



## Data-Driven Decision Making: Financial and Risk Analysis on Equipment Procurement at PT ABC Using Predictive Data Estimation, NPV Analysis, Owner Estimate, and Monte Carlo Simulation

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**ABSTRACT:** This research delves into strategic financial management solutions for PT ABC during the COVID-19 pandemic, concentrating on the procurement of vital airport equipment. It examines the feasibility of securing essential equipment such as ARFF vehicles, X-ray machines, ambulances, and narcotics & explosive detectors amidst financial challenges. Utilizing financial models like predictive data estimation, Net Present Value (NPV) analysis, owner estimates, and Monte Carlo simulations, the study evaluates risk probabilities and distributions linked to different procurement strategies. The research underscores the pandemic's profound impact on the global aviation sector, notably the steep decline in passenger traffic and resulting financial strains on PT ABC. Facing stringent regulatory obligations and the urgent need for equipment upgrade, the study investigates cost-effective procurement avenues, weighing the benefits of leasing against purchasing, given the company's constrained cash flow. The study navigates through the challenges of limited RFI data and internal corporate regulations that restrict leasing durations. It provides a detailed financial analysis to pinpoint the most economical vendors and procurement approaches, leveraging owner estimates as a negotiation tool. Risk evaluation is conducted via Monte Carlo simulation, offering insights into the likelihood and impact of procurement-related risks. Concluding, the research finds that PT ABC can best manage its procurement needs by opting for leasing over buying. This approach aligns with the company's financial strategy amidst the crisis, allowing for the acquisition of necessary equipment within financial limits. The study identifies Vendor A for ARFF vehicles, Vendor D for X-ray machines, Vendor E for ambulances, and Vendor G for narcotics & explosive detectors as the most cost-effective choices. Leasing, particularly on a 3-year term, emerges as the most viable financial option, in compliance with PT ABC's internal regulations and operational requirements. Utilizing owner estimates for negotiations ensures more cost-effective procurement. The Monte Carlo simulation proves invaluable in evaluating procurement risks, indicating a higher risk associated with buying than leasing. This research aids PT ABC in strategic decision-making for equipment procurement, offering lessons for the broader aviation sector navigating post-pandemic recovery.

**KEYWORDS:** PT ABC, COVID-19, aviation industry, financial analysis, equipment procurement, predictive data estimation, NPV analysis, owner estimate, Monte Carlo simulation.

### INTRODUCTION

Navigating through the turbulence of a global health crisis, the aviation industry finds itself at a critical juncture, facing unprecedented challenges that call for strategic financial acumen and decisive action. This thesis embarks on an analytical journey to examine the financial strategies that PT ABC, a key player in the nation's aviation landscape, must consider to weather the storm. It delves into the application of various financial models and strategies to strike a balance between the pressing need for essential equipment procurement and the stark reality of reduced cash flow brought about by the pandemic. Through a lens that focuses on predictive data estimation, net present value (NPV) analysis, owner estimate, and Monte Carlo simulation, this study aims to chart the most feasible financial courses for the company while maintaining the risk. The ensuing chapters unfold the narrative of PT ABC's financial and operational odyssey during these trying times, exploring the impact of the COVID-19 pandemic on the global aviation industry, the specific financial and operational predicaments faced by the company, and the regulatory backdrop mandating the procurement of critical airport equipment.

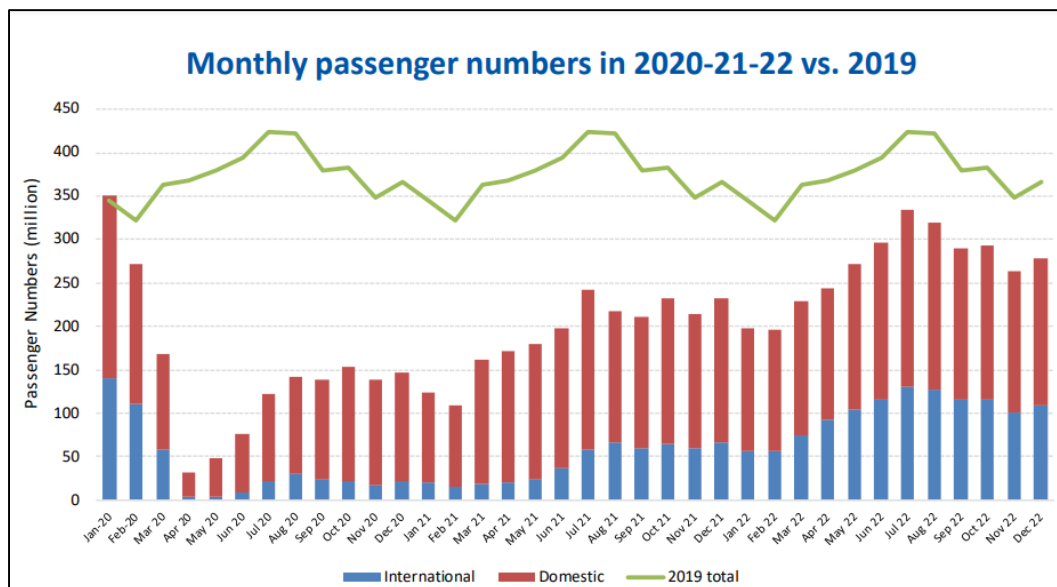
#### *A. Impact of COVID-19 on the Global Aviation Industry*

In recent years, the world has struggled with COVID-19 pandemic, originated from Wuhan, China. The COVID-19 pandemic, has unleashed an unparalleled global crisis, affecting various sectors with the aviation industry being one of the hardest hits. This

pandemic, caused by the novel coronavirus SARS-CoV-2, led to countries implementing strict measures like travel bans and lockdowns, significantly reducing air travel and disrupting global connectivity. Because of this, the COVID-19 is heavily impacted the financial of companies in the aviation industry, with massive net loss in 2020 in their income statements (Bouwer et al., 2022). The COVID-19 pandemic significantly impacted the financial stability of airlines, airports, and air navigation service providers (ANSPs). Airlines, in particular, faced a sharp decline in demand and had very low cash reserves, with most having only two months' worth of cash or less available. The global economic impact of COVID-19 on civil aviation in 2020 and 2021 can be summarised as follow (International Civil Aviation Organization (ICAO), 2023):

- 2020 vs 2019: seats offered –50%; passengers flown –2.703 million; airline revenue loss USD 372 billion.
- 2021 vs 2019: seats offered –40%; passengers flown –2.2031 million; airline revenue loss USD 324 billion.

From the monthly passenger perspective, as seen on the Figure 1, the total number of passenger when the pandemic happens, which is on 2020 until 2022, is far lower than the total monthly passenger before the pandemic in 2019, showing how impactful COVID-19 impacting the civil aviation industry.



**Figure 1.** Monthly passenger numbers pre-pandemic (2019) and in pandemic (2020, 2021, 2022) (International Civil Aviation Organization (ICAO), 2023)

The COVID-19 pandemic has greatly reduced travel demand, affected investor expectations, and caused a negative impact on airline stock (Atems & Yimga, 2021). In 2020, global passenger demand in RPK (revenue passenger kilometer) dropped by 65.9% compared to 2019, resulting in a decrease of airline passenger revenue by USD 418 billion, a 68.9% drop compared to the previous year. This led to airlines posting the largest ever collective net loss of USD 126.4 billion in 2020. Other than that, the reduction in air travel was not gradual but a steep decline, as fear of the virus's spread and government-imposed travel restrictions led to a sudden and significant drop in passenger numbers (International Civil Aviation Organization (ICAO), 2023). In summary, the COVID-19 pandemic had a profound impact on the financial stability of airlines, airports, and ANSPs, leading to revenue losses, reduced air traffic, and the need for financial support to prevent bankruptcy and ensure the survival of these critical stakeholders in the aviation industry.

**B. Financial and Operational Problem at PT ABC**

In the context of Indonesia, PT ABC, a key player in the nation's aviation landscape, faced severe impacts from the pandemic. These impacts were multifaceted, affecting various aspects of its operations. The most immediate and noticeable effect was the sharp decline in passenger traffic. As international and domestic travel dwindled, the company witnessed a drastic drop in its primary revenue source, leading to significant financial challenges.



The decrease in passenger numbers had a direct and profound impact on PT ABC's finances. Airlines, being key customers, reduced their operations, thereby affecting the company's revenue from landing fees, parking charges, and passenger service charges. However, despite the reduced income, the fixed costs associated with airport maintenance and operations remained largely unchanged (Choi, 2021). These costs include personnel expenses, routine maintenance, and essential operational services, creating a financial strain on the company.

Moreover, the pandemic did not alleviate PT ABC's obligations to comply with safety and operational regulations. Ensuring the safety and security of passengers and staff remained a top priority. This compliance involves maintaining and operating critical equipment, such as Aircraft Rescue and Fire Fighting (ARFF) vehicles, sophisticated X-ray machines for security screening, well-equipped ambulances for medical emergencies, and sensitive narcotics and explosive detectors.

A significant challenge that emerged for PT ABC during the pandemic was the need for procurement and maintenance of heavy equipment. The existing infrastructure, including critical safety and security apparatus, was aging and in need of upgrades or replacements. However, the reduced cash flow due to the pandemic made it challenging to allocate funds for new procurements or even for the maintenance of existing equipment. The necessity to adhere to stringent safety standards and government regulations added another layer of complexity to this already challenging situation.

### ***C. Indonesia Government Regulation of Mandatory Airport Equipment***

In order to fulfill the need for maintaining certain safety standards in airports, the government of Indonesia has published several ministerial regulations (Peraturan Pemerintah). In the context of firefighting and airport rescue, the Ministerial Regulation of the Republic of Indonesia Number PM 83 of 2017 on Civil Aviation Safety Regulation Part 139 Regarding Aerodromes mandates the operation of Airport Rescue and Firefighting (ARFF) services to prevent further damage in the event of an accident (Ministry of Transportation Republic of Indonesia, 2017)

In the security aspect of airport, Ministerial Regulation of the Republic of Indonesia Number PM 127 of 2015 on the National Aviation Security Program stated the needs of airport to have functioning X-ray machine and explosive detector to ensure the safety, orderliness, and efficiency of aviation in Indonesia through the establishment of regulations, standards, and procedures, and to provide the necessary protection for passengers, aircrew, ground personnel, and the public from unlawful acts (Ministry of Transportation Republic of Indonesia, 2015). Other than that, the International Civil Aviation Organization (ICAO) Annex 17 - Aviation Security, also state the need of explosive detector and X-ray machine to maintain aviation security (International Civil Aviation Organization, 2022).

Lastly, the need of medical team and infrastructure that support it, in this context is ambulance car, is also stated in the ministerial regulation. Ministerial Regulation of the Republic of Indonesia Number 44 of 2014 regarding the Implementation of Healthy Ports and Airports stated the need of ambulance car to support the operation of ARFF team when accident happen (Minister of Health of the Republic of Indonesia, 2014).

### ***D. Strategic Financial Management for PT ABC Case***

This thesis aims to delve into the strategic financial management decisions that PT ABC must consider to navigate this crisis. It will explore various financial models and strategies that can be employed to balance the urgent need for equipment procurement and maintenance with the reality of reduced cash flow due to the pandemic (Vinod, 2020). The analysis will focus on predictive data estimation, net present value (NPV) analysis, and owner estimate to provide insights into the most feasible financial pathways for the company. While and Monte Carlo simulation is used to evaluate the impact of risk factors on the total risk exposure of the procurement.

In essence, PT ABC's situation is part of the challenges faced by the global aviation industry in the wake of the COVID-19 pandemic. By exploring and addressing these challenges through the lens of strategic financial management, this thesis aims to contribute valuable insights and potential solutions not just for PT ABC but for the aviation sector at large in navigating through and beyond the pandemic, especially in term of maintaining and procuring mandatory heavy equipment in an airport.

## **BUSINESS ISSUES**

PT ABC is currently grappling with a significant financial crisis, a direct result of the disruptions caused by the COVID-19 pandemic. One of the pressing challenges the company faces is the urgent need to procure new heavy equipment. This includes Advanced Rapid



Firefighting (ARFF) vehicles, X-ray machines, ambulances, and narcotics & explosive detectors. A thorough internal audit has highlighted a concerning issue: much of the current equipment is well past its prime in terms of both economic viability and technical performance. A substantial portion of this equipment is no longer fit for operational use.

The crucial task at hand for PT ABC is to strategically decide on the procurement process. This involves a careful evaluation of potential vendors or manufacturers, focusing on the cost of acquisition. The company is at a crossroads, needing to choose between leasing and purchasing the new equipment. To navigate this decision, a detailed Net Present Value (NPV) analysis will be instrumental. This analysis will not only aid in selecting the most economically feasible vendor but also in determining the more cost-effective procurement approach, be it leasing or outright purchase.

Complicating matters is the incomplete data in the Request for Information (RFI). The company's procurement guidelines, as per the directive regulations, limit leasing agreements to a maximum of three years. However, the current RFI data only encompasses leasing terms for five and ten years. To bridge this gap, the research will initially employ predictive analysis tools, including solver add-ins and linear interpolation. These tools will estimate the missing data for the three-year leasing scheme, ensuring a comprehensive analysis. Following this, the NPV analysis will be pivotal in choosing the right vendor and the most cost-effective procurement method, whether that involves leasing or buying. Finally, the process will involve using owner estimates. This step is critical to verify that there is no price markup and to provide a solid foundation for negotiating lower leasing or purchase costs. The decision on whether to lease or buy, and from which vendor, will be based on the insights gained from the NPV analysis.

Key stakeholders involved in this issue include the CEO of PT ABC, who is the decision-maker, the finance, legal compliance and operation departments of PT ABC, who are the problem owners. Additional stakeholders are the heavy equipment vendors and the thesis writer, who serves as a third-party financial analyst to provide recommendations to the finance and operation departments. The vendors and their specific product models are listed in Table 1.

**Table 1.** List of vendor and model name of each equipment (Author, 2023)

Equipment Type	Vendor Name	Model Code
ARFF	Vendor A	A1 6x6
	Vendor B	A2 6x6
X-Ray	Vendor C	X1 B
	Vendor D	X2 B
Ambulance Car	Vendor E	Amb1
	Vendor F	Amb2
Narcotics & Explosive Detector	Vendor G	E1n
	Vendor H	E2n

Given the high cost of heavy equipment like Aircraft Rescue and Fire Fighting (ARFF) vehicles, ambulance cars, X-ray machines, narcotics & explosive detector, it is crucial to identify the most cost-effective options. Decisions will also consider factors such as the average number passengers at each airport to determine its difference in urgency. Lastly, scenario planning will be carried out to mitigate risks, such as a vendor choosing to terminate negotiations or not agreeing in ABC's offers.

**METHODOLOGY**

The research design adopted in this study is crafted as a mixed-method approach, where both quantitative and qualitative data play pivotal roles in achieving a holistic view of the equipment procurement process at PT ABC. The chosen framework allows for the incorporation of a diverse range of data types and sources, ensuring a comprehensive analysis of the financial and risk-related aspects of procurement.

Quantitatively, the study leverages predictive data estimation techniques to anticipate future costs and benefits, NPV (Net Present Value) analysis to assess the value of procurement over time. Qualitative insights are gathered through an owner's estimate, providing context and depth to the numerical data. This multifaceted approach is further enriched by the application of Monte Carlo simulation, which aids in risk assessment by exploring a multitude of possible outcomes and their probabilities.

This combination of methods enables the study to not only predict financial outcomes with a degree of precision but also to capture the nuanced perspectives of stakeholders involved in the procurement process. By engaging with both the statistical probabilities and the subjective estimates of costs and risks, the research design ensures a thorough and balanced investigation, conducive to strategic decision-making within PT ABC's procurement framework. The research is mainly divided into two parts, financial analysis (Figure 2) and risk analysis (Figure 3).

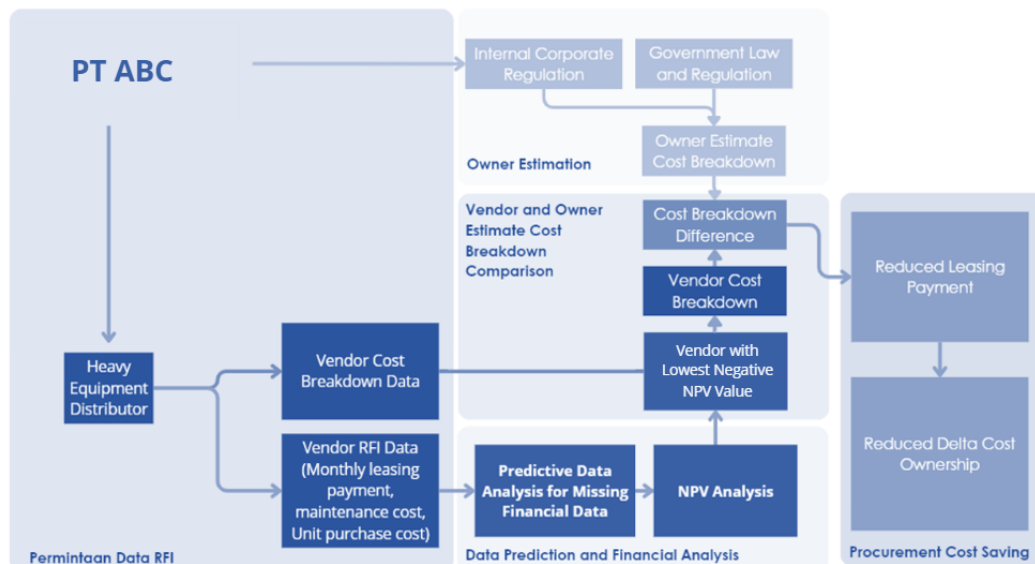


Figure 2. Financial analysis conceptual framework (Author, 2023)

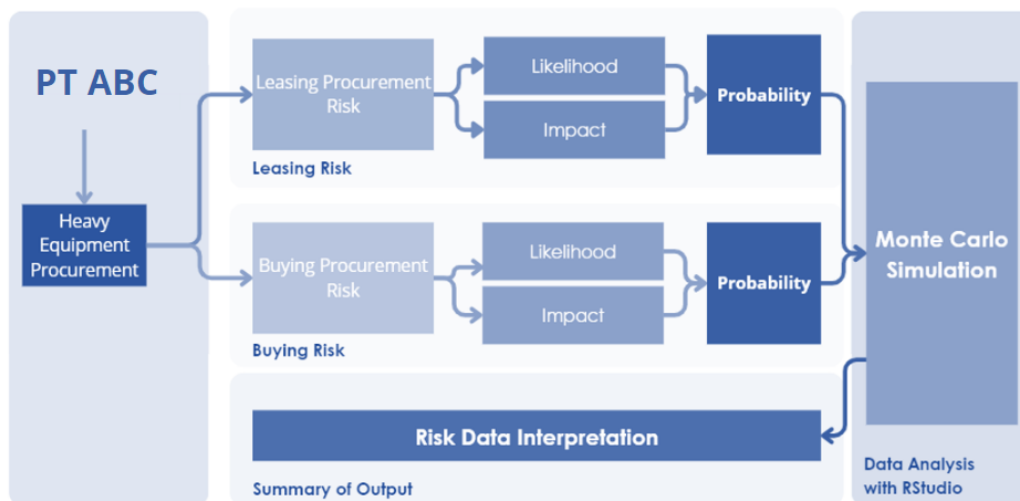


Figure 3. Risk analysis conceptual framework (Author,2023)'

**A. Predictive Data Analysis**

Predictive data analysis plays a crucial role in supplementing missing essential data for conducting financial analysis. Within the scope of this study, particularly in relation to the procurement activities at PT ABC, the absent data that can be estimated through mathematical modelling encompasses the monthly payment details. To achieve this, it is first necessary to ascertain the leasing rate corresponding to the unspecified monthly payment duration using Solver adds-in and linear interpolation. Subsequently, this leasing rate is converted into the monthly payment amount using PMT formula from excel. The predictive data analysis can be summarized in diagram from Figure 4.

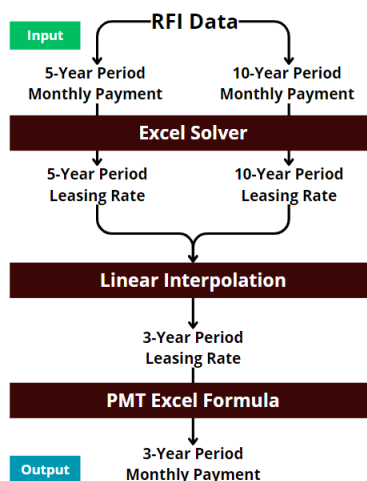


Figure 4. Predictive data analysis diagram (Author,2023)

**1) Finding Known Leasing Rate with Solver Add-in for Excel**

In the research methodology section of the thesis, the Solver add-in for Excel is utilized to calculate the optimal monthly leasing rate for equipment procurement. Solver is an Excel feature that performs what-if analysis, optimizing the value in a specific cell by varying values in other cells within a defined constraint. For this analysis, the objective is to set the value of cell C4, which represents the monthly leasing payment, to IDR 200,000,000 (see Figure 5).

	A	B	C	D	E	F	G
1	<b>Lease Rate Solver Prediction</b>						
2	Purchasing Cost	---->	IDR 10,000,000,000	Input		Legend	
3	Leasing Period (In Month)	---->	60	Input		<- Input	
4	Monthly Leasing Payment	---->	IDR 200,000,000	Input		<- output	
5							
6	Yearly Leasing Rate	---->		Solver Output			
7	Monthly Leasing Rate						
8							

Figure 5. Example of finding leasing rate with solver (Author,2023)

The payment value in C4 is calculated using the PMT function in Excel, which computes the payment for a loan based on constant payments and a constant interest rate. The formula =ABS(PMT(C6/12, C3, C2)) in cell C4 is designed to calculate the absolute value of the monthly payment. Here, C6 represents the yearly leasing rate, C3 is the leasing period in months, and C2 is the purchasing cost. The ABS function is used to ensure the payment value is a positive number, which reflects a cash outflow.

To find the required yearly leasing rate, the Solver adjusts the value in cell C6. This variable is altered iteratively by the Solver until the PMT function yields the target leasing payment of IDR 200,000,000. The goal is to determine the annual interest rate that, when divided by 12 to obtain a monthly rate and applied over the leasing period, results in the desired monthly payment amount. The next step is to find the desired leasing rate of the missing data by using linear interpolation.

**2) Finding Missing Leasing Rate with Linear Interpolation**

Linear interpolation is an interpolation method for one-dimensional data. It estimates the data value based on input of two data points adjacent to the point that needs to be interpolated (Noor et al., 2014). The simple visual explanation can be seen on Figure 6, while the formula is on Figure 7.

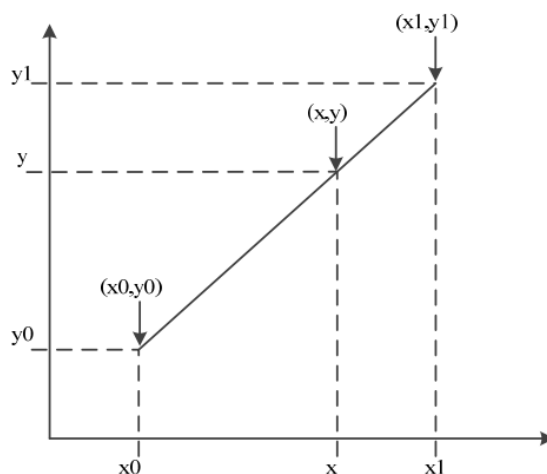


Figure 6. Diagram of linear interpolation (Huang, 2021)

$$y = y_0 + (x - x_0) \frac{y_1 - y_0}{x_1 - x_0}$$

Figure 7. Linear interpolation formula (Noor et al., 2014)

In the context of this research, the linear interpolation is used to determine missing monthly lease expense, by determining the leasing rate of missing monthly payment data. with x-axis is the expense and the y-axis is the year period. For example, the RFI contained data monthly lease expense for 10-year period and 5-year period, while the internal regulation restricts the procurement period to 3-



year period. From this, we input the data in excel, and the formula from Figure III.4 transformed into excel formula =B1 + (A2 – A1) \* (B2 - B1) / (A2 - A1), and can be seen in Figure 8.

	Known Leasing Payment Period (Year)	Known Leasing Rate	
(A1) X0 ->	10	27.07%	<- Y0 (B1)
(A2) X1 ->	5	21.09%	<- Y2 (B2)
	Missing Leasing Payment Period (Year)	Missing Leasing Rate	
(A3) X ->	3	18.702%	<- Y (B3=B12 + (A2 - A1) * (B2 - B1) / (A2 - A1))

Figure 8. Example of linear interpolation on excel (Author, 2023)

### 3) Converting Leasing Rate with PMT Excel Formula

The determination of the monthly leasing cost in the financial analysis of equipment procurement is conducted using the PMT function in Excel. This function is pivotal in calculating the monthly cost based on the initial investment value, the lease rate, and the number of payment periods. To employ this function, the following formula is input into Excel:

$$=PMT(\text{rate}, \text{nper}, \text{pv})$$

Here, 'rate' refers to the monthly lease rate, which is derived by converting the annual lease rate through a process of linear interpolation and then dividing it by 12 to get the monthly equivalent. The 'nper' stands for the total number of monthly payment periods, and 'pv' represents the present value or the initial cost of purchasing the equipment.

By applying this formula, the study can ascertain the incomplete monthly lease costs from vendors, which can then be further analyzed using Net Present Value (NPV) analysis. This step is crucial in ensuring that all financial calculations regarding leasing are grounded in systematic and replicable quantitative methods, thereby providing a reliable foundation for subsequent NPV analysis in the thesis.

### B. NPV Analysis

Incorporating the additional factor of inflation into the NPV analysis methodology, the approach accounts for the future increase in maintenance costs within the purchasing scheme. Recognizing that inflation impacts both material and labor costs, an annual inflation rate of 2.28% on September 2023, is applied to estimate the future value of maintenance costs for spare parts and technician labor (Bank Indonesia, 2023; King & Watson, 2012; Phillips, 1982). The 22% corporate tax rate is based on Law (Act) Number 7 of 2021 concerning Tax Regulation Harmonization (The Government of Indonesia, 2021). This adjustment ensures a more realistic and context-specific projection of the cash outflows associated with equipment maintenance.

The NPV analysis steps are as follows:

- 1) **Annualization of Monthly Leasing Payments:** Convert the monthly leasing payments, calculated through predictive data analysis, into an annual figure to represent the yearly leasing cash flow.
- 2) **Incorporation of Inflation in Maintenance Costs:** Apply the 2.28% annual inflation rate to project the future value of maintenance costs for spare parts and technician labor in the purchasing scenario. This step ensures that the cash outflows for maintenance in future years are adjusted for inflation, reflecting the expected rise in costs due to economic factors.
- 3) **Determination of Cash Flows:** Identify the detailed cash flows for each procurement option. For leasing, include the annual lease payments and tax benefits from deductions. For purchasing, consider the initial purchase cost, inflation-adjusted yearly maintenance costs, and annual depreciation.
- 4) **Tax Shield Calculation:** Calculate the tax benefits using the corporate tax rate of 22%, applied to the leasing payments and the sum of maintenance plus depreciation costs in the purchasing option.
- 5) **Discount Rate Application:** Discount all future cash flows at the company's WACC of 10%, aligning the time value of money and the investment's inherent risk.
- 6) **Present Value Computation:** Calculate the present value of each cash flow with the formula  $PV = \text{Cash Flow} / (1 + \text{WACC})^n$ , standardizing the value to the present day.
- 7) **Summation of NPV:** Finally, sum up the present values of all cash flows for each year to arrive at the total NPV for each procurement option. This cumulative figure represents the net value today of all future cash flows, both inflows, and outflows, associated with each procurement strategy.





By methodically incorporating these steps, the NPV analysis aims to provide a comprehensive, financially sound comparison of leasing versus purchasing, factoring in both immediate costs and future economic changes like inflation. This approach ensures that the final decision is well-informed and reflective of the real-world financial implications for PT ABC. For clarity, the process can be summarized in the Figure 9.

LEASING	Year-1	Year-2	Year-3	Year-4	Year-5
Annual Lease Payment	IDR (7,000,000,000)	IDR (7,000,000,000)	IDR (7,000,000,000)	IDR (7,000,000,000)	IDR (7,000,000,000)
Tax Deductible	IDR 1,500,000,000	IDR 1,500,000,000	IDR 1,500,000,000	IDR 1,500,000,000	IDR 1,500,000,000
Yearly Cashflow	IDR (5,500,000,000)	IDR (5,500,000,000)	IDR (5,500,000,000)	IDR (5,500,000,000)	IDR (5,500,000,000)
NPV1 = $-5.5m / (1+0.1)^0$	← Future Value year 1 / Present Value				
NPV2 = $-5.5m / (1+0.1)^1$		← Future Value year 2			
NPV3 = $-5.5m / (1+0.1)^2$			← Future Value year 3		
NPV4 = $-5.5m / (1+0.1)^3$				← Future Value year 4	
NPV5 = $-5.5m / (1+0.1)^4$					← Future Value year 5
TOTAL NPV = NPV1 + NPV2 + NPV3 + NPV4 + NPV5 ≈ IDR (27,500,000,000)					

Figure 9. NPV analysis visualization (Author,2023)

C. Owner Estimate

The methodology for generating owner estimate in the procurement process at PT ABC is structured to ensure a comprehensive and realistic assessment of potential costs. This assessment is critical for negotiating with vendors and confirming that no unnecessary markups are included in the vendor's pricing. The owner estimate components include Cost of Finance, Insurance, Depreciation Cost, Maintenance Cost, Value Added Tax (VAT), Shipment, and Profit Margin.

The methodology of generating owner estimate involves the following steps:

- Research and Benchmarking:** Conduct extensive research to find benchmarks for each component of the owner estimate. This involves reviewing regulations, laws, and financial data from similar companies and industries to determine standard costs and rates. Online resources, industry reports, and financial publications are crucial for gathering this data.
- Application of Corporate Regulations:** Integrate PT ABC's internal corporate regulations into the estimation process. For instance, if the internal regulation stipulates that leasing periods are valid for a maximum of three years, this factor is incorporated into the cost of finance calculations. This ensures that the estimates align with company policies and operational constraints.
- Cost of Finance Calculation:** Determine the financial cost associated with procurement, taking into account the interest rates and financing terms available in the market, and ensuring they align with internal guidelines.
- Insurance Cost Estimation:** Estimate the insurance costs based on the type of equipment, its value, and the risks associated with its operation and maintenance.
- Depreciation Cost Assessment:** Calculate the depreciation expense based on the expected life span of the equipment and its residual value, adhering to standard accounting practices.
- Maintenance Cost Projection:** Project the costs of maintaining the equipment, including both labor and spare parts, based on industry standards and previous maintenance data for similar equipment.
- Value Added Tax Calculation:** Compute the VAT on the procurement as per the prevailing tax laws and rates, ensuring compliance with fiscal regulations.
- Shipment Cost Estimation:** Estimate the costs associated with the transportation and delivery of the equipment.
- Profit Margin Analysis:** Assess a reasonable profit margin based on industry norms, and internal corporate regulations.

By following these steps, the owner estimate methodology provides a robust, data-driven framework for negotiating with vendors. It ensures that PT ABC secures the best possible terms for equipment procurement, grounded in realistic cost assessments and adherence to both external regulations and internal policies.



**D. Monte Carlo Simulation Using RStudio**

An approach of Monte Carlo Simulation using RStudio is employed to rigorously assess risks and mapping out the possibilities that the risk will occurs at PT ABC. This methodology leverages the statistical capabilities of RStudio, a platform renowned for its robust data analysis and modeling features, to offer a comprehensive understanding of the procurement risk. Monte Carlo simulation will result in histogram distribution chart to show the distribution of risk possibilities outcomes in happening.

To assess the financial risk associated with the equipment procurement options of leasing and buying, a Monte Carlo simulation approach is implemented using the R programming language. The simulation involves a quantitative analysis where risk is calculated by multiplying the likelihood of occurrence by its potential impact, with data drawn from a defined risk matrix for both leasing and buying scenarios.

In this methodology, the R environment is prepared by loading necessary libraries such as 'tidyverse' for data manipulation, 'purrr' for functional programming, and 'ggplot2' for data visualization. A data frame is created for each procurement option, encapsulating the likelihood and impact scores of identified risks. The risk values are then computed through element-wise multiplication of the likelihood and impact for each risk factor.

The core of the Monte Carlo simulation is a user-defined function, run\_monte\_carlo, which accepts the risk data and the number of simulations as arguments. The function uses stochastic sampling methods to simulate the total risk value over a series of iterations, replicating the randomness inherent in real-world scenarios. For this research, a substantial number of simulations—10,000 iterations—are set to run, which provides a robust representation of the potential risk distributions for both leasing and buying.

The simulation results are subjected to statistical analysis to determine the 95% confidence interval for the mean total risk value, providing insights into the variability and the potential range of risk outcomes. Additionally, the probability of exceeding a predefined risk threshold is calculated, which serves as a pivotal indicator of the likelihood of encountering risks beyond the company's risk appetite.

To visualize the distribution of risk values, histograms are generated using the ggplot function from the 'ggplot2' library. The histograms offer a visual representation of the frequency distribution of the total risk values for both leasing and buying, rendered in blue and red respectively, aiding in the visual comparison of risk profiles.

Finally, the main results of the simulation, including the confidence intervals and probabilities of exceeding the risk thresholds, are printed out. These results encapsulate the essence of the Monte Carlo simulation, providing a clear, quantified picture of the risk landscape faced by PT ABC in their procurement decision-making process.

**RESULT AND DISCUSSION**

**A. Estimating Incomplete RFI Data Using Predictive Data Analysis**

The available data that is gathered by the internal procurement team of PT ABC can be seen in Figure 10.

RFI Input Data										
Vendor Name	Equipment Type	Purchasing Cost	Monthly Payment (3-Year Period)	Monthly Payment (5-Year Period)	Monthly Payment (10-Year Period)	Maintenance Cost per Year	Economic Life of Equipment	Inflation Rate	Corporate Tax (PPh)	Company WACC
1	2	3	4	5	6	7	8	9	10	11
Vendor A	ARFF	IDR 20,000,000,000	IDR 700,000,000	IDR 475,260,417	IDR 300,000,000	IDR 1,200,000,000	10 Year	2.28%	22%	10%
Vendor B	ARFF	IDR 19,000,000,000	IDR 707,097,768	IDR 500,000,000	IDR 350,000,000	IDR 1,300,000,000	10 Year			
Vendor C	X-Ray Machine	IDR 5,000,000,000	IDR 200,000,000	IDR 170,000,000	IDR 80,510,533	IDR 475,000,000	15 Year			
Vendor D	X-Ray Machine	IDR 4,800,000,000	IDR 189,487,844	IDR 140,000,000	IDR 110,000,000	IDR 500,000,000	15 Year			
Vendor E	Ambulance	IDR 3,100,000,000	IDR 472,755,036	IDR 150,000,000	IDR 130,000,000	IDR 800,000,000	10 Year			
Vendor F	Ambulance	IDR 3,400,000,000		IDR 200,000,000	IDR 180,000,000	IDR 780,000,000	10 Year			
Vendor G	Narc & Explosive	IDR 570,000,000		IDR 34,000,000	IDR 29,000,000	IDR 230,000,000	15 Year			
Vendor H	Narc & Explosive	IDR 600,000,000		IDR 30,000,000	IDR 28,000,000	IDR 210,000,000	15 Year			
			Unavailable Data							
			Available Data from Vendor							

Figure 10. RFI data from internal PT ABC procurement team (PT ABC internal data)

Based on the internal corporate regulations of PT ABC, procurement through leasing is restricted to a 3-year period. However, much of the data for this duration is missing. To address this gap, predictive data analysis is conducted to estimate the missing 3-year period data, enabling the execution of NPV analysis for the leasing option over this specific timeframe.



Although the 5-year and 10-year leasing period does not comply with the internal corporate regulations, it is still essential to determine the missing monthly payment data to provide decision-makers with comprehensive information for evaluation. An example of this is the monthly payment data for a 5-year leasing period for an ARFF from Vendor A.

By using solver, linear interpolation, and PMT formula in excel, the missing data can be predicted, and the summary of completed data can be seen in Figure 11.

Vendor Name	Equipment Type	Purchasing Cost	Monthly Payment (3-Year Period)	Monthly Payment (5-Year Period)	Monthly Payment (10-Year Period)
1	2	3	4	5	6
Vendor A	ARFF	IDR 20,000,000,000	IDR 700,000,000	IDR 475,260,417	IDR 300,000,000
Vendor B	ARFF	IDR 19,000,000,000	IDR 707,097,768	IDR 500,000,000	IDR 350,000,000
Vendor C	X-Ray Machine	IDR 5,000,000,000	IDR 200,000,000	IDR 170,000,000	IDR 80,510,533
Vendor D	X-Ray Machine	IDR 4,800,000,000	IDR 189,487,844	IDR 140,000,000	IDR 110,000,000
Vendor E	Ambulance	IDR 3,100,000,000	IDR 178,396,579	IDR 150,000,000	IDR 130,000,000
Vendor F	Ambulance	IDR 3,400,000,000	IDR 227,589,351	IDR 200,000,000	IDR 180,000,000
Vendor G	Narc & Explosive	IDR 570,000,000	IDR 39,127,732	IDR 34,000,000	IDR 29,000,000
Vendor H	Narc & Explosive	IDR 600,000,000	IDR 34,832,611	IDR 30,000,000	IDR 28,000,000
			Data Generated from Predictive Data Analysis		
			Available Data from Vendor		

Figure 11. Completed data generated from predictive data analysis (Author, 2023)

**B. NPV Analysis for the Best Vendor and Procuring Option**

To find the best vendor, NPV analysis is conducted to every equipment and vendor, both for leasing and buying scheme. The NPV analysis for leasing option can be seen on Figure 12, while the analysis for buying option can be seen on Figure 13.

The NPV analysis is conducted to find the most cost-efficient vendor for each equipment and the best procuring option between leasing and buying the equipment, in this case, this means the vendor and procurement that has the lowest negative NPV value, since the analysis is cost-centric.

NPV Leasing Analysis											
Vendor A											
ARFF											
	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10	
3 Year	Annual Lease Payment	IDR (8,400,000,000)	IDR (8,400,000,000)	IDR (8,400,000,000)							
	Tax Deductible	IDR 1,848,000,000	IDR 1,848,000,000	IDR 1,848,000,000							
	Annual Cash Flow	IDR (6,552,000,000)	IDR (6,552,000,000)	IDR (6,552,000,000)							
	Net Present Value	IDR (6,552,000,000)	IDR (5,956,363,636)	IDR (5,414,876,033)							
5 Year	Annual Lease Payment	IDR (5,703,125,006)	IDR (5,703,125,006)	IDR (5,703,125,006)	IDR (5,703,125,006)	IDR (5,703,125,006)					
	Tax Deductible	IDR 1,254,887,501	IDR 1,254,887,501	IDR 1,254,887,501	IDR 1,254,887,501	IDR 1,254,887,501					
	Annual Cash Flow	IDR (4,448,437,505)	IDR (4,448,437,505)	IDR (4,448,437,505)	IDR (4,448,437,505)	IDR (4,448,437,505)					
	Net Present Value	IDR (4,448,437,505)	IDR (4,044,034,095)	IDR (3,676,394,632)	IDR (3,342,176,938)	IDR (3,038,342,671)					
10 Year	Annual Lease Payment	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)	IDR (3,600,000,000)
	Tax Deductible	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000	IDR 792,000,000
	Annual Cash Flow	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)	IDR (2,808,000,000)
	Net Present Value	IDR (2,808,000,000)	IDR (2,552,727,273)	IDR (2,320,661,157)	IDR (2,109,691,961)	IDR (1,917,901,783)	IDR (1,743,547,075)	IDR (1,585,042,796)	IDR (1,440,947,996)	IDR (1,309,952,724)	IDR (1,190,866,112)
	NPV 3 Year	IDR (17,923,239,669)									
	NPV 5 Year	IDR (18,549,385,842)									
	NPV 10 Year	IDR (18,979,338,876)									
Vendor B											
ARFF											
	Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10	
3 Year	Annual Lease Payment	IDR (8,485,173,212)	IDR (8,485,173,212)	IDR (8,485,173,212)							
	Tax Deductible	IDR 1,866,738,107	IDR 1,866,738,107	IDR 1,866,738,107							
	Annual Cash Flow	IDR (6,618,435,106)	IDR (6,618,435,106)	IDR (6,618,435,106)							
	Net Present Value	IDR (6,618,435,106)	IDR (6,016,753,197)	IDR (5,469,781,079)							
5 Year	Annual Lease Payment	IDR (6,000,000,000)	IDR (6,000,000,000)	IDR (6,000,000,000)	IDR (6,000,000,000)	IDR (6,000,000,000)					
	Tax Deductible	IDR 1,320,000,000	IDR 1,320,000,000	IDR 1,320,000,000	IDR 1,320,000,000	IDR 1,320,000,000					
	Annual Cash Flow	IDR (4,680,000,000)	IDR (4,680,000,000)	IDR (4,680,000,000)	IDR (4,680,000,000)	IDR (4,680,000,000)					
	Net Present Value	IDR (4,680,000,000)	IDR (4,254,545,455)	IDR (3,867,768,595)	IDR (3,516,153,268)	IDR (3,196,502,971)					
10 Year	Annual Lease Payment	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)	IDR (4,200,000,000)
	Tax Deductible	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000	IDR 924,000,000
	Annual Cash Flow	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)	IDR (3,276,000,000)
	Net Present Value	IDR (3,276,000,000)	IDR (2,978,181,818)	IDR (2,707,438,017)	IDR (2,461,307,288)	IDR (2,237,552,080)	IDR (2,034,138,254)	IDR (1,849,216,595)	IDR (1,681,105,995)	IDR (1,528,278,178)	IDR (1,389,343,798)
	NPV 3 Year	IDR (18,104,975,372)									
	NPV 5 Year	IDR (19,514,970,289)									
	NPV 10 Year	IDR (22,142,562,022)									

Figure 12. NPV analysis for leasing (Author, 2023)



NPV Buying Analysis												
Vendor A												
ARFF		Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10	
3 Year	Depreciation Cost	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)								
	Maintenance Cost	IDR (1,200,000,000)	IDR (1,227,360,000)	IDR (1,255,343,808)								
	Tax Deductible	IDR 704,000,000	IDR 710,019,200	IDR 716,175,638								
	Purchase Cost	IDR (20,000,000,000)	IDR -	IDR -								
	Annual Cash Flow	IDR (20,496,000,000)	IDR (517,340,800)	IDR (539,168,170)								
Net Present Value	IDR (20,496,000,000)	IDR (470,309,818)	IDR (445,593,529)									
5 Year	Depreciation Cost	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)						
	Maintenance Cost	IDR (1,200,000,000)	IDR (1,227,360,000)	IDR (1,255,343,808)	IDR (1,283,965,647)	IDR (1,313,240,064)						
	Tax Deductible	IDR 704,000,000	IDR 710,019,200	IDR 716,175,638	IDR 722,472,442	IDR 728,912,814						
	Purchase Cost	IDR (20,000,000,000)	IDR -	IDR -	IDR -	IDR -						
	Annual Cash Flow	IDR (20,496,000,000)	IDR (517,340,800)	IDR (539,168,170)	IDR (561,493,209)	IDR (584,327,250)						
Net Present Value	IDR (20,496,000,000)	IDR (470,309,818)	IDR (445,593,529)	IDR (421,858,155)	IDR (399,103,374)							
5 Year	Depreciation Cost	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	IDR (2,000,000,000)	
	Maintenance Cost	IDR (1,200,000,000)	IDR (1,227,360,000)	IDR (1,255,343,808)	IDR (1,283,965,647)	IDR (1,313,240,064)	IDR (1,343,181,937)	IDR (1,373,806,485)	IDR (1,405,129,273)	IDR (1,437,166,220)	IDR (1,469,933,610)	
	Tax Deductible	IDR 704,000,000	IDR 710,019,200	IDR 716,175,638	IDR 722,472,442	IDR 728,912,814	IDR 735,500,026	IDR 742,237,427	IDR 749,128,440	IDR 756,176,569	IDR 763,385,394	
	Purchase Cost	IDR (20,000,000,000)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	
	Annual Cash Flow	IDR (20,496,000,000)	IDR (517,340,800)	IDR (539,168,170)	IDR (561,493,209)	IDR (584,327,250)	IDR (607,681,911)	IDR (631,589,058)	IDR (656,000,833)	IDR (680,989,652)	IDR (706,548,216)	
Net Present Value	IDR (20,496,000,000)	IDR (470,309,818)	IDR (445,593,529)	IDR (421,858,155)	IDR (399,103,374)	IDR (377,322,656)	IDR (356,504,269)	IDR (336,632,153)	IDR (317,686,098)	IDR (299,645,416)		
NPV 3 Year	IDR (21,411,903,347)											
NPV 5 Year	IDR (22,232,864,876)											
NPV 10 Year	IDR (23,920,656,068)											
Vendor B												
ARFF		Year-1	Year-2	Year-3	Year-4	Year-5	Year-6	Year-7	Year-8	Year-9	Year-10	
3 Year	Depreciation Cost	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)								
	Maintenance Cost	IDR (1,300,000,000)	IDR (1,329,640,000)	IDR (1,359,955,792)								
	Tax Deductible	IDR 704,000,000	IDR 710,520,800	IDR 717,190,274								
	Purchase Cost	IDR (19,000,000,000)	IDR -	IDR -								
	Annual Cash Flow	IDR (19,596,000,000)	IDR (619,119,200)	IDR (642,765,518)								
Net Present Value	IDR (19,596,000,000)	IDR (562,835,636)	IDR (531,211,172)									
5 Year	Depreciation Cost	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)						
	Maintenance Cost	IDR (1,300,000,000)	IDR (1,329,640,000)	IDR (1,359,955,792)	IDR (1,390,962,794)	IDR (1,422,676,736)						
	Tax Deductible	IDR 704,000,000	IDR 710,520,800	IDR 717,190,274	IDR 724,011,812	IDR 730,988,882						
	Purchase Cost	IDR (19,000,000,000)	IDR -	IDR -	IDR -	IDR -						
	Annual Cash Flow	IDR (19,596,000,000)	IDR (619,119,200)	IDR (642,765,518)	IDR (666,950,972)	IDR (691,687,854)						
Net Present Value	IDR (19,596,000,000)	IDR (562,835,636)	IDR (531,211,172)	IDR (501,090,136)	IDR (472,432,111)							
5 Year	Depreciation Cost	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	IDR (1,900,000,000)	
	Maintenance Cost	IDR (1,300,000,000)	IDR (1,329,640,000)	IDR (1,359,955,792)	IDR (1,390,962,794)	IDR (1,422,676,736)	IDR (1,455,113,765)	IDR (1,488,290,359)	IDR (1,522,233,379)	IDR (1,556,930,072)	IDR (1,592,428,078)	
	Tax Deductible	IDR 704,000,000	IDR 710,520,800	IDR 717,190,274	IDR 724,011,812	IDR 730,988,882	IDR 738,125,028	IDR 745,423,879	IDR 752,889,143	IDR 760,524,616	IDR 768,334,177	
	Purchase Cost	IDR (19,000,000,000)	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	IDR -	
	Annual Cash Flow	IDR (19,596,000,000)	IDR (619,119,200)	IDR (642,765,518)	IDR (666,950,972)	IDR (691,687,854)	IDR (716,988,737)	IDR (742,866,480)	IDR (769,334,236)	IDR (796,405,456)	IDR (824,093,901)	
Net Present Value	IDR (19,596,000,000)	IDR (562,835,636)	IDR (531,211,172)	IDR (501,090,136)	IDR (472,432,111)	IDR (445,193,595)	IDR (419,328,761)	IDR (394,790,109)	IDR (371,529,023)	IDR (349,496,261)		
NPV 3 Year	IDR (20,690,046,808)											
NPV 5 Year	IDR (21,663,569,055)											
NPV 10 Year	IDR (23,643,906,804)											

Figure 13. NPV analysis for buying (Author, 2023)

Based solely on the analysis from the figure above on ARFF NPV analysis comparison, the best vendor would be to lease the ARFF for 3-year period from vendor A. This is because the option has the lowest negative NPV value. The analysis then conducted for other equipment type, such as X-ray machine, ambulance car, and narcotics & explosive detector. The summary of the NPV analysis results can be seen on Figure 14.

NPV Leasing Analysis Results				NPV Buying Analysis Results			
<b>Vendor A</b>				<b>Vendor A</b>			
ARFF				ARFF			
NPV 3 Year	IDR	(17,923,239,669)		NPV 3 Year	IDR	(21,411,903,347)	
NPV 5 Year	IDR	(18,549,385,842)		NPV 5 Year	IDR	(22,232,864,876)	
NPV 10 Year	IDR	(18,979,338,876)		NPV 10 Year	IDR	(23,920,656,068)	
<b>Vendor B</b>				<b>Vendor B</b>			
ARFF				ARFF			
NPV 3 Year	IDR	(18,104,975,372)		NPV 3 Year	IDR	(20,690,046,808)	
NPV 5 Year	IDR	(19,514,970,289)		NPV 5 Year	IDR	(21,663,569,055)	
NPV 10 Year	IDR	(22,142,562,022)		NPV 10 Year	IDR	(23,643,906,804)	
<b>Vendor C</b>				<b>Vendor C</b>			
X-ray Machine				X-ray Machine			
NPV 3 Year	IDR	(5,120,925,620)		NPV 3 Year	IDR	(5,834,711,742)	
NPV 5 Year	IDR	(7,805,988,116)		NPV 5 Year	IDR	(6,304,303,779)	
NPV 10 Year	IDR	(12,652,892,584)		NPV 10 Year	IDR	(7,233,461,262)	
<b>Vendor D</b>				<b>Vendor D</b>			
X-ray Machine				X-ray Machine			
NPV 3 Year	IDR	(4,851,765,780)		NPV 3 Year	IDR	(5,697,226,395)	
NPV 5 Year	IDR	(7,395,699,300)		NPV 5 Year	IDR	(5,702,704,668)	
NPV 10 Year	IDR	(11,987,846,694)		NPV 10 Year	IDR	(7,196,925,785)	
<b>Vendor E</b>				<b>Vendor E</b>			
Ambulance Car				Ambulance Car			
NPV 3 Year	IDR	(4,567,778,069)		NPV 3 Year	IDR	(4,657,129,504)	
NPV 5 Year	IDR	(6,962,807,893)		NPV 5 Year	IDR	(5,527,352,292)	
NPV 10 Year	IDR	(11,286,163,782)		NPV 10 Year	IDR	(7,235,452,274)	
<b>Vendor F</b>				<b>Vendor F</b>			
Ambulance Car				Ambulance Car			
NPV 3 Year	IDR	(5,827,340,697)		NPV 3 Year	IDR	(4,895,482,630)	
NPV 5 Year	IDR	(8,882,798,854)		NPV 5 Year	IDR	(5,732,037,752)	
NPV 10 Year	IDR	(14,398,318,072)		NPV 10 Year	IDR	(7,375,932,274)	
<b>Vendor G</b>				<b>Vendor G</b>			
Narcotics and Explosive				Narcotics and Explosive			
NPV 3 Year	IDR	(1,001,851,015)		NPV 3 Year	IDR	(1,048,442,687)	
NPV 5 Year	IDR	(1,527,153,038)		NPV 5 Year	IDR	(1,314,764,345)	
NPV 10 Year	IDR	(2,475,394,923)		NPV 10 Year	IDR	(1,834,964,635)	
<b>Vendor H</b>				<b>Vendor H</b>			
Narcotics and Explosive				Narcotics and Explosive			
NPV 3 Year	IDR	(891,876,039)		NPV 3 Year	IDR	(1,033,646,722)	
NPV 5 Year	IDR	(1,359,514,721)		NPV 5 Year	IDR	(1,275,136,177)	
NPV 10 Year	IDR	(2,203,666,400)		NPV 10 Year	IDR	(1,747,080,236)	

Figure 14. NPV result summary (Author, 2023)



Based on the summary, the best vendor and scheme can be concluded in Table 2.

**Table 2.** Best vendor and procuring option based on NPV analysis (Author, 2023)

Equipment Type	Vendor Name	Procurement Option
ARFF	Vendor A	Leasing in 3-Year Term
X-Ray	Vendor D	Leasing in 3-Year Term
Ambulance Car	Vendor E	Leasing in 3-Year Term
Narcotics & Explosive Detector	Vendor G	Leasing in 3-Year Term

**C. Owner Estimation for Negotiating Basis**

The owner estimate (OE) is mainly conducted by finding regulation and company data that can justify the OE component. The component can be summarized in Table 3.

**Table 3.** Owner estimate component (Badan Pusat Statistik, 2023; Ministry of Transportation Republic of Indonesia, 2014; Indonesia Financial Services Authority [OJK], 2023)

Percentage	Component	Reference
10%	Cost of Finance	Indonesia Banking Investment Credit
1%	Insurance	Insurance Data of PT XYZ
10%,20%,33%	Depreciation	Economic Life of Equipment
10%	Maintenance	Financial Statement Vendor A
11%	Tax	Value Added Tax
3%	Shipment	Ministry of Transportation Regulation Number PM78 of 2014 Regarding Cost Standards in the Ministry of Transportation
10%	Profit Margin	10% = Internal Corporation Regulation
20%		Average profit margin of fund lending companies according to the Financial Services Authority (OJK) statistics, August 2023

The owner estimate percentage then used to calculate the cost breakdown of the vendor price offering, by multiplying the percentage with the purchasing cost for shipment and depreciation, and with annual lease payment for the remaining component, the calculation can be seen on Table 4.

**Table 4.** Owner estimate component calculation (Author, 2023)

A	Cost of Finance	Multiplied by (x)	Annual Lease Payment	
B	Insurance		Annual Lease Payment	
C	Depreciation		Purchase Cost	Divided by (/) Lease Period (in year)
D	Maintenance		Annual Lease Payment	
E	Tax		Annual Lease Payment	
F	Shipment		Purchase Cost	
G	Profit Margin		Annual Lease Payment	

The next step is to generate every possible scenario of each equipment procurement with various different cost breakdown, which is the depreciation and profit margin. From this, there are 6 different scenario that can be seen on Table 5. The owner estimate lease payment can be generated by summing all the OE component, from A to E.



Table 5. Various scenario of different OE percentage (Author, 2023)

Scenario	1	2	3	4	5	6
Component	10-Year Lease Term	10-Year Lease Term	5-Year Lease Term	5-Year Lease Term	3-Year Lease Term	3-Year Lease Term
A Cost of Finance	10%	10%	10%	10%	10%	10%
B Insurance	1%	1%	1%	1%	1%	1%
C Depreciation	10%	10%	20%	20%	33%	33%
D Maintenance	10%	10%	10%	10%	10%	10%
E Tax	11%	11%	11%	11%	11%	11%
F Shipment	3%	3%	3%	3%	3%	3%
G Profit Margin	10%	20%	10%	20%	10%	20%

To assess the owner estimate, we need to calculate the difference in monthly payment, that eventually lead to the difference of profit margin from vendor data and the predicted real profit margin that the vendor takes. The calculation formula to gain those insight can be found in Figure 15.

Calculation	A	B	C	D	E	F	G
Annual Lease Payment Owner Estimate	A + B + C + D + E + F + G						
Annual Lease Payment Difference	Annual Lease Payment OE - Annual Lease Payment Venc						
Estimated Profit Margin Percentage	(Harga Sewa per Year dari Vendor - [A + B + C + D + E + F])						
Total Cost Ownership (TCO)	Annual Lease Payment x Leasing Scheme						
Profit Margin Difference	TCO Vendor - TCO OE						

Figure 15. Owner estimate profit margin calculation (Author, 2023)

The chosen vendors of each equipment to be calculated is based on the NPV analysis result of Table IV.1. For example, the calculation for ARFF equipment on vendor A can be seen in Figure 16.

ARFF Vendor A	10-Year Lease Term	10-Year Lease Term	5-Year Lease Term	5-Year Lease Term	3-Year Lease Term	3-Year Lease Term
Annual Lease Payment	IDR 3,600,000,000.00	IDR 3,600,000,000.00	IDR 5,703,125,006.42	IDR 5,703,125,006.42	IDR 8,400,000,000.00	IDR 8,400,000,000.00
Purchase Cost	IDR 20,000,000,000.00	IDR 20,000,000,000.00	IDR 20,000,000,000.00	IDR 20,000,000,000.00	IDR 20,000,000,000.00	IDR 20,000,000,000.00
A Cost of Finance	Annual Lease Payment	Annual Lease Payment	Annual Lease Payment	Annual Lease Payment	Annual Lease Payment	Annual Lease Payment
B Insurance	IDR 360,000,000.00	IDR 360,000,000.00	IDR 570,312,500.64	IDR 570,312,500.64	IDR 840,000,000.00	IDR 840,000,000.00
C Depreciation	Annual Lease Payment	Annual Lease Payment	IDR 57,031,250.06	IDR 57,031,250.06	IDR 84,000,000.00	IDR 84,000,000.00
D Maintenance	Purchase C: Divided by (/) Lease Period	IDR 200,000,000.00	IDR 200,000,000.00	IDR 800,000,000.00	IDR 800,000,000.00	IDR 2,200,000,000.00
E Tax	Annual Lease Payment	IDR 360,000,000.00	IDR 570,312,500.64	IDR 570,312,500.64	IDR 840,000,000.00	IDR 840,000,000.00
F Shipment	Annual Lease Payment	IDR 396,000,000.00	IDR 396,000,000.00	IDR 627,343,750.71	IDR 627,343,750.71	IDR 924,000,000.00
G Profit Margin	Purchase Cost	IDR 600,000,000.00	IDR 600,000,000.00	IDR 600,000,000.00	IDR 600,000,000.00	IDR 600,000,000.00
	Annual Lease Payment	IDR 360,000,000.00	IDR 720,000,000.00	IDR 570,312,500.64	IDR 1,140,625,001.28	IDR 840,000,000.00
Annual Lease Payment Owner Estimate	IDR 2,312,000,000.00	IDR 2,672,000,000.00	IDR 3,795,312,502.70	IDR 4,365,625,003.34	IDR 6,328,000,000.00	IDR 7,168,000,000.00
Annual Lease Payment Difference	IDR 1,288,000,000.00	IDR 928,000,000.00	IDR 1,907,812,503.72	IDR 1,337,500,003.08	IDR 2,072,000,000.00	IDR 1,232,000,000.00
Estimated Profit Margin Percentage	45.78%	45.78%	43.45%	43.45%	34.67%	34.67%
Monthly Payment OE	IDR 192,666,666.67	IDR 222,666,666.67	IDR 316,276,041.89	IDR 363,802,083.61	IDR 527,333,333.33	IDR 597,333,333.33
Total Cost Ownership From Vendor	IDR 10,800,000,000.00	IDR 10,800,000,000.00	IDR 28,515,625,032.10	IDR 28,515,625,032.10	IDR 84,000,000,000.00	IDR 84,000,000,000.00
Total Cost Ownership From Owner Estimate	IDR 6,936,000,000.00	IDR 8,016,000,000.00	IDR 18,976,562,513.48	IDR 21,828,125,016.69	IDR 63,280,000,000.00	IDR 71,680,000,000.00
Delta Profit Margin	IDR 3,864,000,000.00	IDR 2,784,000,000.00	IDR 9,539,062,518.62	IDR 6,687,500,015.41	IDR 20,720,000,000.00	IDR 12,320,000,000.00

Figure 16. Owner estimate calculation for ARFF equipment on vendor A (Author, 2023)

The internal corporate regulation restricts the profit margin that the vendor can take into 10%, and for leasing term 3-year period. The best scenario that adheres to internal rules is scenario 5, with profit margin 10% and leasing term 3 year. Based on the owner estimate analysis in scenario 6, PT ABC could negotiate to vendor A to reduce the monthly leasing payment from Rp700,000,000 to Rp527,333,333.33. This will lead to Rp6,216,000,000 reduced cost. The summary of owner estimate analysis and the reduced cost can be seen on Table 6.



Table 6. Suggested monthly payment from OE and its implication to profit margin difference (Author, 2023)

<b>ARFF Vendor A</b>	
Monthly Payment OE	IDR 527,333,333.33
Total Cost Ownership From Vendor	IDR 25,200,000,000.00
Total Cost Ownership From Owner Estimate	IDR 18,984,000,000.00
<b>Delta Profit Margin</b>	<b>IDR 6,216,000,000.00</b>
<b>X-ray Vendor D</b>	
Monthly Payment OE	IDR 135,584,894.57
Total Cost Ownership From Vendor	IDR 6,821,562,391.75
Total Cost Ownership From Owner Estimate	IDR 4,881,056,204.53
<b>Delta Profit Margin</b>	<b>IDR 1,940,506,187.21</b>
<b>Ambulance Car Vendor E</b>	
Monthly Payment OE	IDR 111,093,230.01
Total Cost Ownership From Vendor	IDR 6,422,276,857.79
Total Cost Ownership From Owner Estimate	IDR 3,999,356,280.27
<b>Delta Profit Margin</b>	<b>IDR 2,422,920,577.52</b>
<b>Narcotics &amp; Explosive Detector Vendor G</b>	
Monthly Payment OE	IDR 23,083,647.26
Total Cost Ownership From Vendor	IDR 1,408,598,336.56
Total Cost Ownership From Owner Estimate	IDR 831,011,301.36
<b>Delta Profit Margin</b>	<b>IDR 577,587,035.21</b>

**D. Risk Analysis Using Monte Carlo**

The internal team of PT ABC has done conducting their research on the risk related to procurement by buying and leasing, the analysis are stated on Figure 17 and Figure 18.

<p><b>LIKELIHOOD</b></p> <ol style="list-style-type: none"> <li>1. Improbable (unlikely to occur): <b>close to zero</b></li> <li>2. Remote (unlikely, though possible): <b>&lt; 3x per year</b></li> <li>3. Occasional (likely to occur occasionally during standard operations): <b>3-5x per year</b></li> <li>4. Probable (not surprised, will occur in a given time): <b>6-9x per year</b></li> <li>5. Frequent (likely to occur, to be expected): <b>&gt; 9x per year</b></li> </ol>	<p><b>IMPACT</b></p> <ol style="list-style-type: none"> <li>1. No impact on business and finance.</li> <li>2. Financial impact &lt; IDR 100 Million per year</li> <li>3. Financial impact &gt;= IDR 100 Million per year</li> <li>4. Disrupting operational of the airport</li> <li>5. Causing cessation of airport operations</li> </ol>
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Figure 17. Risk assessment scoring (PT ABC internal data, 2023)

Leasing				Buying			
IDENTIFIED RISK	LIKELIHOOD	IMPACT	RISK VALUE	IDENTIFIED RISK	LIKELIHOOD	IMPACT	RISK VALUE
1 Failure in enforcing SLA (Service Level Agreement) / SLG (Service Level Guarantee)	1	4	4	1 Failure in enforcing SLA (Service Level Agreement) / SLG (Service Level Guarantee)	3	4	12
2 Fixed Cost	5	3	15	2 Disruption in the management of safety & security	2	4	8
3 Facilities not recorded as assets	5	3	15	3 Initial Investment	5	3	15
4 Constraints on asset utilization flexibility	2	4	8	4 Asset Tax	5	3	15
				5 Asset-Related Costs	5	3	15
				6 Challenges in replacing assets damaged before the end of their useful life	2	4	8
				7 Maintenance of assets that cannot yet be written off / cannot be destroyed	4	2	8
				8 Failure of guarantee mechanisms for maintenance assurance	3	4	12

Leasing Total Risk Value: 42  
 Buying Total Risk Value: 93

Figure 18. Identified risk and its value on leasing and buying in procurement (PT ABC internal data, 2023)



Figure 19. Monte Carlo simulation distribution graph result for leasing



Figure 20. Monte Carlo simulation distribution graph result for buying

Based on the internal team data of PT ABC, it is riskier to do buying than leasing, from the total risk value comparison. The distribution histogram of leasing from Monte Carlo simulation can be seen on Figure IV.10 and distribution histogram for buying on Figure IV.11. The distribution shows that the total risk value has normal distribution, with skewness on the right, showing higher probability that the project might cause higher risk, that is, caused higher impact and likelihood.

Based on the Monte Carlo output, below are the results interpretation for leasing Option,

- **95% Confidence Interval:** The simulation for the leasing option revealed a 95% confidence interval for the total risk value ranging between 24 and 60. This interval indicates that there's a 95% probability that the total risk value for the leasing option will fall within this range.
- **Probability of Exceeding Threshold:** The probability of the total risk value surpassing a predefined threshold is approximately 40.79%. This suggests a moderate level of risk, indicating that there's a 40.79% chance that the risks associated with leasing could exceed the set threshold.





And the output of the buying option is:

- **95% Confidence Interval:** For the buying option, the 95% confidence interval for the total risk value lies between 75 and 110. This wider range suggests a higher variability in risk outcomes compared to leasing.
- **Probability of Exceeding Threshold:** The probability of the total risk value exceeding the threshold is around 45.15%. This implies a slightly higher risk level than leasing, indicating a nearly 45.15% likelihood that the risks in the buying option will exceed the threshold.

**E. Business Solutions**

Based on the analysis, the most cost-effective vendor is listed below:

1. ARFF: Vendor A with leasing term of 3 year provide the lowest negative-valued NPV with value of IDR (17,923,239,669).
2. X-ray machine: Vendor D with leasing term of 3 year provide the lowest negative-valued NPV with value of IDR (4,851,765,780).
3. Ambulance car: Vendor E with leasing term of 3 year provide the lowest negative-valued NPV with value of IDR (4,567,778,069)
4. Narcotics & explosive detector: Vendor G with leasing term of 3 year provide the lowest negative-valued NPV with value of IDR (1,001,851,015).

Since all the leasing option result are 3-year period, the result adds a feasibility aspect since the internal corporation regulation of PT ABC currently only allows leasing of heavy equipment in 3-year terms.

The summarized owner estimate calculation for each vendor already showed in Table 6. For clarity, the value for negotiation and the reduced cost from the difference in value between owner estimate and vendor monthly payment is summarized in Table 7.

**Table 7.** Monthly payment reduction and its effect on total cost reduction

<b>ARFF Vendor A</b>	
Monthly Payment OE	IDR 527,333,333.33
Monthly Payment Vendor	IDR 700,000,000.00
Monthly Payment Reduction	IDR 172,666,666.67
<b>Total Cost Reduction</b>	<b>IDR 6,216,000,000.00</b>
<b>X-Ray Vendor D</b>	
Monthly Payment OE	IDR 135,584,894.57
Monthly Payment Vendor	IDR 189,487,844.22
Monthly Payment Reduction	IDR 53,902,949.64
<b>Total Cost Reduction</b>	<b>IDR 1,940,506,187.21</b>
<b>Ambulance Vendor E</b>	
Monthly Payment OE	IDR 111,093,230.01
Monthly Payment Vendor	IDR 178,396,579.38
Monthly Payment Reduction	IDR 67,303,349.38
<b>Total Cost Reduction</b>	<b>IDR 2,422,920,577.52</b>
<b>Narcotics &amp; Explosive Detector Vendor G</b>	
Monthly Payment OE	IDR 23,083,647.26
Monthly Payment Vendor	IDR 39,127,731.57
Monthly Payment Reduction	IDR 16,044,084.31
<b>Total Cost Reduction</b>	<b>IDR 577,587,035.21</b>

In summary, PT ABC should do a procurement of ARFF to vendor A, X-ray machine to vendor D, ambulance car vendor E, and narcotics & explosive detector. Fortunately, all the equipment procurement NPV value shows the lowest negative-valued on the 3-year term, which is following the internal corporate regulation to PT ABC. To further saving cost for PT ABC, the result of owner estimate monthly payment can be applied as negotiation basis to the vendors when procurement occurs. The risk analysis also showed that leasing has lower risk compared to buying, further indicating that 3-year leasing term for each equipment is the best option.



## CONCLUSION

The conclusion of this research reveals several key findings and recommendations for PT ABC. Firstly, in the midst of a financial crisis, the company can feasibly secure essential equipment, including ARFF vehicles, X-ray machines, ambulances, and narcotics & explosive detectors, by choosing leasing over purchasing. This approach aligns with PT ABC's financial strategy during the crisis, minimizing upfront costs and ensuring the acquisition of necessary equipment within financial constraints.

Secondly, a meticulous vendor selection process has identified Vendor A for ARFF vehicles, Vendor D for X-ray machines, Vendor E for ambulances, and Vendor G for narcotics & explosive detectors as the most cost-effective options. These vendors not only meet financial viability criteria but also adhere to PT ABC's procurement policies. Additionally, leasing is established as a more financially viable option than buying, offering flexibility and suiting the company's short-term financial capabilities, which is particularly beneficial during a financial crisis.

The study also highlights that a 3-year leasing term is financially feasible and complies with internal regulations, striking a balance between cost management and operational needs. Moreover, the utilization of owner estimates proves to be a crucial negotiation tool, enabling PT ABC to secure favorable procurement terms and ensuring cost-effectiveness.

Furthermore, the effectiveness of the Monte Carlo simulation in evaluating procurement risks is underscored. It indicates a moderate risk level for leasing, with a 40.79% chance of risk exceeding a certain threshold, compared to a higher risk of 45.15% for purchasing. This risk assessment is vital for PT ABC in making informed procurement decisions.

In summation, the strategic procurement plan for PT ABC should prioritize leasing ARFF vehicles from Vendor A, X-ray machines from Vendor D, ambulances from Vendor E, and narcotics & explosive detectors from Vendor G on a 3-year lease. This plan, supported by strategic negotiations using owner estimates and informed by a comprehensive understanding of risk factors through Monte Carlo simulation, equips PT ABC to manage its procurement efficiently and cost-effectively during the financial crisis.

## RECOMMENDATIONS

The research culminates in a set of recommendations designed to refine PT ABC's procurement and risk management strategies. A key suggestion is the enhancement of data collection and analysis methods. PT ABC is advised to incorporate a broader range of historical data, which is expected to significantly improve the accuracy of predictive data analysis and risk assessments. This approach will offer deeper insights into procurement and operational risks, aiding in more informed decision-making.

Another recommendation focuses on the efficiency of maintenance costs. By reducing these costs, the option of buying equipment, as opposed to leasing, may become more financially advantageous for PT ABC. This shift could lead to long-term cost savings and investment optimization.

The study also underscores the importance of a continuous review and assessment of vendor performance and procurement strategies. Implementing a vendor performance tracking system, coupled with a regular procurement strategy review process, will ensure that PT ABC consistently opts for the most cost-effective and efficient procurement methods.

Moreover, there is a suggestion to modify internal corporate policies to allow greater flexibility, especially in leasing term limits. Reevaluating and potentially extending these limits beyond the current 3-year cap could offer PT ABC more cost-effective and adaptable procurement options, particularly if longer terms like 5 or 10 years prove to be more economical in future procurements. The development of a comprehensive risk management framework is also recommended. Given the insights from the risk analysis, PT ABC should consider a framework that evaluates not just financial risks, but also operational, compliance, and strategic risks associated with procurement. This holistic approach will ensure a more robust and resilient procurement strategy.

Finally, the research suggests areas for future studies, which could include expanding the scope of analysis to encompass a wider range of procurement options and scenarios. Investigating the impact of external factors such as market trends and regulatory changes on procurement decisions is also recommended. These areas of research promise to yield valuable insights, further aiding PT ABC in refining its procurement strategies and practices.

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