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Investment Feasibility Analysis Addition of CV. XYZ New Milling Machine by Considering Price Changes and Sensitivity Analysis

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Abstract

This Article is a development and refinement of the Article by Rachadian et al. (2013), which discusses the feasibility analysis of adding a new milling machine by paying attention to the attributes and parameters of a more comprehensive investment feasibility analysis. The calculation of the previous research was evaluated by considering the calculation of income, the taxes, the depreciation expense, and the assumption of the selling price itself. In addition, consideration has been carried out on exchange rate fluctuations and relations aspects of each key parameter on investment using sensitivity analysis. The best result was obtained in the form of alternative 2 with Rp. 20,000/plat of selling price assumption. The calculated value of NPV DC2-A is Rp. 123,683,069 with an IRR value of 37.5%, a B/C ratio value of 2.14, a PP value of 1 year six months, and a PI value of 2.47. The values of the various calculations are considered feasible because they have reached the specified requirements. The target for plate production on the DC 2-A alternative in the first year is 3350 units in order not to suffer losses. The alternative production value of DC-2A is the most sensitive to changes in annual cost. If the business unit increases the annual cost by 20%, the business unit will lose much money.

Keywords

Feasibility Investment, price changes, sensitivity analysis, DC 2-A

1. Introduction

As machines and production equipment age, this causes a decrease in their ability to carry out their duties. The decrease in their reliability can cause various waste and losses that cause the company to suffer losses (Daellenbach & Mcnickle, 2005). The company needs to make continuous improvement efforts in dealing with these problems. Improving machine maintenance management and investment in purchasing new machines are crucial options that must be considered to answer these problems. The investment feasibility analysis is indispensable in projecting both options.

CV. XYZ is a manufacturing business unit engaged in the production engineering of printing machines. In implementing its production, a milling machine is a critical object that supports the production economy. For almost 20 years, the milling machine has experienced many problems that cause waste and losses. There are

various incidents of waste and losses experienced by CV. XYZ pushed it to reduce the rate of obstacles through efforts to increase productivity and machine effectiveness.

Based on research by Rachadian et al. (2013), CV. XYZ has several weaknesses in the production and machine maintenance system, which causes losses and waste. First of all, milling machines that are more than 20 years old in CV. XYZ causes production delays. Second, the company does not apply any schedule for maintaining the machine, which causes breakdown losses. Furthermore, the last one, the company will replace the damaged machine components only, even though the machine has passed its limit, which causes a decrease in capability. These aspects will adversely affect the effectiveness of the machine. Rachadian et al. (2013) also discuss the alternative comparison analysis used by CV. XYZ to reduce waste and losses through investment in adding a new milling machine (alternative 1) or replacement of damaged components (alternative 2) within ten years with an interest rate of 15%. In proposing the investment feasibility study, Rachadian et al. (2013) consider several parameters such as PP, NPV, and PI to know the best investment alternatives which solve the problems. However, Rachadian et al. (2013) still have several shortcomings in conducting a feasibility analysis study on the addition of CV. XYZ's milling machine. First, this study's expense and income are not certainties calculated. Second, the depreciation expense and the income tax have not been calculated. Third, it does not consider the price changes in investment, so the investment assumption of constant price is unrealistic. Fourth, there is no correlation between any variables affecting decision-making.

The times value of money outlines inflation and deflation (Gynther, 1965). The changes in the rate of money exchange will increase the level of purchasing price in general, impacting the company's operational costs (Sullivan et al., 2015). Likewise, changes in differential prices will cause the prices of some types of commodities to change at a different rate from changes in prices that generally occur (Pujawan, 2015). In anticipating the impact of price fluctuations, it is necessary to calculate the income stream and the rate of inflation/deflation on the feasibility of the proposed investment to obtain a realistic income stream, such as Bodnar et al.'s research (1993) (Oyegoke & Dabai, 2018). In addition, many researchers argue that investment feasibility analysis needs to consider aspects of the impact of the relationship of each key parameter on investment using sensitivity analysis (Daellenbach & Mcnickle, 2005; Sullivan et al., 2015). Many studies use sensitivity analysis in investment feasibility, such as research by Budisulistyo and Krumdieck (2015), which consider sensitive parameters in the thermodynamic discussion, research by Kismet al. (2017) that compares the four critical variables of investment decisions, research by Sutopo et al., (2018) use sensitivity analysis to explain the models' ability in response to uncontrolled inputs, and research by Jang et al., (2021) using sensitivity analysis in determining the effect of subsidies on the economic value of investments used from the financial aspect, and so on.

This Article is a development and refinement of the Article by Rachadian et al. (2013), which discusses the feasibility analysis of adding a new milling machine by paying attention to the attributes and parameters of a more comprehensive investment feasibility analysis. The use of more complete data, assumptions on calculating income, taxes, depreciation costs, and inflation rates, and consider aspects of the relationship of each key parameter on investment using sensitivity analysis. The economic investment parameter used in this Article is the Payback Period (PP), Net Present Value (NPV), Profitability Index (PI), Internal Rate of Return (IRR), and Benefit-Cost Ratio (B/C ratio), considering the price changes factor to explore the profitability of future investments. This study aims to provide a more holistic perspective on comparing the investment feasibility of adding a new milling machine or replacing damaged engine components on the CV. XYZ.

1.1 Objectives

This article aims to determine the feasibility of investing in adding a new milling machine or replacing damaged engine components on the CV. XYZ by considering the addition of price changes factor to the parameters and considering the aspects of the relations of each key parameter to the investment using sensitivity analysis.

2. Literature Review

There are various qualitative and quantitative criteria taken for selecting the best alternative in investment. The consideration of the financial factor of the investment becomes an essential point in this analysis of the feasibility

of the investment (Wignjosoebroto, 2006). Investment feasibility analysis is used to obtain information on whether or not an investment can provide the desired rate of return. Investment feasibility is also used to obtain a source of eligibility for the investment itself (Sullivan et al., 2015). In investment control, the controlled and uncontrolled inputs are necessary to obtain the desired rate of return (Daellenbach & Mcnickle, 2005). Considering the price changes aspect to provide more realistic value in anticipating the impact of price fluctuations is very needed, which means the calculations between income flows and rate of inflation/deflation on investment feasibility. In addition to these controls, the relation between controlled and uncontrolled inputs is also essential in analysing investment feasibility. Sullivan et al. (2015) argue that investment feasibility analysis needs to consider an aspect of the relationship impact of each key parameter on investment using sensitivity analysis. Likewise, Sutopo et al. (2018) conducted research using sensitivity analysis to explain the model's ability to respond to uncontrolled inputs. Sensitivity analysis is used to study the effect of the relation of critical parameters on several variations that have been tested on investment feasibility. The following is a brief description of some of the methods used as critical parameters in this research.

a. Net Present Value (NPV)

The NPV method is well-known as a method often used to make decisions about the feasibility of an investment with definite cash flow value. This method is based on discounting all future cash flows within a predetermined investment time limit in case to determine the size of the benefit or deficit itself. The investment will be accepted if it has a positive value of NPV (NPV > 1) and rejected if it is the opposite (Sullivan et al., 2015). The NPV method can be denoted by the following formula:

$$\mathrm{NPV(i\%)} = \sum_{k=0}^{N} F_k(1+i)^{-k}$$

Description:
i = interest rate
k = period index th-k (0 k N)
F_k = cash flow at the end of period k
N = number of periods in the analysis horizon

The income stream used in the NPV method is already subject to tax value and conversion of the actual value. The calculation of taxes is stipulated in PMK by No. 99/PMK.03/2018 explains that every unit business with gross income does not have more than Rp. 4.3 billion in a year are required to pay income tax of 0.5% of gross income. In addition, the calculation between the income stream and the inflation/deflation rate on the feasibility of the proposed investment to obtain a realistic income stream is based on Indonesia's average annual inflation rate in 2016-2020 with a value of 2.83%.

b. Benefit-Cost Ratio (B/C Ratio)

The Benefit-Cost Ratio is a method to calculate the ratio between cash flow receipts and cash flow payments in present value. The B/C Ratio is used as an additional measuring tool for the portion of derived profits by the proposed investment. The B/C Ratio is accepted if it has a value of 1 and rejected if it is the opposite (Sullivan et al., 2015). The B/C ratio can be denoted by the following formula:

$$B - C = \frac{PW(B)}{I - PW(MV) + PW(O\&M)}$$

Description:
PW(B) = Present Value of The Benefits obtained
I = Initial investment
PW(MV) = Present Value of The Market Value of the Investment at the end of the period
PW(O&M) = Present Value of Operating and Maintenance Costs

c. Pay Back Period (PP) and Profitability Index (PI)

PP is the period that is needed by the company to get a return on investment by considering the net cash flow. Investment is accepted if the payback period on investment is shorter than the economic life itself and rejected if it is the opposite (Sullivan et al., 2015). PP can be denoted by the following formula:

$$PP = \frac{\text{Investasi}}{\text{Net Benefit}} \times 1 \text{ Tahun}$$

Meanwhile, PI is the ratio between the annual equivalent value of cash flows of income and the annual equivalent value of cost cash flows. The best alternative is the alternative that has the most considerable PI value. A project is feasible if it has a PI > 1 and the greater the value, the better the project has proposed (Sullivan et al., 2015)

$$\text{PI} = \frac{\text{NPV}}{\text{Intial Investment}}$$

Business units often have a minimum requirement for the feasibility analysis of an investment according to their perspectives (Daellenbach & Mcnickle, 2005). Based on the research by Rachadian et al., CV. XYZ does not have any information about investment on the minimum requirements for the feasibility analysis, so in this study, it is assumed that the project will be accepted if (1) the project period is less than the investment analysis period, (2) the profit value, B/C ratio must be >1, (3) value of the internal return of the investment exceeds predetermined interest percentage limit, and (4) the NPV of the project is more than 0 (Istiqomah and Sutopo, 2021).

d. Internal rate of Return (IRR)
IRR is the interest rate that causes a balance between the outcome and the income assuming that every result obtained is reinvested with the same ROR rate (Pujawan, 2015). IRR can be accepted as the maximum interest rate given before the company suffers a loss because the IRR will be calculated at the time of investment analysis NPV = 0 (Sullivan et al., 2015). The IRR method can be denoted by the following formula:

$$\text{IRR} = \text{i}_1 + \frac{(\text{i}_2 - \text{i}_1) \times \text{NPV}_1}{\text{NPV}_1 - \text{NPV}_2}$$

e. Break Event Point (BEP)
BEP is the point of production where the sales proceeds have the same value as the total cost required (Sullivan, 2015). In making a profit, the implemented project has to produce and distribute its product greater than or equal to the break-even amount. BEP can be denoted by the following formula:

$$EW_A = f_1(y)$$

Description:
EW_A = Equivalent Value ($PW_{inflow} - PW_{outflow}$)
y = Factors that affect the value of EW
In addition to obtaining factor points, the break-even point can also be mapped on a graph to determine the project's characteristic. It is helpful to see the interval at which one alternative is better than the other.

f. Sensitivity Analysis
The effect of the relations between critical parameters on several variables that have been tested on investment feasibility is the main objective of the sensitivity analysis (Daellenbach & Mcnickle, 2005; Rezzouk & Mellit, 2015; Sullivan et al., 2015). Sensitivity analysis is also used to explore what happens to the project's profitability when the estimated values of several research are varied (Sullivan et al., 2015).).

3. Methods

This article is the result of criticizing and refining the analysis of the article by Rachadian et al. (2013) entitled "Investment Feasibility Analysis of Adding New Milling Machines to CV. XYZ". This article refines and develops the previous article by paying attention to the attributes and parameters of a more comprehensive investment feasibility analysis. Using more complete data, calculation of income, taxes, depreciation expense, calculation of the inflation rate, and considering aspects of the relations of each key parameter on investment using sensitivity analysis. In this article, we examine the effect of the relation through sensitivity analysis on three key parameters: capital investment, annual cost, and MARR value. The sensitivity analysis carried out has a change value between -50% to 50%, which will obtain information on the relations between crucial parameters. In this article, we also conducted additional methods such as IRR and B/C ratio by considering the price changes factor to explore more realistic investment profitability. In addition, this article considers some data and information, such as assumed selling prices, machine maintenance costs, depreciation or taxes charged on the gross income. The assumption used in this research consists of comparing the selling price and the objectives of

CV. XYZ's stakeholders are not influenced by politics business, and there is no shift in CV XYZ. This article uses a flow chart to reference regular and structured work. The flow chart in this research can be depicted in the following Figure 1:

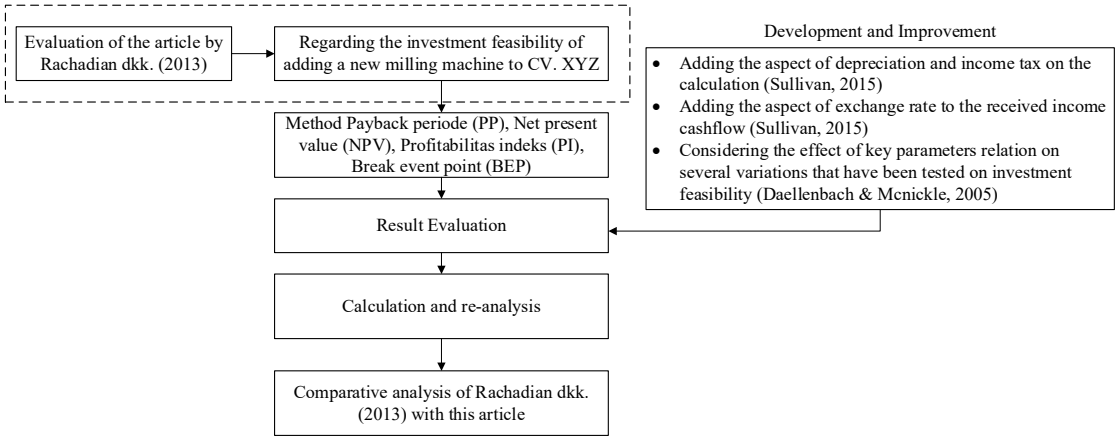


Fig 1. Research's Flow Chart

4. Data Collection

In developing and refining the previous article, several data on financial aspects are needed to support the recalculation and analysis process from previous research and other supporting sources. The following is the data used in the research: (Table 1)

Table 1. Assumptions Used

Assumption	**Value**		
	A	B	C
Product Selling Price	Rp. 20,000	Rp. 10,000	Rp. 15,000
MARR	15%		
PPh	*0.05% x Gross Income*		
Period	8 years		

Source: Rachadian et al., (2013)

In the research of Rachadian et al. (2013) had been done, they obtained some data on provisions such as investments made for eight years of 15% MARR value. There was no provision for taxes to be paid in the previous article, so we refer to PMK No.99/PMK.03/2018 as a taxpayer for MSMEs, which will be taken as the consideration in this article. In line with taxes, this article also assumes that the product's selling prices are divided into three selling price levels. In addition to using the assumption data, investment plan data and annual costs are described in Table 2.

Table 2. Investment Plan and Annual cost

Investments and Expenses	**Value (IDR)**	
	Alternative 1	Alternative2
Initial Investment	180,000,000	50,000,000
Depreciation	16,200,000	4,500,000
Property Taxes	300,000	300,000
Maintenance	8,000,000	8,000,000

Source: Rachadian et al., (2013)

The allocation of depreciation expense for an asset is obtained using the straight-line method. Income data obtained from previous research is the primary basis for determining the number of products produced. The explanation of data on the number of products and income CV. XYZ is described in Table 3.

Table 3. Product Amount and Annual Income

End of Year	Number of Products		Income (IDR)	
	Alternative1	Alternative 2	Alternative1	Alternative 2
1	5000	2000	100,000,000	50,000,000
2	6000	2750	120,000,000	60,000,000
3	7500	3000	150,000,000	75,000,000
4	6500	3500	130,000,000	65,000,000
5	7000	2250	140,000,000	70,000,000
6	7250	2500	145,000,000	72,500,000
7	8000	3000	160,000,000	80,000,000
8	6500	2500	130,000,000	65,000,000
9	5000	2000	100,000,000	50,000,000
10	5500	2250	110,000,000	55,000,000

Source: Rachadian et al., (2013)

In addition to using outcome and income flows, this article also uses Indonesia's inflation rate from 2016 to 2020 as the primary basis for considering price changes. The inflation value obtained is the actual value of the Rupiah, which supports Indonesia's economic growth data. Here is the value of Indonesia's inflation in the following Table 4:

Table 4. Indonesia's inflation rate

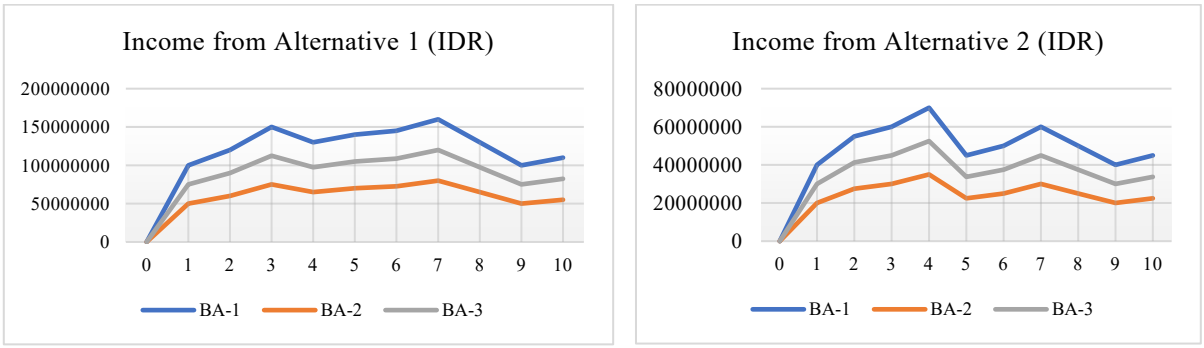
Indonesia's inflation growth rate	
Year	Inflation rate
2016	3.02%
2017	3.61%
2018	3.13%
2019	2.72%
2020	1.68%
Average	2.83%

Source: (BPS, 2021)

5. Results and Discussion

5.1. Estimated Income and Outcome

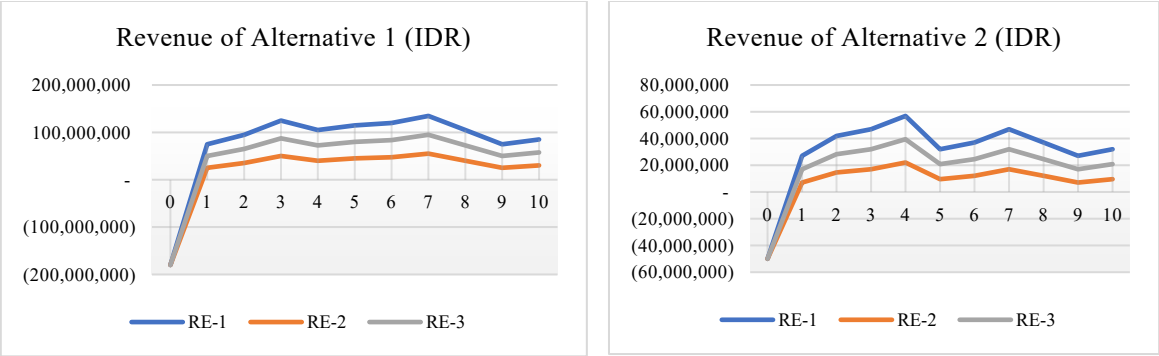
Gross income on the CV. XYZ is based on producing printing machines. The milling machine is used to produce printing machine frame component plates. The Milling Machine is a critical object that supports the production economy of CV. XYZ. However, the milling machine faces various waste and losses, so the business unit losses out. The company needs to improve to reduce waste and losses through investment in adding new milling machines (alternative 1) or replacing damaged components (alternative 2) within the next ten years. The reflection of gross income obtained using the assumption of a selling price can be described in Figure 2. The selling price assumption is based on anticipation of the level of price fluctuations, so it is necessary to calculate the income stream with the inflation/deflation rate on the feasibility of the proposed investment to get a realistic income stream.



(a) (b)

Fig 2. The estimated earnings of alternative 1 (a) and alternative 2 (b)

The outcome stream will reduce the income stream obtained in the graphic above. In this article, the outcome is stated in annual costs such as depreciation costs, machine maintenance costs, building land taxes, and income tax costs. The allocation of depreciation expense is obtained using the straight-line method. In addition, the income stream also considers the price change aspects to provide a more realistic income value in anticipating the impact of fluctuations in the value of the Rupiah. The results can be explained in Figure 3.



(a) (b)

Fig 3. The estimated earnings of alternative 1 (a) and alternative 2 (b)

5.2. Investment Feasibility Analysis

a. *Net Present Value Analysis*

The calculation of NPV is determined by discounting all future cash flows to the present value within a predetermined investment time limit. The calculation in this article uses 15% MARR and an average inflation rate (2016-2020) of 2.83%, which is used to consider the price changes factor to explore future investment profitability. The results of the calculation of the NPV value can be explained in Table 5.

Table 5. NPV Summary Investment Alternative

NPV (IDR)				**Eligibility Indicator**
Decision of Choice	A	B	C	
Alternative 1	275,281,589	(6,913,083)	134,184,253	> 0
Alternative 2	123,683,069	8,339,917	66,011,493	> 0

The investment will be accepted if it has a positive NPV value (NPV >0) and rejected if it is the opposite. Based on Table 5, there are only two price assumptions that are accepted from the NPV value of alternative 1. Meanwhile, all of the assumptions in alternative 2 have a positive NPV value. The calculations show that they are slightly different from the previous article by Rachadian et al. (2013) because this article calculates the value of deflation, taxes and considers the price changes factor based on the rate of inflation growth. The analysis obtained is more accurate because of minimizing the unrealistic constant price caused by the growth of the inflation rate. In

addition, the assumption of the selling price, which is based on anticipation of price fluctuations, also impacts the acquisition of the NPV value that occurs.

b. BC *Ratio*, Payback Period, and IRR

The maximum interest rate given before the company faced losses is the basis of the IRR. IRR It will cause a balance between the interest rate of outcome and the income of an investment. The same as the NPV value, the IRR of all alternatives with the assumption of selling costs is declared feasible (MARR > IRR), except for alternative 1, assumption two, which has an IRR value of 13.78%. The following is an IRR summary Table 6 of all available alternatives and assumptions:

Table 6. Investment Alternative IRR Summary

IRR				**Eligibility Indicator**
Decision of Choice	A	B	C	
Alternative 1	33.41%	13.78%	19.26%	> 15%
Alternative 2	37.50%	19.64%	20.35%	> 15%

In addition to the IRR calculation, the ratio between cash flow receipts and cash flow payments in present value is also calculated. The results of the acquisition of the B/C ratio are in line with the acquisition of the NPV and IRR values. We obtained the value of the B/C ratio that can be explained in Table 7.

Table 7. Investment Alternative B/C Ratio Summary

B/C Ratio				**Eligibility Indicator**
Decision of Choice	A	B	C	
Alternative 1	1.94	0.98	1.46	> 1
Alternative 2	2.14	1.08	1.61	> 1

Based on the analysis of financial projections using the IRR and B/C Ratio, Alternative 1 and Alternative two were chosen with the assumption of the best-selling price for calculating PP and PI. PP is the initial fee-back period. The faster the return, the more attractive the alternative is compared to other alternatives. PP and PI values obtained in alternative one assumption 1 (DC-1A) are 2.05 years and 1.53%. Meanwhile, the PP and PI values in alternative two assumptions 1 (DC 2-A) are 1.54 years and 2.47%. Both alternatives are eligible because they meet the PI value > 0 and the PP value < 10 years. From calculating the NPV B/C ratio, IRR, PI, and PP, it can be concluded that DC 2-A is superior to DC 1-A, so further BEP calculations will be carried out for DC 2-A.

c. *Break-Even Point* (BEP)

In order to obtain optimal profit, the implemented project must produce and distribute its product greater than or equal to the break-even amount. Further information regarding the break-even amount that the milling machine must produce can be explained in the BEP summary table of the number of plates produced for all available alternatives. (Table 8)

Table 8. Investment All Alternatives Break-Even Point (BEP) Summary

BEP (Unit)			
Decision of Choice	A	B	C
Alternative 1	11189.32	30681.82	16199.04
Alternative 2	3349.16	9442.06	5023.04

In order that the business unit does not suffer losses, CV. XYZ must determine the target production in the first year. The plate production target for alternative DC 2-A can be described in Figure 4. The relations between related variables will be explained based on the figure, such as fixed cost, variable cost, revenue, and BEP DC 2-A.

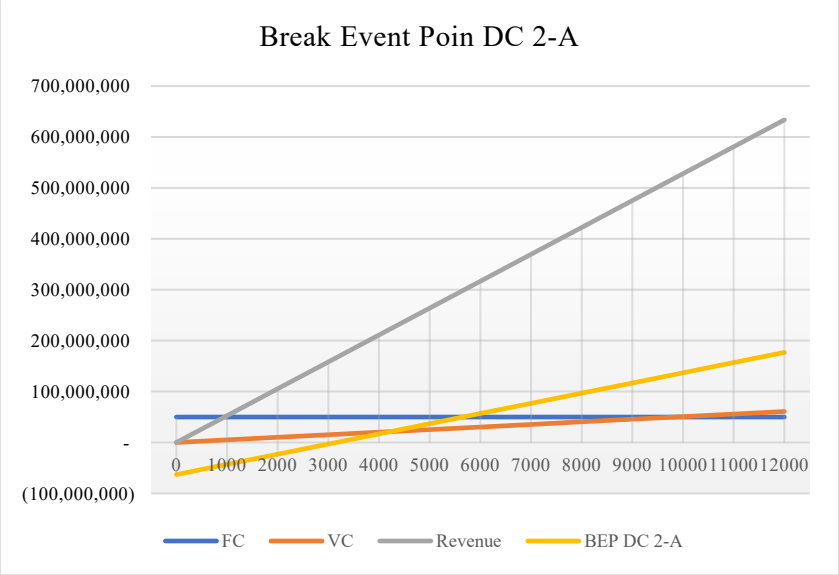


Fig 4. Break-Even Point (BEP) DC 2-A

d. Improvement Proposal

The calculation of the articles that we propose differs from the previous article by Rachadian et al. (2013). This article pays attention to the attributes and parameters of a more comprehensive investment feasibility analysis. The following is a summary table of the comparison results between the previous article by Rachadian et al. (2013) with the proposals that we provide, which can be explained in Table 9.

Table 9. Summary of comparative analysis between the previous article and the proposed article

Aspect	(Rachadian et al., 2013)	Proposal
Net Present Value (NPV)	Rp 211,227,000	Rp 123,683,069
Payback Period (PP)	1 year 4 month(s)	1 year 6 month(s)
Profitability Index (PI)	4.2	2.47
Internal Rate of Return (IRR)	-	16.62%
Benefit Cost Ratio (BCR)	-	2.44
Inflation Rate (2016-2020)	-	2.83%

e. Validation

This article validates the sensitivity analysis stage shown in Table 10. Sensitivity analysis will show the effect on the investment's characteristics to be made to determine the effect of the decision on changes in the variables that have been used. Several variables will be discussed in sensitivity analysis in this article, such as Capital Investment, Annual Cost, and MARR

Table 10. Spider Plot for DC 2-A Sensitivity Analysis

% Change in Factor	Capital Investment	Annual Cost	MARR
-50%	34,033,628	(20,483,186)	34,109,291
-40%	29,033,628	(14,579,823)	27,878,292
-30%	24,033,628	(8,676,461)	22,343,437
-20%	19,033,628	(2,773,098)	17,409,285
-10%	14,033,628	3,130,265	12,995,378
0%	9,033,628	9,033,628	9,033,628
10%	4,033,628	14,936,990	5,466,213
20%	(966,372)	20,840,353	2,243,857
30%	(5,966,372)	26,743,716	(675,582)
40%	(10,966,372)	32,647,079	(3,328,257)
50%	(15,966,372)	38,550,441	(5,745,290)

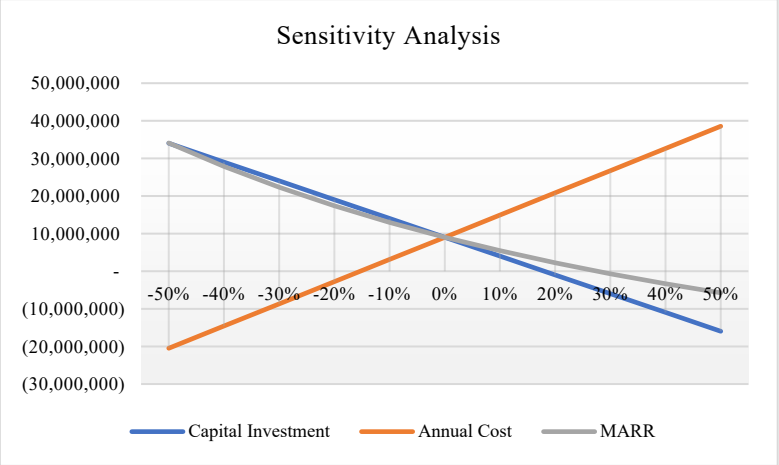


Fig 5. Break-Even Point (BEP) DC 2-A Alternative

In the Spider Plot graphic, the Sensitivity Analysis shows the effect of changing the variable's value on the amount of the DC 2-A production target. The Capital Investment variable is directly proportional to the return value of MARR. The value of Capital Investment will decrease if the value of MARR returns decreases if it is the opposite. Meanwhile, the annual cost value is inversely proportional to the Capital Investment and MARR. If the company wants to increase the cash flow value, it must minimize the MARR or Capital Investment results. The DC-2A production target value is the most sensitive to changes in annual costs (Figure 5). If the business unit adds 20% annual cost, the business unit will lose much money. Sensitivity Analysis will show the effect on the investment's characteristics. The company can find out the range of additions and subtractions of the three variables before the project declared is not eligible or does not generate profits.

6. Conclusion

The feasibility of investment can be used as a proposal for a new alternative that can provide benefits for the company. Based on the analysis of the investment feasibility by adding a new milling machine of replacing damaged engine components on the proposed CV. XYZ, it can be concluded that:

1. The Analysis carried out has the same results as the previous article by Rachadian et al. (2013), the second alternative. The second alternative that has been chosen is DC 2-A which has an assumption of Rp. 20,000/plate selling price. It is obtained based on the calculated value of NPV DC 2-A is Rp. 123,683,069 (NPV>0), the IRR value is 37.5% (IRR>MARR), the B/C ratio value is 2.14 (B/C Ratio >0), the PP value

is one year six month(s) (PP<10 years), and the PP value if one year six month(s) (PP<10 years). PI is 2.47 (PI>1). The values of the various calculations are considered feasible because they have reached the specified requirements. The calculation of this article is slightly different from the previous article because it pays attention to the attributes and parameters of a more comprehensive investment feasibility analysis. Using more complete data, calculation of income, taxes, depreciation expense, calculation of the inflation rate, and considering aspects of the relations of each key parameter on investment using sensitivity analysis. In addition, there is an assumption of selling price to anticipate the fluctuation of the plate selling price in the future.

2. The business unit does not face any suffering loss if the plate production target for alternative DC 2-A in the first year is 3350 units. If the company wants to increase profits, it must increase the number of plate production, for fixed costs and variable costs have a constant value to the amount of plate production.
3. The relations between Capital Investment, Annual Cost, and MARR value to the number of plate production. The alternative production value of DC-2A is the most sensitive to changes in annual cost. If the business unit adds an annual cost of 20%, the business unit will lose out. Meanwhile, the alternative production value of DC-2A has a more negligible effect on increasing and decreasing Capital Investment and MARR value.

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