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# Financial Feasibility Study and Maintenance Strategy of Articulated Dump Truck (A Case Study of PT. KLM)

**Fajar Ikhwan Rosyidi[1], Ahmad Danu Prasetyo[2]**
Bandung Institute of Technology[1,2]
Jl. Ganesa No.10, Lb. Siliwangi, Coblong Sub-District, Bandung Regency, Jawa Barat, 40132, Indonesia
Correspondence Email: fajar_ikhwan@sbm-itb.ac.id
ORCID ID: https://orcid.org/0000-0003-2461-0332

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**ABSTRACT**

Beyond 2021, the challenging difficulties would need coal mining firms, particularly PT.KLM, to increase operational efficiency. The author conducts a root cause analysis in order to determine one of the causes of the business's inefficiencies. At the time, one of PT. KLM's inefficiencies is a result of the articulated dump truck's (ADT) performance, which fell short of the projected aim. The author provides two alternatives for ADT at PT. KLM, starting from Certified Rebuild Machine (CRM) then Full Maintenance Service (FMS) and CRM then Full Maintenance Contract (FMC). Feasibility studies are undertaken in order to determine the most viable alternative. Both sensitivity analysis and Monte Carlo simulation is conducted to determine the input variable's influence on changes in NPV (Net Present Value) and to generate a variety of possible outcomes and probabilities of various situations. The author proposes scenario 2 as the optimal scenario with the highest NPV based on the study. Additionally, following the Monte Carlo simulation, the mean NPV + minimum NPV and mean NPV + maximum NPV values for scenario 2 are the highest in comparison to the other scenario.

**Keywords:** Articulated Dump Truck, Certified Rebuild Machine, Feasibility Study, Full Maintenance Contract, Full Maintenance Service, Monte Carlo Simulation, Net Present Value

**JEL Classification:** G11, G31, G32

## INTRODUCTION

Coal is critical to our society because it permits the production of affordable power and also helps to the creation of our communities through its usage in electricity, steel, and cement. Coal is used to create 37% of global electricity and more than 70% of global steel (WCA, 2021). Demand for coal is being pushed out of existence on a regular basis in many industrialized nations as a result of a combination of environmental legislation and intense competition from a rising number of cost-competitive renewables energy. Expanding renewable energy and maintaining stable $CO_2$ prices in the European Union will help the European Union continue to reduce its reliance on coal. Coal-fired power plant retirements are accelerating in developed countries. Additionally, low-carbon generating technologies such as wind and solar continue to gain traction as costs come down and regulatory support remains consistent (IEA, 2021). China's coal-fired winter heating systems emit substantial volumes of harmful pollutants, degrading the country's air quality dramatically (Fan M, 2020).

When compared to the previous year, the Indonesian Ministry of Energy and Mineral Resources reported that investment realization had fallen to more than 60% as of October 2020, a significant decrease. Miners are being compelled to scale back their capital expenditure estimates (APBI-ICMA, 2021). This trend is expected to continue in 2021, with investment realization in the mining and coal sectors reaching just 23 percent by the end of May 2021 (IDX, 2021). This long-term fall in demand has put downward pressure on coal prices, driving coal mining companies to increase their efficiency.

At the time, one of PT. KLM's inefficiencies is related to the articulated dump truck's (ADT) performance, which fell short of the projected aim. PT. KLM employs articulated dump trucks to transport top soil preparatory to coal mining and reclamation. This under-performance ADT causes opportunity losses because the transferred top soil capacity does not meet the target. This has an influence on the delay in the process of opening mine land and reclamation, which results in the reclamation guarantee not being able to be dispersed as quickly as it should be. Typically, a mining business will run a fleet of dump trucks to meet daily output targets. A high level of truck availability is crucial for meeting the production objective (H. HUSNIAH, 2018).

## LITERATURE REVIEW

### Capital Budgeting

Capital budgeting is the process through which business owners decide whether long-term investments or capital expenditures are worthwhile. Capital budgeting, in other words, is the process of planning, analyzing, selecting, and managing capital investments (Baker & English, 2011).

To evaluate investment options and choose the one that maximizes wealth, one must first compute the cash flows connected with each investment, followed by an assessment of the uncertainty associated with all cash flows. There are six commonly used strategies for appraising long-term investments (Peterson & Fabozzi, 2002):

1. Payback period.
2. Discounted payback period.
3. Net present value.
4. Profitability index.
5. Internal rate of return.
6. Modified internal rate of return.

**Operating Cash Flow (OCF)**

The cash flow generated by a business's everyday activities, such as manufacturing and selling its goods or services, is referred to as operating cash flow (OCF) (Gitman & Zutter, 2015). The operating cash flow formula:

*OCF = [EBIT x (1 - T)] + Depreciation*

Where:
*OCF* = Operating cash flow
*EBIT* = Earnings before interest and taxes
*T* = Corporate tax rate

**Net Present Value (NPV)**

A complex capital budgeting technique that subtracts the initial investment ($CF_0$) from the present value of the project's cash inflows ($CF_t$) discounted at the firm's cost of capital (r) (Chartered Financial Analyst, 2018), the NPV Formula:
NPV = Present value of cash inflows - Initial investment

$$\mathrm{NPV} = \sum_{t=1}^{n} \frac{CF_t}{(1+r)^t} - \mathrm{CF}_0$$

Where:
$CF_t$ = Present value of cash inflow in year t
$CF_0$ = Initial cash flow or investment
*r* = Cost of capital

NPV is a critical tool in discounted cash flow (DCF) analysis and is a widely used approach for evaluating long-term projects by utilizing the time value of money (Wikipedia, 2021). In this research, author analyze NPV from operating cost in order to choose projects with the highest net present value.

**Cost of Equity - Capital Asset Pricing Model (CAPM)**

The term "cost of equity" refers to the needed rate of return for a business's shareholders. (Baker & English, 2011). The most often used approach for evaluating the cost of equity is the Capital Asset Pricing Model. CAPM establishes a relationship between non-diversifiable risk and projected returns (Gitman & Zutter, 2015). CAPM will be used to determine cost of equity. The CAPM formula:

$$r_E = R_F + [\beta \times (r_m - R_F)]$$

Where:
$r_E$ = Cost of equity
$R_F$ = Risk free rate of return
$\beta$ = Levered beta coefficient
$r_m$ = Market return

**Weighted Average Cost of Capital (WACC)**

The discount rate, which is the rate of return required to compensate capital sources (bondholders and owners) for the risk they incur, is a proxy for the business risk associated with a project. From the investor's perspective, the discount rate is the needed rate of return (RRR). The discount rate is the firm's cost of capital, or the cost of raising a dollar of fresh capital (Gitman & Zutter, 2015).

Typically, the cost of capital is determined by determining the overall cost of capital of the business. The corporation begins by calculating the cost of debt, preferred stock, and ordinary equity. The weighting of each expenditure is then determined by the proportion of each source to be raised. The weighted average cost of capital is the name given to this average (WACC). The WACC formula:

$$WACC = \left(w_D \times r_D(1 - Tax\ Rate)\right) + (w_E \times r_E)$$

Where:

| | |
|---|---|
| *WACC* | = Weighted Average Cost of Capital |
| $w_D$ | = Proportion of debt-based financing |
| $r_D$ | = Before-tax cost of debt |
| $w_E$ | = Proportion of equity-based financing |
| $r_E$ | = Cost of equity |

**Certified Rebuild Machine (CRM)**

A certified rebuild machine is a reconditioning program that has been recognized and approved by the original equipment manufacturer (Original Equipment Manufacturer). CRM is conducted by authorized dealers designated as OEM representatives. CRM-manufactured equipment performs as well as new equipment. The refurbishment process is a conceptual stage in the life cycle of a product. It is incorporated into current field equipment by adding value to reconditioned and repaired equipment (Abdul Hamid, 2016).

**Sensitivity Analysis**

Sensitivity analysis determines the rate of change in present value that occurs as a result of a specified change in an input, with all other variables kept constant. This is the most common type of risk analysis and is used by virtually every company. It starts with a base case scenario where the project's net present value (NPV) is calculated using the base case value of each input variable (Brigham & Houston, 2009).

**Monte Carlo Simulation**

Monte Carlo Simulation is a sophisticated spreadsheet-based method that enables better understanding and visualization of risks and uncertainties for discounted cash flow (DCF) analysis. The main output is the net present value (NPV) histogram, which plots the overall distribution of possible results in a bell-shaped curve, thereby determining the probability of project success (Clark, Reed, & Stephan, Fall 2010).

## RESEARCH METHOD

This research is associative research using quantitative approach. Calculations are performed by totaling the expenditures associated with each scenario. Revenue is not considered in this study since revenue is constant regardless of the scenario chosen. All expenditures will be estimated with the effect of any taxes in mind. The optimal scenario is determined by the scenario with the highest net present value.

The author utilized the majority of the data in this calculation from the company's assumptions. Additionally, the author employs the WACC (Weighted Average Cost of Capital) technique for discount rate, in which all projects are funded with firm equity. The cost of equity is calculated using the CAPM (Capital Asset Pricing Model) method using the equity risk premium by Damodaran (Damodaran, 2014).

Additionally, the author conducts sensitivity analysis and Monte Carlo simulations for each scenario as a sort of risk analysis. Sensitivity analysis is used to determine the effect of an input variable on changes in NPV. The author does this sensitivity analysis with a swing input of 20% and a swing input of -20% to the base. Meanwhile, Monte Carlo simulations provide a large number of alternative outcomes and probabilities that may be used to assess the likelihood of various occurrences where the best-case & worst-case variables are obtained from history data.

## RESULTS

The results of the calculations from the two scenarios are different. This is due to the fact that each scenario has a different set of input variables.

### Scenario 1: CRM & FMS

Financial Analysis

The CRM will be utilized in the repair of ADT type A. CRM capacity for the contractor is 24 pieces of equipment each year, however the quantity of equipment for which CRM will be accountable is 36 pieces of equipment. This means that CRM for all equipment will be completed in 1.5 years; 24 pieces of equipment in the first group will be finished by the end of 2022, followed by 12 pieces of equipment in the second group by the end of 2023. Following the completion of CRM, the equipment will be maintained in accordance with a comprehensive maintenance service strategy (FMS).

The majority of the costs associated with scenario 1 are incurred as a result of component replacement. In 2022, it can be observed that the cost of replacing components is the second greatest expense after CRM, and that this is driven by schedule maintenance costs such as service 500 hours, 1000 hours, and 2000 hours that are performed throughout the year (see Figure 1) when a large number of components are replaced at the same time as they near the end of their designed life, the costs appear to rise. Some of the equipment components in the first group will require replacement beginning in the second year (2023). As a result, component replacement will account for the majority of the expenditure in 2023. As seen in Figure 1, expenditures will dramatically increase in 2024 and every three years afterwards, owing to the fact that the majority of equipment components in the first group have reached the end of their useful lives and will require component replacement at some point. Expenses increased every three years in 2025, when the majority of components in the second group reached their life lifespan and required component replacement. The same procedure occurred in the previous year.

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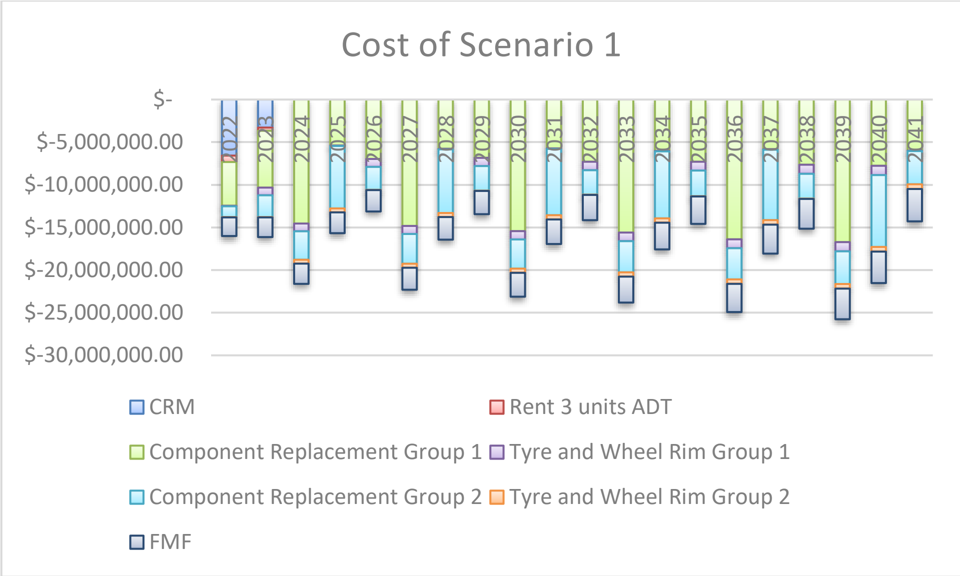
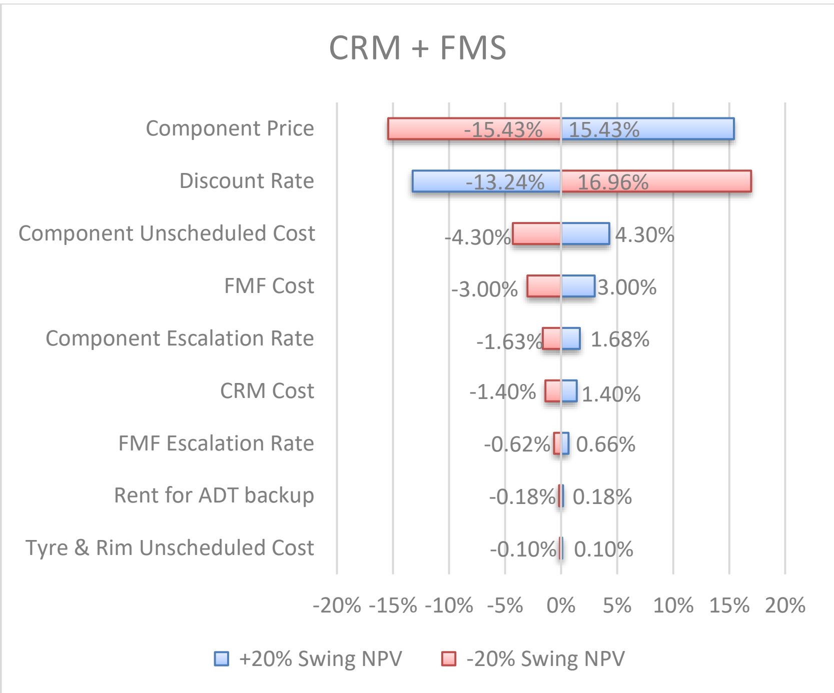
**Figure 1.** Cost Breakdown in Scenario 1




Sensitivity Analysis

According to the results of a sensitivity analysis performed on scenario 1, the variable component pricing has the greatest impact on changes in NPV, with a 15.43 percent deviation from the base value. Following that, the discount rate has an average effect on the net present value (NPV) of 15.10 percent. It is particularly sensitive to changes in net present value when it comes to component price and discount rates. Other factors, on the other hand, have a relatively minor impact on changes in net present value. Figure 2 depicts the magnitude of the changes that take place throughout the course of this calculation.

**Figure 2.** Tornado Chart of Scenario 1



Monte Carlo Analysis

Monte Carlo simulations of scenario 1 are run with a varying input range to see how it turns out. The simulations are carried out using 1000 variables every iteration of the code. The Monte Carlo simulation in scenario 1 returns a negative net present value (NPV) of -$ 153,233,004.70 and a negative net present value (NPV) of -$ 53,832,144.18. The average net present value (NPV) generated by the simulation was -$ 88,279,897.17, with a standard deviation of $ 17,109,546.51 (see table 1). Because of their negative skewness, the simulation results show that the majority of the net present value distribution is greater than the average net present value (skewness = -0.45). The kurtosis result for scenario 1 is -0.31, suggesting that the NPV distribution generated by the simulation is included as platy kurtosis.

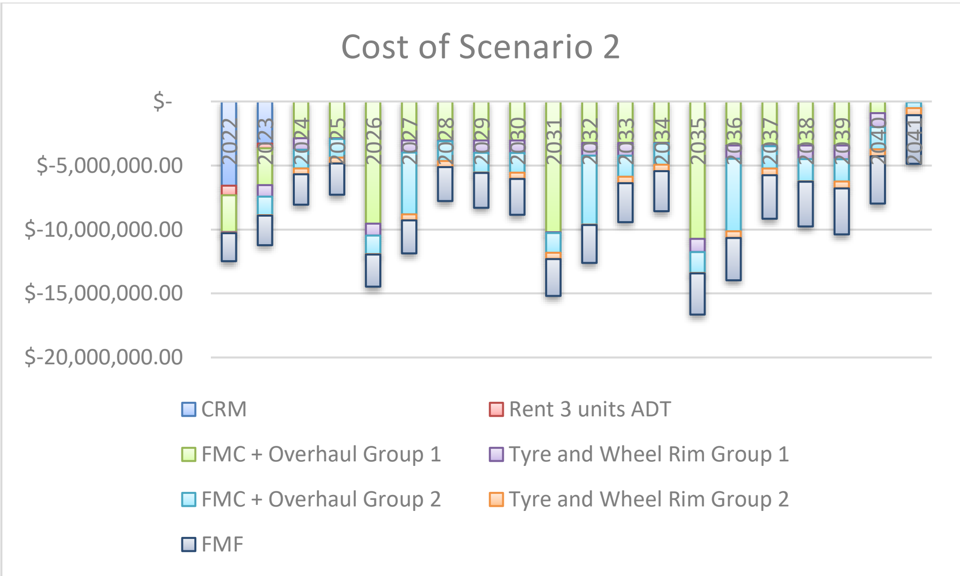
### Scenario 2: CRM & FMC

Financial Analysis

Scenario 2 is similar to Scenario 1 in that ADT type A will be refurbished utilizing the CRM, with a timeline that includes 24 pieces of equipment (1st group) to be completed in 2022 and 12 pieces of equipment (2nd group) to be completed in 2023. In contrast to Scenario 1, in Scenario 2, following the completion of CRM, the equipment will be maintained utilizing the FMC strategy.

The high cost during the first two years of the project was due to the implementation of a CRM program from the outset. In the next stages, the expenses associated with scenario 2 are mostly related to the FMC and overhaul costs. When a large number of components are changed during an overhaul, the costs appear to rise. As seen in Figure 3, expenditures considerably increase in 2026 and every 25,000 working hours thereafter as a result of the requirement to overhaul equipment in the first group. The similar procedure occurred in 2027, with expenditures increasing every 25,000 operational hours when equipment in the second group reached the threshold for being overhauled.

**Figure 3.** Cost Breakdown in Scenario 2



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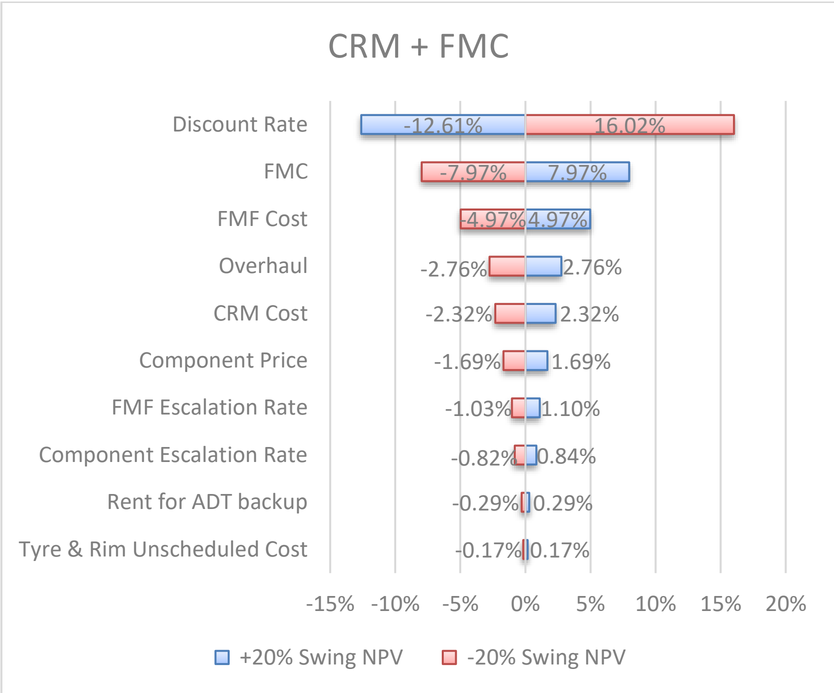
<u>Sensitivity Analysis</u>
Sensitivity analysis of scenario 2 reveals that the variable discount rate has the greatest influence on variations in NPV, which is 14.32 percent on average from the base. Following that, the FMC has an average effect of 7.97 percent on the NPV. Discount rates and FMC cost are particularly sensitive to changes in net present value. Meanwhile, other variables have a negligible influence on changes in NPV. What distinguishes it from scenario 1 is that component replacement is already factored into the FMC rate in scenario 2. Figure 4 illustrate the extent of the changes that occur throughout this calculation.

**Figure 4.** Tornado Chart of Scenario 2




<u>Monte Carlo Analysis</u>
Monte Carlo simulations of scenario 2 with a varying input range are undertaken. Simulations are run 1000 times. The input variable's worst-case and best-case values are generated mostly from the company's assumption data. The Monte Carlo simulation in scenario 2 produces a minimum NPV of -$ 72,166,830.95 and a maximum NPV of -$ 39,360,892.92. Average NPV generated from the simulation -$ 53,578,637.52 with a standard deviation of $ 8,184,502.49. The simulation results indicate that the skewness score is -0.25 (negatively skewed), implying that the majority of the NPV distribution is greater than the average NPV. For scenario 2, the kurtosis score is -1.06, suggesting that the NPV distribution created by the simulation is included as platy kurtosis. The results of the Monte Carlo simulation for scenario 2 can be shown in table 1.

**Table 1.** Summary of Monte Carlo Simulation Both Scenarios

| Item | Scenario 1 | Scenario 2 |
|---|---|---|
| NPV (base) | -111,372,714.99 | -67,180,275.09 |
| Min NPV | -153,233,004.70 | -72,166,830.95 |
| Max NPV | -53,832,144.18 | -39,360,892.92 |

| Item | Scenario 1 | Scenario 2 |
|---|---|---|
| Mean NPV | -88,279,897.17 | -53,578,637.52 |
| Standard Deviation | 17,109,546.51 | 8,184,502.49 |
| Median | -86,462,151.90 | -52,675,205.78 |
| Mean + Min NPV | -264,605,719.69 | -139,347,106.04 |
| Mean + Max NPV | -165,204,859.17 | -106,541,168.01 |
| CV | -0.19 | -0.15 |
| Kurtosis | -0.31 | -1.06 |
| Skewness | -0.45 | -0.25 |

*Note. NPV* = Net Present Value, *CV* = Coefficient of Variation.

## DISCUSSION

Each scenario has been calculated and results in a varied set of numbers depending on the circumstance. The author attempts to compare the outcomes of each scenario in order to determine which scenario is the most favorable.

When comparing the two scenarios, scenario 2 has a greater NPV (base) than the other scenario, with a value of $ 67,180,275.09 in compared to the other scenario. Furthermore, scenario 2 has a bigger average net present value (NPV) than scenario 1, with a value of - $53,578,637.52. The scenario with the lowest standard deviation is scenario 2, which implies that the NPV values obtained via the Monte Carlo simulation are closest to the average NPV obtained by the simulation. The Mean + Min NPV and the Mean + Max NPV of scenario 2 are both higher than those of the other scenario, indicating a superior performance.

Using Scenario 1, which has a greater CV value of 0.19, we can see that a $1 change in net present value carries a $0.19 risk. This means that in compared to scenario 2, scenario 1 poses a greater risk. Based on the results of the Monte Carlo simulation, the kurtosis and skewness values for each scenario may be utilized to calculate the NPV distribution for each scenario. If kurtosis decreases, the data distribution becomes more sloping on the normal distribution curve. When the kurtosis value is less than 3 in all cases, the condition is known as platy kurtosis. All of the scenarios are skewed in the negative direction (negatively skewed), showing that the NPV distribution is skewed to the right in a normal distribution curve, as indicated by the NPV distribution being skewed to the right.

## CONCLUSION

In consideration of the research that has been conducted, the author suggests scenario 2 as the best option with the highest net present value. Furthermore, following the Monte Carlo simulation, the results of the mean NPV + lowest NPV and the mean NPV + maximum NPV in scenario 2 generate the highest values when compared to the results of the Monte Carlo simulation in scenario 1. Moreover, scenario 2 has lower coefficient of variation than scenario 1. This makes scenario 2 lower risk than scenario 1.

**ACKNOWLEDGMENT**
The authors gratefully acknowledge to the PT. KLM which has given permission to conduct research with cases at PT. KLM.

## DECLARATION OF CONFLICTING INTERESTS

The research was carried out in order to determine which choice is preferable for PT KLM, and the author was not under any pressure from any other party throughout the course of the research.

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