# Feasibility study of development of coal transport support infrastructure with conveyor system in coal mining industry

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# Feasibility study of development of coal transport support infrastructure with conveyor system in coal mining industry

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**Abstract.** As a result of the significant decline in coal prices in 2014 and 2015, as many as 125 coal companies closed (source: kompas.com). The survived companies are required to make a cost down in order to survive. Electric conveyor as a hauling system replaces the dump truck hauling system. The case study was conducted at one of the coal companies in Central Kalimantan where the annual target of coal hauling is 7 million tons. This investment feasibility study was carried out by economic analysis for 15 years hauling and NPV of $ -101.604,769 was obtained, IRR of -4.69%, Payback Period for 16.37 years, B / C Ratio amounting to 0.827. The investment feasibility study was also carried out for 25 years hauling (to use up the remaining coal reserves) and an NPV of $ 373,723,630, an IRR of 52.12%, a Payback Period of 0.948 years, a B / C ratio of 1.639. This investment is said to be feasible if hauling is carried out for 25 years with a target of 7 million tons per year.

## 1. Introduction

Indonesia is a country that is very rich in its natural resources. One of the big commodities in Indonesia is coal. Coal Mining in Indonesia is one of the largest mines in the world. For its own coal reserves, Indonesia ranks 9th with around 2.2 percent of total global coal reserves (based on the Statistical Review of World Energy BP). This means that if the current level of production continues, coal reserves in Indonesia are expected to run out in the next 83 years.

At the end of 2012, world coal prices began to decline after being able to reach the highest price in mid-2012 at 120 USD per ton. This makes almost half of all mining businesses in Indonesia have to close their businesses because they continue to suffer losses. In early 2016, the increase in coal commodity prices in Indonesia gave a fresh breeze to the coal mining industry. This price increase was in line with the increase in crude oil prices and Indonesia's domestic coal demand which also increased along with the increase in the construction of steam power plants. Until the end of semester 1 2018, the increase in coal prices had reached the highest point in the last 5 years and had almost touched the figure of 115 USD per ton. The increase in coal prices automatically makes demand for these commodities also increase. Almost all coal mining business owners raise their production targets, this is also in line with the government's plan to increase Indonesian coal exports.

Coal in Indonesia is dominantly located in the basin area of southern Sumatra and also in the Kalimantan region. Both on the island of Sumatra and in Kalimantan, the location of these coal reserves is generally located quite far from the coast of the island because coal is formed from organic plant deposits that experience chemical decay and geophysics. The only coal export route abroad is through sea access. In order to be able to ship and export the coal, delivering coal from mine to the port needs to be constructed. This activity is known as coal hauling to port. In Kalimantan, the average distance of coal hauling ranges from 30 - 120 km, the length of the hauling distance causes the mining costs as a whole to be more expensive.

Coal mining businesses continue to seek efforts to reduce mining costs and one of them is by providing good mining infrastructure. From the available data, the highest average cost of mining is hauling cost, which is almost 50% of the total mining cost. The main infrastructure

for hauling is of course the hauling road. Due to this high hauling cost, other alternatives of hauling system need to be considered, one of them is to use a conveyor system.

## 2. Investment assessment method

To determine an economically feasible investment, an engineering economic analysis must be carried out. The methods used for economic feasibility analysis in this study are as follows:

- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Benefit Cost Ratio (BCR)
- Payback Period (PBP)

### *2.1. Net Present Value (NPV)*

Net Present Value (NPV) is a method for evaluating the size of the project that is most often used by companies, this method calculates the present money value from the estimated net future cash flows on an amount of the value of the investment to be made (Anthes, 2003).
Positive results from the Net Present Value (NPV) means that the investment that will be made can ultimately increase the value of the company, so the company should accept the project. Negative results from the Net Present Value (NPV) means that the investment that will be carried out can ultimately reduce the value of the company, so the company should reject the investment project. If the results obtained by the Net Present Value (NPV) are zero then the value of the investment to be made will not change the value of the company.

### *2.2. Internal Rate of Return (IRR)*

Internal Rate of Return (IRR) is a method that calculates a discount rate that makes the present value of all estimated cash inflows equal to the present value of expected cash outflows (Hazen, 2009). IRR is the interest rate that makes the calculated NPV value equal to zero.
If the IRR results obtained are greater than the cost of capital, then describing that the investment made will produce a return greater than expected, so the company should accept the project. IRR that is smaller than the cost of capital describes the investment made will produce a return smaller than expected, so the company should reject the investment project. Whereas for the IRR which is the same as the cost of capital, the investment made is expected to generate returns as expected (Peterson, 2002). In addition, it can also refer to the minimum acceptable rate of return or minimum attractive rate of return (MARR). MARR is the minimum rate of return from an investment that an investor dares to do. If the IRR is smaller than MARR, then the investment is not economically feasible. Conversely, if the IRR is greater than MARR, this proves that this investment is economically feasible.

### *2.3. Benefit Cost Ratio (BCR)*

Benefit Cost Ratio analysis is an analysis technique in knowing the value of the benefits of a project that will be carried out by comparing the value of benefits with the value of investment / capital.
This BCR analysis is often used as an additional analysis in validating the results of an investment evaluation.
If the BCR results obtained are greater or equal to 1, then the company should accept the proposed project. If the BCR results obtained are smaller than 1, then the company should reject the project.

*2.4. Payback period (PBP)*

The Payback Period analysis (Giatman, 2006) aims to find out how long the investment period will be returned at the time the breakeven point occurs.

If the PBP results obtained are smaller or equal to the investment age, the company should accept the project. If the PBP results obtained are greater than the investment age, the company should reject the project.

## 3. Research methods

The method used in data analysis in this study is descriptive quantitative. Secondary data in this study are hauling coal cost and rate data, topographic data and design of hauling road plan, hauling production data until the end of mining period, and conveyor price bid data. The data sources used are from a mining contracting company in Central Kalimantan, PT ABC. The variables used for calculating the capital cost for constructing the conveyor line are Mechanical Work, Structural Work, Civil Work, Electrical Work, General Work.

The analysis process begins with the calculation of capital costs to procure a conveyor line from pit to port. In addition to capital costs, maintenance costs and operational costs will also be calculated for hauling with the conveyor system. Furthermore, after all costs are obtained, next step is the calculation of income earned per year. After all income and costs are obtained, economic analysis is done using the method of Net Present Value (NPV), Internal Rate of Return (IRR), Benefit Cost Ratio (BCR) and Payback Period (PBP).

## 4. Results and discussion

Calculation of investment costs for the construction of electric conveyors are as follows:

**Table 1.** Investment costs on construction of an electric conveyor

| No. | Description | Est.QTY | Unit | Total Price (US$) |
|---|---|---|---|---|
| A. | Preparation Work | 1 | LS | 37,241 |
| B. | Mechanical Work | 61,400 | m’ | 122,800,00 |
| C. | Structural Work | 30,700,000 | kg | 69,075,000 |
| D. | Civil Work | 6,198,000 | $m^3$ | 31,839,041 |
| | | 73,680 | $m^3$ | 3,027,945 |
| E. | Building Work | 1 | LS | 200,000 |
| F. | Electrical Work | 61,400 | m’ | 61,400,000 |
| G. | General Work | 1 | LS | 103,448 |
| | Total | | | 288,445,435 |
| | Vat 10% | | | 28,844,543 |
| | **Grand Total** | | | **317,289,978** |

In operating an electric conveyor, it still needs a other units, namely the loader and support unit because the electric conveyor only replaces the role of the hauler truck. The total cost needed for unit support and investment is shown in table 2 below.

**Table 2.** Need for supporting tools and investment costs

| Equipment | Type | Qty | Equipment Proce per Unit (US$) | Total Equipment Price (US$) |
|---|---|---|---|---|
| Loader | WA500 | 5 unit | 569,802.70 | 2,849,013.52 |
| General Work | PC300 | 2 unit | 436,816.48 | 873,632.96 |
| General Work | CWB-520 | 10 Unit | 110,359.29 | 1,103,592.85 |
| Fuel Truck | P380CB6x6FT | 1 unit | 122,621.43 | 122,621.43 |
| **Total** | | | | **4,948,860.77** |

Investment value in 2019 → $ 338.350.781 (inflasion 5 %)
Owner's equity 30 % → $ 101.505.234
Bank loan 70 % → $ 236.845.547

From the above data cash flow after tax can be obtained, it is shown in Table 3.

**Tabel 3.** Cashflow coal hauling dengan electric conveyor

| Year | After Tax Cash Flow |
|---|---|
| 2019 | (486,971,219) |
| 2020 | 58,302,033 |
| 2021 | 71,360,385 |
| 2022 | 69,107,319 |
| 2023 | 66,916,506 |
| 2024 | 65,489,811 |
| 2025 | 64,673,831 |
| 2026 | 62,574,544 |
| 2027 | 60,550,926 |
| 2028 | 58,606,760 |
| 2029 | 53,509,634 |
| 2030 | 36,057,631 |
| 2031 | 41,876,964 |
| 2032 | 43,758,846 |
| 2033 | 45,742,132 |
| 2034 | 1,343,528 |

Economic analysis then can be carried out to obtain NPV, IRR, payback period and B / C Ratio values (Table 4).

**Table 4.** Results of economic analysis

| Indicator | Analysis Result | Parameter | Status |
|---|---|---|---|
| NPV | -101.604.769 US$ | NPV > 0 | Not Feasible |
| IRR | -4,69% | IRR>MARR (MARR = 12%) | Not Feasible |
| PBP | 16,37 years | PBP < investment period (investment period = 15 years) | Not Feasible |
| B/C Ratio | 0,827 | B/C Ratio > 1 | Not Feasible |

From the analysis, it can be seen that the NPV value <0, IRR <MARR, B / C Ratio <1 and the payback period is above the investment age. Therefore, it can be concluded that this investment is not feasible. In terms of investment time, hauling coal that uses electric conveyors has a long service life (About 15 years). But the conveyor belt can still be operated by replacing some

parts. The cost of replacing this conveyor belt is 20% of the investment value of the conveyor belt.

If the mining period can be carried out for more than 15 years, then the alternative coal hauling using an electric conveyor system has the potential to be said to be worthy of being accepted as a substitute for conventional hauling. For this reason, further analysis is needed which covers the mining of all available coal reserves to run out.

From the data provided by PT ABC, the remaining coal reserves to be excavated is 188,953,426 million tons (data as of the end of 2016). For the annual production target of 7 million tons, the remaining coal reserves above can be excavated for another 10 years. So that the total time to excavate all existing coal reserves is 25 years (calculated from 2018). The coal calculation target can be seen in table 5.

**Table 5.** Distribution of coal targets for further economic analysis

| Year | Production Target | Accumulative | Remain Reserve | Remark |
|---|---|---|---|---|
| 2016 | 4,500,000 | 4,500,000 | 188,953,426 | |
| 2017 | 5,000,000 | 9,500,000 | 184,453,426 | Actual/on progress |
| 2018 | 5,000,000 | 14,500,000 | 179,453,426 | |
| 2019 | 7,000,000 | 21,500,000 | 174,453,426 | |
| 2020 | 7,000,000 | 28,500,000 | 167,453,426 | |
| 2021 | 7,000,000 | 35,500,000 | 160,453,426 | |
| 2022 | 7,000,000 | 42,500,000 | 153,453,426 | |
| 2023 | 7,000,000 | 49,500,000 | 146,453,426 | |
| 2024 | 7,000,000 | 56,500,000 | 139,453,426 | |
| 2025 | 7,000,000 | 63,500,000 | 132,453,426 | |
| 2026 | 7,000,000 | 70,500,000 | 125,453,426 | |
| 2027 | 7,000,000 | 77,500,000 | 118,453,426 | Data for feasibility study |
| 2028 | 7,000,000 | 84,500,000 | 111,453,426 | |
| 2029 | 7,000,000 | 91,500,000 | 104,453,426 | |
| 2030 | 7,000,000 | 98,500,000 | 97,453,426 | |
| 2031 | 7,000,000 | 105,500,000 | 90,453,426 | |
| 2032 | 7,000,000 | 112,500,000 | 83,453,426 | |
| 2033 | 7,000,000 | 119,500,000 | 76,453,426 | |
| 2034 | 7,000,000 | 126,500,000 | 69,453,426 | |
| 2035 | 7,000,000 | 133,500,000 | 62,453,426 | |
| 2036 | 7,000,000 | 140,500,000 | 55,453,426 | |
| 2037 | 7,000,000 | 147,500,000 | 48,453,426 | |
| 2038 | 7,000,000 | 154,500,000 | 41,453,426 | |
| 2039 | 7,000,000 | 161,500,000 | 34,453,426 | Remain reserve |
| 2040 | 7,000,000 | 168,500,000 | 27,453,426 | |
| 2041 | 7,000,000 | 175,500,000 | 20,453,426 | |
| 2042 | 7,000,000 | 182,500,000 | 13,453,426 | |
| 2043 | 6,453,426 | 188,953,426 | 6,453,426 | |
| 2044 | | | | |

So for the next 25 years, the economic analysis becomes (Table 6):

**Table 6.** Results of advanced economic analysis

| Indicator | Analysis Result | Parameter | Status |
|---|---|---|---|
| NPV | 373.723.630 US$ | NPV > 0 | Feasible |
| IRR | 52,12% | IRR>MARR (MARR = 12%) | Feasible |
| PBP | 0,948 year | PBP < investment period (investment period = 15 years) | Feasible |
| B/C Ratio | 1,639 | B/C Ratio > 1 | Feasible |

From the analysis, it can be seen that the NPV value, IRR, B / C ratio and payback period have met the required parameters so that this investment becomes feasible to run.

## 5. Conclusion

For 25 years of mining life with a coal hauling target of 7 million tons per year, alternative hauling using electric conveyor is the right investment because investors will get the most benefits, namely the fastest break even time, the lowest coal transportation cost, which is 0.068 $ / ton.km (only 68.7% compared to hauling cost using dump trucks) and has a capacity of 31% more that has the potential to increase coal production targets which ultimately can provide greater revenue.

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