CHAPTER THREE

RESEARCH METHODOLOGY

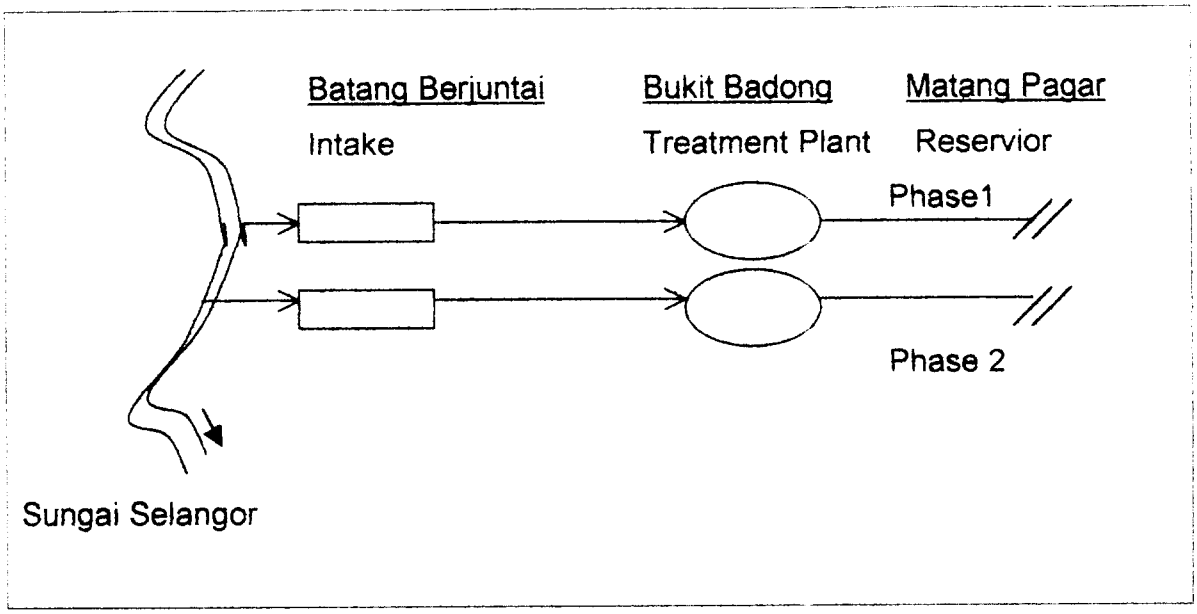
This chapter discusses in detail the research methodology used in carrying out this study. The research methodology includes the scope of study, data collection and financial valuation methods. The Sungai Selangor Treatment Plant Phases 1 and 2 are selected for the scope of this study. Information is mainly obtained from the relevant government agencies and past studies. Discounted Cash Flow and Equivalent Annual Annuity financial analyses will be carried out to calculate the returns of the two projects.

3.1 Scope of The Study: *Sungai Selangor* Water Supply Treatment Plant

This study will focus on the privatisation of water supply projects in the state of Selangor, namely the Sungai Selangor Water Treatment Plant. The Sungai Selangor water supply treatment plant consists of two different phases which include Phases 1 and 2. The Sungai Selangor Phase 1 water treatment plant (Phase 1) involves MC mode of privatisation whereas BOT is used in the Sungai Selangor Phase 2 water treatment plant (Phase 2). This selection is based on one main criterion that both projects have similar capacity of water generated and both reflects the privatisation of water supply projects under MC and BOT respectively.

Figure 3.1 shows the schematic layout plan of both Phases 1 and 2. In general both phases comprise the following components which will be considered in this study:

Figure 3.1 Schematic Diagram of Phases 1 and 2



Source: Author's illustration

a. Headworks (water intake structure and treatment plant)

Water intake structures are located at Batang Berjuntai abstracting raw water from the Sungai Selangor. The water treatment plants are located at Bukit Badong treating water to render it potable.

b. Distribution System

The bulk delivery supply systems convey treated water to terminal reservoir at Matang Pagar for distribution to demand areas in the northern sector of Kuala Lumpur, Petaling Jaya and Shah Alam. It also comprises a separate delivery system conveying treated water to supply to Klang (Syed Muhamad, Hooi and Binnie, 1986).

The details of Sungai Selangor Water Supply Treatment Plant Phases 1 and 2 are presented in Table 3.1. Both Phases 1 and 2 have a similar work capacity of 950 million liter per day (Mld) capacity. Both phases were implemented in two stages, each having 475 Mld capacity for Stages 1 and 2.

Table 3.1: Sungai Selangor Water Treatment Plant

Description	Phase 1	Phase 2
Plant Capacity	950 Mld Stage 1 – 475 Mld Stage 2 – 475 Mld	950 Mld Stage 1 – 475 Mld Stage 2 – 475 Mld
Year of Completion	Stage 1 – 1992 Stage 2 – 1994	Stage 1 – 1998 Stage 2 - 2001
Year of Operation	Stage 1 – 1993 Stage 2 – 1995	Stage 1 – 1999 Stage 2 - 2002
Capital Cost	RM 1, 135 million	RM 1, 382 million
Mode of Privatisation	Management Contract (MC)	Build, Operate and Transfer (BOT)
Private Operator	Perangsang Group	Puncak Niaga
Concession Period	1993-2003	1996-2020
Water Tariff	23sen/m^3	43.5sen/m^3(upon operation of Stage 1) 59sen/m^3(upon operation of Stage 2)
Monthly Payment	No	RM 1.75 million (upon operation of Stage 1) RM 3.5 million (upon operation of stage 2)

Source: JBAS, 1997 and Puncak Niaga's Prospectus, 1997

3.1.1 Phase 1

JBAS commissioned Phase 1 Stage 1 in 1992 and operations began in 1993. JBAS completed Phase 1 Stage 2 in 1994 and the plant started operation in 1995.

The Selangor State Government has funded Phase 1 fully with a total capital cost of RM 1,135 million (Syed Muhammad Hooi and Binnie, 1994). The operation of Phase 1 was privatised to Perangsang Group under a MC by the Selangor State Government. Peransang Group is to take-over, operate, maintain, manage, rehabilitate and refurbish the Phase 1. The concession is for a period of 10 years beginning in mid 1993 to mid 2003 (JBAS Interview, 1997). Sg. Harmoni, a subsidiary of Perangsang Group is currently running the Phase 1 plant.

Under the management contract, Perangsang Group is required to produce a pre-determined minimum level of quality and a minimum quantity of a potable water, referred to as the "designated quantity". The designated quantity is based on the water treatment plant design capacity, that is, 475 Mld upon commencement of operation of Phase 1 Stage 1 and its full design capacity of 950 Mld upon commencement of operation of Phase 1 Stage 2.

In return, the Selangor State Government is required to purchase bulk supply no less than the designated quantity from Peransang Group at a rate of 25 sen per cubic metre of treated water (JBAS Interview, 1997). Any requirement of extra quantities of water is chargeable at the same price.

3.1.2 Phase 2

Construction of Phase 2 Stage 1 commenced in March 1996 and is expected to be completed and ready for operation in 1998 and 1999 respectively. Construction of Stage 2 is anticipated to commence in 1999, to be completed and ready for operation in the years 2001 and 2002 respectively.

Phase 2 was privatised to Puncak Niaga Sdn. Bhd. (PNSB), a subsidiary of Puncak Niaga Holding Berhad by the Selangor State Government on 22 March 1995. PNSB is required to construct, operate, maintain and manage Phase 2 on a BOT scheme. PNSB has fully funded the capital cost for Phase 2 of about RM 1, 871 million. The concession period is approximately 25 years from 22 March 1995 to 31 December 2020. At the end of the concession period, PNSB is expected to hand over the management of Phase 2 to the Selangor State Government for a consideration of RM 1.00.

The government is required to purchase bulk supply no less than the designated quantity which is equivalent to the designed capacity of Phase 2. The bulk water rate is 43.5 sen per cubic metre treated water upon commencement of operations of Stage 1 tentatively scheduled in 1 January 1999 until 31 December 2001. When Phase 2 Stage 2 starts to operate tentatively on 1 January 2002, the bulk supply rate will be increased to 59 sen per cubic metre.

Apart from that, PNSB also receives additional payment from the Selangor State Government as compensation for the capital cost of Phase 2. A monthly lump sum payment of RM 1.75 million that is equivalent to RM 21 million yearly, will be claimed from the government on completion and commencement of operation of Stage 1. The monthly payment will be increased to a total amount of RM 3.5 million, equivalent to RM 42 million yearly upon operations of Stage 2.

3.2 Data Collection

To conduct the study, secondary data was mainly collected from the Jabatan Bekalan Air Selangor (JBAS) that is, the Department of Water Supply Selangor. Related reports from other relevant government agencies such as the Jabatan Kerja Raya (JKR) or the Public Works Department were also collected.

Information on the two private operators were gathered through personal interviews with the JBAS's officers. In addition, information on Puncak Niaga was mainly obtained from its prospectus. On the other hand, information on Perangsang Group was gathered from other relevant reports.

3.3 Financial Evaluation - Discounted Cash Flow Method

Discounted cash flow (DCF) analysis is a financial evaluation method that takes into account time value of money thus, it is also called time value of money analysis. It is used to find the present or current value of future cash flows, which is a vital step in decision process. In this study, DCF analysis method will be used as it is considered to be the most accurate method of valuation (Brigham and Fapenski, 1994).

Discounting: $$PV = \frac{FV_n}{(1+k)^n}$$

Where,

PV = Present Value

FV = Future Value

k = Discount Rate

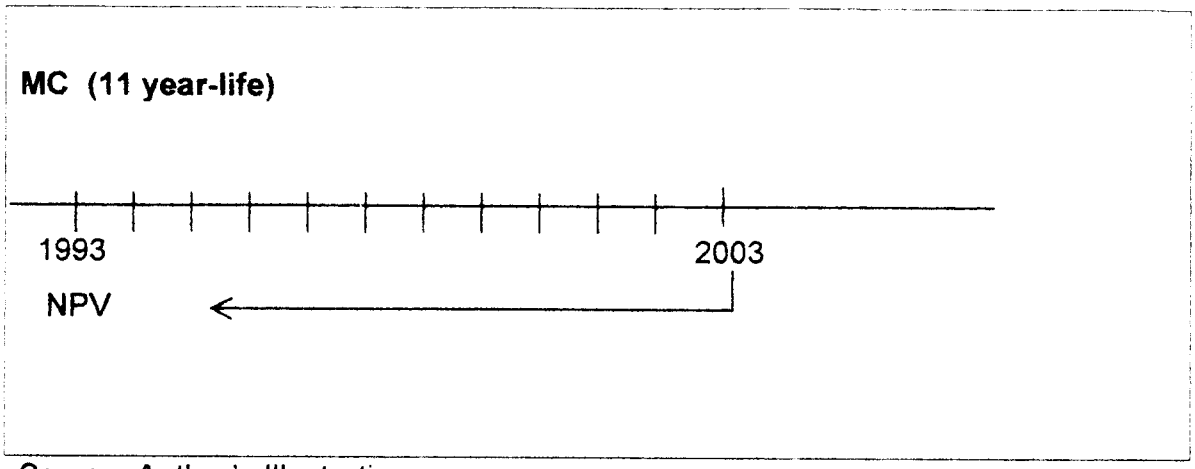
n = Number of Periods

3.3.1 Time Line

Time line is a tool of DCF analysis. It will be set up over the life of a project to help visualise the time value of money in the discounted cash flow analysis. The cash outflow expected over the life of a project will be estimated from capital cost and operation and maintenance cost. The cash inflow is estimated from the revenue. Losses on depreciation and corporate taxation will be taken into

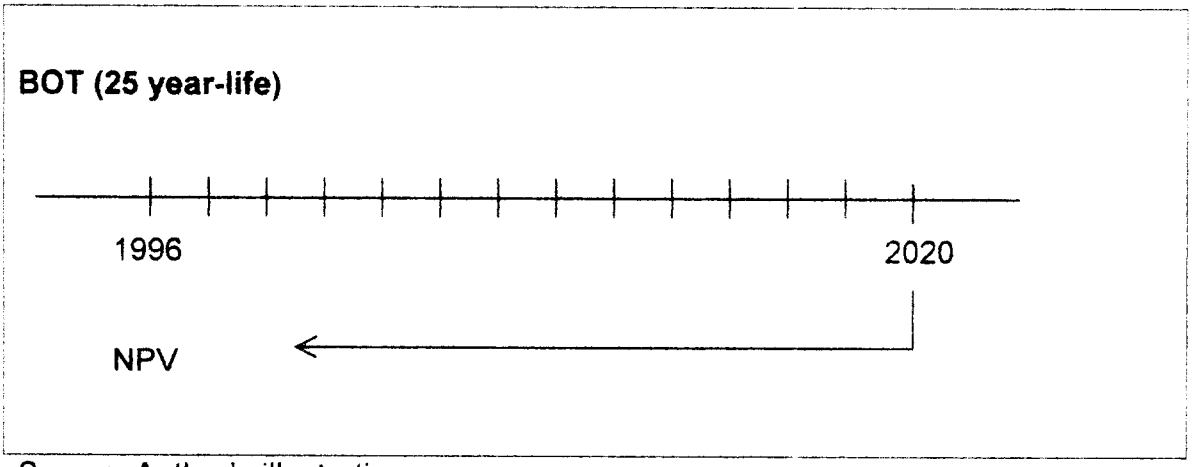
consideration in the cash flow. Figures 3.2 and 3.3 show the time line for the respective phases.

Figure 3.2 Time Line For Phase 1



Source: Author's Illustration

Figure 3.3 Time Line For Phase 2



Source: Author's illustration

3.3.2 Discount Rate

Discount rate, k is defined as the opportunity cost rate. It is required to discount the future cash flow because this incorporates risk into the financial evaluation of a project. The evaluation of a project is highly sensitive to the discount rate.

The risk of the project is assumed to be the same as the risk of the firm in most analyses. The risk of the firm is equal to the firm's overall cost of capital or firm average cost of capital. It is defined as the return required by the investors to compensate the time value of money and the risk a company is taking. It could be estimated by calculating the weighted-average cost of capital (WACC). This assumption is acceptable so long as the investments being considered are as risky as the firm. WACC will be used as the discount rate in the DCF analysis (Brigham et al, 1994). The following section explains the process used to estimate WACC

3.3.2.1 Weighted-Average Cost of Capital (WACC)

The WACC is defined as the weighted average cost of each new dollar of capital raised at the margin (Brigham et al, 1994, p360). Capital represents the funds used to finance the firm's assets and operations. Normally capital constitutes the entire right-hand side of the balance sheet, including short-term and long-term debt, preferred stock, and common equity. The cost of each capital component needs to be determined, and the capital cost components are then combined to form the WACC. Capital structure defined as the mix of debt, and equity will also be determined to calculate the weights of debt and equity.

WACC can be calculated by multiplying the costs of debt and equity by their respective portions to be raised by the firm. The general formula for WACC is as follows: (Harrington and Wilson, 1991)

$$WACC = W_d K_d + W_e K_e$$

Where,

W_d = Target weights for debt

W_e = Target weights for equity

K_d = After-tax cost of debt

K_e = Cost of equity

The following sections explain the methods used to calculate K_d and K_e for the purpose of this study.

(i) The After-Tax Cost of Debt (K_d)

The pre-tax cost debt is the ratio of the interest rate to the principal amount of the debt. As interest payments are tax deductible, all capital costs are calculated based on an after-tax basis. The after-tax cost of debt is a multiplication of the former ratio and the corporate tax rate. Therefore, after-tax cost of debt, K_d can be obtained from the following equation:

$$K_d = i\,(1-T)$$

Where,

i = interest rate

T = tax rate

(ii) The marginal cost of equity (K_e)

In this study, cost of equity, K_e is estimated by using Capital Asset Pricing Model (CAPM) because of its logical appeal. CAPM is often used in the cost of capital estimation process. Under the CAPM the cost of equity is equal to the risk-free

rate plus a risk premium that is based on the stock's beta coefficient and the market risk premium as set in the Security Market Line (SML) equation below:

Cost of equity = risk-free rate + risk premium

$$K_e = K_{RF} + (K_m - K_{RF})b_i$$

Where,

K_{RF} = risk-free rate

K_m = rate of return on the market

b = firm beta

Beta is the measurement of sensitivity of a firm's return to the market index's return (Brigham et al., 1994). It is estimated from the stock's characteristic line by running a linear regression between past returns on the stock and past return on market Index. Emas Index was chosen to represent the market situation in this study. It is considered the best indicator of market condition as it is based on all the stocks available in the Kuala Lumpur Stock Exchange (KLSE).

3.3.2.2 Compounded Average Growth Rate (CAGR)

The value of WACC cannot be calculated for Phase 1 due to the unavailability of data. Therefore, Compounded Average Growth Rate (CAGR) of profit after tax will be used as the discount rate. The CAGR of profit after tax is the measurement of average growth rate for the profit after tax. The CAGR will be calculated based on the projected profits after tax over the life period of a project.

$$CAGR = \left[\frac{\text{Profit obtained in the last year of contract, n}}{\text{Profit in year 1}}\right]^{1/(n-1)}$$

3.3.3 Net Present Value (NPV)

NPV represents the present value of the net worth of an investment, which will contribute to a firm at the end of its project life. It could also be defined as lump sum today, that is the present value of all the current and future benefits less the costs (Harrington et al, 1991). The future cash flow will be projected and discounted to a base year to find its present value. The process of finding present value is called discounting. NPV will be calculated by means of a discount rate with the inputs of cash outflow and inflow over a period of time. A positive NPV (NPV > 0) indicates that a project is worth undertaking that is, its cash flows are generating an excess return.

The NPV is calculated as follows:

$$NPV = \frac{CF_1}{(1+k)^1} + \frac{CF_2}{(1+k)^2} + \ldots\ldots + \frac{CF_n}{(1+k)^n}$$

Where,

NPV	= Net Present Value
CF_n	= Expected net cash flow at period n
	(cash flow benefits minus cash flow costs)
k	= Discount rate (Cost of Capital)
1,2, n	= Number of period (year)

Sensitivity analysis will also be conducted to indicate how much the NPV will change in response to a given change in discount rate (Brigham and Gapenski, 1994). The values of discount rate will be changed ranging from 5% to 13%, to calculate the values of the respective NPVs.

3.4 Projected Free Cash Flow

Free cash flows will be projected over the project life period in order to conduct the discounted cash flow analysis. Free cash flow is defined as cash that is not retained and reinvested in the business. It is simplified in the following equation.

Free Cash Flow = Revenue - Costs - Investment

In order to prepare the projected free cash, profit & loss account and project cash flow will be first formulated. Table 3.2 shows the format of profit & loss account used in this study. It provides the projected profit after tax over the project's life period. Table 3.3 shows an example of project cash flow, together with interest expenses and income. Table 3.4 shows the format of free cash flow used in this study. DCF analysis will be conducted to calculate the NPV from the free cash flow.

Table 3.2: Profit and Loss Account

Year	1	2	3	4				n
Capital Cost	xxx							
Revenue	xxx	xxx	Xxx	xxx	xxx	xxx	xxx	xxx
Less: O&M Cost	xx	xx	Xx	xx	xx	xx	xx	xx
Depreciation	Xx	xx	Xx	xx	xx	xx	xx	xx
Interest (Expenses) /Income:	x	x	x	x	x	x	x	x
Profit Before Tax	x	x	x	x	x	x	x	x
Less Tax at 30%	t	t	t	t	t	t	t	t
Profit After Tax	pat_1	Pat_2	pat_3	pat_4	pat	pat	pat	pat_n

Compounded Average Growth Rate (CGAR, %) for profit after tax
$= (pat_n / pat_1)^{1/(n-1)}$

Source: Author's Illustration

Table 3.3: Cash Flow Analysis

Year	1	2	3	4	5			n
Profit Before Tax	x	X	x	x	X	x	x	x
Depreciation	xx	Xx	xx	xx	xx	xx	Xx	xx
Operating Cash Flow	x	X	x	x	x	x	x	X
Less: Tax	t	t	t	t	t	t	t	t
Capital Expenditure	xxx							
Additional Cash/Debt	xxx xx	xx	xx	xx	xx	xx	xx	Xx
Net Cash/Debt at start	xxx xxx	xxx	xxx	xxx	xxx	xxx	xxx	Xxx
Net Cash/Debt at end	xxx xxx	xxx	xxx	xxx	xxx	xxx	xxx	Xxx
Average Cash	xxx xxx	xxx	xxx	xxx	xxx	xxx	xxx	Xxx
Interest (Expense)/Income	xx xx	xx	xx	xx	xx	xx	xx	Xx

Source: Author's Illustration

Table 3.4: Free Cash Flow Analysis

Main Parameter: Discount Rate = k%

Year	1	2	3	4	5			N
Revenue	xxx	xxx	xxx	xxx	xxx	xxx	xxx	Xxx
Less: O&M Cost	xxx	xxx	xxx	xxx	xxx	xxx	xxx	Xxx
Tax at 30%		t	t	t	t	t	t	T
Operating Cash Flow	cf_1	cf_2	cf_3	cf_4	cf	cf..	cf..	cf_n
Capital Cost	xxx							
Net Cash Flow	ncf_1	ncf_2	ncf_3	ncf_4	ncf_7	ncf.	ncf..	ncf_n
Present value	xx pvn_1	pvn_2	pvn_3	pvn_4	pvn	pvn	pvn	Pvn_n
NPV	npv							

Source: Author's Illustration

The following sections provide details on the items used in formulating the free cash flow.

i) Revenue

The estimation of revenue will be based on the payment to be received from the government through the water sales. The annual revenue is estimated according to the bulk supply rate and the total annual water produced which is equivalent to the design capacity of the treatment plant. It is calculated based on the following equation:

Revenue = total water generated x water tariff

For Phase 2, fixed monthly payments are also included as part of the revenue. An escalation inflation rate of 6% per annum will be assumed for the revenue estimations (JBAS, 1997).

ii) Operation and Maintenance (O&M) Cost

The O&M cost for Phase 1 is estimated at 23 sen per cubic metre at 1993 price (Syed Muhammad, Hooi dan Binnie, 1994). The O&M cost for Phase 2 is estimated at 25 sen per cubic metre at 1994 price (Syed Muhammad, Hooi and Binnie, 1994). It has been assumed that all O&M cost are escalated by 4% per annum based on the average inflation rate recorded from 1991 to 1995 in Malaysia (estimated from data obtained from Statistic Department).

iii) Depreciation

Capital expenditure is depreciated on a straight line basis over the operation period. However, as the concessionaire of Phase 1 (Perangsang Group) does

not own the treatment plant, there is no depreciation item in its cash flow consideration.

iv) Taxation and Capital Allowances

The corporate tax rate applicable during the concession period is assumed to be 30% per annum based on the 1994 Budget announcement. Taxes are levied on all water revenues as well as interest on cash deposits. Taxes are to be paid in the year following the period in which the liability arises.

The concessionaire of Phase 2 (Puncak Niaga) owns the headworks and bulk transfer system, therefore an estimated capital allowance of 70% is to be claimed on the construction works (Puncak Niaga Prospectus, 1997).

3.5 Equivalent Annual Annuity (EAA) Analysis

Equivalent annuity cash flow (EAA) is defined as the annual receipt that generated from the investment over the project life period (Brigham et al, 1994, p446). The EAAs contribute the same present value as the project's NPV, which was originally calculated from the free cash flow projected for the entire project life period (refer Figure 3.4). In evaluating projects with significantly different lives, the project with higher NPV does not necessary appear to be the better project (Brigham et al, 1994). In this study EAA analysis will be used as the extended analysis to compare projects with different lives. The EAA analysis involves three steps:

(i) Find each project's NPV over its initial life from the DCF analysis using CAGR of profit and WACC discount rates for Phases 1 and 2 respectively.

(ii) EAA is calculated from the initial NPV obtained by solving the following formula:

$$NPV = \frac{EAA}{(1+k)^1} + \frac{EAA}{(1+k)^2} + \frac{EAA}{(1+k)^3} + \ldots\ldots\ldots + \frac{EAA}{(1+k)^4}$$

Where,

EAA = Equivalent Annual Annuity

k = Discount Rate

(iii) Assuming that continuous replacements can and will be made each time a project's life ends, these EAAs will continue on to infinity constituting perpetuities. The NPV of the infinite EAAs is equal to the value of a perpetuity value, V.

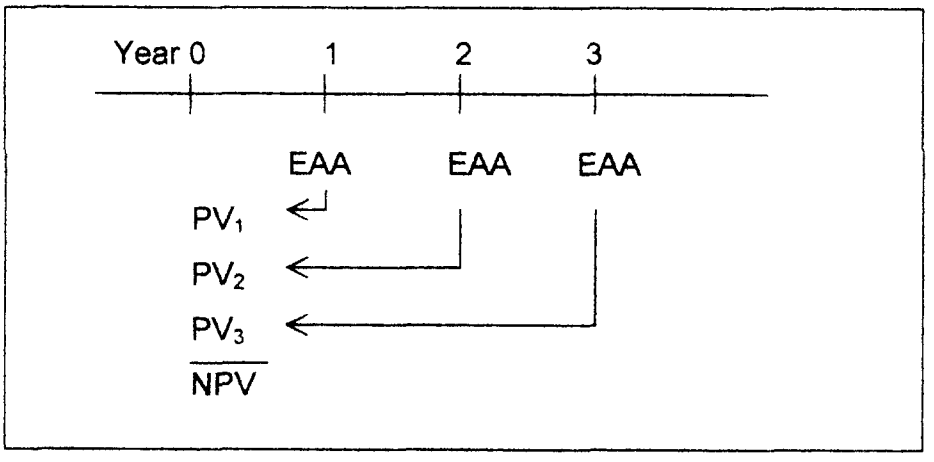
$$V = \frac{EAA}{k}$$

Where,

EAA = Equivalent Annual Anuity

k = discount rate

Figure 3.4 EAA Time Line



Source: F. Brigham et al., 1994, p446

3.6 Limitations

In calculating the WACC for Puncak Niaga, beta was estimated only from 3 months' data due to the unavailability of data. This is because Puncak Niaga was listed not long ago on 11/8/97. The results obtained from this study are strictly limited to the financial aspect.