Economic Evaluation of Burner Unit Removal Project at Nickel Processing Company

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Abstract
This case study was carried out to determine the economic study of the implementation of the burner unit removal project. Three investment alternatives have been developed and compared in this study to determine the most economical option, i.e. operational refractory burner system as well as current state (alternative 1), remove unit burner to ladle shop building in accordance build a new building in ladle shop building and also modify existing overhead crane (alternative 2), remove unit burner to ladle shop building in accordance build a new building in ladle shop without modifying overhead crane unit (alternative 3). Economic evaluation is studied by performing cost saving analysis, increment cash flow projection, NPV, IRR, and Payback Period. Furthermore, sensitivity analysis of the most economic option was carried out based on three investment parameters which are a projection of the operational saving cost, discounted rate, and cost of investment changes. The result shows that alternative 2 have the highest NPV, IRR, and Payback period has slightly lowest than alternative 3. In term of sensitivity analysis, alternative 2 have a big tolerance to the all of investment parameter. Therefore, this study has been successfully confirmed that alternative 2 is the most economical option.

Keywords:
Economic Evaluation, NPV, IRR, Payback Period, Sensitivity

1. Introduction
Nickel material is one of the main components of the electric battery which is projected to immediately replace fossil fuels. It will become the emergence of more nickel material processing companies, especially in Indonesia as one of the biggest nickels producing countries in the world. Nickel material commodity is one of the commodities that have price volatility, it is influencing by various global factors. Economic factors play a major role in the sustainability of a production process and improvement of production systems (Couper 2003). This encourages nickel material processing companies to improve operational and maintenance cost efficiency to survive with these conditions. In the last few years, XYZ has implemented cost efficiency programs in all departments, to achieve operational and maintenance cost-efficiency.

The refractory work unit is one of the units owned by the operation and maintenance department of PT. XYZ which has the main task of keeping all production equipment operating at high temperatures well protected. The Unit burner has a function as a combustion device of processing refractory material to raise high-temperature services as an operational necessity, especially in kiln and furnace.

Presently, the processing refractory material was carried out by 2 different locations, which are Ladle Shop and Heavy-duty Shop. Demolition and castable work were carried out in a ladle shop. Meanwhile, the refractory combustion process is carried out in a heavy-duty shop. It causes inefficient works process and also impacted to the operating budget, especially in cost of mobilization. In 2019, the total annual operational budget of the refractory burner work unit is $382,100.00 and it tends to increase 2.82% every year. The annual operational budget of the refractory burner unit from 2010 - 2019 can be seen in Figure 1 below.

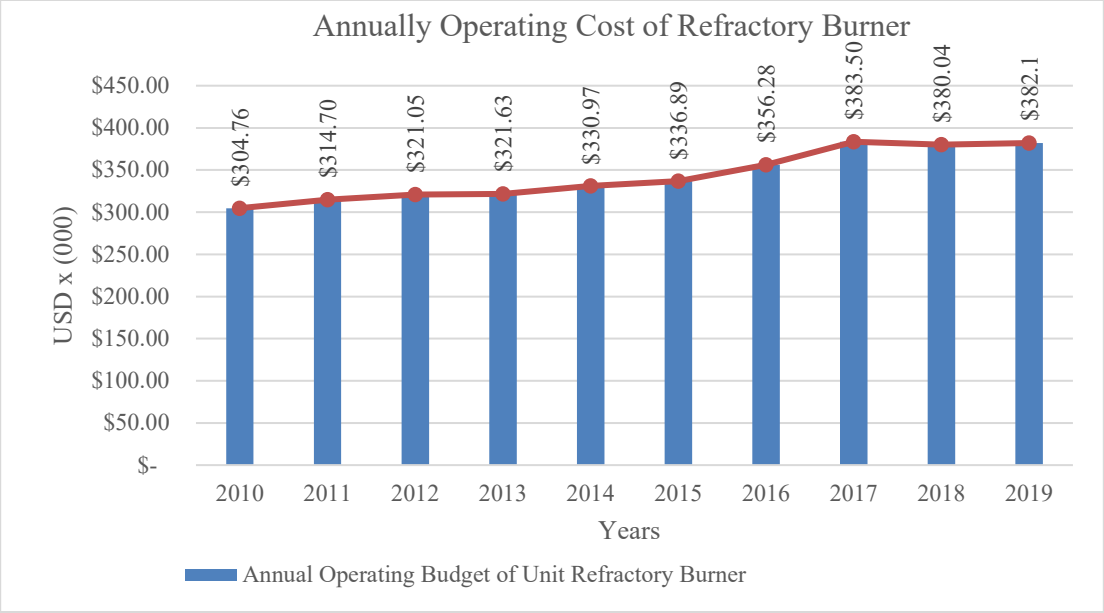


Figure 1. The Annual Operational Budget of Refractory Burner Unit, 2010 – 2019.

The cost component of the operational budget is classified as 3 kinds: fabrication and castable casting (including material), combustion (unit burner), and mobilization. The average percentage each of the component budget of a refractory burner unit can be seen in Figure 2 below.

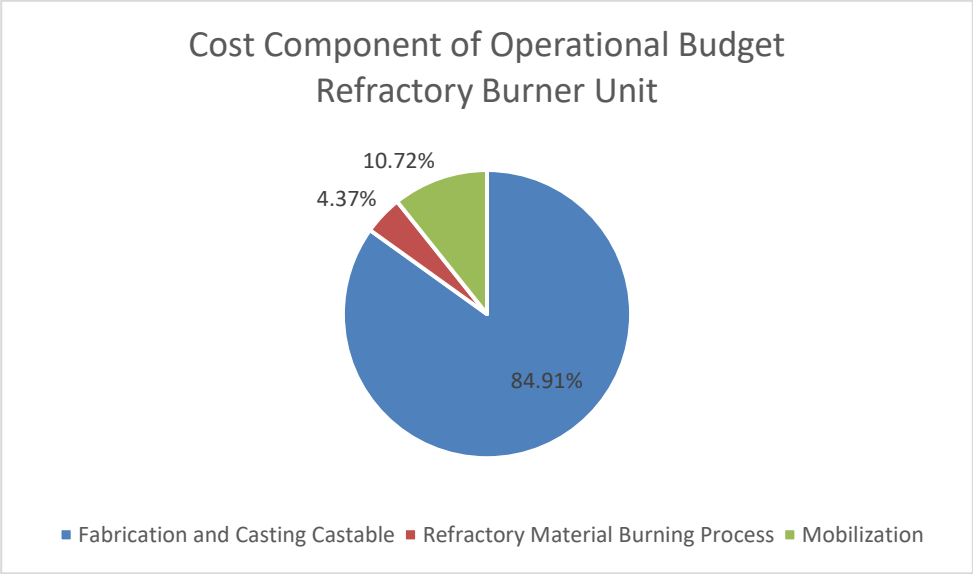


Figure 2. Cost Component of Operational Budget Refractory Burner Unit.

There are three alternatives were proposed to solve these problems to aim the cost efficiency of refractory burner work units, especially in the mobilization or transportation cost component. The first alternative is to keep doing as a current work process. The second alternative is to move the burner unit from the heavy-duty shop to the ladle shop, by modifying the ladle shop building and overhead crane. Modifications the overhead crane unit aims to the material handling process will fully be supported by overhead crane. While the third alternative is by modifying the building of the ladle shop only (without modification of the overhead crane unit), it takes the lower investment costs than alternative 2. However, the material handling process still requires telehandler support. It will be considered to

compare of each alternative in the economic evaluation study. Projected Annual Operating Cost, NPV, IRR, and Payback Period is carried out in term of economic analysis of each alternative. Economic analysis of the alternatives above will be carried out further in this case study, so that later it will be known which alternative provides greater profit for the company as a recommendation for investment decision making.

In term of project economics and economic evaluation study, there were three major parameters should be discussed: capital requirements, operating expenses, cash flow and profitability or cost saving measures (Couper 2003). Capital requirements include fund required to purchase material, design, cost install equipment, install building to realize a project so that it can operate. Source of found is debt and equity (Humpreys 2000). Capital cost or cost of investment consists of hard, owners and soft cost. Hard cost consists of material and installation cost. Owner cost consists of engineering cost, project contingency, start up and commissioning cost. Where soft cost is indirect and financing fee (Couper 2003; Humpreys 2000). Annual operating cost divided into fixed cost and variable cost. Fixed cost consists of cost of maintenance, where variable cost is consists of material, mobilization, labour cost (Couper 2003). Net Present Value of annual cash flow projection (revenue and expenses) is defined as sum of present value of each annual projection cash flow. NPV is a discounted rate cash flow analysis, and it was standard method of time of money to appraise of long term-project **(**Fraser and Jewkes 2013; Kirkwood et al. 2015; Zizlavsky 2014). Internal Rate of Return is the ability to return the investment cost (Fraser and Jewkes 2013; Omran et al. 2017). Payback Period is period time that required to return the cost of investment (Fraser and Jewkes 2013; Omran et al. 2017). While the analysis of sensitivity is carried out to know the ability of the investment by probability of change of investment parameter (Couper 2003; Fraser and Jewkes 2013).

2. Refractory Working Process

Refractory materials have a function to protect the equipment from high-temperature exposure due to operability. To achieve this service temperature, the refractory material through to the combustion process. Air Pipe in the Kiln, Tahu Murray, and Ring Brick of Furnace are the operation equipment that protected by refractory material with the combustion process by a unit burner. The current refractory working process of those equipment shown in Figure 3 below.

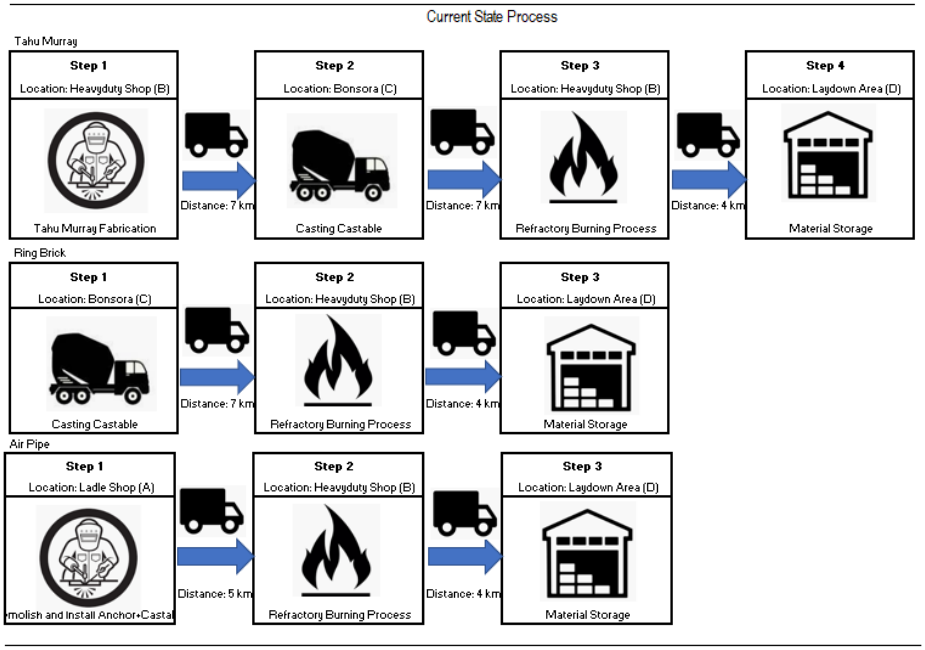


Figure 3. Refractory Burning Process (Current State).

3. Economic Evaluation

3.1 Assumption Parameter

In determining the investment parameters, there are 3 things that become assumption parameter:

- Depreciation. In the development of alternatives that will be provided, the investment will be made is by adding new buildings. It will be classified as a permanent building with 20 years economic life. While amount and depreciation method that used in this research is 5% with straight line depreciation method.
- Income Tax. The amount of tax used refers to the tax standards that apply to the Indonesian government regulation. The amount of tariff is 25%.
- Discounted Rate. Use the Weighted Average Capital Cost (WACC) value which is the cost of capital of a variable capital cost is to calculate the WACC using the formula:

$$WACCnominal = \frac{D}{V} \times Kd \times (1 - Tc) + \frac{E}{V} \times Ke \quad (1)$$

where,
D = Market value of the firm's debt
E = Market value of the firm equity
V = D + E = Total; market value of the firm's financing
D/V = Percentage of financing that is debt (30%, internal corporate data)
E/V = Percentage of financing that is equity (70%, internal corporate data)
Tc = Corporate tax rate (34% in Brazil)
Kd = Cost of debt = 3.9%
Ke = Cost of equity

While the cost of equity (Ke) is calculated by the formula:

$$Ke = Rf + CDS + \beta s\,(Rm - Rf) \quad (2)$$
Ke = 2.92% + 1.31 x 4.66% = 10.6%

where:
Rf = Risk free return expected on the market = 2.92%
CDS = Country Default Spread of Indonesia = 1.59%
βs = sensivity to market risk from the average beta of mining sector = 1.31
$(Rm - Rf)$ = The historical risk premium from 1928-2018 = 4.66%

Then the nominal WACC calculation obtained parameter data from company in 2019 as follow:

$$WACC_{nominal} = D/V\ Kd\ .\ (1\text{-}Tc) + E/V.\ Ke \quad (3)$$
$WACC_{nominal}$ = 30%. 3.9%. (1-34%) + 70% .10.6% = 8.2%

with inflation of 2.13%,

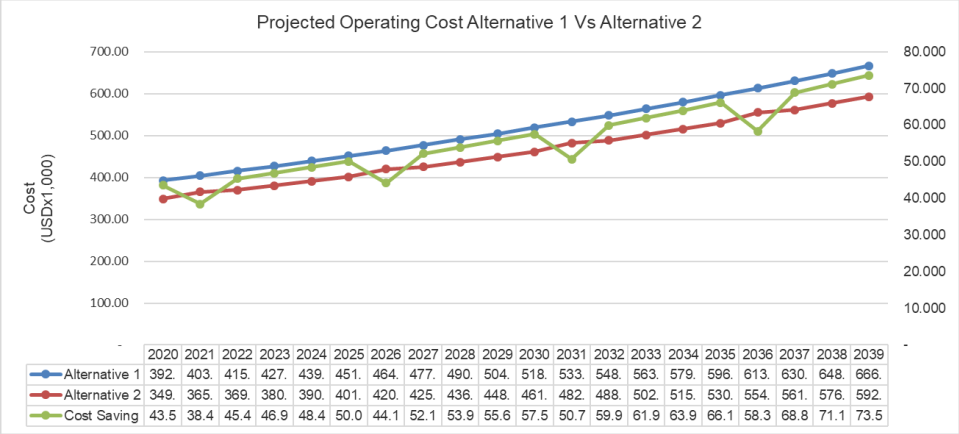
$WACC_{real} = WACC_{nominal} - \text{inflation}$
$WACC_{real}$ = 8.20% - 2.13% = 6.07% or round to 6.00%

3.2 Cost Analysis

Incremental cost components and cost savings occurred in several activities, includes:

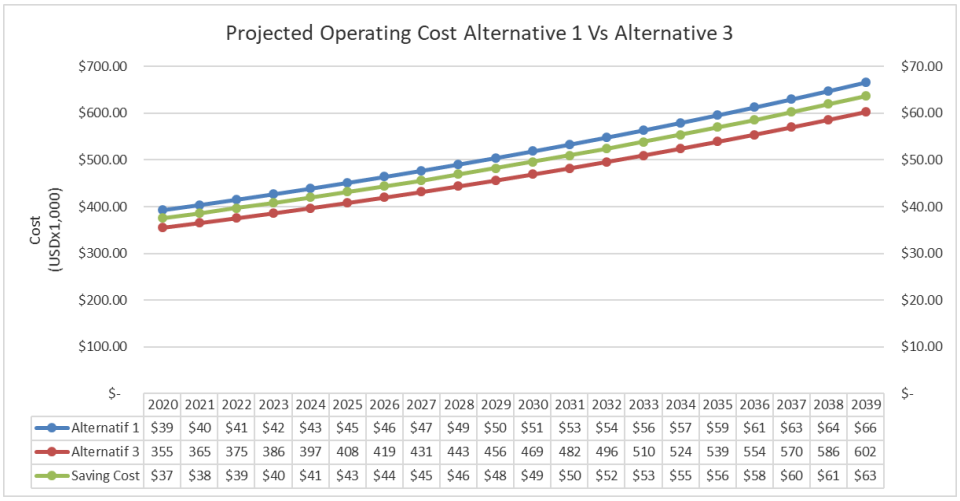
- Projected operating costs in 2020 to 2039 are assumed to increase by 2.82% annually.
- Alternative 1 is a currently working process with nil investment cost.
- The cost components of Alternative 2 consisted of maintenance cost of the overhead crane unit and operational cost-saving that will be calculated in cash flow analysis. The maintenance cost of overhead crane consists of costs of routine maintenance (include with spare part) and overhaul cost every 5 years. Maintenance cost of overhead crane is projected increase 15% every 5 years. Where the cost-saving is carried out by cost reduction of current annual operating cost with projection annual operating cost of alternative 2. Meanwhile, alternative 2 requires an investment cost $53,600.00.

- The cost component of alternative 3 consisted of material handling cost (telehandler support) and saving cost. Where the cost-saving is carried out by cost reduction of current annual operating cost with projection annual operating cost of alternative 3. Meanwhile, alternative 3 requires an investment cost $46,100.00, its lowest than alternative 2.
- Projected operating cost alternative 2 and 3 are respectively comparison with alternative 1 to find out whether those alternatives have more efficient operating costs than the current works process. It shown in figure below.



	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Alternative 1	392.	403.	415.	427.	439.	451.	464.	477.	490.	504.	518.	533.	548.	563.	579.	596.	613.	630.	648.	666.
Alternative 2	349.	365.	369.	380.	390.	401.	420.	425.	436.	448.	461.	482.	488.	502.	515.	530.	554.	561.	576.	592.
Cost Saving	43.5	38.4	45.4	46.9	48.4	50.0	44.1	52.1	53.9	55.6	57.5	50.7	59.9	61.9	63.9	66.1	58.3	68.8	71.1	73.5

Figure 4. Projected Annually Operating Costs Alternative 1 vs Alternative 2.



	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
Alternatif 1	$39	$40	$41	$42	$43	$45	$46	$47	$49	$50	$51	$53	$54	$56	$57	$59	$61	$63	$64	$66
Alternatif 3	355	365	375	386	397	408	419	431	443	456	469	482	496	510	524	539	554	570	586	602
Saving Cost	$37	$38	$39	$40	$41	$43	$44	$45	$46	$48	$49	$50	$52	$53	$55	$56	$58	$60	$61	$63

Figure 5. Projected Annually Operating Costs Alternative 1 vs Alternative 3.

- Based on those comparison it shown that alternatives 2 and 3 are projected to have lower operational costs than alternative 1. This confirms that both of those alternatives have effective operational costs instead of the current work process (alternative 1).
- The next step is carried out an economic evaluation of alternatives 2 and 3 and compare respectively to get the best alternative who gives the highest profit to a company.

3.3 Cash Flow Projection and Analysis

Projection and analysis of alternative 2 which remove the unit burner to ladle shop building with $53,600.00 investment cost of modification the existing ladle shop building, modify overhead crane and remove cost of unit burner. Alternative 2 has cash flow results in positive NPV $395,000.00, IRR 62.5% > 10.3% MARR and 1.69 years of a payback period.

While projection and analysis of alternative 3 which remove the unit burner to ladle shop building with $46,100.00 investment cost of modification the existing ladle shop building (without modify overhead crane) and remove cost of unit burner. Alternative 3 has cash flow results in positive NPV $354,000.00, IRR of 65.1% > 10.3% MARR and 1.59 years of a payback period.

Both of those alternatives are projection gives profit to a company. Since the both of those alternatives have the same lifetime of investment, the best alternative will determine by the largest NPV value. Based on the cash flow projection and analysis above, alternative 2 gives the highest NPV ($395,000.00). It is confirmed that alternative 2 gives the highest profit to a company and will be proposed for the best option. Furthermore, sensitivity analysis of alternative 2 will be carried out to know the tolerance limits allowed to occur in investment parameters.

3.4 Sensitivity Analysis

The investment parameters consist of investment costs, discount rates, and saving costs. Sensitivity analysis is carried out to determine the limits of each investment parameter change that is still allowed (Fraser and Jewkes 2013; Omran et al. 2017). Sensitivity analysis is carried out by adding and subtracting per-stages from each parameter until reaching NPV = 0. Sensitivity analysis alternative 2 as shown in Figure 6, 7, and 8 below.

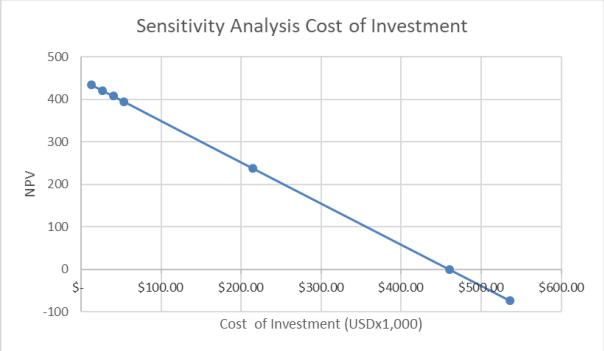


Figure 6. Sensitivity Analysis Cost of Investment.

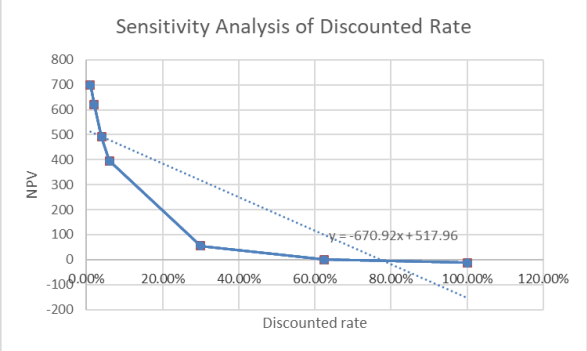


Figure 7. Sensitivity Analysis of Discounted Rate.

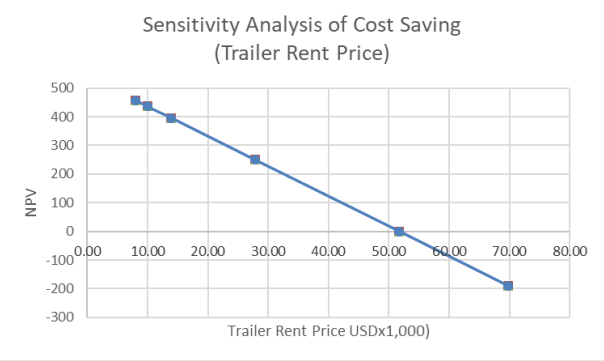


Figure 8. Sensitivity Analysis of Cost Saving.

The highlight of sensitivity analysis alternative 2:

- Sensitivity analysis on investment cost parameters: the sensitivity analysis of investment cost parameters with NPV value = 0 is reached if an investment cost increase of 758% ($459,900.00) occurs.
- Sensitivity analysis on the discount rate parameter: the sensitivity analysis of the discounted rate parameter with NPV = 0 is reached if a discounted rate increase of 942% (from 6% to 62.5%).
- Sensitivity analysis of cost-saving parameters: the sensitivity analysis of the cost-saving parameter with NPV = 0 is reached if there is an increase in trailer rental prices by 270.69% (from $250/hr to $556.02/hr).

- Overall, all parameters have a wide tolerance to reach a nil NPV value. The cost-saving parameter has less tolerance with the change up to decrease 270.69%, however it still a quite wide tolerance.

4. Conclusion

Both of alternative 2 and 3, it brings a profit to company where the NPV above nil and IRR value is above the required minimum criteria of 6.00%. However alternative 2 it gives a greater profit to company. In term of sensitivity analysis, alternative 2 have a wide tolerance to the all investment parameter. It is mean that alternative 2 have a robust value of the investment parameter and indicated that the alternative has considerable economic viability.

Based on those consideration, alternative 2 is recommended as the most economical option that given for investment decisions made by the company.

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