THE INDONESIAN JOURNAL OF
BUSINESS ADMINISTRATION
Vol. 2, No. 14, 2013:1695-1705

INVESTMENT FEASIBILITY STUDY FOR IRON ORE MINING PROJECT (CASE STUDY : PT INA TOUNA MINING)

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Abstract— With increasing industry sector in Indonesia, lead to higher demand for industry raw materials especially in natural resources industry. PT. Ina Touna Mining, a national private company in Indonesia is conducting mineral exploration of iron ore in Tojo, Tojo Una Una regency, Central Sulawesi province for 8 years concession period. In its efforts to get the licence in conducting its business, author create the investment feasibility study which will calculate the cash flow in the 8 years concession period. To calculate the investment feasibility study, author uses capital budgeting approach, sensitivity analysis and risk handling management strategy.

Keywords: iron ore, feasibility study, capital budgeting, sensitivity analysis, risk management

1. Introduction

PT. Ina Touna Mining, a national private company in Indonesia is conducting mineral exploration of iron ore in Tojo, Tojo Una Una regency, Central Sulawesi province. This activity is expected to continue up to the stage of exploitation, so PT Ina Touna Mining expects to take part in providing iron ore domestic consumption and also for the export.

In its efforts to improve the exploration licences into exploitation licences, therefore author creates the investment feasibility study, which will examine the activities of technical and non-technical aspects to be used as a basic reference in assessing whether a project is feasible to developed or not.

PT Ina Touna Mining has five business scope in conducting iron ore mining business, such as :

a. Mining and Geology
   To evaluate all geological data for mining plan design, consist of :
   - Global, regional, and local geologic situation in mining plan area
   - Shape and spread of iron ore
   - Study of geological structure in the form of geology cross section and structure contour maps, scale 1 : 1000
   - Calculation and classification of iron ore
   - Cartography deployment of iron ore, scale 1 : 5000

b. Iron Ore Quality Control
   To determine iron ore quality based on its spread, consist of :
   - Provide recommendations in iron ore handling and processing
   - Study of the possibility of iron ore exploitation
   - Design and prepare plant and stockpile plan (layout plant)
   - Selection of necessary equipment

c. Open Mine Design
   To generate open mine design to be applied in existing iron ore mine area, consist of :
   - Determine open mine boundaries
   - Determine mining methods
   - Planning production schedule and mine lifetime
   - Planning waste disposal
   - Determine mining equipment and tools
   - Planning supporting facilities and infrastructure

d. Transportation
   To evaluate the possible transportation of iron ore from production area to consumer in terms of technical and economic aspects, consist of :
   - Evaluate transport technical feasibility and method of transport

e. Financial Feasibility Study
   To calculate investment cost and iron ore feasibility stud

The issue that planned to be raised only limited in financial study, such as :

1. Operational cost
   Consist of costs and resources associated with pre-mining activites until post-mining activities, such as :
   - Pre-mining cost
   - Infrastructure cost
   - Equipment cost
   - Labour cost
   - Other fixed and variable cost that affect the business
2. Revenue stream
   The revenue stream is a form of revenues which PT Ina Touna Mining will get in this business. PT Ina Touna Mining only gets a single revenue from the sales of its iron ore product. To get the optimum revenue, PT Ina Touna Mining should know at what price they will sell their product. It is necessary to use the forecast techniques in order to get the projected price for the next years. Author plans on using a crystal ball predictor to forecast the iron ore price.
3. Financial evaluation
   From financial evaluation, PT Ina Touna Mining will get whether the financial performance is feasible or not. This financial evaluation will be calculated using capital budgeting techniques, such as :
   a. Payback Period, *acceptable if value > concession period*
   b. Net Present Value, *acceptable if value > 0*
   c. Internal Rate of Return, *acceptable if value > cost of capital*
   d. Profitability Index, *acceptable if value > 1*
4. Sensitivity analysis and risk management

2. Business Issue Exploration

A. Conceptual Framework

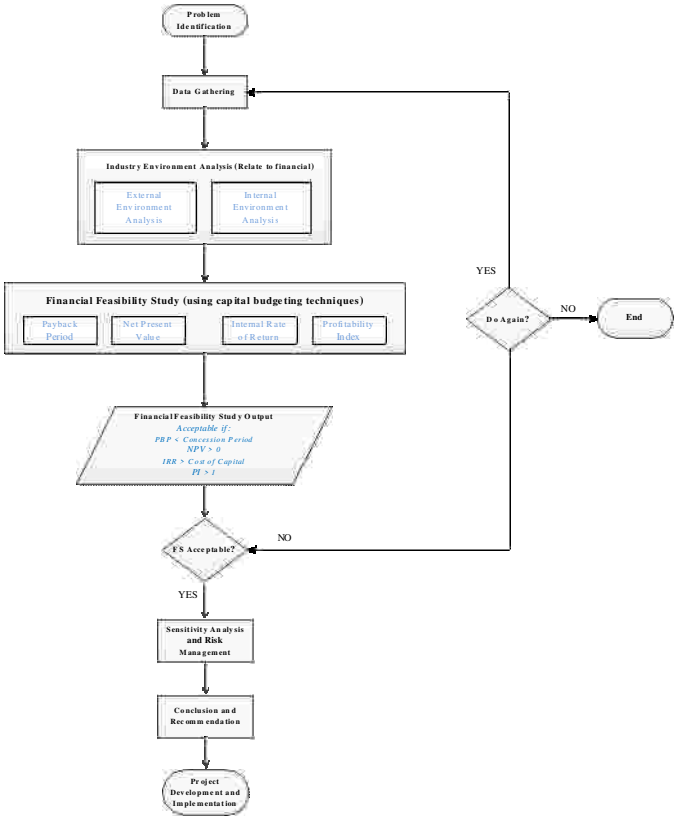

Figure 1 : Conceptual framework

B. Method of Data Collection and Analysis

Based on conceptual framework, author will analyze every factor contained in the framework. The problem identification is obtained from company business issue. The next step is to gather industry environment data which consist of external environment and internal environment. External environment is obtained through PESTEL analysis, which factors that affecting the financial situation for PT Ina Touna Mining in conducting its business. Internal analysis consist of business process, is obtained from estimation through other companies that has been conducting iron ore mining business as a benchmark. After the data has been gathered, the next step is to calculate the investment feasibility with capital budgeting techniques. As for investment feasibility study is accepted, next step is to analyze the variables which possibly have significant impact to the financial performance. Based on the sensitivity analysis, risk management handling can be determined based on author's judgement to weight and rating the variables and giving solution to the risk that possibly to occurred.

C. Analysis of Business Situation

Based on the issue exploration, PT Ina Touna Mining will get the data needed to calculate the financial feasibility study. The data can be seen on tables below.

Table 1. Cash Planning

Year	Production (tons)	Local Price	Sales Revenue	Operating Expense
0	0	0	IDR -	IDR (30,592,800,000.00)
1	105800	IDR 477,820.37	IDR 50,553,395,498.67	IDR (36,989,750,353.71)
2	168000	IDR 511,418.88	IDR 85,918,371,840.00	IDR (57,089,202,491.23)
3	192000	IDR 497,792.64	IDR 95,576,186,880.00	IDR (64,808,319,609.52)
4	192000	IDR 503,301.12	IDR 96,633,815,040.00	IDR (64,997,582,749.72)
5	192000	IDR 501,078.40	IDR 96,207,052,800.00	IDR (65,131,347,713.17)
6	192000	IDR 501,980.37	IDR 96,380,231,680.00	IDR (65,307,742,499.83)
7	192000	IDR 501,626.03	IDR 96,312,197,120.00	IDR (65,484,836,173.35)
8	152000	IDR 501,754.88	IDR 76,266,741,760.00	IDR (52,925,422,861.55)

Table 2. Depreciation Expence

Year	Depreciation Expense
0	IDR -
1	IDR 633,500,000.00
2	IDR 633,500,000.00
3	IDR 633,500,000.00
4	IDR 633,500,000.00
5	IDR 465,500,000.00
6	IDR 389,500,000.00
7	IDR 389,500,000.00
8	IDR 389,500,000.00

The calculation for depreciation expense is using straight line depreciation method. This method is the most common method that estimates the salvage value at the end of the period during its useful life. PT Ina Touna Mining uses all of its equity to funds the iron ore business, therefore to calculate the cost of capital, author use capital asset pricing model (CAPM) approach. The capital asset pricing model links nondiversifiable risk to expected return. The equation for capital asset pricing model is :

$r_i = R_F + (ß_i \times R_p)$

where,

r_i = required return for asset i

R_F = risk free rate of return

$ß_i$ = beta coefficient or index of nondiversifiable risk for asset i

R_p = risk premium

PT Ina Touna Mining cost of capital or the minimum required return calculation can be seen below.

$r_i = R_F + (ß_i \times R_p)$

$r_i = 5.25\% + (1.47 \times 8.80\%) = 18.19\%$

Therefore, the minimum required return for PT Ina Touna Mining in conducting its business is 18.19%.

3. Business Solution

D. Alternative of Business Solution

1) Payback Period

Payback period is commonly used to evaluate proposed investments. The payback period is the amount of time required for the firm to recover its initial investment in a project, as calculated from cash inflows. The payback period can be found by dividing the initial investment by the annual cash inflow. Although popular, the payback period is generally viewed as an unsophisticated capital budgeting technique, because it does not explicitly consider the time value of money. To calculate the payback period, the data can be seen on table 3.3 below.

Table 3. Cumulative Cashflow

Year	Cashflow		Cumulative Cashflow	
0	IDR	(30,592,800,000.00)	IDR	(30,592,800,000.00)
1	IDR	5,928,394,436.86	IDR	(24,664,405,563.14)
2	IDR	12,179,626,598.32	IDR	(12,484,778,964.82)
3	IDR	12,973,523,397.26	IDR	488,744,432.45
4	IDR	13,329,118,872.87	IDR	13,817,863,305.32
5	IDR	13,000,378,983.06	IDR	26,818,242,288.38
6	IDR	12,954,184,069.28	IDR	39,772,426,357.66
7	IDR	12,853,804,057.66	IDR	52,626,230,415.31
8	IDR	9,788,269,838.92	IDR	62,414,500,254.23

According to table 3, the positive value acquired in year 4, so the payback period can be calculated with the equation below.

Payback period = (P-N) / P + Ny

Where,

Ny = The number of years after initial investment at which the last negative value of cumulative cash flow occurs

N = The value of cash flow at which the last negative value of cumulative cash flow occurs

P = The value of cash flow at which the first positive value of cumulative cash flow occurs

PT Ina Touna Mining payback period = (12,973,523,397.26 – 12,179,626,598.32) / 12,973,523,397.26 + 3 = 3,06 years.

2) Net Present Value

When firms make investment, they are spending money that they obtained, in one form or another. Investor expect a return on money that they give to firms, so firm should undertake an investment only if the present value of the cash flow that the investment generates is greater than the cost of making the investment in the first place.

The net present value (NPV) is found by subtracting a project's initial investment (CF0) from the present value of its cash inflows (CFt) discounted at a rate.

NPV = Present value of cash inflows – initial investment

$$?? \quad ? \; ? \quad ? \frac{??}{?? \; ? \; ??^{?}} ? \; \#\& \; ?$$

To calculate the NPV for PT Ina Touna Mining, the required return used for discounting the cashflow into present value of cashflow is 18.19% (based on CAPM model). Therefore, the NPV calculation can be seen on table 4 below.

Table 4. NPV Calculation

Year	Cashflow	DF 18.19%	PV of Cashflow
0	(IDR 30,592,800,000.00)		
1	IDR 5,928,394,436.86	0.846123906	IDR 5,016,156,259.51
2	IDR 12,179,626,598.32	0.715925665	IDR 8,719,707,271.32
3	IDR 12,973,523,397.26	0.60576182	IDR 7,858,865,149.01
4	IDR 13,329,118,872.87	0.512549558	IDR 6,831,833,983.39
5	IDR 13,000,378,983.06	0.433680434	IDR 5,638,009,999.71
6	IDR 12,954,184,069.28	0.366947383	IDR 4,753,503,942.47
7	IDR 12,853,804,057.66	0.310482953	IDR 3,990,887,042.38
8	IDR 9,788,269,838.92	0.262707049	IDR 2,571,447,485.59
Total PV of Cashflow			IDR 45,380,411,133.37
Total Initial Investment (Year 0)			(IDR 30,592,800,000.00)
Net Present Value (NPV)			**IDR 14,787,611,133.37**

Based on the calculation above, PT Ina Touna Mining get a positive NPV which is IDR 14,787,611,133.37. Therefore the investment is feasible to be accepted. According to Gitman, if the NPV is greater than 0, the firm will earn a return greater than its cost of capital, so the project can be accepted.

3) Internal Rate of Return

The internal rate of return (IRR) is one of the most widely used capital budgeting techniques. The internal rate of return (IRR) is the discount rate that equates the NPV of an investing opportunity with IDR 0 (because the present value of cash inflows equals the initial investment). It is the rate of return that the firm will earn if it invest in the project that receives the given cash inflows. Mathematically, IRR is the value of r in equation that causes NPV to equal IDR 0.

$$? \quad \frac{??}{?? ? \ ?? \ ?^{?}} ? \ ?? ?$$

IRR calculation can be seen on table 5 below.

Table 5. IRR Calculation (1)

Year	Cashflow	18.19% required return		32% required return	
		DF	PV	DF	PV
0	(IDR 30,592,800,000.00)				
1	IDR 5,928,394,436.86	0.846123906	IDR 5,016,156,259.51	0.75757576	IDR 4,491,207,906.71
2	IDR 12,179,626,598.32	0.715925665	IDR 8,719,707,271.32	0.57392103	IDR 6,990,143,823.65
3	IDR 12,973,523,397.26	0.60576182	IDR 7,858,865,149.01	0.43478866	IDR 5,640,740,826.51
4	IDR 13,329,118,872.87	0.512549558	IDR 6,831,833,983.39	0.32938535	IDR 4,390,416,444.03
5	IDR 13,000,378,983.06	0.433680434	IDR 5,638,009,999.71	0.24953435	IDR 3,244,041,167.71
6	IDR 12,954,184,069.28	0.366947383	IDR 4,753,503,942.47	0.18904118	IDR 2,448,874,204.36
7	IDR 12,853,804,057.66	0.310482953	IDR 3,990,887,042.38	0.14321301	IDR 1,840,832,006.67
8	IDR 9,788,269,838.92	0.262707049	IDR 2,571,447,485.59	0.10849471	IDR 1,061,975,465.89
Total PV of Cashflow			IDR 45,380,411,133.37		IDR 30,108,231,845.52
Total Initial Investment (Year 0)			(IDR 30,592,800,000.00)		(IDR 30,592,800,000.00)
Net Present Value (NPV)			**IDR 14,787,611,133.37**		**(IDR 484,568,154.48)**

Because IRR is the discount rate that equates the NPV of an investing opportunity with IDR 0, so after another value that makes NPV negative will be interpolated. The interpolation can be seen on table 6 below.

Table 6. IRR Calculation

R1	0.1819
R2	0.32
NPV1	IDR 14,787,611,133.37
NPV2	(IDR 484,568,154.48)

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)22 ? ?⁇6@ ? ?? ⁇??2

PT Ina Touna Mining IRR is 31.56%. According to Gitman, if IRR is greater than the cost of capital, accept the project. If IRR is less than the cost of capital, reject the project. PT Ina Touna Mining cost of capital using CAPM model is 18.19%, therefore the iron ore mining business feasible to be accepted because the IRR = 31.56% is greater than its cost of capital = 18.19%.

4) Profitability Index

A variation of NPV rule is called the profitability index (PI). For a project that has an initial cash outflows followed by cash inflows, the profitability index is simply equal to the present value of cash inflows divided by the initial cash outflow. The equation can be seen below.

The decision rule to invest is when the index greater than 1.0. According to the calculated profitability index above, iron ore mining business is acceptable because PI = 1.48 > 1.0. This shouldn't be surprising because the project has a positive NPV. Profitability index will determine the decision if there is more than one projects, which indicates the bigger PI is preferred over the lower PI.

E. Analysis of Business Solution

1) Sensitivity Analysis

Sensitivity analysis shows how sensitive a business decision faced by the exchange value of variables affecting the business itself. In order to make sure an investment decision keep on track, so every decision should be followed by sensitivity analysis. Sensitivity analysis describes how far a decision will strong enough if it faced with the exchange variables that affecting the financial or business performances. This sensitivity analysis in PT Touna Mining investment project is done by changing the value of one variable and see how the effect on this alternate investment decision in this iron ore business, whether it will significantly affect or not. Author will analyze the five variable that possible to have the significant impact which is variable iron ore production, variable exchange rate USD – IDR, variable operating expense, variable cost of capital, and variable retention for growth. After plotting the data based on the assumed valuation, the sensitivity analysis spider can be seen on figure 2 below.

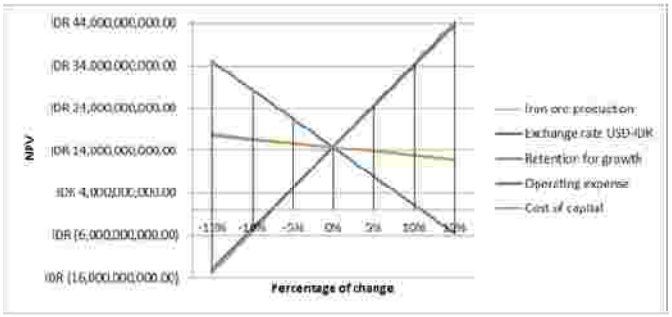

Figure 2 : Sensitivity analysis spider

From the figure 2 above, there are two variables that significantly affect the business, which is variable iron ore production and variable exchange rate USD – IDR. This two variables are considered significant because the curves are the most vertical compared to the variable operating expense, variable cost of capital, and variable retention for growth. For the analysis, author ranks the variables based on the sensitivity figure above from the most affecting variables to less affecting variables as follows :

- Iron ore production gives impact for every 1% increase in it will increase NPV as IDR 1,981,630,897.33
- Exchange rate USD – IDR gives impact for every 1% increase in it will increase NPV as IDR 1,917,227,893.17
- Operating expense gives impact for every 1 % increase in it will decrease NPV as IDR 1,352,455,232.28
- Cost of capital gives impact for every 1% increase in it will decrease NPV as IDR IDR 192,299,458.36
- Retention for growth gives impact for every 1% increase in it will decrease NPV as IDR 184,775,745.94

2) Risk Management

From the sensitivity analysis, PT Ina Touna Mining has five risk that potentially to happened, are summarized in table 3.11 below.

Table 7. List of Risk

No	Risk
1	Decreasing of iron ore production
2	Exchange rate (USD - IDR) fluctuation
3	Increasing of operating expenses
4	Increasing of cost of capital
5	Increasing of retention for growth

In order to manage the risk on PT Ina Touna Mining iron ore business process, there are three alternative act that can be chosen, which is :

1. Avoid the risk
   It means that the company try to avoid this risk at all, for example avoid the source of risk. In general, this act is done if there is any high risk but there is no significant benefits achieved.
2. Accept the risk
   It means that the company accept the risk because the risk is not on only give a less effect to the business performance. The business still sustain if this type of risk happened.
3. Minimize the risk
   It means that the company do an act with its resources to minimize the risk with consideration.

To measure the risk, author uses rating to rank the risk that may arised. The rating is divided into two categories which is possibility rating and consequence rating, can be seen on table 8 and 9 below.

Table 8. Possibility Rating

Rating		Criteria	
		Qualitative	Quantitative
E	Very High	Very likely to occurred	> 80%
D	High	Likely to occurred	> 60% - 80%
C	Moderate	Equal chances to occurred	> 40% - 60%
B	Low	Less likely to occurred	> 20% - 40%
A	Very Low	Not likely to occurred	< 20%

Table 9. Consequense Rating

Rating	Criteria
1	Not Important
2	Minor
3	Medium
4	Major
5	Extreme

To simplify the measurement of both ratings, author creates a matrix to determine the risk level. The example for the matrix can be seen on table 10 below.

Table 10. Risk Measurement Matrix

		Consequence				
		1	2	3	4	5
Probability	E	T	T	E	E	E
	D	M	T	T	E	E
	C	R	M	T	E	E
	B	R	R	M	T	E
	A	R	R	M	T	T

Description :
E = Extreme risk
T = Major / high risk
M = Moderate / medium risk
R = Low risk

To measure the risk that occurred during the implementation, author analyzes the possibility to happen based on judgment considering the internal and external business situation and the consequence of the risks if occurred to affect the company performances in conducting its business. The level of risk measurement can be seen on table 11 below.

Table 11. Level of Risk Measurement

No	Risk	Possibility	Consequence
1	Decreasing of iron ore production	B	5
2	Exchange rate (USD - IDR) fluctuation	B	5
3	Increasing of operating expenses	C	4
4	Increasing of cost of capital	C	2
5	Increasing of retention for growth	C	2

4. Conclusion and Implementation Plan

F. Conclusion

From business solution that has been analyzed, the conclusion for PT Ina Touna Mining iron ore mining project in sub district Tojo, district Tojo Una-una, Central Sulawesi are :

1. The financial feasibility study that generated from the capital budgeting techniques calculation shows a good results and can be said financially profitable. The summarize of the capital budgeting calculation can be seen on table 12 below.

Table 12. Capital Budgeting Summarize

Indicator	Value	Conclusion
PBP	3,06 years	Acceptable because the investment return long enough before the concession period end
NPV	IDR 14,787,611,133.37	Acceptable because NPV > 0
IRR	31.56%	Acceptable because the IRR = 31.56% is greater than its cost of capital = 18.19%.
PI	1.48	Acceptable because PI > 1

2. From the sensitivity analysis, there are two variables that significantly affect the business, which is variable iron ore production and variable exchange rate USD – IDR. This two variables are considered significant because the curves are the most vertical compared to variable operating expense, variable cost of capital and variable retention for growth.

G. Risk Handling

As discussed in business solution, the risk that may arise in this business are (1)decreasing of iron ore production, (2)exchange rate (USD – IDR) fluctuation, (3)increasing of operating expense and (4)increasing of cost of capital and (5)increasing of retention for growth. The five risks that may arise are summarized on table 13 below.

Table 13. Risk Measurement Matrix

		Consequence				
		1	2	3	4	5
Probability	E					
	D					
	C		4 & 5		3	
	B					1 & 2
	A					

To handle the risk, author proposes a strategy as an act that PT Ina Touna Mining should take as follows :

Table 14. Risk Handling Strategy

Risk Type	Description	Act
Extreme	5B – Decreasing iron ore production. This risk is less likely to occurred because from the calculation, the iron ore production is estimated at the very conservative way or worst case scenario.	Avoid the risk. Avoid it by doing a forward contract with the buyer, so the price will become fixed price. As for the decreasing iron ore production the company should have safety stock to prevent stock-outs. So it will give some time to analyze the problem. For the increasing operating expense, it can be avoided by reviewing a cash flow at least once a month
	5B – exchange rate (USD – IDR) fluctuation. This variable also directly connected with the iron ore price, because the price is converted from USD to IDR	
	4C – Increasing of operating expense. This risk is equal chance to occurred. As for the operation expense is estimated to grow in the calculation, but in reality there are many external factors influence the performance.	
Medium	2C – Increasing of cost of capital. In calculating cost of capital using CAPM approach, consist of risk free rate of return (R_F) from 5 years government bond, beta coefficient or index of nondiversifiable risk for asset i ($ß_i$) from average mining industry, and risk premium (R_p) from Indonesia country risk. This three CAPM elements may vary based on situation in business and country where the business take place	Accept the risk. Because it is not greatly affect the financial performance.
	2C – Increasing of retention for growth. This variable is determined from the company whether the company wants to expand or not	

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