2.750	Part Availability → Leadtime	1.374
Custom Clearance → Leadtime	1.322	Preferred Supplier → Procurement Process Performance	1.686
Leadtime → Preferred Supplier	1.639		
Leadtime → Procurement Process Performance	1.686	Price → Preferred Supplier	1.763
Location of Supplier → Leadtime	1.545	Quality → Preferred Supplier	2.272

The hypothesis testing results reveal a significant relationship between Cost and Preferred Supplier, indicating a potential influence ranging from negative to positive. Approximately 3.5% of the variance in Preferred Suppliers can be explained by variations in Cost. The examination of Custom Clearance and time indicates a substantial relationship, with potential effects ranging from negative to positive and approximately 0.9% of the variance in time explained by Custom Clearance. The Analysis underscores a highly significant relationship between lead time and Preferred Suppliers, with potential effects ranging widely. Approximately 25.9% of the variance in Preferred Suppliers can be attributed to variations in lead time, emphasizing its crucial role.

Moreover, investigating the relationship between lead time and Procurement Process Performance shows a significant connection with broad potential effects. Approximately 19.6% of the variance in Procurement Process Performance can be explained by variations in lead time, highlighting its substantial impact. Examining the relationship between the Location of the Supplier and lead time reveals a significant connection with potential broad effects. Approximately 30.2% of the variance in lead time can be attributed to variations in the Location of the Supplier, emphasizing the critical role of supplier location. Exploring the relationship between Part Availability and lead time unveils a highly significant connection with potential effects ranging from negative to positive. Approximately 3.7% of the variance in lead time can be attributed to variations in Part Availability, emphasizing the importance of prompt part availability. Investigating the relationship between Preferred Suppliers and Procurement Process Performance highlights a significant connection, potentially yielding various impacts. These results stress the necessity of thoughtfully evaluating supplier preferences within procurement process performance. Examining the relationship between Price and Preferred Suppliers reveals a highly significant connection, with potential effects ranging from negative to positive. Approximately 0.5% of the variance in Preferred Suppliers can be attributed to variations in price, emphasizing the significance of price considerations. Lastly, examining the relationship between Quality and Preferred suppliers provides compelling insights into a highly significant connection, with potential effects ranging from negative to positive. Approximately 0.2% of the variance in Preferred Suppliers can be attributed to variations in Quality, underscoring the importance of quality considerations.

Table 5 Hypothesis Test

Hypothesis	Path Confidence t	P-value	97.5 Confidence Interval of Path Coefficients		f Square
			Lower Band	Higher Band	
Cost → Preferred Supplier	0.000	0.000	-0.196	0.684	0.035
Custom Clearance → Leadtime	0.000	0.000	-0.429	0.166	0.009
Leadtime → Preferred Supplier	0.000	0.000	0.053	0.897	0.259
Leadtime → Procurement Process Performance	0.000	0.000	-0.035	0.899	0.196
Location of Supplier → Leadtime	0.000	0.000	0.185	0.897	0.302
Part Availability → Leadtime	0.000	0.000	-0.283	0.661	0.037
Preferred Supplier → Procurement Process Performance	0.000	0.000	-0.551	0.567	0.000
Price → Preferred Supplier	0.000	0.000	-0.366	0.482	0.005
Quality → Preferred Supplier	0.000	0.000	-0.374	0.460	0.002

5. Discussion

Analyzing Factors Affecting Procurement Lead Time in the Indonesian Aviation MRO Industry reveals three significant contributors: Custom Clearance, Supplier Location, and Parts Availability. The SEM-PLS analysis exposes a positive relationship between Custom Clearance and Lead Time (Path Coefficient β =

0.000, t = 0.000, p = 0.000), emphasizing its crucial role in supply chain efficiency. Similarly, Supplier Location shows a significant positive relationship with Lead Time (Path Coefficient β = 0.000, t = 0.000, p = 0.000), highlighting the strategic importance of supplier selection. Moreover, a robust positive relationship is found between Part Availability and Lead Time (Path Coefficient β = 0.000, t = 0.000, p = 0.000), underscoring the critical role of prompt part availability in effective lead time management.

The study explores crucial determinants in supplier selection decisions by examining Procurement Factors in Selecting Preferred Suppliers in the Indonesian Aviation MRO Industry. The Analysis uncovers noteworthy positive relationships between Cost and Preferred Supplier (Path Coefficient β = 0.000, t = 0.000, p = 0.000), Price and Preferred Supplier (Path Coefficient β = 0.000, t = 0.000, p = 0.000), Quality and Preferred Supplier (Path Coefficient β = 0.000, t = 0.000, p = 0.000), and Lead Time and Preferred Supplier (Path Coefficient β = 0.000, t = 0.000, p = 0.000). These significant findings highlight the pivotal role of these factors in the supplier selection process, offering valuable insights for practitioners to optimize their procurement strategies.

Examining Factors Influencing Procurement Performance in the Indonesian Aviation MRO Industry, the study tackles Research Question Three by investigating essential determinants in procurement process performance. The Analysis reveals a highly significant and positive relationship between Lead Time and Procurement Process Performance (Path Coefficient β = 0.000, t = 0.000, p = 0.000), underscoring the pivotal role of lead time management. Additionally, a significant positive relationship is observed between Preferred Supplier and Procurement Process Performance (Path Coefficient β = 0.000, t = 0.000, p = 0.000), highlighting the strategic importance of supplier selection in optimizing procurement outcomes. These insightful findings offer valuable recommendations for industry professionals seeking to enhance operational efficiency in the dynamic and competitive aviation MRO sector.

6. Conclusion

This study, employing SEM-PLS analysis, comprehensively explores critical dimensions within the Indonesian Aviation MRO industry. By investigating factors impacting procurement lead time, including Custom Clearance, Supplier Location, and Parts Availability, this research underscores their significance in reducing lead time. The study also reveals the substantial impact of Cost and Lead Time on supplier preference, shaping decisions related to supplier selection. Furthermore, examining hypotheses highlights the pivotal role of lead time management and strategic supplier selection in determining procurement efficiency and performance. Notably, the Analysis confirms significant relationships between factors such as Cost, Custom Clearance, and Lead Time with Preferred Supplier selection, emphasizing their influential roles. These findings offer actionable insights for refining procurement strategies and enhancing operational efficiency in the Indonesian Aviation MRO sector. Additionally, the study lays a robust foundation for future research endeavours, suggesting potential avenues for deeper investigation and practical applications within the field.

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