COST REDUCTION STRATEGY IN DISTRIBUTION PIPELINE IN PERSPECTIVE OF CAPITAL BUDGETING A CASE STUDY IN AREA "C" GREENLAND INTERNATIONAL INDUSTRIAL CENTER (GIIC)

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ABSTRACT

*The oil and gas sector in Indonesia has become a solid pillar for the country's economy. Revenues from the oil and gas sector have provided more than 15% of the average income for the Indonesian government. However, the contribution of the oil and gas sector to state revenues has decreased significantly, from 14.11% in 2014 to 4.46% in 2015. Due to the downward trend, companies engaged in the sector must struggled to survive. The most common problem faced by companies in this field were the lack of resources and also the increasing costs of development and management of infrastructure. PT Perusahaan Gas Negara ("GAS") which was engaged in natural gas distribution business and became a subsidiary of oil and gas state-owned company was also affected by the condition. GAS revenue began to decline in 2015, which previously stood at USD 2,896 million in 2014, down to USD 2,571 million in 2015, followed by a decline to USD 2,499 million in 2016. In 2016, at the time where companies were tried to optimize their costs of development and management of infrastructure, options were raised for GAS whether to install steel, polyethylene, or polyamide pipeline system for the future project. The purpose of this study is to analyze and decide which option generates the most cost efficiency for the GAS on the project located in specific area of Greenland International Industrial Center ("**GIIC**") West Java using the primary data that were collected in year 2017. Capital Budgeting Model indicators: Payback Period, Return on Investment (ROI), Net Present Value (NPV), Profitability Index, Discounted Payback Period, and Internal Rate of Return (IRR) were used to analyze the data. The findings showed that polyethylene pipeline system was the most cost efficiency option. The authors believe that the findings will be beneficial to be implemented in the other projects.*

Keywords: cost reduction, distribution pipeline, Greenland International Industrial Center (GIIC).

INTRODUCTION

Oil and gas sector in Indonesia became the strong pillar for the economy of the country, before the fall of the oil prices in 2013 the oil and gas sector generated USD 28 billion a year in foreign income. This income from oil and gas sector provided more than 15% in average of the revenue for the government and supported for 280.000 job in this country. However, since 2015 the oil and gas sector's contribution to the country revenues decreased significantly along with the decline in reserves and production. Thus, revenue from the oil and gas industry decreased by almost 80% from Rp 216 trillion in 2014 (14% of state revenues) to Rp 78.2 trillion in 2015 (4.46% of state revenues) and to Rp 44 trillion in 2016 (2.8% of state revenues), before rising oil prices improved the contribution of the oil and gas sector in 2017.

The Government set a moderate target of 4.2% for 2018 target contribution from oil and gas sector which showed that the government did not seem to be optimistic with the oil and gas industry for this year. The Government projected a return to a growth rate of 5.2% and begun to release a series of economic stimulus packages to support the goal. If the Government followed through on its commitment to accelerate infrastructure spending, particularly on the 35,000 MW project, we could expect the domestic economy to recover, and this could drive demand for energy, including natural gas.

Regarding the Indonesian oil and gas condition, many companies who were engaged in that field were struggling to survive. Most problem faced by companies were the decrease of resources and also high operational cost. Many company sent their employees off to reduce cost because it was the only way that they could thought. Most of the company did not try to find the root cause for having those problems. One of the example of companies miss action was executing capital expenditure project without detail consideration of next operation phase such as improper material selection in term of easiness on operation and maintenance. Improper material selection for operational purpose during the project might not be a problem, but in the future, it will. Haven't realized what was going, companies have already created problems in the early stage of the asset life cycle. The problems, in the future after project finished, drove company to spend more expense than normally the company should be, and it also means unnecessary expenses spent by company.

The study conducted at one of the gas company in Indonesia located at the area of GIIC. GIIC was chosen because there were many construction project occurred and improper material selection during project phase case was found (Database Industrial Estates, 2016). Improper material selection caused operational expenses incurred were higher. Our discussion were limited to one of the gas company in Indonesia which was GAS. Not all GAS field area were discussed in this study. The study were limited to GAS area in GIIC located in Cikarang, West Java. The problem we highlighted was about inefficiency of facility system that were already installed in the GIIC due to improper material selection during project phase. Our focus was to install new system application using another alternative material which cause the improvement in term of cost efficiency. Comparation of cost effectiveness between existing and our proposed idea were provided.

LITERATURE REVIEW

NATURAL GAS TRANSPORTATION SYSTEM

Pipeline system was one of the transportation mode to deliver gas from source to energy users. Gas pipelines were an integral part of how the business works in GAS (Annual Report, 2016). Gas transportation was the activity of transporting natural gas owned by shipper from receiving points in the form of a gas field or other source to the delivery point through a high-pressure transmission pipelines. GAS operated transmission pipelines to deliver gas owned by shipper and to get benefits in the form of toll fees. Distribution business segment was the activity of distribution and sale of natural gas to end users such as Power Plants, Commercials, Industries, and Households by using variety of modes, both pipeline and non-pipeline. In developing distribution network, GAS used pipe material made from steel or thermoplastic. Material used in the gas pipeline was one of the important factor that could affect cost incurred.

GAS PIPELINE MATERIAL

Gas Pipeline was a conduit made from pipes connected end-to-end for long-distance gas transport. Various materials were used to make gas pipelines for decades, such as metal pipe and non-metal pipe material. Currently, both steel and thermoplastic materials were used for natural gas distribution pipeline. Material for gas pipeline had to be able to maintain the structure of the pipe under certain environmental conditions, chemically in accordance with the fluid being distributed, and meet the requirements according to the application. Different materials resulted in a different operational cost, and the cost in some cases could be slightly different. Thus material selection on the design phase of the project became crucial since it would affect cost to be incurred by the company in the operational phase.

Nowadays, there was one family of thermoplastic materials, namely the Polyamide (PA) materials. Steel had a long history in gas installation and it was still the only option for real high-pressure gas transportation at 50 bar or higher (American Society for Testing and Material, 2012). Steels were the material of choice when fabricating pipes for the economic transmission of natural gas from remote regions to populated areas where the fuels were exploited in the generation of energy. The American Petroleum Institute (API) provided standards for pipe that were suitable for use in conveying gas, water, and oil in both the oil and natural gas industries. The API 5L specification described the requirements of chemical composition, tensile test characteristics and impact toughness behavior (American Petroleum Institute, 2012). Steel pipeline was the most commonly used material because it was easy to install. However, steel pipeline had to deal with corrosion problems hence it needed corrosion-resistant coatings to protect the pipe surface from corrosion hazards and also corrosion protection (Standar Teknis dan Material, 2018). The corrosion protection was a very cost-effective component in the steel system calculation and in spite of all corrosion protection efforts over the life time rather high maintenance costs had to be carried for the steel networks.

Polyethylene (PE) was a thermoplastic polymer with variable crystalline structure and an extremely large range of applications depending on the particular type. PE pipes were increasingly being used to replace the aging iron and steel pipes in the low-pressure distribution system because of lower construction and maintenance costs. Many kinds of polyethylene were known, with most having the chemical formula: $(C_2H_4)_n$. PE was classified by its density and branching. Its mechanical properties depend significantly on variables such as the extent and type of branching, the crystal structure, and the molecular weight (Standard Teknis dan Material, 2014). There were several types of polyethylene such as Lower Density Polyethylene (LDPE), Medium Density Polyethylene (MDPE), and High-Density Polyethylene (HDPE). PE100 as the latest development of High Density Polyethylene (HDPE) received the approval for operating pressures up to 10 bar however this comprises only a small share of distribution networks.

PA was a thermoplastic belong to the general class of polymers called polyamides. PA were characterized by methylene groups of various lengths joined by amide linkages. PA were named by the number of carbon atoms in the monomer unit. The general formula for PA like Polyamide 12 is: $[HN(CH_2)_{11}CO]_n$. PA was a high-performance polymer with outstanding mechanical properties and excellent chemical stability. It was the preferred material in many demanding applications, e.g. in the automotive industry for fuel lines of passenger cars or for air brake tubing's in trucks. Compared to polyethylene (HDPE) it has a higher mechanical and impact strength and melting temperature (Lohmar, 2006).

Each of materials mentioned above had their own characteristic that could suit particular condition in term of gas pipeline transportation. In order not to create unnecessary cost incurred in the future, material selection were crucial factor need to be considered.

BASIC PRINCIPLE OF CAPITAL BUDGETING

Capital budgeting, or investment appraisal, was the planning process used to determine whether an organization's long-term investments such as new machinery, replacement of machinery, new plants, new products, and research development projects were worth the funding of cash through the firm's capitalization structure (debt, equity or retained earnings)(daryanto, 2014). It was the process of allocating resources for major capital, or investment, expenditures. Capital budgeting had a rich history and sometimes employed some pretty sophisticated procedures. Fortunately, capital budgeting relied on just a few basic principles. Capital budgeting was very important for corporation. The principles of capital budgeting had been adopted for many other corporate decisions, such as investments in working capital, leasing, mergers and acquisitions, and bond refunding. The valued principles used in capital budgeting were similar to the valuation principles used in security analysis and portfolio management. Although analysts had vantage point outside the company, their interest in valuation coincides with the capital budgeting focus maximizing shareholder value. Because capital budgeting information was not ordinarily available outside the company, the analyst might attempt to estimate the process, within reason, at least for companies that were not too complex. Further, analysts might be able to appraise the quality of the company's capital budgeting process; for example, on the basis of whether the company has an accounting focus or an economic focus (Clayman, 2012).

VARIABLES OF CAPITAL BUDGETING MODEL

There were 6 (six) capital budgeting criteria decision tools used in this study.

1. PAYBACK PERIOD (PP)

Payback period in capital budgeting refers to the period of time required to recoup the funds expended in an investment, or to reach the break-even point. Payback period is the number of years over which the investment outlay will be recovered (paid back) from the cash inflows if the estimates turn out to be correct. If the payback period is equal to, or only slightly less than, the economic life of the project, then the proposal is clearly unacceptable. If the payback period is considerably less than the economic life, then the project begins to look attractive. The formula is as follows:

$$PP = Years\ full\ recovery + \frac{Unrecovered\ cost\ at\ beginning\ of\ last\ year}{Cash\ Flow\ in\ Following\ Year}$$

2. RETURN ON INVESTMENT (ROI)

Return on Investment is the ratio between the net profit and cost of investment resulting from an investment of some resources. A high ROI means the investment's gains compare favorably to its cost. As a performance measure, ROI is used to evaluate the efficiency of an investment or to compare the efficiencies of several different investments. To calculate ROI, the benefit (or return) of an investment is divided by the cost of the investment. The result is expressed as a percentage or a ratio. The formula is as follows:

$$ROI = \frac{Accounting\ Profit}{Initial\ Investment}\ x\ 100\%$$

3. NET PRESENT VALUE (NPV)

Net Present Value (NPV) is a measurement of profit calculated by subtracting the present values (PV) of cash outflows (including initial cost) from the present values of cash inflows over a period of time. Incoming and outgoing cash flows can also be described as benefit and cost cash flows, respectively. The rate at which the cash inflows are discounted is called the required rate of return, the discount rate, or the hurdle rate (Daryanto, 2018). The different between the present value of the cash inflows and the amount of investment is called the net present value (NPV). If the NPV is non-negative amount, the proposal is acceptable. The formula is as follows:

$$NPV = \Sigma\ Discount\ Factor\ x\ Net\ Cash\ Flow$$

t = Time when cash inflow or cash outflow is disbursed.
It is assumed that all cash is disbursed at the end of the year.

t=1

4. PROFITABILITY INDEX (PI)

Profitability Index also known as profit investment ratio (PIR) and value investment ratio (VIR), is the ratio of payoff to investment of a proposed project. It is a useful tool for ranking projects because it allows you to quantify the amount of value created per unit of investment. In order to compare two proposals under the NPV method, therefore we must relate the size of the discounted cash inflows to the amount of money risked. This is done simply by dividing the present value of cash inflows by the amount of investment, to give ratio that is called the profitability index. Thus, the project with an NPV of zero has a profitability index 1,0. The preference rule is: The higher the profitability index, the better the project. The formula is as follows:

$$PI = \frac{NPV}{Initial\ Investment}\ x\ 100\%$$

PI = Profitability Index
NPV = Net Present Value

5. DISCOUNTED PAYBACK PERIOD (DPP)

Discounted Payback Period is the amount of time that it takes (in years) for the initial cost of a project to equal to discounted value of expected cash flows, or the time it takes to break even from an investment. It is the period in which the cumulative net present value of a project equals zero. A more useful and more valid from the payback period is the discounted payback period. In this method, the present value of each year's cash inflows is found, and these are cumulated year by year until they equal or exceed the amount of investment. The year in which this happens is the discounted payback period. A discounted payback period of five years means that the total cash inflows over a five-year period will be large enough to recover the investment and to provide the required return on investment. If the decision maker believes that the economic life will be at least this long, then the proposal is acceptable. The formula is as follows:

$$DPP = Year\ before\ the\ DPP\ period\ occurs + \frac{Cumulative\ cash\ flow\ in\ year\ before\ recovery}{Discounted\ cash\ flow\ in\ year\ after\ recovery}$$

6. INTERNAL RATE of RETURN (IRR)

Internal Rate of Return (IRR) is a method of calculating rate of return. The rate or discount factor that makes NPV equal zero is called the IRR (Daryanto, 2018). The term internal refers to the fact that its calculation does not involve external factors, such as inflation or the cost of capital.

The higher the IRR, the better the project. When the NPV method is used, the required rate of return must be selected in advance of making the calculations because this rate is used to discount the cashflows in each year. As already pointed out, the choice of an appropriate rate of return is a difficult matter. The Internal Rate of Return (IRR) method avoids this difficulty. It computes the rate of return that equates the present value of the cash inflows with the present value of the investment-the rate that make the NPV equal zero. This rate is called the internal rate of return, or the discounted cash flow (DCF) rate of return. The formula is as follows:

$$IRR \quad = iNPV\ Positive + \frac{NPV\ Positive}{(NPV\ Positive - NPV\ Negative)}\ x\ (iNPV\ Negative - iNPV\ Positive)$$

METHODOLOGY

To accomplish this study, the steps are: (1) Define the terms and conditions of project implementation related to material selection in GIIC. The terms and conditions were used in the study to clearly set parameter on the calculation and analysis; (2) Evaluate the readiness of GAS to implement the cost reduction strategy in term of providing altenatives of material selection on the project based on qualitative model using SWOT analysis. Qualitative model was used because it gave more perspective on the existing codition within GAS to implement the proposed alternatives; (3) Analyze the feasibility of each proposed alternative to the project based on Capital Budgeting Model criteria in terms of Payback Period, Return On Investment, Net Present Value, Profitability Index, Discounted Payback Period, and Internal Rate of Return; (4) Determine the most efficient alternative to be implemented in the project. This informed which alternative should GAS taken into account on implementing the most efficient alternative. In this study, data were collected from GAS in the year of 2017.

RESULT AND DISCUSSION
PROJECT TERM AND CONDITION

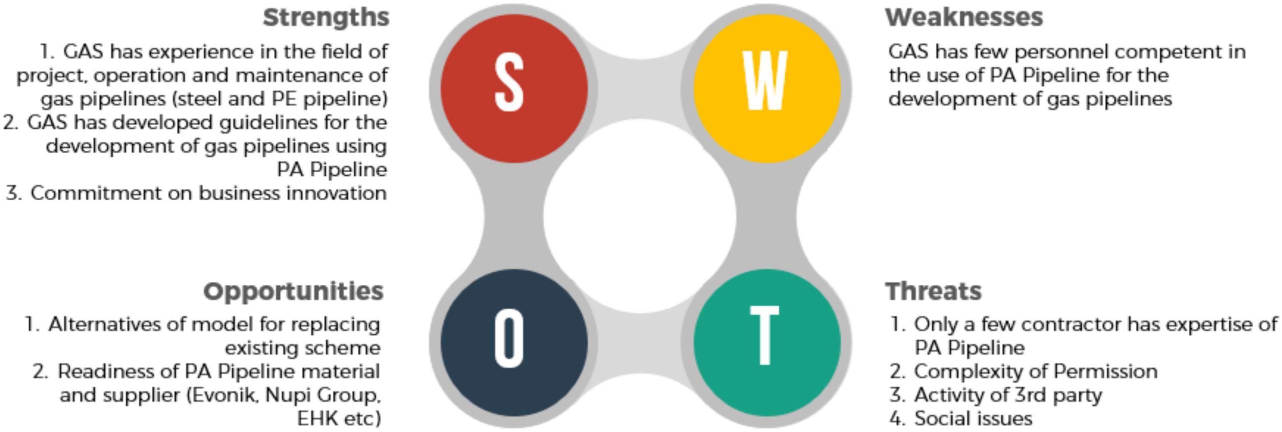
To complete the analysis of the project implementation, conditions were as follows:

1. The period of asset life was based on initial design which was 20 years, start from 2017-2037. The period of time were used to calculate depreciation period.
2. Depreciation type used in this study was Double Declining Balance – Straight Line.
3. Terminal value was 0 (zero).
4. Project was fund by company's investment-fund themselves, and minimum IRR was 11%.
5. Discount rate was 11%.
6. Government tax was 25%.
7. Exchange rate was USD 1 = IDR 13,350.
8. NPV should be positive.
9. Investment will be considered if payback period were not more than half of design life of asset.
10. Operational expenditure were calculated based on condition of each alternatives.
11. All data were taken from year 2017.

GAS READINESS

Readiness of GAS to implement the project were analyzed using SWOT. SWOT analysis result indicated that GAS had many strengths and opportunities while weaknesses and threats were still manageable. The result was shown on Figure 1.

Figure 1: SWOT Analysis



Some actions need to be prepared in order to make sure that the project can be implemented, (1) building partnership with supplier of material, (2) knowledge transfer with experience contractor, (3) improving coordination with industrial area owner, local peoples, customers, and government, (4) if necessary, conduct benchmarking to other experienced company.

CAPITAL BUDGETING ANALYSIS

Cost reduction strategy to the project related to the use of these alternatives of material, they were Steel Pipeline (which was the standard), Polyethylene (PE) Pipeline, and Polyamide (PA) Pipeline as the alternatives. Those alternatives were compared each other as shown below.

In term of Payback Period, PE Pipeline came as the shortest with the number of 2.07 years, while PA Pipeline and Steel Pipeline came after with the number of 3.53 years and 6.45 years respectively.

Table 1: Payback Period for Steel Pipeline

Year	Cash Flow (IDR)	Accumulated Cash flow (IDR)
0	(19,271,424,597.60)	(19,271,424,597.60)
1	2,769,304,952.21	(16,502,119,645.39)
2	2,644,304,747.08	(13,857,814,898.31)
3	2,531,005,309.99	(11,326,809,588.33)
4	2,775,024,257.07	(8,551,785,331.26)
5	3,264,972,540.90	(5,286,812,790.35)
6	3,486,747,446.14	(1,800,065,344.21)
7	3,956,676,092.32	2,156,610,748.11
Payback Period		**6.45 years**

Table 2: Payback Period for PE Pipeline

Year	Cash Flow (IDR)	Accumulated Cash flow (IDR)
0	(13,968,961,937.00)	(13,968,961,937.00)
1	6,152,114,403.06	(7,816,847,533.94)
2	7,270,455,191.20	(546,392,342.74)
3	7,786,599,896.40	7,240,207,553.66
Payback Period		**2.07 years**

Table 3: Payback Period for PA Pipeline

Year	Cash Flow (IDR)	Accumulated Cash flow (IDR)
0	(16,966,144,509.04)	(16,966,144,509.04)
1	4,514,193,531.94	(12,451,950,977.10)
2	4,819,685,124.28	(7,632,265,852.83)
3	4,885,678,127.02	(2,746,587,725.81)
4	5,136,700,219.53	2,390,112,493.71
Payback Period		**3.53 years**

Average ROI calculation during discounted payback period showed that PE Pipeline were the highest and put big gap to the PA Pipeline and Steel Pipeline. The numbers of ROI for PE Pipeline, PA Pipeline, and Steel Pipeline were 50.61%, 29.51%, and 18.16% respectively. As general, ROI for each alternatives were tend to increase year by year. This was happen because depreciation constantly decrease while revenue and operational expenditure were relatively steady.

Table 4: ROI for Steel Pipeline

Year	Accounting Profit (IDR)	ROI (%)
1	2,769,304,952.21	14.37
2	2,644,304,747.08	13.72
3	2,531,005,309.99	13.13
4	2,775,024,257.07	14.40
5	3,264,972,540.90	16.94
6	3,486,747,446.14	18.09
7	3,956,676,092.32	20.53
8	4,160,433,323.67	21.59
9	4,614,146,063.34	23.94
10	4,803,308,978.84	24.92
Average ROI		18.16

Table 5: ROI for PE Pipeline

Year	Accounting Profit (IDR)	ROI (%)
1	6,152,114,403.06	44.04
2	7,270,455,191.20	52.05
3	7,786,599,896.40	55.74
Average ROI		50.61

Table 6: ROI for PA Pipeline

Year	Accounting Profit (IDR)	ROI (%)
1	4,514,193,531.94	26.61
2	4,819,685,124.28	28.41
3	4,885,678,127.02	28.80
4	5,136,700,219.53	30.28
5	5,677,687,570.94	33.46
Average ROI		29.51

On the NPV calculation, all of those alternatives showed positive numbers. On this NPV calculation, the period of time used on each alternatives were follow the period of discounted payback period because discounted payback period were still less than half of design life of asset. Since all of those alternatives were resulted in positive numbers, all of those alternatives were good to be implemented.

Table 7: NPV for Steel Pipeline

Year	Cash Flow (IDR)	PV Factor (11%)	Present Value (IDR)
0	(19,271,424,597.60)	1.00	(19,271,424,597.60)
1	2,769,304,952.21	0.90	2,494,869,326.32
2	2,644,304,747.08	0.81	2,146,177,053.06
3	2,531,005,309.99	0.73	1,850,649,268.69
4	2,775,024,257.07	0.66	1,827,994,432.14
5	3,264,972,540.90	0.59	1,937,602,290.47
6	3,486,747,446.14	0.53	1,864,157,569.84
7	3,956,676,092.32	0.48	1,905,766,319.04
8	4,160,433,323.67	0.43	1,805,322,255.22
9	4,614,146,063.34	0.39	1,803,783,995.20
10	4,803,308,978.84	0.35	1,691,650,869.10
NPV			56,548,781

Table 8: NPV for PE Pipeline

Year	Cash Flow (IDR)	PV Factor (11%)	Present Value (IDR)
0	(13,968,961,937)	1	(13,968,961,937)
1	6,152,114,403	0.900900901	5,542,445,408
2	7,270,455,191	0.811622433	5,900,864,533
3	7,786,599,896	0.7312	5,693,494,734
NPV			3,167,842,738

Table 9: NPV for PA Pipeline

Year	Cash Flow (IDR)	PV Factor (11%)	Present Value (IDR)
0	(16,966,144,509)	1	(16,966,144,509)
1	4,514,193,532	0.900900901	4,066,841,020
2	4,819,685,124	0.811622433	3,911,764,568
3	4,885,678,127	0.7312	3,572,365,738
4	5,136,700,220	0.6587	3,383,703,539
5	5,677,687,570	0.5935	3,369,431,229
NPV			1,337,961,585

In term of Discounted Payback Period, the result were similar with Payback Period calculation. PE Pipeline came with the shortest and followed by PA Pipeline and Steel Pipeline. The numbers for PE Pipeline, PA Pipeline, and Steel Pipeline were 2.44 years, 4.6 years, and 9.97 years respectively.

Table 10: Discounted Payback Period for Steel Pipeline

Year	Cash Flow (IDR)	PV Factor (discount rate 11%)	Discounted Cash Flow (IDR)	Cumulative Discounted Cash Flow (IDR)
0	(19,271,424,597.60)	1.00	(19,271,424,597.60)	(19,271,424,597.60)
1	2,769,304,952.21	0.90	2,494,869,326.32	(16,776,555,271.29)
2	2,644,304,747.08	0.81	2,146,177,053.06	(14,630,378,218.22)
3	2,531,005,309.99	0.73	1,850,649,268.69	(12,779,728,949.53)
4	2,775,024,257.07	0.66	1,827,994,432.14	(10,951,734,517.40)
5	3,264,972,540.90	0.59	1,937,602,290.47	(9,014,132,226.93)
6	3,486,747,446.14	0.53	1,864,157,569.84	(7,149,974,657.09)
7	3,956,676,092.32	0.48	1,905,766,319.04	(5,244,208,338.05)
8	4,160,433,323.67	0.43	1,805,322,255.22	(3,438,886,082.83)
9	4,614,146,063.34	0.39	1,803,783,995.20	(1,635,102,087.63)
10	4,803,308,978.84	0.35	1,691,650,869.10	56,548,781.47
Discounted Payback Period			**9.97 years**	

Table 11: Discounted Payback Period for PE Pipeline

Year	Cash Flow (IDR)	PV Factor (discount rate 11%)	Discounted Cash Flow (IDR)	Cumulative Discounted Cash Flow (IDR)
0	(13,968,961,937.00)	1.00	(13,968,961,937.00)	(13,968,961,937.00)
1	6,152,114,403.06	0.90	5,542,445,408.17	(8,426,516,528.83)
2	7,270,455,191.20	0.81	5,900,864,533.07	(2,525,651,995.76)
3	7,786,599,896.40	0.73	5,693,494,733.89	3,167,842,738.12
Discounted Payback Period			**2.44 years**	

Table 12: Discounted Payback Period for PA Pipeline

Year	Cash Flow (IDR)	PV Factor (discount rate 11%)	Discounted Cash Flow (IDR)	Cumulative Discounted Cash Flow (IDR)
0	(16,966,144,509.04)	1.00	(16,966,144,509.04)	(16,966,144,509.04)
1	4,514,193,531.94	0.90	4,066,841,019.76	(12,899,303,489.28)
2	4,819,685,124.28	0.81	3,911,764,568.03	(8,987,538,921.24)
3	4,885,678,127.02	0.73	3,572,365,738.28	(5,415,173,182.96)
4	5,136,700,219.53	0.66	3,383,703,539.50	(2,031,469,643.46)
5	5,677,687,569.94	0.59	3,369,431,228.68	1,337,961,585.22
Discounted Payback Period			**4.60 years**	

As a summary, calculation showed that PE Pipeline were the most likely to be implemented due to its shortest of Payback Period, Discounted Payback Period, highest ROI, IRR, and Profitability Index. Whereas PE Pipeline and Steel Pipeline came afterward respectively.

Table 13: Summary Result

Item	Steel Pipeline		PE Pipeline		PA Pipeline	
	Value	Unit	Value	Unit	Value	Unit
Payback Period	6.45	years	2.07	years	3.53	years
Return On Investment	18.16	%	50.61	%	29.51	%
Net Present Value	56,548,781	IDR	3,167,842,738	IDR	1,337,961,585	IDR
Profitability Index	0.29	%	22.68	%	7.89	%
Discounted Payback Period	9.97	years	2.44	years	4.60	years
Internal Rate of Return	11.06	%	23.25	%	13.98	%

MOST EFFICIENT ALTERNATIVE

In term of determining the most efficient alternative between options available, this study used Steel Pipeline as the standard. And since the efficiency can only be measured after phase of operational, therefore operational expenditure was the main parameter to be compared. Calculation resulted in PE Pipeline gave more efficiency with the number of 40.9% compared to Steel as standard and PA Pipeline efficiency was 23.5% compared to Steel Pipeline.
It is concluded that PE Pipeline was the most efficient alternative between the others.

LIMITATION

This study has expanded the literature about gas transportation system and capital budgeting model in the real working world. In order to produce more generalizes result, it is suggested to conduct research by contributing many companies in the gas industry. Since the focus of the study is on one specific company engaged in gas industry, it is suggested to explore on a wider scale and also find out whether another company produce the same result. Revenue is not in the research scope and is not relevant to be compared because the capacity of the available options are the same. As an addition, this study mainly focuses on financial point of views. To give wider point of view, the research might includes the non-monetary considerations on detail such as environment, legal, political, and administration.

CONCLUSION AND RECOMMENDATION

The objective of this study was to analyze the correlation of improper material selection during project phase to the unnecessary cost incurred in the operational phase. Referred to calculation result on the most effective alternative, it showed that improper material selection caused higher operational cost in the future after project finished. Thus, it was very important to properly discussed material selection in the beginning of the project.

Based on qualitative method, GAS was ready to implement three proposed alternatives of material selection as a cost reduction strategy. The feasibility was analyzed using capital budgeting criteria in term of Payback Period, Return on Investment, Net Present Value, Profitability Index, Discounted Payback Period, and Internal Rate of Return. It showed that PE Pipeline was the most profitable due to its shortest period of Payback Period and Discounted Payback Period, and highest ROI, IRR, and Profitability Index. In addition, PE Piline was also the most efficient alternative compared to other alternatives. The second choice of alternative was PA. PA came in second in term of Payback Period, Discounted Payback Period, Profitability Index, and Internal Rate of Return.

This study pointed out that the most efficient between proposed alternatives was PE Pipeline. Referred to calculation result above, it was concluded that PE Pipeline was the most likely to be chosen to be implemented on the project. GAS was quite experienced with the PE Pipeline and also feasible to be implemented based on capital budgeting analysis.

However, for some cases where the customers required pressure above 10 bar, PA Pipeline could be the alternative. GAS should also consider future condition of pressure within the Area C of GGIC to consider which alternative should be chosen.

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