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CAPITAL INVESTMENT DECISION-MAKING PROCESS IN THE CARICOM REGION

S. Lau [1] and A. Young Hoon [2]

ABSTRACT

This paper reports on a survey of the capital investment decision making process in the CARICOM region in an attempt to assess the gap existing between generally accepted theory and practice. The survey encompassed private sector firms and public sector institutions concerned with the preparation, promotion and financing of industrial projects. The use of quantitative techniques including both naive (eg. payback period, accounting rate of return) and sophisticated (net present value and internal rate of return) is well established. Consideration of uncertainty and risk in the investment decision, though understood is not treated by use of sophisticated techniques as utility theory and probabilistic models. Allowances for risk in practice are made on the basis of convenient and conservative operational approaches, such as incorporation in the discount rate of expected values of cash flow estimates, and higher level management value judgements.

1.0 INTRODUCTION

Capital investment decision making is a perennial multidisciplinary activity involving engineering, finance, and management. The process attempts to investigate and identify prospective investment opportunities, collect data and information on viable alternatives, define and estimate cash flows followed by economic analysis, all with the object of allocating scarce capital resources and determining the size of the budget and its financing. The exercise is usually undertaken in an environment of uncertainty about markets, technology and its obsolescence, and government regulations (macro-economic conditions).

In the advanced industrialised countries, capital budgeting has received a great deal of attention both by academics and the business community. A survey of the relevant literature over the last three decades have indicated that the analytical techniques employed by management are becoming increasingly sophisticated. For instance, the concept of the time value of money is now generally accepted and has found widespread application. In 1959, it was reported that only about 10% of firms employed discounting methods as the primary device for ranking projects whereas in 1987, 87% of firms surveyed were using such techniques, [1 - 12]. The academic literature is replete with arguments supporting the use of these normative capital budgeting techniques, because they are oriented with the objective of the investment decision behavior of maximization of the long-run value of the owners of the firm's securities. Another approach of more recent vintage employs management science techniques. These new techniques have not yet found widespread use, and have been adopted by only a small number of firms, employing large capital intensive operations with high investment outlays. [3,9,12].

Comparable studies relating to the practice of capital budgeting in developing countries have not appeared in the international literature. The extent to which the normative tools of capital budgeting (as employed in the developed countries) are practiced in the developing countries, has not been researched. The financial and economic evaluation of investment projects in developing countries are no less crucial than in a highly developed exchange economy like the USA, since all investors seek to maximise their rate of return. It is felt that in recent years, project evaluation and business decisionmaking has shifted from a more or less intuitive qualitative approach to a much more analytical and mathematical approach as a result of the availability of trained graduates, personal computers and appropriate software packages. Consequently, this paper reports on a recent survey of capital investment decision making practices of leading companies in the CARICOM region, in an attempt to assess the gap existing between generally accepted theory and its practice.

2.0 SURVEY

The survey was conducted through the use of a questionnaire designed to elicit information regarding the full scope of the firms capital budgeting practices. The commonly surveyed areas of practice included:

(i) The preparation of capital investment budget and level of decision making
(ii) Computation of project cash flows
(iii) Evaluation techniques
(iv) Determination of discount rates
(v) Treatment of risk

1. *Department of Mechanical Engineering, The University of the West Indies*
2. *Department of Chemical Engineering, The University of the West Indies*

The questionnaire was designed largely on a multiple choice type format where more than one choice was allowed with the facility to indicate or specify options not listed. The options listed was based largely on generally accepted techniques drawn from the academic literature.

A sample of 64 firms was selected to take part in this survey. These firms represented some of the major companies operating in the more industrialised territories of the CARICOM region viz, Trinidad and Tobago, Jamaica, Barbados and Guyana. Table 2.1 provides a detailed breakdown of the firms selected for study by country or location, type of business and average project size. The survey comprised mainly the private sector, although the public sector institutions were also included. Within the private sector firms, attempts were made to include both the heavy industrial and manufacturing sector, but inevitably there was some bias towards the dominant industry associated with any particular territory, such as oil production and refining in Trinidad and Tobago, and aluminium processing in Jamaica. The public sector institutions, parastatal by shareholding, were largely associated with development financing, and concerned with the preparation, promotion, implementation and financing of new industrial projects. The inclusion of this sector is felt to be important since development financing institutions influence to varying degrees, the techniques and criteria used in project evaluation. In a general way, the basis for the selection of participating companies was similar to that employed in similar surveys undertaken in the USA or UK eg, [1, 6, 9, 13]. In the former, such firms were selected from Fortune 500 Industrials except where specific groups were targeted, and in the latter, the leading 200 to 300 firms measured in terms of "market capitalisation", were surveyed.

There were 27 responses, a 42% response rate. The composition and characteristics of the respondents are also highlighted in Table 2.1. This rate of response is well within the range reported in the literature for this type of survey [10]. The respondents were heavily biased towards the larger and more established companies lending credibility to the suggestion that firms using the more sophisticated capital budgeting techniques would be more likely to respond [8]. The results are therefore likely to reflect this bias, but all previous surveys have acknowledged suffering from this tendency.

3.0 DISCUSSION OF SURVEY RESULTS

3.1 *Personnel/Investment Classification*

The range of personnel involved in the identification, preparation, evaluation and selection of projects in the capital budgeting process as seen in the sample of respondents included engineers, accountants, project managers/leaders (middle management), general managers and outside consultants (local and foreign). The identification of strategic opportunities and/or problems are more likely to be perceived by top-level management, whilst the preparation and development of technical, financial and economic analysis are generally confined to lower level management. Three broad levels of decision making in the management hierarchy can thus be identified:-

(i) Operating level - project analyst, accountant, etc. who are generally assigned operating projects (involving a relatively small amount of funds and resource commitments) not significantly deviating from what the firm has been doing in the past (eg. repetitive, routine replacement of machinery and equipment, etc.)

(ii) Middle level administrative type management such as project managers/leaders who are generally assigned to projects requiring moderate resource commitments and of intermediate duration and semi-structured in nature (Safety and Health, Environmental Safeguards).

(iii) Strategic decisions by top level management (including Board of Directors). Such decisions involve major organizational resource commitments and are non-routine and largely unstructured in nature.

With respect to preparation of capital budgets, 77% of the firms responding have indicated that annual capital budgets are prepared as a matter of policy. However an equal proportion of the sample would seize the opportunities for capital projects individually (outside the annual budgets) as they are proffered during the year. The influence of portfolio selection and availability of funds are significant factors in budget preparation.

At least 85% of project activities dealt with investment ranging from acquisition of new plant and machinery, equipment and tooling replacement for new products and make or buy decisions. The other 15% of the respondents were involved in capital decisions of the acquisition/merger type. Dollar limits for investment were broad and ranged from less that US $100,000 to greater that US $1,000,000.

3.2 *Evaluation Techniques*

Among the various criteria or techniques used to evaluate relative project profitability are the following:

Payback Period (PBK)
Accounting Rate of Return (ARR)
Internal Rate of Return (IRR)]
Discounted Cash Flows (DCF)
[Net Present Value (NPV)],
Linear Programming
Portfolio Analysis

There is substantial acceptance of payback period (PBK) and discounted cash flow (DCF) methods for assessing project desirability. However for certain category of projects, (eg. export market development, use of indigenous raw materials and environmental protection) the above methods are relaxed in preference to social cost-benefit analysis.

The academic literature has emphasised the use of quantitative criteria that recognise the time value of money. Generally the net present value (NPV) is accepted as the best method in some theoretical sense, but other measures like the internal rate of return (IRR), accounting rate of return (ARR) and payback period (PBK) are widely employed. The first two methods, NPV and IRR employ discounted cash flow techniques and are generally referred to as sophisticated as opposed to the latter naive approach. These techniques are detailed in Appendix A.

Table 3.1 and 3.2 summarise the use of the above capital budgeting techniques in this survey. Aside from 4 responses or 15% of the sample all other firms indicate the use of two, three, or four different evaluation techniques. The most widely used technique is the payback period used by 78% of the respondents, but only 15% of the firms use it as the only evaluation technique. IRR is used by 56% of the firm whilst NPV is employed by 48%. 76% of all firms use at least one discounted cash flow method and 35% employed both the NPV and IRR. ARR was used by 22% of the firms in the sample as one of the method.

Linear integer programming under capital rationing and portfolio analysis are just two of a number of management science techniques than have been applied to investment analysis. The extent to which these management science techniques are practised is summarised in Table 3.3. Only 8% or 2 respondents indicated applying linear programming technique and 42% or 11 respondents included portfolio analysis as part of their evaluation exercise. 50% of the sample did not respond to this query.

Table 3. 1

PERCENTAGE OF FIRMS USING EACH OR COMBINATION OF CAPITAL BUDGETING TECHNIQUES

Techniques	Percentage
PBK	15
PBK, IRR, NPV	23
PBK, IRR, NPV, other	4
PBK, ARR, IRR, NPV	4
PBK, ARR	11
PBK, IRR	8
IRR, other	8
PBK, NPV	11
NPV, other	4
PBK, ARR, IRR	4
IRR, NPV	4
ARR, IRR	4

Table 3.2

PERCENTAGE OF FIRMS USING CAPITAL BUDGETING TECHNIQUES

Techniques	Percentage
PBK	78%
ARR	22%
IRR	56%
NPV	48%

TABLE 3.3

PERCENTAGE OF FIRMS USING MANAGEMENT SCIENCE TECHNIQUES

Techniques	Percentage of Sample
Linear Programming	8
Portfolio Analysis	42
No Indication	50

3.3 *Forecasting Project Cashflows*

A key activity of the investment analysis process involves the formulation of the expected cash flows associated with the various alternatives. The cash flow stream employed in sophisticated capital budgeting approaches has three distinct parts:

(i) the initial cost of the investment
(ii) operating cash flows, and

(iii) terminal value.

The initial investment cost includes cost of plant equipment and facilities purchased plus related costs (transportation, legal, training, spare parts, installation, etc.), patents and licenses and working capital.

The operating cash flows include cash revenues from sales less cash outflows from production cost and income taxes. The estimated terminal value of a project comprise the sum of net working capital released and the funds realised from the sale of assets net of tax consequences.

Common errors in cash flows usually have their origin in the computation of the above factors and the treatment of depreciation and interest charges. The number of firms submitting specimen samples of cash flow projections were too few in number and consequently, it was not possible to draw any conclusions regarding the accuracy of cashflow determinations.

3.4 Risk Adjustment

Risk is generally referred to as the probability the actual return from an investment will deviate from the expected return. Risk in capital budgeting can be associated with financial risk, business risk, risk of technological change, obsolescence, etc., and risk due to errors in estimation of the parameters employed in the analyses itself. A variety of methods for assessing risk ranging from the more informal and intuitive to the complex statistical analyses have been employed. Simplistic techniques tend to make unrealistic assumptions whereas the more sophisticated techniques advanced by the academics have operational complications and are difficult to implement in practice. The most appropriate method quite often depends on the nature of the project and the area in which top-level management decision-making employing heuristics are involved. Some of the more recognised though not strictly vigorous risk treatment methods cited in the literature are:

(i) Risk Adjusted Discount Rate

The essence of this approach is to employ a modified discount rate to account for the risk associated with the project. The extent of the modification is usually based on historical evidence or intuition and is specific for specific projects.

(ii) Sensitivity Analysis

Sensitivity analysis is concerned with exploring the effects of changes in the variables associated with any function, largely with the object of determining whether reasonable variations both positive and negative, are within acceptable bounds. Such an analysis could explore, for example, the effects of changes in variable and fixed production cost, of delays in plant start-up, of different market growth patterns, or of any other parameter as they relate to the viability of a project. The method acknowledges the presence of uncertainty in these variables, but does not attempt to quantify its value.

(iii) Probability Distributions and Cash Flow Projections

Two approaches are in common use; one is to vary the cash flow projections to satisfy the risk perceived to be associated with the project and secondly to employ cash flows based on some likely probability distribution function. Operationally there are a number of difficulties when attempting to evaluate these on a quantitative basis and solutions quite often revert to the subjective.

(iv) Capital Asset Pricing Model (CAPM)

This equilibrium model relates the investor's required rate of return to the systematic risk of a financial asset. It is based on a number of simplifying assumptions about both the capital market and the behaviour of the investor.

The Capital Asset Pricing Model takes the follow form:

$$E(r_{PROJ}) = r_f + \beta_{PROJ}\,(E(rm) - r_f)$$

$E(r_{PROJ})$	=	expected rate of return on project
r_f	=	risk-free interest rate
β_{PROJ}	=	Beta coefficient of project.
$E(r_m)$	=	expected return on market portfolio

A project's ß reflects the sensitivity of changes in a project's expected returns to changes in the returns of the market. A beta of 1.0 indicates nominal risk (greater than 1.0 reflects above average risk and below 1.0 is a below average risk). Betas can be calculated from financial assets or obtained from published sources of betas. In only a few cases, it is possible to estimate project betas using historical information for projects.

The use of risk adjustment methods for the survey are summarised in Table 3.4 and 3.5. Of the 26 respondents, all but one i.e. 96% of the firms, apply some form of risk adjustment in carrying out their capital budgeting exercises. The results also indicate

that 58% of the respondents apply at least one analysis whilst 31% apply at least two analyses and 7% up to three.

The use of sensitivity analysis was acknowledged by 65% of the firms, the highest in this survey. Cash flow adjustment was used by 50% of the respondents (with no reported usage of probabilistic distribution of cash flows), whilst risk adjusted discount rate was applied by 19% of the sample. Capital asset pricing model was not used.

The survey clearly indicates the awareness of firms to the existence of risk in capital budgeting exercises in that most firms apply at least one formal method of risk assessment. The high propensity for the use of sensitivity analysis seem to suggest a lack of knowledge of the real risk involved in the projects.

Table 3.4

PERCENTAGE OF FIRMS USING VARIOUS RISK ADJUSTMENT TECHNIQUES

Method	Percentage
Risk-adjusted Discount Rate	19
Sensitivity Analysis	65
Cash Flow Projections	50
Cash Flow Probability Distribution	0
Capital Asset Pricing	0
Others	15

Table 3.5

NO. OF RISK-ANALYSIS TECHNIQUES USED BY FIRMS

No. of Techniques	Percentage
Zero	4
One	58
Two	31
Three	7

3.5 Discount Rate Determination

The use of evaluation techniques that recognise the time value of money requires for its determination either a discount rate (if NPV is used) or a cutoff rate (if IRR is used), both of which refer to a threshold rate that a prospective project must exceed in order to be accepted. Many methods have been suggested for the determination of this rate. Academic literature suggests that this rate be based on cost of capital, should reflect the firm's internal situation, the project risk (if cash flows are not adjusted before discounting) and organisational or firm's risk.

The survey results are summed in Table 3.6. 35% of the firms responding use the firm's rate of return to determine their hurdle rate whilst another 42% employed the cost of capital of its borrowed funds, 23% by market rate of borrowing/lending and 15% employed a weighted average of cost of available capital. The default free method was not employed by any of the firm responding.

In 4 cases, or 15% of the sample responding, two measure were employed and in three of those cases the firm's rate of return and cost of borrowed capital were used. The other case used the firm rate of return and the market rate of credit.

Table 3.6

METHODS USED IN DISCOUNT RATE DETERMINATION

Firms Rate of Return	35
Cost of Borrowed Funds	42
Market Rate of Borrowing/Lending	23
Default Free Rate of Interest	0
Others (Weighted Average)	15

4.0 CONCLUSIONS

This survey provides a very important insight into the capital budgeting practices of firms and institutions in the CARICOM region. The use of quantitative methods appear to be well established with both naive and sophisticated techniques being practiced together: 78% of all respondents used payback period whilst 76% used at least one discounted cash flow method. Internal rate of return was applied by 56% of the sample and net present value by 48%. Discount rates were determined largely by the firms rate of return or by the cost of borrowed funds. Most firms make allowances for risk associated with the projects and 58% of those responding indicated some attempt to adjust for this factor. Management science techniques were not practised to any significant extent. It is expected that with the widespread use of microcomputers and available software, decision support system (inclusive of management science models) together with management judgement will find increasing application in capital budgeting in the Caribbean.

APPENDIX A

EVALUATION TECHNIQUES

(i) Net Present Value

For any project, the net present value is given by

$$NPV_k = \sum_{i=0}^{i=n} a_i (1+k)^{-i} \qquad (1)$$

where

- a_i = the net after tax cash flow for any period i.
- k = the minimum rate of return which the project must provide to be accepted, i.e. minimum acceptable rate of return
- n = economic life of the project

Project selection rule is based on

NPV > 0,	accept project
NPV < 0,	reject project
NPV = 0,	indifferent

(ii) Internal Rate of Return

The internal rate of return of an investment project is generally defined as the discount rate for which the project's NPV is zero. With reference to Equation (1) above, the IRR is the discount rate q such that

$$o = NPV_q = \sum_{i=0}^{i=n} a^i (1+k)^{-i} \qquad (2)$$

(iii) Payback period

The Payback Period is the time P such that

$$\sum_{i=0}^{P} a_i = 0 \qquad (3)$$

(iv) Accounting Rate of Return

$$ARR = \frac{Avg.\ net\ income\ from\ investment}{Avg.\ investment} \qquad (4)$$

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TABLE 2.1: CHARACTERISTICS OF COMPANIES SELECTED FOR SURVEY.

Company			Country*				Industry		Classification+						Ave. Proj.	Size	$MM
Number	B	G	GR	J	TT		A	C	D	E	M		Respondents		<$.10	<$.10	>$1.0
1		x									x		x		x		
2					x						x						
3					x		x										
4					x			x					x		No Response		
5				x				x					x			x	x
6					x						x						
7		x						x									
8					x			x					x		x	x	x
9				x			x										
10	x								x				x			x	x
11					x			x									
12					x						x						
13					x			x									
14				x				x									
15					x			x					x				x
16				x				x									
17					x						x						
18					x			x									
19				x				x					x				x
20				x							x		x		x	x	
21		x									x						
22				x			x										
23					x				x								
24				x				x					x		x	x	x
25	x							x									
26					x			x					x			x	
27	x								x								
28				x					x								
29					x				x				x		x	x	x
30					x					x			x			x	x
31				x				x									
32					x						x		x			x	
33	x								x				x		No Response		
34					x						x		x			x	
35		x					x										

TABLE 2.1: CHARACTERISTICS OF COMPANIES SELECTED FOR SURVEY (continued)

Company			Country*				Industry		Classification+						Ave. Proj.	Size	$MM
Number	B	G	GR	J	TT		A	C	D	E	M		Respondents		<$.10	<$.10	>$1.0
36				x							x						
37					x		x						x		x		
38				x				x									
39					x						x		x		x		
40					x						x						
41		x									x						
42					x				x								
43					x			x					x		x	x	x
44					x		x						x			x	x
45	x							x									
46					x			x					x		x	x	x
47	x										x						
48				x					x				x			x	x
49	x						x										
50	x						x										
51					x			x					x		No Response		
52				x				x									
53				x					x								
54					x						x		x		x	x	
55				x					x								
56					x						x						
57	x								x				x		x	x	x
58					x		x										
59					x		x										
60	x								x				x		x	x	
61	x							x					x		x	x	x
62			x						x				x		x	x	
63				x					x								
64					x			x									

* B - Barbados; G - Guyana, Gr - Grenada; J - Jamaica; TT - Trinidad & Tobago
\+ A - Agriculture; C - Chemical; D - Development Bank; E - Electrical; M - Mechanical