

Analysis Of Investment Feasibility In A Water Lost Control Program: Study Case Regional Owned Enterprise

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Abstract

This study aims to analyze the financial feasibility of each water loss control program at PERUMDA Tirta Pakuan Bogor City as a solution in reducing the water loss. This feasibility study was conducted by calculating the NPV, Net B/C Ratio, IRR, and Payback Period for three different Scenarios, which are: (i) 100% equity, (ii) 75% equity and 25% debt, and (iii) 50% equity and 50% debt. According to the calculation, the best investment scenario being selected is the one with the highest NPV, that is Scenario 3. Not only this is supported by the value of IRR that is higher than the WACC ($19.05\% > 17.15\%$), it also has the highest Net B/C Ratio. The sensitivity analysis also shows that the interest rate and proportion of loan do not have significant effects on the NPV obtained. At the same level of interest rate, the NPV obtained will be higher if the proportion of debt submitted is larger. However, for the same portion of the loan, the losses occurring will only appear if there is a change in interest rates of more than 600%.

Keywords: Feasibility study, maintenance investment, non-revenue water

INTRODUCTION

Clean and healthy water are one of the most important aspects for supporting human's daily activities. That is why, water utility services become very important in Indonesia. According to Minister for Public Works and Human Settlements (2018), NonRevenue Water (NRW) has now been the most critical problem in clean water services management or piped drinking water (Perusahaan Air Minum, or abbreviated as PAM). The rate of NRW in Indonesia ranges between 20-70% with the national average of 37% (Directorate General of Human Settlements, 2013). Even globally, referring to Farley et al. (2008), NRW volume reaches 32 billion m³ caused by leakages from distribution pipes, each year. Also, the non-billed water caused by embezzlements, bad metering, and corruptions, reaches 16 billion m³.

NRW is not an issue that only occurs in Indonesia, but almost in the whole world. International Water Associations (IWA), the organization handling water loss, stated that water loss has become an important issue in the 21st century (citation). In Indonesia, the average of NRW is still considered to be quite high that is 33,16%. Water loss is unavoidable, but manageable or able to be reduced. For drinking water company, water loss really affects its revenue. Local Water Company (PDAM) as one of the companies should be able to manage the

NRW, and this should be done for the long term and with sustainable concern. The earlier the water loss control program is implemented and conducted, the earlier its revenue can be saved (El-Ahmady & Sembiring, 2014).

PERUMDA Tirta Pakuan Bogor City, is responsible for water distribution in Bogor City Area. In 2018, its services reached 91,44% out of the target which was 91,6%. Its profit grew dynamically from 2015 to 2019, and in 2019, the total profit obtained was IDR 42.130.975.952,10. This profit can be able to grow more if NRW problem is resolved. Some alternatives to the NRW control program are replacement of distribution pipes, installation of District Meter Area (DMA), replacement of master meter, and replacement of water meter and terameter.

Since the NRW or water loss control project must be conducted, investment should be assessed to give sufficient financing to make sure that the project will not harm the company's financial stability. This project investment should be analyzed by using the capital budgeting theory, which consists of Scenarios and Sensitivity analysis. The Scenarios analysis consists of three different schemes of capitals, which are: (i) 100% Equity, (ii) 75% Equity, 25% Debt, and (iii) 50% Equity, 50% Debt. The analyses will give the best scenario with the most feasibility parameters to conduct the investment.

METHOD

This study targets PERUMDA Tirta Pakuan Kota Bogor as an object in analyzing the financial feasibility and water loss control program alternatives. The company now holds seven water source zones as seen in Table 1. This research will focus in Zone 1, MA Tangkil, which is one of zone built in 1974, which is one of the oldest sources and also having the biggest water loss in PERUMDA Tirta Pakuan Kota Bogor.

Table 1: PERUMDA Tirta Pakuan Water Source Zones

No.	Zones	Capacity (Litre/second)	Services Area
1.	MA Tangkil	113,91	Part of South Bogor District
	IPA Cikereteg	36,08	Part of East Bogor District
2.	Mata Air Bantar Kambing	155,72	Part of South Bogor District
3.	IPA Cipaku	274,56	Part of Central and West Bogor District Kecamatan
4.	IPA Dekeng	1.608,05	Part of Tanah Sareal District, Bogor (North, West, Central)
5.	Mata Air Palasari	13,54	Part of South Bogor District
	IPA Palasari	18,45	Part of South Bogor District
6.	Mata Air Kota Batu	67,26	Part of South and West Bogor Districts
7.	IPA Katulampa	300	Part of East and North Bogor District

IPA: (Water Treatment Plants/*Instalasi Pengolahan Air*)

Data in this research is secondary data in nature, obtained from the company reports. The supporting primary data obtained is from interviews with the Engineering Director, Engineering Planning and Supervision Manager, Production Manager, NRW & Transit Manager, and Manager of Public Relation and Customer Services. The summary of data can be seen in Table 2.

Table 2: Data Sources and Collections

Data Type	Data Source	Collections
Main Data		
Company Cashflows Report	PERUMDA Tirta Pakuan Bogor City	Interviews and Reports
Company Income Statement		
Company Equity Report		
Water Loss Report		
Supporting Data		
Literature Study	Central Bureau of Statistics	
Global Water Loss Rate		

Quantitative study was done for this research by analyzing the pipe replacement project. Cashflow analysis is included to obtain the investment feasibility criteria which are Net Present Value (NPV), Internal Rate of Return (IRR), Net Benefit Cost Ratio (Net B/C Ratio), and Payback Period (PP). The analysis is done for a 10-year projection from 2021 to 2031, using Microsoft Excel, with the formula of:

Net Present Value

$$NPV = \sum_{t=0}^n \frac{B_t - C_t}{(1+i)_t}$$

(Kadariah *et al.* 1999 in Nurmalina *et al.* 2009)

For:

- B_t = Benefit In Year-T
- C_t = Gross Cost In Year-T
- n = Age of Business
- t = Year
- i = Discount Rate

Net B/C Ratio

$$Net \frac{B}{C} = \sum_{n=0/1}^n \frac{\frac{B_t - C_t}{(1+i)_t}}{\frac{B_t - C_t}{(1+i)_t}}$$

For :

- B_i = Yearly Benefit
- C_t = Yearly Cost
- n = Total Year
- i = Discount Rate

Internal Rate of Return

$$IRR = i_1 + \frac{NPV_1}{NPV_1 - NPV_2} \times (i_2 - i_1)$$

For :

- i₁ = Discount Rate with Positive NPV (NPV₁)
- i₂ = Discount Rate with Negative NPV (NPV₂)

Payback Period

$$\text{Payback Period} = \frac{I}{Ab}$$

For I = Investment, and Ab = Profit.

The first analysis will be conducted by employing scenario analysis. It consists of three different capital structures, which are: (i) 1st scenario -- 100% Equity as capital, (ii) 2nd scenario -- 75% Equity and 25% Debt, and (iii) 3rd scenario -- 50% Equity and 50% Debt as capital.

Scenario Analysis is followed by Sensitivity Analysis for the best scenario obtained. The aim of sensitivity analysis is to identify how sensitive a decision for particular project is affected by its variables. This analysis is important due to the uncertainty of economic condition that may affect the investment for the project. The variables analyzed are the factors which considered significant to the invested project (Karanivic, 2010).

RESULTS AND DISCUSSION

The first step of this research was data collection, sourced from the company reports. The first step for calculating cashflow is the projection for the number of customers. The growth rate of the customers from 2015 to 2019 can be seen in Table 3.

Table 3 : Number of Customers

No.	Year	Number of Customers	Growth Rate
1.	2015	139.412	3,4%
2	2016	147.094	1,3%
3.	2017	154.132	1,1%
4.	2018	159.290	0,8%
5.	2019	262.985	1,3%
Average			1,58%

Source: PERUMDA Tirta Pakuan Bogor, 2020

From Table 3, the average growth rate of 1,58% is then used for calculating the projection of the numbers of customers in 2020 and the following years. As for the production and distribution of water in 2019, the data from the company report can be seen in Table 4.

Table 4 : Production vs Distribution of Water

No.	Zone	Volume (m ³)	
		Production	Distributed
1.	MA Tangkil	1.139.120	759.414
	IPA Cikereteg	360.821	240.548
2.	IPA Bantar Kambing	1.557.299	1.038.200
3.	IPA Cipaku	2.745.600	2.654.080
4.	IPA Dekeng	16.080.581	10.720.388
5	MA Palasari	135.429	90.286
	IPA Palasari	184.582	123.055
6.	MA Kota Batu	672.611	448.408
7.	IPA Katulampa	30.071	20.048
Total		25.875.789	17.250.526

Source: PERUMDA Tirta Pakuan Bogor, 2020

From Table 4 it is known that with 25.875.789 m³ water produced, only 17.250.526 m³ was distributed to customers. The difference of the water produced and distributed was considered as NRW, and the rate of the NRW is calculated by:

$$\%NRW = \frac{\text{Water Produced} - \text{Water Distributed}}{\text{Water Produced}} \times 100\%$$

$$\%NRW = \frac{25.875.789 - 17.250.526}{25.875.789} \times 100\% = 33\%$$

The Full Cost Recovery in the company can be seen in Table 5. The table shows that NRW causes the difference between the real production of cost of the water, as applied presently and if calculated with the NRW.

Table 5 : Full Cost Recovery PERUMDA Tirta Pakuan

No.	Details	Amount
1.	Revenue from Water in 2019	IDR 275.546.803.271
2	Operational Expenses in 2019	IDR 242.501.284.503
3.	Revenue Water in 2019	40.188.708 m ³
4.	Water Produced in 2019	75.297.322 m ³
5.	Average Price of Water per m ³	IDR 6.856,32
6	Average Cost of Water per m ³	IDR 4.025,73
7.	Difference of Average Price and Cost per m ³	IDR 2.830,60
8.	Average Price/Average Cost per m ³	IDR 170,31
9.	Average Cost of Water with Real NRW of 33% per m ³	IDR 4.736,15

Source: PERUMDA Tirta Pakuan Bogor, 2020

By assuming that the cost of production and revenue increases 3% each year, the comparison between the profit from water using the average cost of water with real NRW, and current average cost can be seen in Table 6, the projection of profit can be seen in Figure 1.

Table 6: Comparison between Current Profit and Real Profit (NRW Calculated)

Year	Consumption	Current Average Water Price	Current Average Water Cost	Real Average Water Price with NRW	Current Profit	Real Profit with NRW
	(m ³ /Year)	(IDR/m ³)	(IDR/m ³)	(IDR/m ³)	(IDR)	(IDR)
2021	42.573.798	7.273,87	5.024,58	4.270,90	93.275.072.655	124.529.395.241
2022	43.767.343	7.492,09	5.175,32	4.399,02	97.591.283.368	130.291.868.476
2023	44.960.888	7.716,85	5.330,58	4.530,99	102.107.222.414	136.320.994.398
2024	46.154.433	7.948,35	5.490,50	4.666,92	106.832.132.024	142.629.112.093
2025	47.347.978	8.186,80	5.655,21	4.806,93	111.775.682.101	149.229.131.626
2026	48.541.523	8.432,41	5.824,87	4.951,14	116.947.990.015	156.134.560.463
2027	49.735.068	8.685,38	5.999,61	5.099,67	122.359.641.305	163.359.531.114
2028	50.928.613	8.945,94	6.179,60	5.252,66	128.021.711.347	170.918.830.056
2029	52.122.158	9.214,32	6.364,99	5.410,24	133.945.788.017	178.827.927.998
2030	53.685.823	9.490,75	6.555,94	5.572,55	140.143.995.412	187.103.011.539
2031	55.296.397	9.775,47	6.752,62	5.739,73	146.629.018.656	195.761.016.295

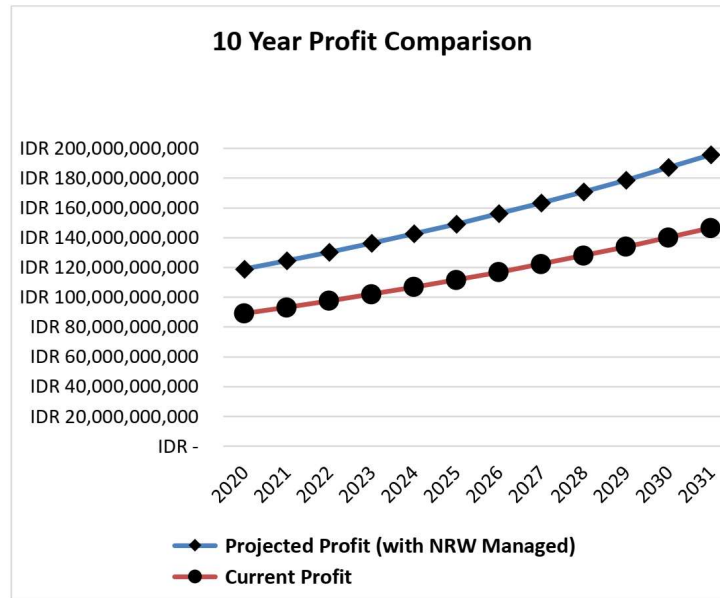


Figure 1: 10 Year Projected Profit Comparison

Table 6 projects that the NRW is overcome in 2022, in when the replacement project will be finished. The recapitulation of the needed replacements investment was obtained, and can be seen in Table 7.

Table 7: Recapitulation of Replacement Project Budget

Details	Unit	Amount	Price per Unit (IDR)	Total Price (IDR)
1. Distribution Pipe Maintenance				
12" Diameter Pipe	Unit	154	3.776.400	581.565.600
16" Diameter Pipe	Unit	536	6.111.700	3.275.871.200
18" Diameter Pipe	Unit	33	7.747.100	255.654.300
20" Diameter Pipe	Unit	422	9.567.700	4.037.569.400
28" Diameter Pipe	Unit	1130	18.628.200	21.049.866.000
36" Diameter Pipe	Unit	105	22.357.650	2.347.553.250
40" Diameter Pipe	Unit	780	32.075.850	25.019.163.000
Saddle Pipe Accessories Replacement	Unit	240	72.000	17.280.000
Valve Pipe Accessories Replacement	Unit	90	3.550.000	319.500.000
Pressure Reducing Valve (PRV) Double Pilot	Unit	30	25.000.000	750.000.000
Pressure Reducing Valve (PRV) Controller	Unit	30	150.000.000	4.500.000.000
Leak Detection (Step Test)	Times	30	650.000	19.500.000
Crain, Capacity: 5 Ton	Unit	30	5.000.000	150.000.000
DMA Procurement	Unit	40	4.125.545	165.021.800
DMA installation	Unit	40	2.394.049.55	95.761.982
Water Meter Replacement	Unit	373	385.000	143.605.000
Heavy Field Cleaning	m ²	480	16.000	7.680.000
Soil Excavation	m ²	720	78.000	56.160.000
Pipe Cutting	meter	360	180.000	64.800.000
Soil Backfill With Material Compaction	m ²	6000	35.000	210.000.000
2. Wages	Persons	240	3.200.000	768.000.000
3. Utilities				
Electricity	Unit	1		125.000.000
Weighbridge 30 Tons (Set)	Unit	1		330.000.000
Electrical Installation	Unit	1		120.000.000
4. Land Transportation				
Pick Up Truck	Unit	1		75.000.000
			Total Investment (IDR)	64.484.551.532

The investment is then modeled using three scenarios, employing flat annual rate of 8,85% (BJB, 2021), total Levered Beta of 3,14 (NYU Stern, 2021), and Risk-Free Rate of 10Y Yield of 6,44% (CNBC Indonesia, 2021). The weighted average cost of capital was firstly calculated and obtained in Table 8.

The financial scenario including debt will be a 5-year financing from Bank, and the 1st installment will be paid from the 0th year (2021). The investment financing is projected to start on August 2021, with the project conducted starting in January 2022. The inflation assumed was 3±1% (BI, 2019), and the growth of income will be 3% referring to the target of inflation related to numbers of customers. The tax used in the analysis was 18% referring to the company report.

Table 8: Weighted Average Cost of Capital Calculation

Assumption for Cost of Capital	Scenario 1		Scenario 2		Scenario 3	
Cost of Debt	0,00%		8,85%		8,85%	
Tax	18%		18%		18%	
Debt & Equivalent	Rp	-	Rp	16.121.137.883,00	Rp	32.242.275.766,00
Debt Proportion	0%		25%		50%	
Debt after Taxes	0,00%		7,26%		7,26%	
Risk Free Rate	6,44%		6,44%		6,44%	
Beta	3,14		3,14		3,14	
ERP	6,56%		6,56%		6,56%	
Equity Proportion	100%		75%		50%	
Cost of Equity	27,04%		27,04%		27,04%	
Debt						
Cash Equivalents	Rp	0	Rp	16.121.137.883,00	Rp	32.242.275.766,00
Long Term Debt	Rp	0	Rp	19.500.000.000,00	Rp	39.000.000.000,00
Net Debt	Rp	0	Rp	3.378.862.117,00	Rp	6.757.724.234,00

	Weight	Cost	Weight	Cost	Weight	Cost
Loan	0%	0,00%	25%	7,26%	50%	7,26%
Equity	100%	27,04%	75%	27,04%	50%	27,04%
WACC		27,04%		22,09%		17,15%

Since the project is a replacement project, the cashflow analyzed is the incremental cashflow; the difference is if the project being conducted (proposed replacement) and with the current situation. The comparison between three scenarios' incremental cashflows can be seen in Table 9, and the NPV comparison between the three scenarios can be seen in Table 10.

Table 9 shows the results for the first scenario that with 27,04% WACC, it gives NPV of IDR 45 billion, with NET B/C Ratio of 1,68 and 15,61% IRR in 3,22 years of Payback Period. This gives unfeasible investment scenario since the $IRR < WACC$. For the 2nd scenario ($WACC = 22,09\%$) with NPV of IDR 55 billion, the Net B/C Ratio 1,85%, the IRR is 17,19% with 3,48 years of Payback Period. It still generates IRR that is lower than the WACC. Accordingly, the 3rd scenario gives the best investment plan, with 17,15% WACC resulting in the biggest NPV (IDR 71 billion) and Net B/C Ratio of 2,11. The Internal Rate of Return is 19,04%, which is higher than the WACC, and the Payback Period is 3,80 Years.

Referring to Nicoleta (2017), traditionally, capital structure counts on book leverage, which means the ratio of the debt and total assets, in which capital cost can be defined as opportunity cost. In order to make a feasible capital budget, the return of investment should be at least the same with other profitability alternatives of investment with the same risk. In addition, Arulvel (2013) stated that the Debt/Equity ratio gives positive correlation in gross profit obtained. This is accordance with static trade-off theory, referring to Visinescu (2009), stating that the use of debt will give tax shield, in which company pays less taxes than the company that does not have debt in their capitals. Ahmeti and Prenaj (2015) in their review of Modigliani and Miler (MM) theorem states that the debt in a company will give higher market value than the company that does not own any debt.

Table 9: Incremental Cashflow Comparison in IDR

Year	Operating Cash Inflows		Scenario 1		Scenario 2		Scenario 3	
	Present	Proposed	Incremental	Proposed	Incremental	Proposed	Incremental	
0	-	(64.484.551.532,00)	(64.484.551.532,00)	(64.484.551.532,00)	(64.484.551.532,00)	(64.484.551.532,00)	(64.484.551.532,00)	
1	80.222.852.361,39	108.461.479.760,42	28.238.627.399,04	105.263.479.760,42	25.040.627.399,04	102.065.479.760,42	21.842.627.399,04	
2	83.925.922.379,56	113.405.363.016,36	29.479.440.636,80	110.207.363.016,36	26.281.440.636,80	107.009.363.016,36	23.083.440.636,80	
3	87.800.348.259,75	118.578.019.526,08	30.777.671.266,33	115.380.019.526,08	27.579.671.266,33	112.182.019.526,08	24.381.671.266,33	
4	91.854.059.323,12	123.990.035.543,13	32.135.976.220,01	120.792.035.543,13	28.937.976.220,01	117.594.035.543,13	25.739.976.220,01	
5	96.095.351.812,24	129.652.487.189,35	33.557.135.377,11	129.652.487.189,35	33.557.135.377,11	129.626.638.289,35	33.531.286.477,11	
6	100.532.905.870,00	135.551.114.223,05	35.018.208.353,05	135.551.114.223,05	35.018.208.353,05	135.551.114.223,05	35.018.208.353,05	
7	105.175.803.304,23	141.749.739.356,11	36.573.936.051,88	141.749.739.356,11	36.573.936.051,88	141.749.739.356,11	36.573.936.051,88	
8	110.033.546.174,33	148.235.199.668,57	38.201.653.494,24	148.235.199.668,57	38.201.653.494,24	148.235.199.668,57	38.201.653.494,24	
9	115.116.076.238,00	155.020.768.171,53	39.904.691.933,54	155.020.768.171,53	39.904.691.933,54	155.020.768.171,53	39.904.691.933,54	
10	120.433.795.297,84	170.683.409.827,40	50.249.614.529,57	170.683.409.827,40	50.249.614.529,57	170.683.409.827,40	50.249.614.529,57	

Table 10: NPV Comparison in IDR

Year	Scenario 1			Scenario 2			Scenario 3		
	Incremental	PVIF	PV	Incremental	PVIF	PV	Incremental	PVIF	PV
0	(64.484.551.532,00)	1,00	(64.484.551.532,00)	(64.484.551.532,00)	1,00	(64.484.551.532,00)	(64.484.551.532,00)	1,00	(64.484.551.532,00)
1	28.238.627.399,04	0,79	22.228.418.650,61	25.040.627.399,04	0,82	20.509.461.758,09	21.842.627.399,04	0,85	18.645.374.513,57
2	29.479.440.636,80	0,62	18.266.242.037,01	26.281.440.636,80	0,67	17.630.607.691,06	23.083.440.636,80	0,73	16.820.271.791,90
3	30.777.671.266,33	0,49	15.011.728.825,57	27.579.671.266,33	0,55	15.153.615.254,71	24.381.671.266,33	0,62	15.165.689.929,21
4	32.135.976.220,01	0,38	12.338.189.493,36	28.937.976.220,01	0,45	13.022.800.381,94	25.739.976.220,01	0,53	13.666.996.269,40
5	33.557.135.377,11	0,30	10.141.677.666,68	33.557.135.377,11	0,37	12.368.873.992,13	33.531.286.477,11	0,45	15.197.823.070,75
6	35.018.208.353,05	0,24	8.330.744.792,39	35.018.208.353,05	0,30	10.571.783.597,81	35.018.208.353,05	0,39	13.548.503.384,92
7	36.573.936.051,88	0,19	6.848.990.972,79	36.573.936.051,88	0,25	9.043.469.964,02	36.573.936.051,88	0,33	12.079.121.136,10
8	38.201.653.494,24	0,15	5.631.214.082,35	38.201.653.494,24	0,20	7.736.679.700,13	38.201.653.494,24	0,28	10.769.908.908,88
9	39.904.691.933,54	0,12	4.630.296.739,02	39.904.691.933,54	0,17	6.619.199.576,45	39.904.691.933,54	0,24	9.603.290.468,56
10	50.249.614.529,57	0,09	4.589.681.841,66	50.249.614.529,57	0,14	6.826.896.284,35	50.249.614.529,57	0,21	10.322.741.950,27
	NPV		43.532.633.569,44	NPV		54.998.836.668,68	NPV		71.335.169.891,56

The sensitivity analysis is then done using the interest rate of 8,85% from Scenario 3 as the lowest rate, with the interval of 5% up to 10 (68,65%) repetitions and debt proportion starting from 10% to 100%. Sensitivity analysis shows that the higher debt portion in the same interest rate, will give higher NPV. On the other hand, with the same debt portion, the higher interest rate will result in lower NPV. The result of sensitivity analysis can be seen in Table 11.

In the same debt portion as Scenario 3, which is 50%, NPV will be almost 0 in the rate of 58,5% and the company will experience loss in the interest rate of 63,85%. This shows that in the same debt portion, only if the interest rate reaches 621,46%, the company will get losses. This amount of difference states that the interest rate in the same debt portion gives no significant result.

The biggest NPV will be gained if the company proposes 100% debt, in which only at 48,85% of interest rate will make the company experience losses. This gives 452% change in interest rate, which can be avoided if the company proposes debt with flat rate interest to the bank.

CONCLUSION

The amount of NRW which reached 33% in PERUMDA Tirta Pakuan can be managed by conducting maintenance for the facility and repairing the water distributions, where the project will need investment in the amount of IDR 64.484.551.532. The investment then was brought into three capital structure scenarios with equity portion of each respectively 100%, 75%, and 50%. The best scenario yet is the 50:50 equity and debt ratio, resulting in 19,05% IRR > 17,15% WACC. The interest rate will not give significant effect until it reaches 600% of change with the same portion of loan. In the same interest rate, 100% portion of

debt will give the biggest NPV to the company. Yet, the decision shall be up to the stakeholders, making sure that the project will align with their financial structure. reason the company is expected to pay more attention to these four factors to improve efficiency in the future.

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