Chapter 5

Incremental Cost Analysis

5.1 Introduction to Incremental cost analysis

Incremental costs are the additional costs incurred in choosing a particular alternative. As these additional costs may increase or decrease as a result of the decision made, they are considered relevant to the decision-making process.

Incremental benefits are the additional revenue made when choosing a particular alternative. As this additional revenue may increase or decrease due to the decision made, it is considered relevant to the decision-making process.

When choosing between alternatives, management will aim to choose the alternatives that result in the greatest net profit, for example, they will choose the alternatives where differences in incremental costs and incremental benefits will give the greatest net profit. In other words, management looks at the increase in costs of one alternative and compares this to the increase in revenue of that same alternative.

In this chapter it will involve with cost analysis of product, by which, before and after change to new raw material, and incremental cost analysis, which will bring to find the Break Event Point (BEP) of this project. Finally, conduct the incremental cash flow and find NPV, IRR and payback period of project, after that, conduct sensitivity analysis to find out which factor is impacted and will be the critical for this project.

5.2 Cost structure

The cost structure of canned liquid coffee is majoring from the cost of raw material. The major raw material, which was used, are coffee powder, milk, salt, flavor, sugar and water. The cost structure can be divided into four parts.

- Material cost
- Fixed cost
- Variable cost
- Depreciation cost

5.2.1 Material (M)

The material cost consists of

- Cost of coffee powder
- Cost of sugar
- Cost of milk
- Cost of flavor
- Cost of premix
- Cost of salt
- Transportation cost of raw material to factory

5.2.2 Fixed cost (F)

Fixed cost is a cost, which is fixed and didn't vary with a production volume, those are;

- Indirect expense cost: cost of general used in manufacturing, such as, paper, printer ink, glove, security, guard, etc. It is a supporting cost for manufacturing, which was set and forecast before in term of budgeting planning.
- Laboratory cost: is a cost of supporting in laboratory work, such as chemical, media culture, etc. It has been set and forecasted in term of budgeting.
- Maintenance cost: is a cost, which was set in order to maintain the machinery conditions and equipment in order to run as a target. This cost had been set as a budget.
- Salary or supervisor cost: cost from salary of middle management and management level.

5.2.3 Depreciation cost (D)

Depreciation cost is cost, which is additional to product by calculating from the value of registered asset divided by life of asset which give asset value to zero. After that, divided by require volume. It will give a depreciation cost per unit volume.

$$\text{Depreciation cost} = \frac{\text{Value of registered asset(Baht)}}{\text{Depreciation(Year)} \times \text{Require volume(Kg)}}$$

5.2.4 Variable cost (V)

Variable cost is a cost, which varied with production volume or goods. It consists of;

- Labor cost; is a cost of labor, which is concerning in the production process including inspection. This cost had varied with the volume of production by charging to the product cost per kilogram of product. The calculation is done by the summation of labor salary and divided by required production volume.

- Utility cost is a cost of utility service and supply to the production process. such as, steam. electricity, and water. These cost are increase or decrease depended on the production volume.

The total cost of product is the summation of four values M+F+D+V. As we can see in the figure 12.
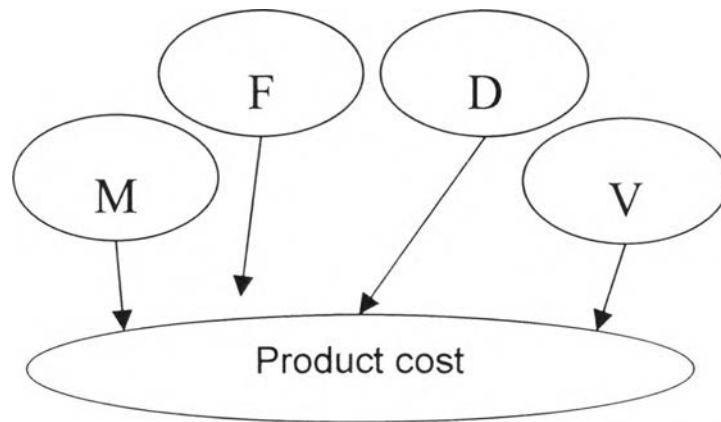

Figure 15: The cost structure model

As the mention structure of product cost above, it can be expressed the cost of liquid coffee by cost analysis. However, the cost of raw materials will be used the forecasting price from the previous chapter.

Material cost

- Price of whole milk powder is 134.651 Baht/Kg (Chapter 3)
  The composition of whole milk powder will be use as %Solid non-fat 69.5 and %fat 27% (From chapter 3)
- Sugar price is 11.120 Baht/Kg (Chapter 2)
- Salt price is 81 Baht/Kg (Chapter 2)
- Flavor price is 1081.20 Baht/Kg (Chapter 2)
- Premix price is 43.70 Baht/Kg (Chapter 2)
- Coffee powder price is 122.07 Baht/Kg. (Chapter 2)
- Fresh milk price is at 12.50 Baht/Kg (Chapter 2)
  The composition of fresh milk will be use as %Solid non-fat 8.46 and %fat 3.84 (Chapter 3)

Production volume

Production volume in calculation sheet will use sale forecast selling volume in year 2002, that is 37,963 Tons.

Investment cost

The investment cost is 7,641,109 Baht with depreciation rate for 10 year

All above information, we can use them in order to calculate the cost of product and comparison between fresh milk and whole milk powder ingredient

Product cost with whole milk

	Description	Cost per unit	Material usage	Cost
		Baht/Kg.	Kg./1000 Kg product	(Baht)
Material cost	Whole Milk Powder	134.651	25.718	3462.94
	Sugar	11.120	100.300	1115.34
	Salt	81.000	1.005	81.41
	Flavor	1,081.200	1.003	1084.44
	Premix	43.700	3.015	131.76
	Coffee powder	122.070	20.800	2539.06
			Subtotal	**8414.94**
Fixed Cost				
	Indirect expense			217.35
	Laboratory			12.47
	Maintenance			208.75
	Salary			217.67
			Subtotal	**656.24**
Depreciation			**Subtotal**	**285.230**
Variable cost				
	Labour			35.20
	Steam			179.50
	Water			121.38
	Electricity			145.41
			Subtotal	**481.49**
Cost of product			Baht/1000Kg. Product	**9837.90**
			Baht/1 Kg product	**9.84**
			Cost not include depre	**9.55**

Table 6: Product cost of liquid coffee by using whole milk powder

Product cost with fresh milk

	Description	Cost per unit	Material usage	Cost
		Baht/Kg.	Kg./1000 Kg product	(Baht)
Material cost	Fresh milk	12.500	210.640	2633.00
	Sugar	11.120	100.300	1115.34
	Salt	81.000	1.005	81.41
	Flavor	1,081.200	1.003	1084.44
	Premix	43.700	3.015	131.76
	Coffee powder	122.070	20.800	2539.06
		Subtotal		**7585.00**

Fixed Cost

Indirect expense			247.04
Laboratory			12.63
Maintenance			212.45
Salary			217.67
	Subtotal		**683.57**

Depreciation

Before investment			285.23
After investment			19.7
	Subtotal		**304.93**

Variable cost

Labour			35.31
Steam			181.01
Water			98.53
Electricity			146.20
	Subtotal		**461.05**

Cost of product

Baht/1000Kg. Product		**9034.55**
Baht/ 1Kg. Product		9.03
Cost not include depre		8.73

Table 7: Product cost of liquid coffee by using fresh milk

From table 6 and table 7, we got the product cost of liquid coffee by using whole milk powder 9.84 Baht/ Kg and by using fresh milk 9.03 Baht/Kg. With this figure, using fresh milk as an ingredient it uses less water but it will consume more electricity and steam. Labor cost of production is also increase because more equipment and operational. In term of fixed cost, it is increasing in term of indirect expenditure, laboratory and maintenance cost. This was caused by the in creasing in asset equipment, more samples to analyze and more operational. Especially, indirect expenditure cost increase by 13.66 percent, because of using more support in order to run the manufacturing. Salary or supervisory cost is still the same, nothing change, because nothing increase in term of supervisor level and management level.

The substitution quantity of fresh milk and whole powder can be done by calculating based on the percent of solid-non fat (SNF). For example, in table 6 and 7, they use whole milk powder 134.651 Kg/1000 Kg. product but use fresh milk as 210.64 Kg/1000Kg product. This example of calculation is below;

Whole milk powder as 69.5% solid-non fat for 134.65 Kg. It will give amount of solid-non fat 93.58 Kg.

By calculating fresh milk quantity as 8.46 percent solid-non fat, it will get

$$\frac{100}{8.46} \times 93.58 = 1106.17 \text{ Kg fresh milk}$$

According to the calculation above, it means that whole milk powder 134.651 Kg as %solid-non fat 69.5 can be replaced by fresh milk 1106.17 Kg as %solid non-fat 8.46. The others ingredients are the same with these two recipe.

In term of standardization, after using fresh milk instead of whole milk powder it will use less water by water from fresh milk. So, it will reduce the water cost in analysis sheet for product cost.

In term of depreciation cost, depreciation cost with the existing plant or by using whole milk powder as ingredient was calculated from the initial investment cost divided by the multiply result of year life of asset and required production volume. The initial investment cost the existing plant is 108.282 million Baht, and year life of asset is 10 year, required production volume for year 2002 is 37963 Tons. After calculation it will get product cost of liquid coffee by using whole milk is 9.84 Baht/Kg product and 9.03 Baht/Kg product by using fresh milk instead.

When we got the product cost, after that, we will use this figure to find the saving value in each year in tem of incremental net cash flow. The incremental cost was done by the different of product cost according to the required production volume in that year. According to the table 6 and 7, we will see that the product cost by using fresh milk is less than using whole milk powder by 0.81 Baht/Kg product. On the other hand, we can say that is a cost saving, which was occurring from the reduction of product cost by substituting with fresh milk.

After that, bring this figure to find the income of the project and evaluate the IRR, NPV, payback period, and Break-event point. This will be done on the economic analysis section.

5.3 Economic Analysis

Economic analysis is a comparative study of investment and return under projects by taking monetary profits into consideration as an important factor. Such analysis is aimed only at benefits or return under economic projects and expenses or cost of projects. That is, the analysis will show a flow of monetary benefits or return arising from projects, and also a flow of expenses or cost to be incurred in the projects. With such benefits and expenses of the projects, it is possible to prepare a Cash flow. This cash flow is helpful as it informs the owner of the project when and how he will have to find money for expenses of the project, such as by obtaining a local or foreign loan. To obtain such loan from a source depends on rate of interest and project officials ability for negotiation. Economic analysis, therefore, is made for proposes of finding a conclusion as to what the financial position of project under our consideration is, and whether or not the project will survive.

In assessment of cash flow with respect to expenses and benefits, it is necessary to use actual buying prices and selling prices under the project or prices found in the market. This will reflect actual amounts of expenses and benefits under the project will justify investment. In this case prices, which are used in assessment of amounts of expenses and benefits, are very important. If price, which is too low or too high, is chosen, the results of assessment will be very inaccurate. Therefore, the price factor is capable of indicating the quality and efficiency of financial analysis of the project in respect of extent of reliability.

In making a decision for investment, it is important to depend on appropriate criteria or tools in decision-making. Tools for using in analysis of projects are four kinds as

5.3.1 Payback period

Payback period is the period in which net return or cash flown from the operation of project is of the same value as an investment in the project. This method considers the number of years in which return will be even with investment funds. This method is a tool suitable for making a decision on project with high risks or in a situation in which political fluctuation is prevalent. Thus, investors may have to consider making investment in project, which yields return in a short time.

In determining the payback period, it is possible to calculate from the number of years in which the accumulated total of cash of benefits (cash inflow) of project is equal to the cash flow of expenses (cash outflow) or the number of years in which the total of net cash flow of project is equal to zero. The formula for calculation can be shown as follows:

$$\sum_{t=0}^{N} \text{Cash Inflow} = \sum_{t=0}^{n} \text{Cash Outflow}$$

or

$$\sum_{t=0}^{N} (\text{Cash Inflow} - \text{Cash Outflow}) = 0$$

or

$$\sum_{t=0}^{N} \text{Net Cash flow} = 0$$

Where   n   =   Payback Period

If a project has a very short payback period, this project is very interesting to invest. If project has a slow payback or high value, that project is placed in the next lower rank.

This method has a weak point, that is expenses, for investment in calculation are for disbursement in the present year. While profits or benefits to receive in returning, are of future years. The value of money in each year may not be constant and it is not advisable to make any comparison. Moreover, this method doesn't take into account return after the payback period throughout the life of the projects. Under this criterion, attention will be given to the selection of any project of which payback period is shortest without regardless of future return after the payback period.

5.3.2 Net Present Value (NPV)

Net Present Value (NPV) is the total of net return for which time value has been adjusted in each year (Accumulated Present Value of cash flow) with a purpose to measure worthwhile return of a project.
In general, a principle for making a decision to choose a project among several ones is that the best project should be one that yields highest NPV or to use the principle of selecting a project which provides highest profits in a short period. Any project with plus value is placed in a group for selection and any project with minus value is regarded as one not worth investing in. In the government sector, a decision for investment is not based always on the highest value of NPV as other factors also will have to be considered. Calculation to find Net Present Value (NPV) can be done as follows:

a) To make calculation to find present value of net return in each year (NPV of Cash flow) and add up the said value of each year throughout the life of the project. Result is NPV of the project. Formula for calculation is as follow:

$$NPV = \sum_{t=0}^{n} \frac{B_t}{(1+i)^t} - \sum_{t=0}^{n} \frac{C_t}{(1+i)^t}$$

or

b) Calculate to determine total return in each year, deduct it with total expenditures in that year and the results is net return or net cash flow of each year. Then, use that value to adjust time value in each year throughout the life of the project. Next, the resultant values are added up to get NPV of the project.

$$NPV = \sum_{t=0}^{n} \frac{B_t - C_t}{(1+i)^t}$$

Where NPV   =   Net Present Value of the project

B_t =   Benefits of the project in year "t"

C_t =   Costs of the project in year "t"

i   =   Interest rate or Discount rate or Opportunity Cost of Capital

N   =   the Life of the project

$1/(1+i)$ =   Present Worth Factor (PWF)

When PWF or $1/(1+I)^t$ is multiplied by value of net monetary flow in the year "t", the result is present value of cash flow in that year. For PWF value refer to the prepared table "Discount Factor Table". It is evident that calculation to determine NPV of the project be either a) or b) method will be produce the same result.

At present, advanced technology in finding NPV, it is possible to get NPV from computer application program, such Excel or Lotus.

5.3.3 Internal Rate of Return (IRR)

Internal Rate of Return of project is discount rate that will make benefits and expenses equal after calculation of discount into present value. This rate is that of ability of investment funds to create sufficient income to cover investment funds. In other words, which discount rate that will make net value equal to zero. This criterion is similar to the determination of NPV. The difference is the changes of the value of "i" value (Interest rate) in NPV to "r" value (Discount rate) in IRR.

In the calculation to determine IRR value, it begins with the reduction of benefits by expenses in each year throughout the project so as to get net return or net cash flow in each year. Next, calculation is made to find a discount rate that will make the total of present value of net return give result in zero.

Calculation to find IRR value is similar to the formula on finding NPV. The difference is to change "i" value to "r" and this "r" value will turn NPV into zero value. Formula for calculation is as follows:

$$\sum_{t=0} \frac{B_t - C_t}{(1 + r)^t} = 0$$

Where   r   =   IRR value of the project

This calculation of IRR is done gradually (Trial and Error). That is experiment has to be made to find r value that will turn NPV into zero. One may have to waste time to make experiments of various values. In practice, interpolation method may employ in determining IRR value that will turn NPV into zero.

$$IRR = DR_L + (DR_H - DRL) \times \frac{(NPV_L)}{NPV_L - NPV_H}$$

Where DR_L =   Lower bound discount rate

DR_H =   Higher bound discount rate

NPV_L =   Net present value of DR_L

NPV_H =   Net present value of DR_H

IRR   =   Discount rate that will made NPV = 0

Thought it may take time to find this value in calculation, but it is a basic principle in making a decision to invest. At present, owing to advanced technology in finding IRR, it is possible to get IRR from computer application program, such Excel program.

In analysis of a project, we have to find IRR value in order to compare it with the market rate of interest or with opportunity cost of capital. If the value of interest in the market in calculation is lower than rate of return form the project, it means that investment in that project will yield worthwhile return suitable for implementation.

5.3.4 Break-event point (BEP)

Break-event point is point where sale equal to total cost and no profits are made. Any sale made above the break-event point will result in a profit, providing that total costs stay the same. The break-event point can be expressed in term of money and unit.

5.3.5 Incremental Cost Analysis

When faced with making the following decisions uses incremental analysis.

- Make or buy component parts.
- Accept or reject a special offer
- Add a new product
- Close a department
- Process a product further or sell as is

In making these decisions, management identifies the alternative courses of action available to them and examines the relevant data associated with making the decision. Management will look at the increase in costs of one alternative and compare this to the increase in revenue of that same alternative and then make a decision.

Incremental cost analysis

Maximum capacity :   60000 Tons/year

Calender year	0 2002	1 2003	2 2004	3 2005	4 2006
Production volume -Tons		41000	44690	48489	53532
Investment cost 7641.11					
Cost -with whole milk powder; 9.55 Baht/Kg		391550	426790	463070	511231
-with fresh milk; 8.73 Baht/Kg		357930	390144	423309	467334
Incremental Net cashflow ;Thousand Baht	-7641.11	33620	36645.8	39761	43896.2

Break-event point	9318.43	Tons
NPV	102784.59	Thousand Baht
Payback period	2.73	Months
IRR	448%	

Table 8: Incremental cost analysis

5.4 Result of incremental cost analysis and economic analysis

According to table 8, we use I=10% interest rate for calculating NPV, MRR+2.75,Thai Farmer Bank September 19,2002. We got

NPV	102.79 Million Baht	,at i= 10
IRR	448 %	
Payback period	2.73 Months	
Break-event point	9318.43 Tons of product.	

Thus, it can be seen that this study has a very high internal rate of return by 449 percent and very fast payback period at 2.73 month with break-event point at 9318.43 tons of product. Especially, NPV of this study is also very high, 102.79 million Baht. This means with this project it has very high of return and ability of investment funds to create sufficient income to cover investment funds.
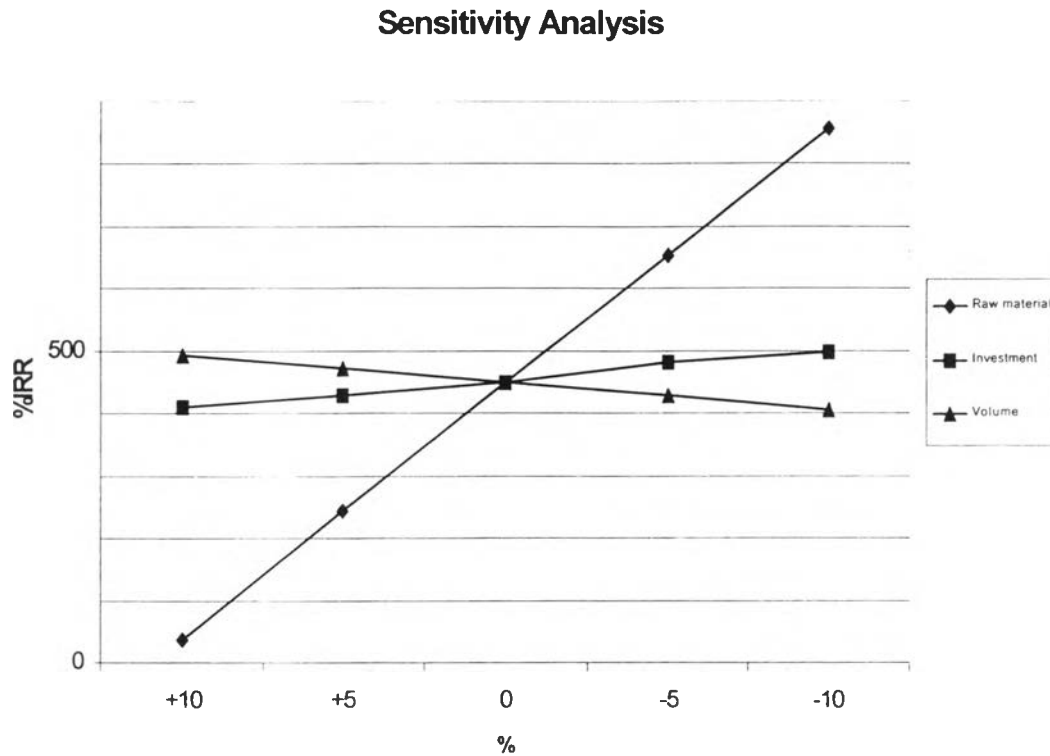
5.5 Sensitivity Analysis

To assess the impact of various variables on the economic viability of the project, sensitivity on the effect of these variables are performed. In analysis of sensitivity of project, important factors affecting the project are raw material cost, production volume, and investment cost. Thus, in this study analyst will use these factors to consider the sensitivity of this study.

Case	+/- %	IRR %	NPV Million Baht	Payback period, month	BEP Tons
Base	-	448	102.79	2.73	9318.43
Investment cost	+5	427	102.44	2.86	9784.35
	-5	482	103.27	2.59	8852.50
	+10	408	102.10	3	10250.27
	-10	497	103.48	2.45	8386.59
Raw material Cost	+5	243	51.93	5.08	17366.16
	-5	653	153.64	1.86	6367.59
	+10	17	1.08	32.57	127351.83
	-10	857	204.49	1.42	4836.15
Production volume	+5	470	108.27	2.60	9318.43
	-5	426	97.30	2.87	9318.43
	+10	492	113.76	2.48	9318.43
	-10	404	91.81	3.03	9318.43

Table 9: Sensitivity Analysis

As seen from the sensitivity analysis table, it can be said that Raw material cost is the most sensitive to this study since range ±5%. In fact, raw material cost is around 85 percent of the product cost if it is increase or decrease in range ±5 percent

it will give the impact to reduce or increase in cost saving value or incremental cash flow.

Sensitivity Analysis

Graph 22: The results of sensitivity analysis based on %IRR

If we are looking at graph 22, this is clearly that raw material cost has a more slope of line. Second factor and third factor, we may say that production volume and investment cost have the same sensitivity level with this project, according to the slope of graph. However, the slope of this two lines have the reverse direction that is if we are increased production volume it will increase both NPV and IRR of this project. While if we are increased investment cost it will decrease both NPV and IRR of this project.

In summary we can conclude from the above analysis that this project is viable and fresh milk can be replace whole milk powder in liquid coffee product by the reason from the economic analysis.