

SPONGE IRON PLANT FEASIBILITY STUDY IN KALIMANTAN, INDONESIA

Nurhadi Wibowo, Rahmat Nurcahyo and Djoko Sihono Gabriel Industrial Engineering, Faculty of Engineering, Universitas Indonesia, Kampus UI Depok, Indonesia E-Mail: <u>rahmat@eng.ui.ac.id</u>

ABSTRACT

The abundance of mineral resources in Indonesia especially iron ore and the regulations supporting mineral and coal mining to producer search that aims to estimate the feasibility of an investment and the cost of investment development of iron ore pellets processing industry in Indonesia, to evaluate the feasibility of various analysis consists of market analysis, technical analysis, organizational analysis, and financial analysis. This study analyzed the risk of financial investments and taking into account the financial resources and ability to repay the cost of principal and payment of interest on the loan from the bank with an interest rate of 14%. Capital budgeting calculations were done, resulting NPV IDR 84,589,784,996 and IRR 39,18% making investment development of iron ore pellets processing industry can be said to be feasible because the IRR is above the MARR value that is equal to 20%. Sensitivity analysis showed that the factors that affect the investmentare the selling price of raw materials and finished product supporter and a price that will be sold to the market.

Keywords: sponge iron, feasibility study, capital budgeting.

INTRODUCTION

Iron is essential metal materials that have much to contribute to the development of human civilization. In nature, the element iron ranks as the fourth largest constituent element of the earth's crust with about 5.30% percentage. Iron ore is a rock from which mineral assemblages of these rocks ferrous metals can be extracted economically. Efforts to use local iron ore to meet the needs of the national iron and steel industry is still hampered by various factors such as the potential problems, the characteristics of the ore, which is a good way of processing and environmental aspects.

Most of the ore reserves of Indonesia has a relatively low level with specific characteristics such as the presence of mineral specification containing titanium and aluminium and silicate levels were high, so it takes a special beneficiation process technology is also different with beneficiation processes that have been developed commercially. Generally, the local iron ore market (exports) in the form of raw material and without any beneficiation touch. This led to Regulation No. 4 of 2009 on the increase in value-added mineral and coal in the country.

Mining operations referred to Regulation No. 4 of 2009 it is the activities in the framework of exploitation of mineral or coal phase of activity covering general investigation, exploration, feasibility studies, construction, mining, processing and refining, transportation and sales as well as post-mining. Mining business should be able to accelerate the development of the region and encourage economic activity in the public or small and medium-sized businesses as well as encouraging the growth of supporting the mining industry.

Regulation No. 4 of 2009 on mineral and coalmining requires efforts to increase value-added mineral products in Indonesia, including iron ore feasibility of unknown prospects. It requires the calculation of the investment feasibility of the development of iron ore mineral processing industry in to consideration the feasibility of the investment.

The purpose of this study is to make the feasibility of the investment undertaking an iron ore processing plant in Kalimantan conform to the characteristics of raw material available in Indonesia in general and a discussion and analysis to assess the feasibility of an operation of an iron ore processing plant to sponge iron in that location.

LITERATURE REVIEW

Research on the exploitation of a sponge iron plant in Kalimantan is using references from several studies in several countries such as journal, entitled Engineering Economy Analysis on the Production of Iron Ore in Nigeria. To increase outside investment for mineral ore sector and to diversify the economy of Nigeria, this study uses discounted cash flow study to evaluate the micro-economic large-scale production of iron ore in Nigeria. Iron ore project in this study had an initial investment of USD 73,934 Million and has an annual expense and profit amounting USD 48,128 Million and USD 270 m. Net Present Value (NPV), Internal Rate of Return (IRR) and payback period of the project is the financial analysis of each USD 833.10 Million, 444.36% and 6 years payback (Adebimpe, 2011). Feasibility studies of mineral raw materials have one main goal; to show that the project is economically feasible if designed and operated properly (Adebimpe, 2011). The exploitation of the iron ore project includes the following process (Adebimpe, 2011):

- Construction of access roads, creating safety and economy
- Drilling and blasting of boulder
- Truck transport to the mine crushing plant
- Truck transport to the beneficiation plant crushing plant
- Beneficiation of iron ore





Mining investment analysis is particularly complex because of the uncertainty of the project, such as the price and quality of the minerals, the physical structure of deposits and mineral deposits. Economic analysis should be made to answer two important questions (Adebimpe, 2011):

- Does the project meet the investment objectives of the company?
- How does this project compare to other investment opportunities?

Analysis of the data used in this study are:

- Net Present Value (NPV)
- Internal Rate of Return (IRR)
- Discounted Payback Period (DPP)

In exploiting iron ore, this study uses Mine Economic Investment Model to estimate the range of costs including:

- Equipment Cost
- Maintenance Cost
- Labour Cost
- Supplies Cost
- Personnel Calculation

The purpose of engineering economic studies is to determine whether a project is also economically feasible technically. Sensitivity analyses were performed on iron ore project is to determine the impact on the profitability of the project. There are several factors that affect the economic gains in irone reprojects in Nigeria. The second factor that affects the sensitivity is the initial investment and the price of iron and also influence government policy to stimulate the growth of solid mineral sector (Adebimpe, 2011).

Other studies on iron ore to become a reference in this study is the study of the feasibility study of mining in South Africa, in the study of the feasibility set has the mineral ingredients of the main goals is to show that the project is economically visible if the project is designed, constructed and operated properly. Feasibility study including estimated ore reserves, mining methods, mineral processing concept and scale of the project capacity (Rupprecht, 2004). To get the integrated and iterative, in a study to conduct a full feasibility study requires a detailed study of them is (Rupprecht, 2004):

- Geological Data
- Resource Estimation
- Estimated Reserves
- Geotechnical Data
- Mine Design
- Design Process and Logistics
- Infrastructure
- Construction, Location and Permits
- Environment
- Capital and Operational Costs
- Evaluation and Marketing

Feasibility study is needed to process mining evaluation is an important tool in the decision-making process, which enables the mining executives, senior consultants and investors to understand the inherent value of the project. This literature review work to be done on the various types of feasibility study is useful as a handle and there may be slight differences in the actual conditions (Rupprecht, 2004).

Other studies are also one of the references used in this study is about the development of economical culation case studies new unit processing of iron ore pellets in Odisha. The purpose of this paper is to study the techno-economic parameters to build iron ore pellet processing plant in Odisha (Naik, 2012). The study is based on data available from various sources and in various aspects of project planning. Some secondary informationwas also collected from a variety of sources to prepare papers covering (Naik, 2012):

- Pellet manufacturing company's annual report.
- Status of the iron & steel sector
- Status of raw materials
- Import and export statistics of the Ministry of Commerce
- Information about specific state policies and incentives that apply

To build iron ore pellet processing plant in India industrial license is not required from GOI, but must enter information in the form Entrepreneurs Industrial Memorandum to the Secretariat for Industrial Approval; include the following information (Naik, 2012).

- Export-Import Policy
- Incentives Locations
- Capital Investment Subsidy

Other studies are used as a reference is the economic analysis of investment research on the mining industry in Belgium. This study mentions basically investing in the processing of mineral resources is no different from other investment models. Some of the things that specific characteristics that must be considered in the analysis of which can affect the final result later. Some specific things that are (Radev, 2003):

- a) The period of time the use of mineral resources in geologically is between 8-12 years.
- b) Social conditions and political environment of the area of mineral processing
- c) Cannot be renewed mineral resources and energy resources available.
- d) Policies used during the process of mining and mineral processing.

Depletion is one of the important factors that must be considered as well. Depletion is the residual reserves of mineral and energy resources that have been made mining (Radev, 2003). There are several methods of depletion are used in the process include the cost of mining depletion and the rate of depletion. After getting



estimates and data required for economic proposals for mining and energy, the next step is to determine the advantages of the project life cycle using accounting methods. Net cash flow is the best indicator in the assessment of an investment. Cash flow calculation is an estimation inflows and outflows of the project period per unit time. Net cash flow is the difference between cash inflows from the sale of operating costs and capital costs. Some investment projects generate cash flow turns negative into a positive and in line with the start of production (Radev, 2003). Net cash flow is different from the calculation of profit and loss, three things that distinguish the two is the cost of depreciation, cost of reserve/inventory and cost of capital. Some of the methods of analysis used in the mining industry including the Accounting Rate of Return (ARR), Payback Period (PP), Net Present Value (NPV) and Internal Rate of Return (IRR). From the above explanation can be drawn some conclusions on the economic analysis of manufacturing process in industries such as mining (Radev, 2003):

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- a) There is no Acceptable Rate of Return is common in the mining industry investment.
- b) There is no method that can evaluate this project for sure. Actor's analysis should use some possibility of some value to generate the corresponding IRR of the project.

METHODS

Iron Ore Processing Industry development is planned is located in Kalimantan. The consideration in the determination of this location is, inventories of raw materials, marketing of products, utilities, labor, geographical location, and transportation. Another consideration is the area currently under development by the Ministry of Industry. Iron Ore Processing Industry development is planned in Kalimantan, which is an area of the industry for mines with a production capacity of 50,000 tons per year of raw materials. Production processes in the manufacture of iron ore pellets will be the first sponge iron refining process/beneficiation of raw materials in comminution and magnetic separation, due to the local iron ore raw materials are still many impurities which would lead to lower levels of iron in the material standard so that the standard product manufacture sponge iron will be difficult to achieve if there are impurities in the raw materials.

The following are steps in the process for the processing of iron ore to sponge iron.

- a) Beneficiation Process
- Crushing Process; The equipment used is Jaw Crusher
- Secondary Crushing Process; The equipment used is Hammer Crusher
- Grinding Process; The equipment used is Ball Mill
- Magnetic Separation Process; The equipment used is Magnetic Separator 1000 and 7000 G
- b) Peletization Process; The equipment used is Disc Pelletizer

c) Reduction Process; The equipment used is Rotary Kiln with temperature 1300°C

After the purification process/beneficiation completed, the mixing process is carried iron ore concentrate that has been purified by using a binder such as bentonite and lime. Function of bentonite and lime is to draw impurities remnants that still exist at the time of the reduction so that the levels of iron in the sponge iron can be increased. Once the process is done next peletization reduction process using Rotary Kiln to get the desired iron content. This study meets the requirements for future commercialization of the industry, sponge iron production capacity to be improved to 50,000 tons/year of raw materials. Prices of sponge iron products with levels of > 80% in the current conditions is at IDR 3,000,000 per ton. Projected annual revenue includes estimates of the number of good sales in units and dollars. Projected annual costs include the total cost of raw materials, labor, and other costs. Basic calculations such as maintenance costs, increase operating costs, depreciation of buildings and equipment on the research information was also obtained from similar companies like Smelter in South Kalimantan in 2010. Assumed economic life for 10 years. which is determined based on the economic life of the equipment, the minimum rate of investment is assumed at 14% per year with a 10-year loan term and repayment period of 12 months. Depreciation calculation method used is the method of Straight Line (SL), and assumed salvage value on equipment investment is zero. MARR company set profit goals of the company describes the policies are usually based on top / senior management of the opportunities that will come with the company's financial situation. If the MARR is too high then the investment with a good rate of return will be rejected and if it is too low MARR feared unfavorable proposals will be accepted. MARR on this project is set at 20% with respect to the other exit costs for investments and investment risk factors. Exchange rate assumptions used is Indonesian Rupiah. The exchange rate used for the purchase of machinery and equipment is assumed that IDR 10,000/US \$ during the operational period of the project or for 10 years. Having established the necessary assumptions. subsequent financial reporting is indispensable in analyzing the feasibility of the investment.

To determine the level of profitability of the production goes on iron ore pellet making plant carried out an analysis using the Net Present Value (NPV), Internal Rate of Return (IRR), and Payback Period (PP). Calculations were performed using the income statement, cash flow and balance sheet flow. Income statement is the amount of income earned during the company's operating activities less costs to be incurred include loan repayment costs, depreciation, interest expense, income taxes and insurance costs. Stream of cash flows is a result of cash inflows less the cash out for any period of the year. Where that includes cash income is cash out while including, among others, operational and maintenance costs, capital costs, depreciation and insurance costs as well as income





tax. Usage fee does is use of bank loans by 70% and 30% of its own capital issued during the company's investment activities and operations take place. In this research, the analysis carried out during the life of the project, which is a 10-year economic life of the medium used.

RESULTS

Based on calculations of data analysis sponge iron production iron ore raw materials locally, it can be

seen of the investment business based on the total investment in land, buildings and equipment. Total investment of land, buildings and equipment can be seen in Table-1 of IDR 28,104,100,000 where necessary land area of 3 ha with a price per m^2 of IDR 300,000, production building area of 2000 m^2 and 1000 m^2 warehouse products at a price per m^2 building is IDR 5,000,000 is the result of information obtained from peers.

Table-1. Land ac	quisition, building	g and equipment cost.
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Item	Volume	Cost(IDR)	Total (IDR)
Land	3 hectare	3,000,000,000	9,000,000,000
		Building	
Production site	2,000 m ²	5,000,000	10,000,000,000
Warehouse	1,000 m ²	5,000,000	5,000,000,000
Office building	200 m ²	3,500,000	700,000,000
Electrical and water	1 pck	3,000,000,000	3,000,000,000
Office equipment	1 pck	54,100,000	54,100,000
Water pond and drainese pond	120 m ³ /d	350,000,000	350,000,000
		Total building cost	19,104,100,000
		Total land and building cost	28,104,100,000

Table-2. Production equipment investment cost.

Equipment	Unit	Capacity	Price (IDR)	Total (IDR)
Jaw crusher	1	65 ton/hour	105,000,000	105,000,000
Hammer crusher	1	65 ton/hour	260,000,000	260,000,000
Balmill	2	32 ton/hour	1,020,000,000	2,040,000,000
Magnetic separator 1000G	1	65 ton/hour	63,000,000	63,000,000
Magnetic separator 7000G	1	65 ton/hour	100,000,000	100,000,000
Vibrating Screen	4	180 ton/hour	60,000,000	240,000,000
Disc Pelletizer	2	18 ton/hour	230,000,000	460,000,000
Rotary kiln	1	100 ton/ day	4,300,000,000	4,300,000,000
Thickener	1	1000 ton/hour	420,000,000	420,000,000
Belt conveyor	100 meter	100 ton/hour	1,800,000	180,000,000
Slurry pump	3	40 m3/hour	160,000,000	480,000,000
Genset 1825	1	1825 Kva	1,200,000,000	1,200,000,000
Dry mixer plant + silo	1	60m3/h	1,000,000,000	1,000,000,000
			Total	10,848,000,000

Total investment of sponge iron production iron ore raw materials locally based on the total cost of the equipment used in the production of sponge iron made from local iron ore is IDR 10,848 billion as outlined in Table-2. Equipment prices derived from the bid price offered by the seller of the equipment China and partially based on information from equipment makers in Bandung. The total investment for the procurement of material handling and transportation as a support in the process of making sponge iron made from local iron ore based on the following Table-3 description in which there are many material handling and transportation required. Amount of



material handling and transportation requirements have been adjusted to the amount of production that will be performed is 50,000 t/y. The prices obtained in the

Table-3 total material handling and transportation investments based on prices obtained from the market and experts.

Туре	Unit	Price	Total
Forklift	2	350,000,000	700,000,000
Dump truck	4	500,000,000	2,000,000,000
Wheel loader	1	1,500,000,000	1,500,000,000
Operational vehicle	5	200,000,000	1,000,000,000
Excavator	1	1,000,000,000	1,000,000,000
crane	1	1,000,000,000	1,000,000,000
		Total	7,200,000,000

Table-3. Material handling and transportation cost.

Needs of the operational costs in the manufacturing of local iron ore pellet to sponge iron consists of operating costs of raw materials consisting of low-grade iron ore and iron ore of high grade binder as well as mixtures thereof, the need of raw materials obtained from the simulation results obtained from material balance research has been done on the model. Fuel operating costs adjusted for heavy equipment specifications based on the fuel consumption per day. Operational costs of production equipment power needs to come from the standard specification equipment and operating costs are also personnel that are tailored to a type of several mining companies that the average salary is above minimum wage South Kalimantan which are described in the following Table-5.

Table-4.	Raw	material	and	fuel	for	operational	cost.
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Raw material cost							
D () I	Daily	needs	Annual	Price per	Raw material		
Raw material	10% losses	No losses	needs	tonnage (IDR)	cost per year (IDR)		
Iron ore, fe < 60	134.00	148.89	40,200	450,000	18,090,000,000		
Iron ore, $fe > 60$	34.00	37.78	10,200	600,000	6,120,000,000		
Bentonit	3.00	3.33	900	3,000,000	2,700,000,000		
Limestone	2.00	2.22	600	500,000	300,000,000		
Coal	22.00	24.44	6,600	700,000	4,620,000,000		
				Total raw material	31,830,000,000		
		F	uel cost				
Equipment	Unit	Usage (litre/hour)	Daily needs (litre)	Cost (price per litre, IDR)	Fuel cost (IDR)		
Forklift	2	15	480	10,000	1,440,000,000		
Dump truck	4	2	128	10,000	384,000,000		
Wheel loader	1	35	560	10,000	1,680,000,000		
Operational vehicle	5	2	100	10,000	300,000,000		
Excavator	1	35	560	10,000	1,680,000,000		
				Total fuel cost	5,484,000,000		



6,388,164,000

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kWh per year Equipment Unit KW Work hour cost per year (IDR) Jaw crusher 1 55 8 132,000 120,780,000 Hammer crusher 1 280 8 672,000 614,880,000 2 Balmill 400 3,840,000 16 3,513,600,000 Magnetic 1 3 16 14,400 13,176,000 separator 1000G Magnetic 1 30 16 144,000 131,760,000 separator 7000G Vibrating Screen 4 6 16 115,200 105,408,000 1 11 **Disc Pelletizer** 16 52,800 48,312,000 1 6 Rotary kiln 16 28,800 26,352,000 1 8 Thickener 16 38,400 35,136,000 3 Belt conveyor 100 meter 16 1,440,000 1,317,600,000 Slumy pump 1 55 16 264,000 241,560,000 Dry mixer plant + 1 50 16 240,000 219,600,000 silo

Table-5. Electrical cost.

Table-6. Employment cost.

Total

Position	Manpower	Salary per month (in million IDR)	Total per month (in million IDR)
General Manager	1	25,000,000	25,000,000
Production Manager	3	15,000,000	45,000,000
QC Manager	3	15,000,000	45,000,000
Engineering & maintenance manager	3	15,000,000	45,000,000
Office Staff	20	5,000,000	100,000,000
Production Supervisor	12	6,000,000	72,000,000
Logistics manager	3	15,000,000	45,000,000
Operator	30	3,500,000	105,000,000
Technician	20	4,500,000	90,000,000
		Total permanent staff	377,000,000
		Total part time staff	195,000,000
		Total per month	572,000,000
		Total per year	6,864,000,000

DISCUSSIONS

Initial working capital for iron ore pellet manufacturing activities to sponge iron in the first year (initial working capital) obtained from 4 months prorated from the total operating cost of IDR 18,799,551,000. Sources of funds included in the initial working capital needs total investment and operational costs with the scheme 30% equity and 70% equity loan from the bank. Income received by the company from selling products that have a sponge iron production capacity of 50,000 t / y of raw materials which can produce 32,000 t/ y of finished products sponge iron with a selling price of IDR 3,000,000 and assumed selling price increased by 5% each year.

In the analysis of the Net Present Value (NPV), the investment is feasible to run if it meets the criteria of the magnitude of the NPV is greater than zero, if the NPV equal to zero, the investment does not provide profit or loss. Whereas if the NPV is less than zero means that the investment development of iron ore pellets processing industry is said to be feasible to run, because when



executed will result in losses to investors. NPV calculations result in NPV of IDR 84,589,784,996 which means the investment is worth it to run.

In the analysis of the Internal Rate of Return of investment development of iron ore pellets processing industry is feasible if it meets the criteria of magnitude greater than the current IRR desired returns, if the IRR is less than the desired flow return on investment means that activities can be said to be not feasible. On this analysis, the current value is the desired minimum return of 14%; this figure is derived from the investment credit interest rate of Bank Mandiri in April 2013. From the results of these calculations obtained an IRR of 39.18% which results IRR greater than the lending rate and the MARR of 20% set, so it can be said to be well worth the investment. Period of return (payback period) is usually expressed in term time per year. In this research, payback period (payback period) is obtained from the results of the calculations have been done is 2 years 6 months.

Based on the analysis of sensitivity to the price of raw materials and auxiliary raw material price stories by 20% decline from the current IRR is equal to 30.07% with a NPV of IDR 53,408,163,041, for a larger increase of 50% obtained with the IRR 16.10%, NPV IDR 6,635,730,107, the IRR is below the MARR of 20% but still above the bank rate used is 14%. For the decline in raw material prices and the support of 20% obtained an IRR of 48.47% with a NPV of IDR 115,771,406,952 while for the decline in raw material prices and the support of 50% obtained an IRR of 63.14% and a NPV of IDR 162,543,839,885.

Table-7. Increase and decrease in raw material cost 10%-50%	ó.
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	0	10%	20%	30%	40%	50%
NPV	84,589,784,996	68,998,974,018	53,408,163,041	37,817,352,063	22,226,541,085	6,635,730,107
IRR	39.18%	34.62%	30.07%	25.51%	20.87%	16.10%
Payback Period	2 years 6 months	3 years 0 months	3 years 4 months	3 years 8 months	4 years 4 months	5 years

	-50%	-40%	-30%	-20%	-10%	0
NPV	162,543,839,885	146,953,028,907	131,362,217,930	115,771,406,952	100,180,595,974	84,589,784,996
IRR	63.14%	58.12%	53.24%	48.47%	43.79%	39.18%
Payback Period	1 years 6 months	1 years 8 months	2 years 0 month	2 years 3 months	2 years 4 months	2 years 6 months

Sensitivity analyzes were obtained by using the selling price increases and decreases selling price by 10% - 20%. To increase selling prices by 10% sensitivity analysis results obtained for the value of IRR is 50.22% and NPV of IDR 126,449,094,932 there is an increase IRR and NPV of the current conditions. To increase the selling price by 20% IRR values obtained 60.93% with NPV of IDR 168,308,404,868. For sensitivity analysis of the

decline in the selling price by 10% IRR obtained a reduction of 27.48% with a NPV of IDR 42,730,475,060, a decline in the IRR and NPV of the current conditions. For the price reduction of 20% to a decline of 14.30% IRR with NPV IDR 871,165,125 where the value is below the value of MARR of 20% and approached the bank interest rate that is used today is 14%.

Table-8. Increase	and dec	rease in s	selling j	orice	10%-20%.
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	-20%	-10%	0	10%	20%
NPV	871,165,125	42,730,475,060	84,589,784,996	126,449,094,932	168,308,404,868
IRR	14.30%	27.48%	39.18%	50.22%	60.93%
Payback Period	Not feasible	3 years 6 months	2 years 6 months	2 years 1 month	1 years 7 months

CONCLUSIONS

Conclusions of this research will focus on the use of NPV, IRR, and Payback Period. The results of these calculations can help to determine the feasibility of an investment is executed or not from the financial aspect. Based on the analysis carried out the importance of the conclusion:

- The results of the feasibility analysis investment industry development of local iron ore pellet to sponge iron from the financial aspects of the construction industry that the project is feasible Torun on the following considerations:
- Positive NPV IDR 84, 589, 784, 996
- IRR of 39.18% which is greater than the specified MARR of 20%
- Investment payback period for 2 years 6 months





With a sensitivity analysis of the selling price and the price of iron ore raw materials can be said to be very influential on the selling price of the feasibility of the project, due to the decrease in sales price by 20% with a decrease in the normal production capacity NPV IDR 871,165,125, IRR to 14.30% while the mean value of IRR MARR below and can be said to be not feasible

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