REAPPRAISAL OF MATHEMATICAL PROGRAMMING APPROACH TO CAPITAL BUDGETING DECISIONS

by

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Being a Research Dissertation Submitted to the School of Post Graduate Studies, Ahmadu Bello University, Zaria in partial fulfilment of the requirement for the award of Masters of Science degree in Accounting and Finance

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DECLARATION

This research work, entitled 'Reappraisal of Mathematical Programming Approach to Capital Budgeting Decisions', has not, to the best of my knowledge and belief, been submitted to Ahmadu Bello University, Zaria or to any other institution for the award of a degree.

All references made to other works have been duly acknowledged, and I take responsibility for any representation made in the work.

CERTIFICATION

This dissertation entitled "Reappraisal of Mathematical Programming Approach to Capital Budgeting Decisions", by Ali Othman Ahmed, meets the regulation governing the award of the Degree of Master of Science (Accounting and Finance) of the Ahmadu Bello University, and is approved for its contribution to knowledge and literary presentation.

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DEDICATION

To Anna and Family,

with love

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ABSTRACT

There could be many reasons why most investments in capital projects fall below expectations in developing countries. But one vital reason is the lack, or ignorance of an appropriate method of analysing such investments before taking decisions.

In aijy -investment, decision problem, the choice of technique of analysis is as important as taking the final decision. This is because a particular technique could be best for some circumstances and yet be worst for other circumstances. However, inspite of changing circumstanoes, investment decision makers in Nigeria seem to be conservative over the methods they employ.

It is in the light of the above problem that this work examines the Mathematical Progamming Approach to Capital Budgeting with the hope of identifying a particular model that could, with little or no alteration, be most appropriate for Nigeria.

Since the models were formulated with developed countries in mind, a survey of the characteristics typifying capital budgeting problems in developing countries was undertaken in this work before forming a clear picture of what qualities a model must possess to pass as ideal. Based on these characteristics, the Stochastic Goal Programming Model was found to be relatively

better than any existing model. To make it most appropriate, however, certain modifications are suggested in the model to **incorporate the effects of the rapid and unpredictable changes in factors affecting Capital Budgeting that are observed to be common in Nigeria.**

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Chapter 1

1.0 INTRODUCTION

1.1 General

The success or failure of a business organisation depends on its ability or inability to achieve its objective. It is indispensable for a determined business organisation to identify its objective and work towards achieving it. However, it is one thing to identify such objective and quite another to ensure its attainment.

Given a set of objectives on inception, as is usually the case, an organisation has to cautiously study each and every bit of its undertakings. It has to be certain what is likely to become of its actions. That is to say, a business organisation has tobe able to foretell, with a reasonable degree of confidence, what to expect from its commitments - especially financial commitments - and to take the most efficient decision whenever faced with problem of choice among alternative lines of action.

Financial commitment is a major character in business. It could be of current and operational nature or of long term commitments of funds. Long term commitments of funds, referred

to as capital investment, are far more crucial than operational commitments in that the former always determines the latter. The point here is that, the most relevant indicator of a business as continuity is the efficiency of its capital investment (i.e. long term commitment of funds). Firms however face a lot of problems when addressing investment as a function. These problems basically consist of the decision problems and the implementation problems. The dgcision problems arise in choosing a technique of analysis, factors to be considered, and the criteria for accepting or rejecting an investment proposal. Upon the selection of a project then comes the implementation problem. This includes selecting a method or mode of financing the investment and also making detailed plans to carry out the project. The problem of concern in this work, and perhaps the most important of the two problems, is the decision problem.

Two areas of investments that pause decision problems to management are investments in capital projects (like establishing a new plant or introducing a new product line) and portfolio investments, i.e. investments in shares of companies. In portfolio decision, a firm is faced with the problem of selecting a portfolio, which includes making inference about the future performance of shares and the actual choice among different combinations of shares.

Decision on investment in capital project (also known as capital budgeting) has been a major problem issue for long. As

David B Hertz[1] said, "of all the decisions that business executives must make, none is more challenging - and none has received more attention - than choosing among alternative capital investment opportunities".

What makes capital budgeting decision challenging and much attended to is the significance of such decision to the life of a business and the need to achieve optimum solution to the problem. For a capital budgeting decision to be optimum, an efficient and realistic technique of analysis and decision process must be established. That is to say, before contesting the 'accept or reject' criteria, a sub-decision needs to be made by way of deciding on the technique of analysis to be employed and the procedure to be adopted. This sub-decision, though not the final decision represents the crux of the problem in the entire decision process.

Only when the sub-decision has been properly taken can the final decision be anything optimal. This is because the extent of the optimality of the final decision depends largely on the idealness and efficiency of the technique applied in making the decision.

The choice of a technique of analysis thus becomes paramount. Any good technique should not only consider the objective of an organisation but must also reflect all factors and circumstances surrounding the decision. However, the question of what technique actually reflects all factors and

circumstances has been a serious issue.

Several attempts have been made to evolve a comprehensive model of analysis, and though progress has been made, particularly, under the Mathematical Programming Approach, none of the suggested models could yet be regarded adequate.

1.2 Problem of Study

Before any technique of analysis could be considered adequate for use in project evaluation it must be capable of solving simultaneously and logically, all the problems underlining capital budgeting decisions. These problems could be identified as follows: (i) determining all financial and non-financial constraints on capital resources; (ii) establishing statistical relationship among constraints; (iii) identifying the interelationships among projects; (iv) providing for uncertainty in future events, and (v) choice among alternative projects or selection of a given project.

As indicated by some surveys2, most companies apply the Payback Period Method, the Net Present Value or some other discount method. But these methods of analysis consider only a little of the total problems surrounding capital budgeting decisions. None of the methods can consider alternative projects simultaneously, and all the methods only seek to attain single objective or goal.

Despite the adjustments and modifications made to such models to incorporate risk and uncertainly, they remain highly subjective and unrealistic - though they are said to be simple and straight forward and easy to apply.

Beside the inadequacy of the methods used in project analysis, most business organisations in Nigeria do not even seem to have a clearly defined set of objectives. Their activities suggests that they only think of progress in terms of increased profit margin. This perhaps is due to the fact that most literature on objective of the firm centre around financial objective.

It has been generally believed that the financial objective of the firm should be to maximize owners' economic welfare. But, there is a controversy between the traditional economic theorists and the modern financial theorists regarding what maximizes owners economic welfare.

However, both theories recognise only a single objective (maximizing owner's welfare). But in view of the contemporary role of firms in the society, financial objective cannot be said to be the only objective for their existance.

It will be wrong to assume that capital budgeting decisions are intended to achieve only one objective. In any organisation, investment decisions, and infact the implementation of projects,

are influenced by the behavioural pattern of the participants. This behavioural pattern is assumed to be determined by the theory of the firm. Therefore, to contest whether capital budgeting should be to achieve a single goal, a brief look at the theory of the firm becomes important.

Two theories are easily identifiable in the literature. The classical theory and the organisational theory of the firm. The major area of conflict between these two theories is the objective function that a firm is deemed to fulfill. The classical theory proposes that the firm is deemed to maximise a single objective, basically, profit. The organisational theory on the other hand, tends to propose that a firm has no single goal. What should be regarded as the firms goal, it insists, is the representation of the whole goals of the members of the organisation, which include employees and all other affected parties. According to the organisational theory, organisations are motivated by wide variety or psychological, social, and economic needs of its entire participants. These participants are interested in the survivals of the organisation and its ability to continue to meet their needs.

The practical behaviour of firms in modern times seems to have casted doubts in the minds of most experts and observers as to whether firms are set up for only a single objective. Already contemporary planners have started recognising the increasing necessity to emphasis multiple organisational goals such as

profit-making, meeting the welfare needs of employees, contributing to social development, etc. However, decision and planning under a case of multiple objectives is always difficult. Some goals may be incompatible or conflicting. It is not easy to attempt satisfying all the goals simultaneously, but that is exatly what a good model of analysis should do.

1.3 Objective of the Study

The foregoing problems highlight the need for a comprehensive model of analysis for capital budgeting - a model that can provide optimal solution while recognising all constraints and objectives of a firm simultaneously.

The objective of this study is to find out whether such technique exists or not, or if with modifications any other particular technique could be accepted as comprehensive or suitable for use in Nigeria.

For purposes of guidance, it should be noted that any ideal model must not only provide for uncertainties in expected future events but must also reflect the statistical relationship among the various constraints and variables. The model must also provide for the effects of changes in one constraint or variable on other constraint(s) or variable(s) and in the overall decision. This is particularly important because in an economy like the type we have in Nigeria where unpredictable and rapidly

changing government policies influence business activities, most constraints are greatly exposed to changes.

1.4 Hypotheses

Three null hypotheses are to be tested in the study. These are:

1.4.1 Hypothesis: (H_{o_1})

The efficiency or otherwise of an investment decision is not a function of the technique of analysis employed in evaluating the proposal.

1.4.2 Alternative Hypothesis: (H_{A_1})

H_{o_1} is not true.

1.4.3 Hypothesis two: (H_{o_2})

Constraints variables are independent such that a change in one variable factor does not influence a change in another.

1.4.4 Alternative Hypothesis: (H_{A_2})

H_{o_2} is not true.

sampling technique used in administering the questionnaire was a random selection. But due to the differences in firms in terms of sizes and nature of business, cluster sampling was considered most suitable among other forms of random sampling. The population was divided according to type of business, ownership structure, and usual sizes of capital projects undertaken.

Based on the information collected an opinion was formed after testing the hypotheses forwarded in the previous section. Some important features of ideal model of analysis were thereafter noted. These features cover all major problem situations existing in practical life and also serve as guidance in the selection of a particular method of analysis.

In the second part of the research, the Stochastic Goal Programming Approach to capital budgeting was selected, following its logical superiority over all other models. This model was then examined in the light of the practical aspects of capital budgeting problems obtained from the questionnaire. Certain necessary issues were considered and a variant of the model was suggested to make it more properly applicable to Nigeria.

1.6 Plan of Study

The entire study is divided into five chapters. The first chapter constitutes the introduction to the whole work. The chapter contains problems and objectives of the study, the

research methodology adopted and also the Hypotheses to be tested.

The second chapter is a review of the literature on Mathematical Programming Approach to Capital Budgeting Decisions. It starts with introduction to the chapter then examines the Linear Programming Model, the Goal Programming Model and the Stochastic Goal Programming Model, among other aspects reviewed. A short conclusion is also drawn at the end of the chapter.

In the third chapter various factors (mostly external) that affect capital budgeting decisions are discussed. These factors are discussed in the context of a third world economy. The entire environment and circumstances characterising investment decision problem in such economy has been fully analysed in the chapter and a conclusion drawn as to what things must be taken into consideration while making investment decision in such economy.

Analysis of the data collected through questionnaire are made in the fourth chapter. Also in fourth chapter all the three hypotheses forwarded in this work are tested, and a brief summary is given made at the end of the chapter.

The last chapter is the summary and conclusions to the whole work. Major findings are summarised, based on which some conclusions are drawn. It is in this chapter too that the limitations of the work are stated.

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1. **Hertz**, David B.: 'Risk Analysis in Capital Investment', Harvard Business Review, Vol. 42, No. 1, Jan. - Feb., 1964.

2. Management Accounting, I.C.M.A., Jan. & Feb., 1988.

Chapter 2

2.0 REVIEW OF LITERATURE

2.1 Introduction

In this chapter only the mathematical programming approach to capital budgeting is examined. The literature has been systematically presented to show the trend of development in the area.

The review starts with a linear programming model applied to Capital Budgeting by H. M. Weingartner[1]. Another major application of a reformulated version of the L.P. model by Baumol, W. J., and Quandt, E[3] was also discussed.

Limitations of the LP model as a tool for capital budgeting decisions were highlighted and a better model resorted to. That is, the Goal Programming Model, which was first applied to capital budgeting problem in 1974 by Hawkins, C. A. and Adams, R. M.[5]. After examining the GP model however, it was found among other limitations, that it neglects uncertainty in future events.

To take care of the limitations of LP and GP models, the Stochastic Goal Programming (SGP) model was applied to capital budgeting in 1985 by J. Agarwal[10]. This model and its application are also presented in this chapter.

After reviewing the aforementioned works, a summary was given nd conclusions drawn as to which of the models is better.

2.2 Linear Programming (LP) Model

LP is a mathematical technique of maximizing a given objective under limitations imposed by a number of constraints. The objective could be profit maximization while some of the constraints could be budget constraints representing the distribution of funds among competing uses in a particular period. The model, in a conical form is as follows:

$$\text{Maximize} \quad Z = \sum_{j=i}^{n} C_j X_j$$

$$\text{subject to:} \quad \sum_{j=i}^{n} a_{ij} x_j \leq b_i$$

$$x_j \geq 0$$

$$\text{or Minimize } P = \sum_{j=i}^{n} C_j x_j$$

$$\text{subject to} \quad \sum_{j=i}^{n} a_{ij} x_j \geq b_i$$

$$X_j \geq 0$$

Where Z and P are the respective goals to be maximized or minimized; C_j, b_i and a_{ij} (for i = 1, 2 ... m, j=1, ... n) are constraints obtained from the problem; and x_j represents project

j to be considered.

Our review starts with the LP format of the Lorrie and Savage[2] problem formulated by H. M. Weingartner[1]. The objective of the problem is to select a combination of projects given a budget of $50 million in period I and $20 million in period II. The details of the problem are shown in Table 2.1.

Table 2.1 — Investment decision problem

Investment Project	Present value of outlays in millions of $		Present value of Investment in Millions of $
	Period I	Period II	
1	12	3	14
2	54	7	17
3	6	6	17
4	6	2	15
5	30	35	40
6	6	6	12
7	46	4	14
8	36	3	10
9	18	3	12

Source: Lorie and Savage (1955) page 234.

The linear programming form for the problem was given by Weigngartner as follows:

$$\text{Maximize} = 14x_1 + 17x_2 + 17x_3 + 15x_4 + 40x_5 + 12x_6 + 14x_7 + 10x_8 + 12x_9$$

$$\text{Subject to: } 12x_1 + 54x_2 + 6x_3 + 6x_4 + 30x_5 + 6x_6 + 48x_7 + 36x_8 + 18x_9 \leq 50$$

$$3x_1 + 7x_2 + 6x_3 + 2x_4 + 35x_5 + 6x_6 + 4x_7 + 3x_8 + 3x_9 \leq 20$$

$$1 \geq x_j \geq 0 \text{ for } j = 1, 2, \ldots 9.$$

The solution to the above problem was obtained using the simplex method as

$x_1 = 1.0$ $x_4 = 1.0$ $x_7 = 0.045$

$x_2 = 0.0$ $x_5 = 0.0$ x_8 0.0

$x_3 = 1.0$ $x_6 = 0.97$ $x_9 = 1.0$

Source: Weingastner (1963) page 18 Table 3.1

The solution indicates the fraction of each investment proposal to be adopted as an x_j value. The total value of Z is $70.27, obtained as follows:

$$14(x_1) + 17(x_3) + 15(x_4) + 12(0.97x_6) + 14(0.045x_7) + 12(x_9) = 70.27$$

As Baumol and Quandt[3] observed, "it is difficult to overstate the power and flexibility of models of this type". However, the particular model above was formulated on the assumption

that interest rate has been determined, applied to the future funds flow, and the present values obtained. If the application of the interest rate, i.e. the discount rate is to be made part of the model, the following model could be adopted.

$$\text{Max} \quad \pi = \sum_{j=i}^{n} \sum_{t=0}^{T} [a_{jt}/(1+i)^t]x_j$$

$$\text{Subject to} \quad \sum_{j=1}^{n} b_{jt}x_j \leq F_t$$

$$\text{for } t = 0, 1, 2, \ldots T$$

where i represents the rate of interest; a_{jt} represents the net cash flow obtained from a unit of project j during period t; b_{jt} is the net amount of cash used up by a unit of project j during period t; x_j is the number of units of project j constructed; and F_t is the amount of fund made available from outside sources during t. Thus

$\sum_{t=o}^{T} [a_{jt}/(1+i)^t]$ is the discounted

present value of the earnings of project j.

The LP model has the versatility to handle certain situations that could not be handled by any model other than those under the Mathematical Programming Approach. For instance, in the model given above, it can be observed that

(i) where funds F_o, F_1, ... invested in the various periods must eventually be rapid, the F values in the contraints can easily be made negative for the required repayment dates.

(ii) where a project can only be taken as a whole or rejected as a whole the values of X_j can simply be made an integer in the programming, i.e., $X_j = 1$ or $X_j = 0$;

(iii) if two projects, a and b, are indivisible and mutually exclusive, we simply make $X_a + X_b = 1$. Since both X's will be non-negative and invidivisible, if project a is adopted, so that $X_a = 1$, then necessarily $x_b = 0$. i.e., project b is automatically rejected and vice versa.

However, the LP model also has its limitations as pointed out by Baumol and Quandt. They (Baumol and Quandt) therefore reformulated the model to take care of such limitations.

The limitations observed in the LP model could be stated as follows:

(i) there exists the possibility that funds may also be used for investment outside the firm or for personal consumption by the capitalist (the stockholder) and the model described has not made explicit allowance for these alternatives;

(ii) funds unused during period t can normally be retained for use during later periods and the model should provide for this;

(iii) there is apparently some relationship between a_{jt} and b_{jt} since whenever an investment adds a positive (or negative) cash flow it should add to (or reduce) the amount of money available during that period for use in other investamnets. This relationship as described by Baumol and Quandt is the equation

$a_{jt} = -b_{jt}$ which was described as follows:

Let C_{jt} = total cost incurred by project j in period t,

R_{jt} = total revenue generated by project i in period t,

Then $b_{jt} = C_{jt} - R_{jt}$ i.e. net outflow.

but $a_{jt} = R_{jt} - C_{jt}$ and thus

$a_{jt} = -b_{jt}$.

The above relationship, however, cannot stand if revenue earned in period t-i becomes available only in period t or some other future period.

One other issue on which Baumol and Quandt based their work was that of determining the right discount rate.

As could be observed in the work of Lorries and Savage, Weingartner, and others, future cash flows were always discounted using the 'company's cost of capital'. But the cost of capital is an ill-defined concept which has been a subject of a great deal of controversy in the literature[9]. Besides, the general cost of capital cannot be used for capital rationing purposes since the company cannot lend or borrow freely i.e. F_t is

limited, hence the company is cut off from the capital market.

In their effort to determine an objective discount rate, Baumol and Quandt suggested that the correct form of the objective function in Rationing Capital should be

$$\overline{\Pi} = \sum_{j=1}^{n} \sum_{t=r}^{T} (a_{jt} \quad {}^{P_t}/P_o)\, x_j$$

instead of

$$\overline{\Pi} = \sum_{j=1}^{n} \sum_{t=o}^{T} (a_{jt}/(i + 1)^t) X_j$$

where $\frac{d\Pi}{dF_t} = P_t$, and

$$\frac{d\overline{\pi}}{dF_o} = P_o$$

They discarded the use of $(1 + i)^{-t}$ as discount rate and replaced it with P_t/P_o.

The basis for the modification of the discount rate ($P_t/P_o = K$) is discussed as follows:

If $S_o = KS_1$, where S_o is an amount of dollars at present and S_1 is an amount of dollars one period hence, then K is defined as the discount rate. Assuming that slight additional dollars will add $d\overline{\pi}/dF_o$ to the earnings in period zero and the contrubition of S_o dollars approximately equals

an objective rate and a subjective rate as was done by Baumol and Quandt. That not withstanding, however, the suggested model cannot be regarded ideal because it does not consider uncertainty in future events. Also the LP model could not be conveniently used as a means of solving most investment decision problems since it can only be used in situations where the objective of an organisation is single. Where multiple objectives exist, LP proves helpless.

To provide for cases of multiple objectives, therefore, a variant to the LP model, called Goal Programming Model was introduced to capital budgeting.

2.3 Goal Programming (GP) Model

Goal Programming provides a way of striving towards attaining several objectives simultaneously. The basic idea is to establish a specific numerical goal for each of the objectives, formulate an objective function for each objective, and then seek a solution that minimizes the sum of deviations of these objective functions from their respective goals.

To describe this mathematically, let X_1, X_2 ... X_n denote the decision variables of the problem and let K be the number of objectives being considered. For each objective k(k = 1, 2, ... K) let C_{jk} be the coefficient (cost coefficient or weighted coefficient) of X_j (j=1, 2, ... n) in its objective function

(assuming to be linear) and let g_k be the goal of this objective function. The solution being sought is one that comes as close as possible to attaining all of the following goals.

$$\sum_{j=1}^{n} C_{j1}X_j = g_1 \qquad \text{goal 1}$$

$$\sum_{j=1}^{n} C_{j2}X_j = g_2 \qquad \text{goal 2}$$

$$\vdots \qquad\qquad \vdots$$

$$\sum_{j=1}^{n} C_{jk}X_j = g_k \qquad \text{goal k}$$

The composite objective functions for the GP model is formulated thus:

Minimize the sum of deviations from goals

$$Z = \sum_{k=1}^{K} |(\sum_{j=1}^{n} C_{jk}X_j - g_k)|$$

where the two vertical lines denote absolute values for the quality between them.

To solve the objective function we reduce Z to a linear programming format as follows:

$$\text{let } d_k = \sum_{j=1}^{n} C_{jk}X_K - g_K$$

such that the auxiliary variable d_K could be positve or negative. Then

$$Z = \sum_{k=1}^{K} | d_K |$$

where $| d_K | = d_k^+$ or d_K^-

for k = 1, 2, ... K, and $d_K = d_K^+ - d_k^-$, $d_k^+ \geq$, $d_k^- \geq o$.

Consequently, the GP model reduces to

$$\text{Min. } Z = \sum_{k=1}^{K} (d_k^+ + d_k^-)$$

subject to

$$\sum_{j=1}^{n} C_{jk} X_j - (d_k^+ - d_k^-) = g_k$$

and any original LP constraints on X_j.

From the above model, the simplex method can be used to obtain an optimum solution for all of these variables (including the X_j). Thereafter, the d_k^+ and d_k^- can be discarded.

If, as is usually the case, some goals are considered more important than others, or deviation in one direction (+ or -) is considered more important than deviation in the other direction, the difference can be taken into account by assigning different weights, W_k^+ and W_k^- (k = 1, 2, ... K), to the respective d_k^+ and d_k^- deviation. In this case the GP Model would be

$$\text{Min } Z = \sum_{k=1}^{K} (W_k^+ d_k^+ + W_k^- d_k^-)$$

subject to exactly the same constraints given above.

To illustrate the application of the GP model, lets consider the problem presented in Tables 2.2

Table 2.2 Dewright Co. Ltd. Problem

Factor	Unit contribution			Goal	Penalty weight
	Prod.1	Prod.2	Prod.3		
Long run profit	12	9	15	£120	5
Employment	5	3	4	40	2(+), 4(-)
Capital investment	5	7	8	£60	3

Source: Hillier and lieberman[11], page 175 Table 5.1

The goals in the above problem are stated thus

$$12X_1 + 9X_2 + 15X_3 \geq 120 \quad .. \quad .. \quad .. \quad .. \quad .. \quad \text{Profit goal}$$

$$5X_1 + 9X_2 + 15X_3 = 40 \quad .. \quad .. \quad .. \quad .. \quad .. \quad \text{Employment goal}$$

$$5X_1 + 7X_2 + 8X_3 \leq 60 \quad .. \quad .. \quad .. \quad .. \quad .. \quad \text{Investment goal}$$

where X_1, X_2 and X_3 and the production rates of products 1, 2 and 3 respectively.

Let $d_1 = 12X_1 + 9X_2 + 15X_3 - 120$

$d_2 = 5X_1 + 3X_2 + 4X_3 - 40$

$d_3 = 5X_1 + 7X_2 + 8X_3 - 60$

Since $d_1 = d_1^+ - d_1^-$

$d_2 = d_2^+ - d_2^-$

$d_3 = d_3^+ = d_3^-$

the GP model could then be formulated as follows

$$\text{Min } Z = 5d_1^- + 2d_2^+ + 4d_2^- + 3d_3^+$$

Subject to:

$$12X_1 + 9X_2 + 15X_3 - (d_1^+ - d_1^-) = 120$$

$$5X_1 + 3X_2 + 4X_3 - (d_2^+ - d_2^-) = 40$$

$$5X_1 + 7X_2 + 8X_3 - (d_3^+ - d_3^-) = 60$$

where $X_j, d_k^+ \geq 0$ $(j = 1, 2, 3,; k = 1, 2, 3)$

The solution to the above problem using the simplex method was obtained as

$$X_1 = 4,\ X_2 = 0,\ X_3 = 5,$$

with $d_1^+ = 3,\ d_1^- = 0,\ d_2^+ = 0,\ d_2^- = 0$

$d_3^+ = 0$ and $d_3^- = 0$

The GP model was first of all developed by Charnes and Cooper (1961) as an extension and modification of LP model. Ijiri (1965) built on the work and developed it as a distinct Mathematical Programming Technique. Before Ijiri, GP problems were regarded as issues of unsolvable linear programming problems.

Hawkins and Adams[5] in 1974 applied the GP to capital budgeting for the first time. This was done by taking up the Lorrie and Savage (1955) case and made a comprehensive analysis of optimal solution as given by Weingartner's LP model and the GP solution obtained by them.

It can be remembered that the Weingartner's LP solution suggests that all of the projects 1, 2, 3 and 9 should be accepted, as well as 97% of project 6 and 4.5% of project 7, while rejecting all other projects completely. The GP solutions gave better results. However, Hawkins and Adams made certain practical assumptions before attempting a solution.

Their first assumption was to consider the decision body as "a manufacturing firm in which each investment proposal is expected to yield a certain amount of revenue in each period and utilize a specified number of man-hour per day". They also assume the following goals to have been established by top management of the firm:

1. The projects as a whole must yield a net present value of at least $32.40
2. In order to maintain an upward sales trend, the sales manager would like the first year to have as close to $70 in sales generated by the investments selected and at least 20% growth in sales for the second year. The growth in sales from year 1 to 2 is determined to be four times as

important as the initial sales goal.

3. The projects selected are desired to require as close to 40 man-hours of labour per day as possible in order to maintain the present level of employment and avoid having to rehire and retrain at a time when labour supply may be low. These goals are determined to be equally important as that of meeting the first year's sales goal.

The modified problem consisting of the Hawkins and Adams's assumptions is shown in Table 2.3.

Table 2.3 GP Problem

Investment Projects	Sales		Man-Hour	
	Period 1	Period 2	Period 1	Period 2
1	14	15	10	12
2	30	42	16	16
3	14	16	13	13
4	11	12	9	13
5	53	52	19	16
6	10	14	14	14
7	32	34	7	99
8	21	28	15	22
9	12	21	8	13

Source: Hawkins and Adams (1974) page 55 Exhibit 3.

The above problem along with the Lorrie and Savage problem was expressed mathematically using the GP. This gives

$$\text{Min } Z = d_4^- + d_4^+ + 4d_5^- + d_6^- + d_6^+ + d_7^- + d_7^+$$

subject to:

$$14X_1 + 17X_2 + 17X_3 + 15X_4 + 40X_5 + 12X_6$$
$$+ 14X_7 + 10X_8 + 12X_5 \geq 32.4 \quad \text{NPV goal}$$

$$12X_1 + 54X_2 + 6X_3 + 6X_4 + 30X_5 + 6X_6 + 48X_7$$
$$+ 36X_8 + 18X_9 \leq 50 \quad \text{Budget goal I}$$

$$3X_1 + X_2 + 6X_3 + 2X_4 + 35X_5 + 6X_6 + 4X_7 + 3X_8 + 3X_9$$
$$\leq 20 \quad \text{Budget goal II}$$

$$14X_1 + 30X_2 + 13X_3 + 11X_4 + 53X_5 + 10X_6 + 32X_7 + 21_8$$
$$+ 12X_9 + d_4^- - d_4^+ = 70 \quad \text{Sales goal 1}$$

$$15X_1 + 42X_2 + 10X_3 + 12X_4 + 52X_5 + 14X_6 + 34X_7 + 28X_8$$
$$+21X_9 + d_5^- = 84 \quad \text{Go sales goal II}$$

$$10X_1 + 16X_2 + 13X_3 + 9X_4 + 19X_5 + 14X_6 + 7X_7 + 15X_8 +$$
$$8X_9 + d_6^- - d_6^+ = 40 \quad \text{production goals I}$$

$$12X_1 + 16X_2 + 13X_3 + 13X_4 + 16X_5 + 14X_6 + 9X_7 + 22X_8$$
$$13X_9 + d_7^- - d_7^+ = 40 \quad \text{production goal II}$$

where $d_j^+, d_j^- \geq 0$ $(j = 1, 2, \ldots 9)$

Using the simplex method, the solution to the above problem was obtained to suggest the selection of the projects as follows:

$X_1 = 1.0$ $X_4 = 1.0$ $X_7 = 0.0$

$X_2 = 0.037736$ $X_5 = 0.0$ $X_8 = 0.0$

$X_3 = 1.0$ $X_6 = 0.99371$ $X_9 = 1.0$

which is interpreted in Table 2.4.

Table 2.4 Goal Programming Solution

Goal Constraint		Optimum Solution
Net Present Value	32.4	70.5660
Budget Constraint I	50.00	49.9999
Budget Constraint II	20.00	19.9999
Sales goal	70.00	51.0691
Sales goal II	84.00	79.2968
Production goal	40.00	54.5156
Production II	40.00	64.5156

Source: Hawkins and Adams (1974) page 55 Exh. 4

Apart from the fact that the GP model considered multiple objectives, the solution obtained (£70.5660) is also superior to that of the LP model (£70.27).

To further demonstrate the flexibility of the GP with respect to reordering of goal priorities, two more solutions were sought under two different assumptions.

The first assumption was that "the organisation feels it is much more important that employment goals be met in case of the two periods than it is that sales goals be met". In which case the objective function become

$$\text{Min} = d_4^- + d_4^+ + 3d_5^- + 6d_6^- + d_6^+ + 6d_7^+$$

subject to same constraints as in above.

The solution to this is

$X_1 = 0.0$	$X_4 = 0.17966$	$X_7 = 0.0$
$X_2 = 0.57462$	$X_5 = 0.22752$	$X_8 = 0.0$
$X_3 = 1.0$	$X_6 = 0.85335$	$X_9 = 0.0$

Although the goal constraints have not been altered, the solution is different from the original solution due to restructuring of the priorities. The interpretation of the solution above is as in Table 2.5

Table 2.5 Goal Programming Solution

	Goal Constraint	Optimum Solution
Net Present Value	32.4	48.6700
Budget Constraint I	50	49.9995
Budget Constraint II	20	19.9998
Sales goal I	70	52.7088
Sales goal II	84	65.9606
Production goal I	40	39.9997
Production goal II	40	39.9997

Source: Hawkins and Adams (1974) page 56 Exhibit 5.

Under the second assumption, where "management re-evaluates its sales goals and determines that they are too high--that these goals have been over stated by 30%", the objective function remains as originally, as well as all the goals except the sales goals which become

$$14X_1 + 30X_2 + 13X_3 + 11X_4 + 53X_5 + 10X_6 + 32X_7 + 21X_8 +$$
$$12X_9 + d_4^- - d_4^+ = 53.8 \quad \text{Sales goal 1}$$
$$15X_1 + 42X_2 + 16X_3 + 12X_4 + 52X_5 + 14X_6 + 34X_7 + 28X_8 +$$
$$21X_9 + d_5^- = 64.6 \quad \text{Sales goal II}$$

and the solution becomes

$X_1 = 0.33307$ $X_4 = 0.0$ $X_7 = 0.0$

$X_2 = 0.53043$ $X_5 = 0.22205$ $X_8 = 0.0$

$X_3 = 0.0$ $X_6 = 0.78311$ $X_9 = 0.0$

with implications as in Table 2.6.

Table 2.6 Goal Programming Solution

	Goal Constraint	Optimum Solution
Net Present Value	32.4	48.9595
Budget Constraint I	50	49.9999
Budget Constraint II	20	19.9998
Sales goal I	53.8	93.1755
Sales goal II	64.6	65.7841
Production goal I	40	39.9999
Production goal II	40	39.9999

Source: Hawkins and Adams (1974) page 56 Exhibit 6

Another effort worth mentioning is the reformulation of the modified Hawkins and Adams problems by Agarwal, Powal and Swamp (1981)[9]. They assigned different priority coefficients (P_i) to the various goals treating negative deviation separate from positive deviation. The solution obtained was higher in value than that of Weingartner (1963), and Hawkins and Adams (1974).

Despite the superiority of the GP model over LP model in respect of handling multiple goals, both models have one important defect that almost nullifies their applicability in practical situations. This defect is their implicit assumption of certainty in future event like flow of funds. The two mathematical programming models may be good in their respective capacities, but the fact that future events can never be determined with precision is one issue too important to ignore.

2.4 Uncertainty And Capital Budgeting

Most literature on investment decisions in the past centre around the assumption of certainty. However, some attempts have been made to incorporate uncertainty in capital budgeting.

It is perhaps proper to indicate, before proceeding, that "risk" and "uncertainty" refer to one and the same thing for our purpose. However, Knight[12] made a distinction between the two concepts. To him, risk refers to a situation where the probability distribution of the future cash flows of an investment proposal is known while uncertainty refers to a situation where no information is available to formulate such probability distribution. But for all we care, the future is in any case unknown.

Neil R. Paine (1964)[6], made a brief discussion of some probability theory and then considered the probability approach to capital budgeting. He used the net present value of an

investment (arrived at discounting at some predetermined rate of discount) as a measure of the worth of the investment. The work implies a single objective, but since our aim is to review the trends of development along the uncertainty models, considering such work is not improper.

So, supposing that X can assume a finite number of values $x_1, x_2 \ldots x_n$; that P_1 is the probability that X takes on the value x_1; P_2 the probability that X takes on the value x_2; etc. Then X is a random variable with expected value

$$E(X) = P_1x_1 + P_2x_2 \ldots P_Nx_N$$

$$= \sum_{i=1}^{N} P_ix_i$$

and variance

$$V(X) = P_1[x_1 - E(X_1)]^2 + P_2[x_2 - E(X_2)]^2 + P_N[x_N - E(X_N)]^2$$

$$= \sum_{i=1}^{N} P_i[x_i - E(X_i)]^2$$

Let R be a random variable such that

$$R = X_1 + X_2 + X_3 + \ldots X_n$$

where X_i are random variables, so that

$$E(R) = E(X_1) + E(X_2) + \ldots + E(X_n).$$

The covariance between X_i and X_j, assuming X_i and X_j are not independent, is defined as

$$\sigma_{ij} = E\{[X_i - E(X_i)][X_j - E(x_j)]\}$$

that is to say σ_{ij} is the expected value of the deviation of X_i from its expected value times the deviation of X_j from its expected value.

One can also say that

$$\sigma_{ij} = \left(\begin{array}{c}\text{correlation between}\\ X_i \text{ and } X_j\end{array}\right) \times \sqrt{v(X_i)} \times \sqrt{v(X_j)}$$

bearing in mind that the correlation coefficient between X_i and X_j is

$$\rho_{ij} = \frac{X_iX_j - \bar{X}_i\bar{X}_j}{\sqrt{(n\,X_i^2 - \bar{X}_i^2)(n\,X_j^2 - \bar{X}_j^2)}} = \frac{\text{Cov. } (X_i, X_j)}{\sqrt{V(X_i).V(X_j)}}$$

$$= \frac{E[(X_i - E(x_i))(X_j - E(X_j))]}{\sqrt{E_i[(X_i - E(X_i)]^2 . E_j[X_j - E(X_j)]^2}}$$

It follows from our definition of R therefore that

$$V(R) = V(X_1) + \sigma_{12} + \sigma_{13} + \ldots + \sigma_{1n}$$
$$+ \sigma_{21} + V(X_2) + \sigma_{23} + \ldots \sigma_{2n}$$
$$+ \sigma_{31} + \sigma_{32} + V(X_3) + \ldots \sigma_{3n}$$
$$\vdots$$
$$+ \sigma_{n1} + \sigma_{n2} + \sigma_{n3} \ldots V(X_n)$$

i.e. $V(R) = \sum_{i=1}^{n} V(X_i) + \text{Cov.}(X_i, X_j)$.

If we let $V(X_i) = \sigma_{ii}$ then

$$V(R) = \sum_{i=1}^{n} \sum_{j=1}^{n} \sigma_{ij}$$

At this point let us suppose that a firm is to make capital investments by choosing from a list of m possible projects. Let P_1 be the net present value of the first possible project; P_2 the net present value of the second possible project, etc.

Assuming P_1, P_2, etc. to be random variables with expected values

$E(P_1)$, $E(P_2)$ etc. and variances

$V(P_1)$, $V(P_2)$ etc respectively,

then if P_1, P_2 etc. are not independent, the values of $E(P_1)$, $E(P_2)$, σ_{11}, σ_{22}, σ_{ij} etc. can be obtained by relying on the probability beliefs of the firm or the use of historical data.

By assuming the above values given, Neil R. Paine (1964) set out a procedure to be followed in choosing capital investment project as follows:

1. By relying on judgement, experiences, common sense, and the like, determine all possible reasonable combinations of capital investments,
2. Compute the expected net present value and variance for each reasonable combination, utilizing formular from the previous section,
3. By carefully considering expected net present values and variances, pick the combination which is most desirable, i.e., the one with highest expected net present values and lowest variance.

Other works that come under chance constraints models include that of Naslund (1966)[13] and Bernhard (1969)[14].

Naslund took up the popular Weingartner's deterministic cash balance constraints and negotiated a conversion of the problem into a chance constraint model by making certain assumptions. He sought to maximize the expected value of terminal wealth, E(G) claiming the existance of a set of comulative cash balance constraint which is $\geq \alpha_t$

The major draw back of the model, however, is that E(G) and α_t are subjective values which cannot be determined. Furthermore

no specific statement was made as to what happens if the chance constraints are not met.

In 1969 Bernhard developed a general model by formulating the capital budgeting problem under certainty conditions and then presenting a modified version incorporating uncertainty.

The chance constrained programming does take care of uncertainty somehow, but the models have two major limitations in common. First, both models consider only a single objective, and second, they suffer from lack of computationally efficient codes.

A simpler to understand model which also considers multiple objectives under conditions of uncertainty is the Stochastic Goal Programming model.

2.5 Stochastic Goal Programming

The Stochastic Goal Programming is one of the mathematical programming approaches applied to capital budgeting to accommodate various problems surrounding such decisions. The model has the qualities of both LP and GP models, and an added quality of incorporating uncertainty.

The idea behind the stochastic programming could be reviewed as follows:

Given a set of goals X_1, X_2 ... X_n let $f(x_1, x_2 \ldots x_n) = b_i$ where b_i represents given goals. This may be written in a

linear function as follows:

$$a_n[x_1, x_2 \ldots x_n] = a_1x_1 + a_2x_2 + \ldots a_nx_n = b_i$$

where a_1, $a_2 \ldots a_n$ are real numbers such that f is a real linear function.

Using matrix algebra, let $\underline{X}$ be a column vector with components x_1, $x_2 \ldots x_n$; and $\underline{b}$ a row vector with components a_1, $a_2 \ldots a_n$; then

$$\underline{A}\ \underline{X} = \underline{b}$$

let m be a matrix with an inverse m^{-1}, if $M\underline{x} = \underline{b}$ where $\underline{b} = b_1$, $b_2 \ldots b_m$ then $\underline{x} = M^{-1}\ \underline{b}$

Taking linear constraints, say

$$BX_i \leq h$$
$$X_i \geq 0$$

the problem may be formulated in a linear programming format as

$$\text{Minimize } Z = (P_i d_i^+ + P_i d_i^-)$$

Subject to

$$ax_i + d_i^- - d_i^+ = b_i$$
$$x_i,\ d_i^-,\ d_i^+ \geq 0$$

where d_i^+ indicates deviations from set goals; P_i refer to priority coefficients or weights.

Let U_i denote random variables which are normally distributed with mean 0 and variance coveriance matrix Σ (the non-singular variance coveriance matrix Σ is assumed known since only non-singlular matrices have ordinary inverse).

The problem can now be stated in a general inverse matrix form as $b_i = ax_i + u_i$ while the linear constraints on the variables are

$$Bx_i \leq h$$

$$x_i \geq 0$$

If b_i's are considered dependent variables and jointly determined and variables x_i are independent, then

$$b_i = ax_i + u_i$$

takes the form of a linear model in a reduced form. Assuming b_i is normally distributed with mean (ax) and variance-coveriance matrix Σ, then

$$f(b_1\ b_2 \ldots b_q) = (2\pi)^{-q/2}|\Sigma|^{1/2}e^{-Q/2} \ldots$$

where the quandratic form Q is

$$Q = (b-ax)' \Sigma^{-1}(b-ax)$$

and q is the rank of the matrix of fixed coefficient 'a'.

Let B^* be a definite region which covers the point b, such

that $b \in B^*$ so that we select goals x_i for which the probability that the random vector $b_i = ax_i + u_i$ will be inside the region B^* is maximized.

By virtue of the definition of U_i, B^* should be considered to centre around b^* in a manner such that

$$Q^* \leq C^2$$

where Q^* is the quantratic form

$$Q^* = (b - b^*)^1 \{^{-1}(b - b^*)$$

and C has a chi-square distribution

and since y is normally distributed and $\{$ is non-singular, then the quadratic above has the chi-square distribution with q degrees of freedom. B^* can then be interpreted as confidence region for b at level x, because if we choose a set of goals X^o such that $E(b) = ax^o = b^*$ then the probability of b falling in the region B^* is given by α. Region B^* may be restricted to be of the form

$$Q^* = C^2$$

At this point the stochastic goal programming model is formulated as follows:

$$\text{Min } Z = (k + XMX^1 + 2P^1X)$$

$$\text{Subject to } BX_i \leq h$$

$$X_i \geq 0$$

where $k = b^{*1} \xi^{-1} b^*$,

$M = a^1 \xi^{-1} a$,

$P = a^1 \xi^{-1} b^*$

for M being (mxn) positive definite if q = n, and semi-positive definite if q < n.

The above model can however be formulated into a linear programming format as follows:

Minimize $Z = (P_i d_i^+ + P_i d_i^-)$

Subject to $ax_i + u_i x_i + d_i^- = d_i^+ = b_i$

$X_i, d_i^+ \geq 0$

Agarwal (1985) applied the stochastic goal programming model to the Lorrie and Savage modified problem. The procedure for solving the problem was, however, not discussed. But reference could be made to 'Wolfe P, 'The Simplex Method for Quadratic Programming', Econometrica, Vol. 21 (1959) pp 382-389.

Nevertheless, the procedure for solving a Stochastic Goal Programming problem such as used in capital budgeting, taking one stage variables, could be briefly stated as follows:

Let the variables of the problem constitute the n vector x $= (x_1, x_2 \ldots x_n)^1$ where x is a column vector with nx1 matrix. Then if A is taken as an mxn matrix and b is mx1, then the linear constraints problem for $\lambda \geq n$, which is

Minimize $f(\lambda, x) = \lambda_{px}.^{1}/2x^{1}\ cx$ .... (1)

may be specified as $x \geq 0$, $Ax = b$

where $x_j \geq 0$ $(j = 1, 2, \ldots n)$

$$\sum_{j=1}^{n} a_{ij}\, x_{ij} = b_i \quad (i = 1, 2 \ldots m)$$

And the condition that the n vector x solves the problem for $\lambda \geq 0$ may be written as

$$Ax = b$$

$$Cx - v + A^1\, U + P^1 \lambda = 0 \ldots (2)$$

or in the detached coefficient form

$x \geq o$	$v \geq o$	U	λ	... (3)
A	0	0	0	= b
C	-1	A^1	P^1	= 0

Constituting mxn equations in 2n non-negative variables and m unrestricted variables, where λ is not considered a variable.

Also, let Z^1, Z^2 and W be component vectors n, x and m respectively. Since $b \geq 0$, initial basis for the system could be formed from the coefficients Z^1, Z^2 and W by using the simplex method to minimize

$$\sum_{i} W_i = 0$$

Keeping V and U zero, we discard W and all unused components of Z^1, and Z^2. If the remaining n components are donated by Z and their coefficients by $\bar{E}$, the solution of the system becomes

$$Ax = b$$

$$Cx - v + A^1U + \bar{E}z = -p^1 \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \qquad (4)$$

$$x, v, z \geq 0$$

Given a basis and basic solution that satisfies (1),

$V^1x = 0$ and $\sum_{k=1}^{n} Z_k = 0$, make one change of basis in the simplex procedure for minimizing the linear form

$$\sum_{k=1}^{n} Zk \text{ for } k = 1, 2, \ldots n \quad .. \quad .. \quad .. \quad .. \quad .. \quad .. \qquad (5)$$

If XK is in the basis, do not admit VK; and if VK is in the basis, do not admit XK.

If $\sum_{k=1}^{n} Z_k > 0$, then repeat step (5) and the form will vanish

in subsequent interactions yielding Z = 0. The x part of the terminal basic solution is a solution of the quandratic programming for λ .

When the number of constraints is larger, let the constraints be

$$A_{11}X_1 + A_{12}X_2 = b_1$$

$$A_{21}X_1 + A_{22}X_2 + Y_2 = b_2$$

$$A_{31}X_1 + A_{32}X_2 = Y_3 = b_3$$

$$X_1 + Y_2, Y_3 > 0$$

so that the new linear constraints system will be

$x_1 \geq 0$	x_2	$Y_2 \geq 0$	$Y_3 \geq 0$	$v_1 \geq 0$	U_1	$U_2 \geq 0$	$U_3 \geq 0$	λ	
A_{11}	A_{12}								$= b_1$
A_{21}	A_{22}	1							$= b_2$
A_{31}	A_{32}		-1						$= b_3$
0				-1	A'_{11}	A'_{21}	A'_{31}	$P'_1 = 0$	
					A'_{12}	A'_{22}	A'_{32}	$P'_2 = 0$	

If $(x_1)k$ is in the basis, do not admit $(V_1)k$, and vise versa; if $(y_2)k$ is in the basis do not admit $(U_2)k$, and vise versa; if $(y_3)k$ is in the basis do not admit $(U_3)k$.

In most cases, the number of variables involved and the number of iteractions required is large. In such situations then computer package programme must be used to arrive at the solution.

2.6 Summary

We have seen some models of analysis put across under the Mathematical Programming Approach to solve capital budgeting problems.

The Linear Programming model is capable of handling multiple projects but seeks to achieve only one objective. It also disregards uncertainty in future events. The Goal Programming Approach is found to be better than LP because it has overcome the problem of multiple objectives. By setting the constraints inequalities to equalities, by introducing 'deviational variables' and attempting to minimize all the deviation, the GP model reasonably satisfies all objectives. One vital aspect left out by the model is uncertainty in future events.

The stochastic goal programming model as we have seen does not only attempt the question of multiple objectives and simultaneous constraints, but also incorporates uncertainly.

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Chapter 3

3.0 FACTORS THAT AFFECT CAPITAL BUDGETING DECISIONS

3.1 Introduction

A survey conducted in 1971[7] showed that more than 50% of firms that fail in the U.S.A. do so in their first five years of existance. But that is even in a developed country. In a developing country like Nigeria the failure rate may be much higher than 50 percent. In fact even the few indigenous firms that survive in Nigeria continue to remain in a stage of development many years after take off. This to a great extent is due to enomous external constraints imposed on them and their inability to identify and fully incorporate such "constraints" in their investment decision process. Constraints like economic instability, changing government policies, and societal problems are by far insufficiently reflected in most investment decision models.

Companies in a stage of development, such as most of our companies, however, face internal problems as well. Such problems consist of training personnel; developing markets and products; obtaining reliable source(s) of supply; obtaining foreign exchange for acquisition of plant and equipment, etc.

These firms usually take to manufacturing new products with untrained employees and inexperienced management, while approaching an unpredictable market with an unproven market strategy and inadequate finance (external finance is always difficult to obtain as the means of evaluating the different risk levels of such firms are greatly limited by the scarcity of objective data.

The purpose of this chapter is to lay the theoretical background necessary for clear understanding of the external constraints affecting business in developing countries. In the concluding part of the chapter a list of measures an investment decision maker should take to avoid unnecessary failure is given.

3.2 Development Economies

Every nation has its peculiar nature and characteristics which could be related to its historical background, culture, and resources. However, developing coutnries do have certain characteristics of underdevelopment that are common to all of them.

M. P. Todaro[3] observed that such common features are in form of

1. low levels of living due to low income, inadequate housing, poor health, limited or no education, high infant mortali-

ty, low life and work expectancy, etc.

2. low levels of labour productivity due to lack of managerial competence and employee motivations, lack of institutional flexibility, and also the absence or acute lack of complementary factor inputs like finance and technical know how;
3. high rate of population growth and dependency burdens;
4. high and rising levels of unemployment and underemployment;
5. substantial dependence on agricultural production and primary product exports;
6. vulnerability to foreign dictatorship and dominance in international relations.

Low incomes amidst high dependency burden, coupled with an alarming rate of inflation makes private savings difficult in a developing country. As a result, financial institutions suffer greater problem of inability to meet the credit demands of many meaningful investors. This contributes to low productivity, which leads to high dependency on imports to meet the demands of the usually swelling population of the developing country.

Poor management of resources also exists in most developing countries. The evidence of this could be seen more clearly in public investments. In countries with severe shortage of skilled man power, emphasis were that their skilled man power can best be utilized by coordinating administrative and entrepreneurial activities, which could also ensure equal distribution of income.

In Nigeria, substantial areas of investments were taken up by the government with no any form of competition from the private sector. With adequate finance and full government supports, the parastatals were expected to generate enough revenue for other development activities. However, due to poor management and excessive corruption, most of these government investments not only fail to fund government activities but also constantly demand its financial assistance to even survive.

This is not to say, however, that management in the private sector is something to be proud of. Most indigenous firms exist today merely on government's protection against foreign competitions, and yet they never grow out of it.

One may say that the poor management and over-dependence on imported goods and inappropriate technologies which contribute to low productivity is due to the historic "international transmission of institutions--values, patterns of consumption and attitudes towards life, work and self", as observed by Todaro. These and other external forces, coupled with internal political structures, power and interest groups greatly determine the social nature and capabilities of most developing countries. In all, these factors exert enomous influence on the economic policies of such countries.

It should be noted that economic policy is only one of three forces that spell the current situation in any country. The economic heritage, consisting not only natural resources and

other structures and ingredients but also the unspent influences of past events; and the behaviour pattern of economic 'agents' within the country reacting to past, present, and expected future events influence more powerfully the nature and state of an economy. As a result, one cannot be certain whether the economy will respond as expected to policy impulses. And in any case, in most developing countries, the economic agents may not have a clear understanding of the signals given out by the policy maker.

In order to safeguard the interest of its long term investment in a developing country, therefore, a firm needs to understand both the economy and the policy makers. It must know how and when changes may occur and how to assess the relative strength and weaknesses of the economic positions.

3.3 Policy Framework

In order to be able to predict the likely policy a government will take in a given situation, a survey of the policy problems and the means available to the policy makers becomes necessary. Policy measures, if carefully taken and well executed represent not only an order but also a very helpful guide to a clever investor. However, in most developing countries, policy measures do not render much help as future indicators because the policy makers in such countries often overestimate the ability of their governments to change the will of the people. It is a fact

that no government could change the will of its people without taking into account the non-economic values of the society, but this fact continues to elude policy makers largely due to lack of an adequate economic theory that incorporates such values.

Despite the limitations, however, there is still the need for a firm to be able to predict a policy and fall in line with it. Even if it (the policy) does not bring the much desired change in the society, the firm can at least gain government support and protection by reflecting the policy in its activities. But to do so in the most favourable way to its business the firm must be able to sense the future and decide on the measures to take.

Predicting a policy would not be difficult if we know the ultimate targets of, and means available to the policy makers. Prominent problems confronting most policy makers consist in how to increase per capita income; creating more employment opportunities; how to incorporate non-monetarised production into development plant; improving terms of trade to favour balance of payments, how to fight domestic inflation and to reduce the impact of world wide inflation; and what steps to take in case of exchange rate crisis.

It is normal to assume that the objective of the policy maker is to attain a balanced economic and social development and that measures are taken only to ensure the attainment or maintenance of such condition. For this purpose, the policy maker

would always try to ensure that:

1. The level of output targeted will release sufficient resources to accommodate the consuption and investment demands of the government and leave enough for the projected increase in the quantum of exports;
2. The level of investment is reasonably divided between the government and private sectors as well as the allocation of bank credit;
3. The amount of bank credit allocated to the government sector is sufficient to finance the residual government budget dificit;
4. The level of total bank credit is consistent with total aggregate demand projected in the presence of credit rationing;
5. The excess aggregate demand projected is consistent with the price projections;
6. The quantum and value of imports are consistent with both the output projection and the money income projection;
7. The level of money supply implied from the credit projection and the overall dificit in the balance of payments are consistent with some demand for money functions; and
8. The export and import price projections and any other exagenious balance of payments items such as official capital movements are realistic.

Whenever any of the above conditions is not satisfied, one

or more monetary or fiscal measures will be taken to correct the situation. The exact policy to be adopted depends on the magnitude of the real or envisaged deviation from desired goals.

It will be difficult to state in clear terms the goals of a policy maker. However, taking the problems of developing country in one hand, and the resources available to it on the other, an optimum set of goals could be presented as discussed in the model below.

Let U represent the policy maker's utility to be maximized; and

Y = economic output such as GNP

E_o = economic inputs

S = Social conditions

P = Political factors

Ed = level of Education

O = non-economic factors

R_o = readily available resources

R_i = amount of R_o utilized.

Then the policy makers utility maximization model could be stated as

$$\text{maximize} \quad U = u(Y, S, P, Ed, O) \;..\;..\;..\

either the lagrangean function or non-linear programming technique could be applied to obtain the optimum solution.

The model discussed only showed how a policy maker could attain maximum utility from given resources. The model presented all constraints variables as unknowns and policy instruments were not formally introduced. However, it is better to have ex-ante more instruments than targets as long as the instruments do not contradict one another, since we cannot corretly predict the efficiency of any given instrument.

3.4 External Constraints

A wholly government owned establishment with the sole purpose of implementing development activities will have a set of objectives to be attained as follows:

Assuming X_o is the ratio of its total available resources to the total resources in the economy available for development activities R_o, then for every resources R_i, allocated to a particular factor the establishment must try to provide X_i of its resources to that course (where X_i is the fraction of Resources R_i to be made available by the establishment).

Under such condition the ideal target would be

$$\text{Max } U = F(X_1R_1\ X_2R_2 \ldots X_5R_5)$$

$$\text{subject to } \sum_{1}^{5} X_i R_i - X_o R_o \leq o$$

$$X_i R_i \geq o$$

where $F \equiv U\,[f(x_1 g_1, x_2 h, x_3 k, x_4 m, x_5 n), x_2 h, x_3 k, x_4 m, x_5 n]$ and same algorithms will be followed to obtain the optimum solution as does the government (policy makers).

But a private firm with obligations to 'satisfy' its shareholders among other management objectives cannot utilize all its resources as in above. However, it also cannot neglect in total the use of resources to assist development, since doing so will mean losing the support and patronage of the government and people.

If the firm diverts a part of its resources towards national development it loses the returns such resources could bring if it had been invested, but if the firm invests that amount instead, it incurs costs in non-monetary terms.

In order to reconcile the two positions, i.e. to maximize productive investments and minimize non-monetary loses, the firm needs to establish a cut-off point between the amount it should invest in active production and the amount to divert for development functions.

Lets assume the firm can either generate Y amount of economic output or X amount of non-economic output if it utilizes

all its available resources for either purpose. If the non-economic output is assumed to be quantifiable, then the production possibility frontier for the firm could be drawn as in chart 3.1. The Y is plotted

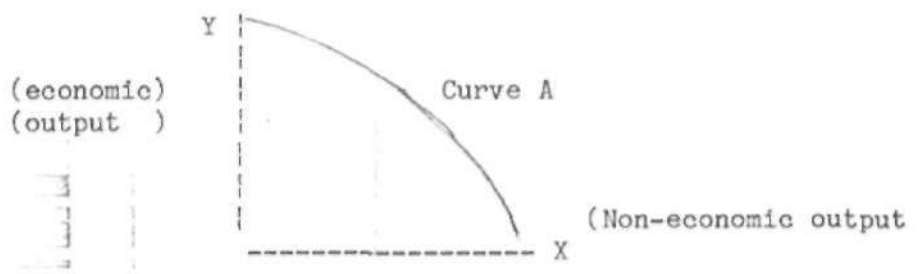


Chart 3.1 Production-possibility frontier

on the y axis and X(non-economic output) is plotted on the x-axis. The curve A is the traditional production possibility frontier, the area under it represents points which indicate various combination of X and Y. It should be noted, however, that X is an output as well as an input for achieving Y. particularly in the long-run. In chart 3.1, though, it is presented that phase of production process when more economic output can be obtained only by giving up some non-economic output. The curve is assumed to be concave to the origin.

The management indifference curve between economic and non-economic outputs can also be drawn (see chart 3.2). The slope of the curve will be negative as with consumer indifference curves. These curves are represented in the chart by U_1, U_2, U_3 indica-

ting higher orders of preference. If the firm's utility function is such that U = u(Y,X), then the equation for an indifference curve is $\bar{U}$ = u(Y, X). Where $\bar{U}$ is constant. It thus follows that at every point on each curve, since

$\bar{U}$ = u (Y, X) and u is a constant,

$\frac{d\bar{U}}{dy}$ = o and hence

$$\frac{\partial \bar{u}}{\partial y} \times dy + \frac{\partial \bar{u}}{\partial x} \times dx = 0,$$

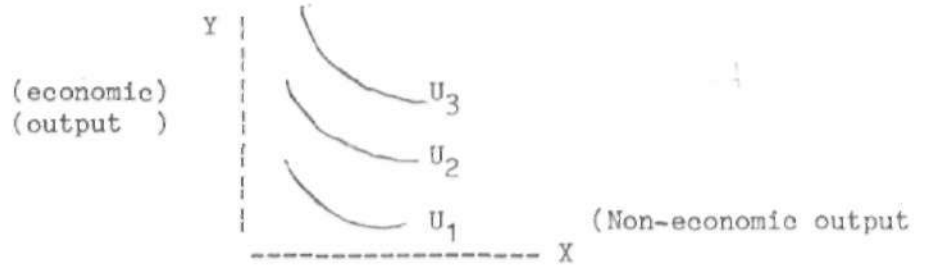


Chart 3.2 Management's indiference curves

The management maximizes the total utility of the firm at point E (See chart 3.3) where the production possibility frontier touches the highest possible indifference curve U*.

At point E, OY_o of economic output and OX_o of non-economic output would be produced, i.e., the total resources would be allocated between productive investments and development activities to produce OY_o and OX_o. The tangent

Political risk, which is often viewed in terms of potential conflict between corporate goals and the national aspirations of a host country arises over many issues. Such issues include the firm's impact on economic development; perceived infringements on national sovereignty; foreign control of key industries; sharing or non-sharing of ownership and control with local interests; impact on a host country's balance of payments or the foreign exchange value of its currency; access to, and control over, export markets; and exploitation of the national patrimony.

The host country always tries to ensure legal and economic dominance in its views over that of the corporate goals. For this reason, host governments have developed a number of techniques to influence the behaviour of firms, particularly foreign firms operating within their country. Such techniques are here referred to as interference.

Government interferences that constraint the free actions of a firm could be classified into four major types as follows:

3.5.1 Non-Discriminatory Interference

This form of intereference is relatively mild and not particularly directed against foreign-controlled operations. It may have impact equally on all forms of business in the country. Some of these interferences are

i Requiring the use of local nationals in management positions.

ii Negotiating transfer prices designed to favour the host country's tax base.

iii Requiring export industries to sell in the home market at a break-even prices in order to subsidize local consumption or investment of the particular product.

iv Requiring social and economic overhead facilities to be constructed by the investing firm.

v Requiring the use of a given percentage of local content in assembly of knocked-down imported components.

vi Temporarily making the host country's currency inconvertible.

3.5.2 Discriminatory Interference

This is intended to give local firms or national groups specified advantages over foreign firms. It includes:

i Allowing only joint ventures, with the foreign firm being limited to a minority position, e.g. in Nigeria, all businesses, except the few that require huge capitals and long gestation periods, must be at least 60% owned by either the government or citizens of Nigeria.

ii Requiring special taxes, excessive fees, huge utility charges, or other hidden forms of extra compensation from foreign-owned firms but not from domestic-owned firms.

iii Legal harassment such as requiring special permits, excessive pollution control requirements, bias in labour arbitrations or mediation, overdocumentation of all transactions, etc.

iv Mandating the terms or conditions under which a corporations potents or expertise may be used.

3.5.3 **Discriminatory Sanctions**

This is intended to push a foreign firm out of business. It involves very strong pressure. The motivation for this may be purely political and nationalistic or it may be to provide more business opportunities and capture more business profits for national entrepreneurs.

It covers

i 'Creeping expropriation'. Laws may prevent profits belonging to foreigners from being remitted and foreign owned capital from being repatriated. Laws may also force foreign firms to invest these blocked funds in specific local government obligations which quickly lose their value because of rampant inflation.

ii Levying taxes, royalties, or other charges against foreign firms to the point at which profits are no longer possible.

iii Claiming huge compensation for past inequities arising out of a concession agreement granted by a previous government but now ruled invalid.

3.5.4 Wealth Deprivation

Government may atimes decide to outrightly take over individual foreign firms. The takeover, known as deprivation, could be selective expropriation of individual foreign firm, nationalization of an entire industry or socialization of the whole country.

3.6 Forecasting Political Risk

A deeper insight into the political, social, and historical make-up of countries is necessary for predictions of political risk. Countries with a high propensity to expropriate foreign investments are usually the less developed, most of which have recently shifted from rightist to leftist governments. Latin America, Africa and the Middle East countries constitute highest risk of this nature.

To forecast political interference, a twofold approach is necessary, one approach is to forecast a particular country's propensity to interfere or expropriate. The second approach is to forecast a particular firm's propensity to be interferred with or expropriated.

The propensity (of a firm) to be interferred with or even be expropriated is subjective among companies. This subjectivity exists even among companies of similar nature. As governments interfere in the interest of their economic development,

companies who have operational policies appreciable by government are not much affected. Eiteman and Stonhill[5] rightly observed that "many firms located in countries with a high propensity to expropriate have not in fact been expropriated. Part of the reason for this situation might be attributed to differences in firms' operating policies, which impact on the degree of political risk they will face".

Even though R. J. Rummel and David A. Heenan[6] have suggested a four-way classification of attempts to forecast political risk ('grandtours;' 'old hands', Delphi techniques, and quantitative methods), firms cannot eliminate completely the risk of host country's political interference within its borders. Whenever foreign-owned firms are perceived, rightly or wrongly, to operate in such a way as to inhibit host country's national economic, political, or social goals, there is likely to be conflict and interference.

It is most important for a company, therefore, to plan protective steps in advance, to minimize the likelihood of political interference and damage that may be incured as a result.

When deciding to invest or establish a firm in a developing country attention must be paid to the priorities of the host country's government. To minimize interference, or even achieve the government's patronage, certain policies must be incorporated

in the investment or business to reflect the wish of the government and the society. Some of the major areas of concern to developing countries could be discussed as follows:

3.6.1 Foreign Exchange

Most developing countries face continuous problem of balance of payment. This is largely due to excess imports over exports. The governments of such countries therefore often adopt strict measures to discourage unnecessary imports, while promoting exports. Foreign exchange, as a result, is so difficult to obtain even in cases of necessary imports in these countries.

Sometimes government enforces selective convertibility of its currency into foreign currencies, depending on the nature of the transaction involved. It may even revalue the exchange rate or adopt multiple exchange rate system depending on the condition of its economy.

In taking a decision about its currency, government normally refers to indicators like level of official resources, trade balances, foreign aid, its own growth strategy, etc., while political considerations at home and abroad are also taken into account.

When undertaking a capital project in a developing country, therefore, the amount of foreign exchange involved and the cost

of using it needs to be carefully studied.

3.6.2 Indigenization

Governments in developing countries are known to take-over companies with predominently foreign share captial. This they do in an attempt to ensure the control of their economies by indigens rather than foreign bodies. In Nigeria, most foreign companies were forced to transfer upwards of 60% of their share capital to the government and citizens of Nigeria by the indigenization decree.

The issue of indigenization had caused tremendous devestment of foreign businesses in developing countries but the governments of such countries prefer indigenization, nontheless.

When confronted with capital budgeting problem, therefore, the proportion of foreign capital involved must be seriously looked into. Could it be that a situation will arise when government will decide to take over the business? Can the project be undertaken without much need for foreign capital? These and similar questions must be answered before taking a decision to invest or not.

Close to indigenisation of control is the pressure by government on companies within the country to make maximum use of local raw materials in their operations. This is to reduce the use of foreign exchange to purchase raw materials and also to

reduce dependency on foreign economies.

The amount of imported raw material necessary to carry out activities must be considered when deciding to venture into a project.

3.6.3 Location of Business

In developing countries, the problem of uneven development among various parts or states within same country is very severe. In an attempt to ensure even industrialization throughout, governments usually offer insentives and sometimes force business organisations to establish branches in certain specific locations.

Different locations suit different types of businesses, so, for a firm to analyse the worth of an investment proposal in such situation the limitations on location must be considered.

3.6.4 Employment

With increase in population and level of education in some developing countries there also increased the rate of unemployment. High rate of unemployment, particularly among school leavers account for a substantial part of the crimes and other social evils typifying developing countries.

Governments of these countries, therefore, embark on

massive campaigns for employement with particular attention to self and private sector employment. In Nigeria every organisation is enjoined to employ at least one out of every set of National Youth Service Corpers that serve with it. The number of employees in an organization has now become an important measure of contribution to national development for the government and even the people.

To secure a comfortable and respected position in such countries, therefore, business eastablishments must create more employment opportunities. Every investment proposal should be assessed from the point of view of employment opportunities in addition to other considerations.

3.6.5 **Social Welfare**

Some business activities by their nature constitute nuisance and discomfort to their environment, while others bring about increase in welfare of the people within and around them. Businesses that are likely to cause air and water polution, damage of roads, erosion or deformation of lands, noise, etc., are no doubt indepted to the society. They must try to minimize these hazards or compensate the society for the damages being done.

The costs to a company of curving such evils vary from one type of business to another and from project to project. It is essential therefore that the management considers not only the

returns from proposed investments but also the financial and moral costs of controlling posible damage to the environment.

The extent of indebtedness to social welfare is so high and still gaining strength that many Accountants are calling for Social Responsibility Accounting. They argue that every concern must publish its contributions to social welfare side by side with its annual financial statements.

3.7 Summary

We have surveyed the general problem characterizing developing countries. We have also seen a model whereby policy makers in such countries can best attempt to maximize their utilities.

As for a private firm, we have also considered the role it is expected to play under any set of development goals in such a manner that will offer it maximum returns on its investments.

Summarily, therefore, it suffices to say that business organisations are better-off in developing countries when they select projects on a basis such that will

i require minimum use of foreign exchange;

ii provide increased employment opportunities;

iii result in less or no social hazards; and

iv make maximum use of local raw materials and capital; among

other factors.

The external constraints listed above and other internal goal constraints together form the global set of objectives of a firm. And our aim is to find a model that will ensure the attainment of these objectives simultaneously.

It should be noted, that in developing countries, government policies and other factors such as highlighted in this chapter are not stable. A sound investment decision taken today on the basis of a given set of conditions may fail to yield any positive result simply due to changes in circumstances.

However, whether such changes do actually affect investments, and if they do, to what extent, will be ascertained in chapter IV.

One important thing which every investor must note is that no business will grow in a developing country without some form of protection by government and the society. It is therefore meritable for an investment decision maker to compromise efforts directed towards real economic gains and non-economic gains. Economic gains refer to profits, while non_economic gains mean all such protections and patronage the government and the society can give. In trying to formulate a model that will weigh the two forms of outputs, an effort should be made to establish any existing relationship between the two. It should be expected that the non-economic gains mentioned here will in the long-run

lead to increase in economic gains as well.

3.8 REFERENCES

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Chapter 4

4.0 DATA ANALYSES AND MODEL REAPRAISAL

4.1 Introduction

The data collected from thirty seven companies of different nature and sizes are presented and analysed in this chapter. The three null hypotheses presented in chapter one are also tested here. Following the analyses, some deductions were made based on the findings.

It was from these findings and deductions that a picture of typical capital budgeting problems in an economy like Nigeria emerged. Considering the nature of such problems the Stochastic Goal Programming Approach was chosen as the most ideal technique of analyses.

However, the Stochastic Goal Programming model shown in chapter II was found not to be fully satisfactory. The short-coming, which was due to one of its assumptions, made the model not comfortably applicable to investment problems in a situation where risk factors differ or fluctuate over time within the life of an investment. A variation of the model is therefore suggested to overcome such short coming.

4.2 Data Presentation

The data obtained from the questionnaire is presented in this section. We start with the classification of the companies according to their nature of business and share capital structure.

Table 4.1 shows the distribution of the companies under such classification.

Table 4.1 Nature of business and share capital structure

Nature of Business	Percentage of Foreign Capital				Total
	0-25%	26-40%	41-60%	over 60%	
Manufacturing	2	5	3	1	11
Construction	1	4	3	-	8
Training	4	6	-	-	10
Service	2	3	1	-	6
Others*	1	1	-	-	2
Totals	10	19	7	1	37

* one of the two companies (with 0-25% foreign capital) is a contract company, while the other one is a conglomerate company.

Table 4.2 shows the distribution of the companies according to their average annual turnover and the size of usual projects they undertake.

Table 4.2 Average turnover and size of projects

Amounts in Millions of Naira	Number of Companies	
	Turnover	Capital project
Less than 25	12	21*
26-50	5	9
51-100	11	7
More than 100	9	-
Totals	37	37

* One of the companies had not undertaken any capital project in over five years. The reason given was lack of finance.

In order to assess the competence of the Management of the companies with regards to project appraisal and financing, information was obtained on the proportion of qualified Accountants and finanace experts at the top executive level. The information is summarized as shown in Table 4.3. The data as could be seen in the Table is grouped according to amount of foreign capital in each company.

Table 4.3 Ratio of Professional Accountants and Finance Experts to Top Executives

% of foreign capital	Total no of Experts	Total no of top Executives	Ratio
0-25%	11	73	1:6:6
26-40%	63	245	1:3.9
41-60%	15	76	1:5.0
61-100%	2	9	1:4.5
Total	91	403	1:4.4

About 83.8% of the companies indicated that feasibility studies are conducted by the management staff while 13.5% said feasibility studies are often jointly carried out by the management staff and independent consultants.

The responses from the questionnaire also show that in 62% of the companies the final decison as to whether a project should be undertaken or not is made by the Managing Director. Nearly 30% of the companies identified the Board of Directors as the final decision making body and the remaining 8% mentioned Division/Unit Managers, and shareholders.

Regarding the nature of the investment decisions, about 75.68% of the companies indicated that they are often faced with the problem of selecting a project or combination of projects

from a number of alternative projects. The remaining number of companies are usually confronted with the problem of deciding whether to accept or reject a given project without regard for alternative ones.

Not even a single company claim that feasibility studies (or project evaluation) is not improtant. Some companies, however, consider it of less importance than others. The following is the response obtained from the questionnaire concerning the importance of project evaluation on the final investment decision.

Response	Number of Companies
Very important	9
Important	22
Less Important	6
Not important	-

The technique of analysis used in evaluating capital project by each company and the reason for selecting such method has been obtained and presented in Table 4.4. The table shows the number of companies using a particular method and why they are using it.

Table 4.4 Technique of Analysis in use

Technique of Analysis used[1]					Reason for using it
PBP	NPV	IRR	LP	OTHERS[2]	
5	2	1	-	-	simplicity
3	4	3	-	-	commonsense
3	9	4	-	2	superiority
-	-	-	-	-	Ignorance
-	-	-	-	1	Others
11	15	8	-	3	

1 PBP = Payback Period Method
NPV = Net Present Value
IRR = Internal rate of return
LP = Linear Programming Method

2 Two of the companies use combination of techniques before taking a decision. The other company is a private limited liability company with no foreign capital, and investments are made based on the intuitive judgement of the owner.

The questionnaire also found out the relationship that commonly exists between expected returns on investments and the actual returns. In respect of 27% of the companies, the actual returns are often greater than expected. 16.2% of the companies indicated that actual returns are often close to expected returns, while for 56.8% of the companies actual returns usually turn out to be less than expected.

The extent to which the technique of analyses used in

selecting an investment project affect the relationship between actual and expected returns is also obtained. The distribution of the companies according to this issue is shown in Table 4.5.

Table 4.5 Comparison of Expected and Actual Returns

Technique's degree of influence	Actual greater than expected	Actual equal to expected	Actual less than expected
0-25%	6	3	4
25-50%	1	1	6
51-75%	3	2	9
Over 75%	-	-	2
	10	6	21

In project appraisal, it is inevitable to consider some factors and constraints. Some analysts prefer to take as many factors as possible into consideration hoping that by so doing they can minimize the risk of uncertainty. Others, however, think it wiser to take only a little number of factors into careful study to avoid confusion and complications which may lead to worse decisions. The companies we studied responded to this issue in the following manner:

Opinion	Number of companies
The less the factors the better	5
The more the factors the better	18
No any strong relation	13
Others*	1

* It all depends on the kind of factors.

Almost all the companies agreed that a change in one such factors does affect other factors also. Only 5.4% think otherwise. When such changes occur, however, 51.4% of the companies suggested that they review their plans in the light of the new development. The remaining 43.2% try to achieve as close to their original goal as possible inspite of the changes. Most of the companies that pursue their original goals believe that the changes come too often to be taken into consideration in capital projects.

The response of the companies on the rate of changes in factors and constraints is as follows:

Rate of Change	Number of companies
Very often	9
Often	17
Rarely	11

The relationship among the variable factors i.e. the extent of influence of a change in one factor on other factors is obtained to be:

Relationship	Number of companies
Very strong	3
Strong	9
Weak strong	23
None	2

On the issue of corporate objectives, all the companies with the exception of one were found to have other objectives beside the normal ambition to maximize returns. The summary of this fining is shown on Table 4.6.

Table 4.6 Other Corporate Objectives

Objectives	Priority					Totals
	1st	2nd	3rd	4th	5th	
Increase Employment	16	11	7	1	-	35
Diversity Investment	5	16	9	2	-	32
Increase Market share	14	8	1	3	1	27
Meet social responsibilities	1	1	9	7	11	29
Others*	-	-	5	6	3	14
Totals	36	36	31	19	15	

* 8 of the companies made reference to increase in volume of exports, 3 suggested the increase in use of local raw materials, while the other 3 companies mentioned various objectives.

The Nigerian economy was assessed differently by the companies. The majority however think it is volatile. The distribution of the companies according to their views of the economy is as follows:

Very volatile	5
Volatile	19
Strong	2
Very strong	-
Others*	11

* Most of the companies suggested that the economy is cyclical (some times volatile, sometimes steady).

Changes in government policies, it was observed, disturbs planned investments in the following manner:

Effects of changes in policies	Number of companies
0-25%	9
26-50%	14
51-75%	11
Over 75%	3

Regarding areas of conflict between the interest of the company and that of the government, we obtained the distribution as shown in Table 4.7.

Table 4.7 Areas of conflict of Interests

Item	Rank				Totals
	1st	2nd	3rd	4th	
Employment	2	2	5	1	10
Foreign Exchange	1	4	-	2	7
Import restriction	13	4	1	-	18
Project location	4	9	3	1	17
Indiginisation	-	-	6	2	8
Social responsibility	3	5	5	-	13
Others*	2	1	-	-	3
Total	2	25	20	6	

* Interest on loans and shipping policies.

The above table indicates that the major areas of conflict between companies and government are import restrictions, project location and social responsibilities.

As means of resolving these conflicts, 24% of the companies that responded to this question avoid investments that could result into such conflicts while the remaining 76% welcome (reluctantly) the policies and do their best to take maximum advantage of insentives offered by the government for that.

4.3 Data Analyses

The data presented in the previous section is analysed under the following subheadings.

4.3.1 Sample Digest

For the purpose of our study, the companies selected are in such manner that will meet various classifications. From the data presented, 29.7% of the companies are manufacturing 27% Trading, and 16.2% services. Construction and others are 21.6% and 5.4% respectively. The percentage represented by each industry is based on the size of the industry.

27% of the total companies have less than 25% of foreign shares, 51.4% have between 26% and 40% foreign shares while 18.9% are between 41% and 60% foreign.

About 46% of the companies have an average turnover of not more than ₦50 million per annum and 54% have turnover of over ₦50 million. However, almost 56.8% of the companies indicated the magnitude of their average capital investment as not more than ₦25 million.

Another classification is to consider the companies from the point of view of their sizes. This classification though difficult, is worth while.

A simple grouping shows that 9 of the companies with more

than ₦50 million annual turnover undertake investments in sizes of less than ₦25 million. Among companies with less than ₦50 million annual turnover, 3 undertake investments in sizes of over ₦25 million on the average.

Let us classify all companies with less than ₦50 million turnover that undertake projects in sizes of less than ₦25 million as small and all companies with over ₦50 million turnover who undertake projects in sizes of over ₦25 million as big, while regarding the others as medium. We then have 37.84% of our sample being small companies, 32.43% medium and 29.73% big. The detail of this is shown on Table 4.8.

Table 4.8 Distribution of companies according to size

Nature of Business		Small	Medium	Large	Total
Manufacturing		4	2	5	11
Construction		2	3	3	8
Trading		4	3	3	10
Services		3	3	-	6
Others		1	1	-	2
Total:	Number	14	12	11	37
	percent	37.84	32.43	29.73	100

4.3.2 Techniques of Analysis

The most commonly used technique of analysis is the NPV. About 40.5% of the companies selected use this method. The PBP method comes second with 29.7%. Some 21.6% of the companies employ the IRR method while the remaining 8.1% use other methods.

Of the companies that use the NPV, 60% regard the method superior to others. 26.6% use it because it is commonly used by similar companies and 13.3% due to its simplicity in application. The PBP is chosen 45.5% of the cases because it is simple to use and 27.3% each due to its commonness and superiority. 50% of companies that use the IRR do so because they believe it is better, 37.5% because they believe it is commonly used while the others use the IRR because it is simple to them.

Obviously the mathematical programming methods of analyses are not at all used by companies selected. Yet no company indicated that it is using a particular method out of ignorance of other methods. The methods of analyses used, however, seem to offer very little in making the best decisions. This is observed when 60% of companies that experience greater actual returns than expected attributed less than 25% of the reason to the method of analyses they use, while about 52.4% of companies that record less actual returns than expected put more than 50% of the blame on the method of analyses they employ.

One cannot say that the companies are not competent enough

to handle these techniques carefully since 59.5% of the companies regard project evaluation important while to 24.3% it is even very important.

Furthermore, in 83.8% of the companies the project appraisal is directly undertaken by the management. The final decision is taken by the Managing Director in 60% of the companies, and by the entire Board of Directors in 30% of the companies. The competence of the Management to suggest the most optimum combination of projects given the ideal technique of analyses could not be doubted since as can be observed, 5 out of every 22 top executives in Nigeria are professional Accountants or qualified finance experts.

From the foregoing findings, it is conclusive that the first hypethesis (H_{o1}) which proposes that "The efficiency or otherwise of an investment decision is not a function of the technique of analysis employed in evaluating the proposal" is not true. The choice of technique of analyses is very important. However, the methods used by most companies studied do not contribute much in making a good decision. To the contrary, the methods account for more than 50% of wrong decisions.

4.3.3 Constraints on Investment

To begin with, all the companies, except one, have indicated that when deciding to invest in a project other goals (objectives) are also regarded beside the normal maximization of

profit. As could be seen in Table 4.6, providing employment, increasing market share and diversifying investments are all common objectives. Fulfilment of social responsibility has also been indicated as a popular objective.

The third hypothesis (H_{03}) which states that "Nigerian firms tend to emphasize single objective rather than multiple objectives for selecting projects" There are always a number of objectives to be met each time a company ventures into investments. Also as could be observed from the data, 75.68% of investment decisions consist in selecting a project or combination of projects among a number of alternatives.

Beside the normal 'budget' and other internal constraints characterising investment problems, other external constraints factors are also evident. These are constrainst monstly imposed on the companies by the state of the economy and the government policies.

The Nigerian economy is volatile, which means there exists a number of risk factors that affect forecasts. Inability to forecast the future correctly makes careful planning and investment decisions very difficult.

Variable factors which are normally considered when taking a decision change often according to 45.9% of the sample while for 24.3% the change is very often. In order to arrive at a good decision, 48.6% of the companies under study suggested that

many factors be taken into consideration. But 13.5% of the companies prefer taking a few essential factors into consideration to avoid complications that may lead to wrong decisions.

A very large number (94.6%) of the companies believe that a subsequent change in one factor usually causes changes in one or more other factors. Over 62% of the companies, however, indicated that the general relationship (or degree of influence) among the variable factors is weak.

Well, the degree of influence of one factor on another may be weak as claimed, but it should be noted that only 5.4% of the companies studied assert that no relationship exists at all.

The fact that there is indeed a relationship between the factors is enough to nullify the second hypothesis (Ho_2) which suggests that "constraints variables are independent such that a change in one vairable factor does not influence a change in another".

One vital variable factor, especially in a country like Nigeria, is the government policy. Governments make or change policies either to restore a certain economic position in a country or to foster growth and development. Such changes, however, affect planned investments to a varying extent. Going by our sample, the effect of the changes in government policies on capital projects is about 26% - 50% in 37.8% of cases and 51% - 75% in 29.7% of cases.

That changes in policies have more than 25% effect on investments in more than 75% of the companies studied, is certainly a cause for concern in planning, especially when such changes are frequent and inconsistent.

Policies are made to serve the interests of the government, and such interests do sometimes conflict with interests of companies and other business organisations. It is therefore a must for any business to identify these conflicts and resolve them in good time and in the best possible way.

Areas of conflict as regards capital investment could be numerous and differ from one form of business to another. Information obtained from the questionnaire shows that (see Table 4.7) the most common areas of conflict between the government and companies in Nigeria are import restriction, project location and social responsibilities. In most cases, however, companies somehow accept the policies as they are made and try to take maximum advantage of incentives offered by the government.

4.3.4 General Analyses

As the survey has indicated, a typical Capital Budgeting problem in Nigeria consists of selecting a project or a combination of projects from among alternative number of projects. This choice is to be made such that the ultimate investments will 'satisfy' more than one objective function. The

objective functions constitute the constraint variables on the investment strategy and the values of the time of making the decision. This is because since the economy is volatile (or unstable), future events could not be accurately predicted.

Due to the influence of changes in external factors on investments, any probability distribution of the likely values of constraints variables will be affected by changes in the factors. These changes, e.g. government policies, as we observed, are beyond the control of the decision maker. As such, any change must have to be reflected on the investment as it occurs. Also the decision maker cannot know extactly when the charges will occur, though predictions could be made, at period t, of likely-hood of changes in period t + 1 by studying the past and present behaviour of a given factor.

It is found that most companies after embarking on an investment, discover that their actual returns are lower than expected, while some others realise higher returns than expected. This shows that the methods of analyses used in appraising the investments usually fail to forecast correctly what is likely to be the returns from such investments. This failure is not because there are no competent management personnel to handle evaluation properly but largely due to technical inadequacies inherent in the methods used.

4.4 Summary

The most popular methods of analysis used in Nigeria are the NRV, PBP and the IRR methods, while the Mathematical Programming Techniques are not used at all. But contrary to the methods employed in analysing projects, most investment decisions in Nigeria consist of selecting a project or a combination of projects from a number of alternatives. Also, there exists the problem of satisfying numerous goals or objectives. These problems can only be solved by adopting a technique of analysis that provides for multiple goals to be attained simultaneously in the order of their respective importance.

Another point is that the risk and uncertainty involved in capital budgeting is very high in Nigeria. This is due to the unstable nature of the economy. Agrevating this problem, however, is the unpredictable nature of government policies, which significantly affect planned investment decisions.

From the tests of the hypotheses, it was observed that a typical capital budgeting problem is to select a project or a combination of projects such that will cater for multiple objectives. Also observed is the fact that changes in one or more constraints is capable of distorting any forecasts made about the future. This means added problems to risk and uncertainty.

It is not possible for the methods of analysis used to

adequatly handle the kinds of problems surrounding a typical investment problem in Nigeria. It is therefore understandable that most companies indicated less confidence in these methods. Yet there does not exist, in practice, a method that can fully handle these problems.

Chapter 5

5.0 Summary and Conclusion

5.1 Summary

The objective of this work as stated earlier in the introduction is to reappraise the Mathematical Programming Approach to capital budgeting decisions; to find out whether or not a particular model could solve all aspects of investment decision problems, particularly in an economy like Nigeria.

From the literature, three main Mathematical Programming Methods were reviewed for this purpose. These are the Linear Programming, the Goal Programming, and the Stochastic Goal Programming. The Linear Programming Model was found to have the qualities of handling certain situations that other models are unable to handle satisfactorily. For instance it was observed that (i) where funds F_o, F_1, ... invested in various periods must eventually be repaid, the F values in the constraints can easily be made negative for the required repayment dates, (ii) where a project can only be taken as a whole or rejected as a whole, the values of x_j can simply be made an integer in the programming, i.e., $x_j = 1$ or $x_j = o$, (iii) if two projects, A and B, are indivisible and mutually exclusive we simply make $X_A + X_B = 1$. Since both X's will be non-negative and indivisible, if project A

is adopted, so that $X_A = 1$, then necessarily $X_B = 0$, i.e. project B is automatically rejected and vice-versa.

However, it was observed that (i) there exists the possibility that funds may also be used for investment outside the firm or personal consumption by the owner(s) and the model described has made no explicit allowance for these alternatives; (ii) funds unused during period t can normally be retained for use during later periods and the model did not provide for this possibility; (iii) there is apparently some relationship between a_{jt} and b_{jt} since whenever an investment yields a positive (or negative) cash flow it increases (or reduces) the amount of money available during that period for use in other investments.

Furthermore, the model was based on the assumption of certainty in future flow of funds. Such funds were also discounted using the companies cost of capital. But in practice certainty does not exist in future events. Also the general cost of capital cannot be used for capital rationning since the company cannot lend or borrow freely. Another drawback in the LP model is that it can only be used in situations of single objective functions, i.e. to maximize profit or minimize cost. It cannot be used in solving investment decision problems in which multiple objectives are present.

The Goal Programming Model, on the other hand, is capable of solving multiple objectives simultaneously. It also has the

flexibility that allows for reordering of goals priorities. However, like the LP model, this model is also based on the assumption of certainty in future events.

The last model reviewed, i.e., the Stochastic Goal Programming Model, could be said to combine the advantages of both LP and GP models. In addition, the issue of uncertainty in future events is not left out of the model. The Stochastic Goal Programming Model is based on three major assumptions, viz:

1. U_1 are random variatbles normally distributed with mean 0 and variance convariance matrix Σ
2. 'a' is a matrix of fixed coefficients with rank q
3. The non-singluar variance-covariance matrix Σ is known.

However, our findings indicated that the first assumption does not hold true for all times during the life of a project. In about 70.2% of the companies studied the variable factors are found to change often. Also, 94.6% of the companies studied indicated that a change in one factor causes changes in one or more other factors. It was therefore observed that there exists a relationship between variables such that a change in one influences a change in another. This finding disproves our second hypothesis.

With regards to factors that could affect capital budgeting decisions, a thorough discussion was made in Chapter III in the light of an economy with characteristics similar to those in

Nigeria. These factors affect decision indirectly. In deciding to invest, the decision maker finds that a lot of quantifiable and unquantifiable factors must be taken into consideration. He also finds that these factors are at times conflicting and inconsistently changing. Any distribution attached to the factors for purposes of analysis at one time could be rendered useless by a change in one of such factors in the following period.

In chapter four analyses two other hypotheses were also tested, which give us an idea as to the nature of capital budgeting problems in Nigeria. The first hypothesis which suppo ses that "the efficiency or otherwise of an investment decision is not a function of the technique of analysis employed in evaluating the proposal" was disproved by the findings. On the issue of objective function, it was discovered that the profit maximization is not the only objective firms have for selecting a project. Objectives like providing employment, diversifying investments, and social responsibilities were all found to exist. Other objectives discovered are increasing market share and increase in volume of exports, use of local raw material, etc. This finding rejects the third hypothesis that "Nigerian firms tend to emphasize single objective rather than multiple objectives for selecting projects".

Because none of the selected companies uses Linear Programming Model, or any other mathematical programming model for that matter, to analyse its projects, and also for certain

limitations stated herein, no actual data was forthcoming to test the efficiency of such models in Nigeria. However, from the review of literature in chapter two and findings stated in chapter four, it only stands to reason that Stochastic Goal Programming Model is most ideal if it were to have a chance to be used in Nigeria. The only major lapse in this model is its failure to categorise risk factors as a function of time. If as we observed, a subsequent change in external fator(s) could affect the probability distribution of constraints variables, it follows that U_i cannot be a random variable with mean 0 and variance covariance Σ for all times.

Assuming we want to consider an investment that will span over two time periods, t_1 and t_2. At time t_o, the distribution of all random variables U_i may be assumed to be normal with mean o and variance co variance Σ. Between t_o and t_1, however, any number of changes in the factors could occur and such changes will certainly affect the distribution of the 'random' variables in t_2.

The Stochastic Goal Prgramming Model as discussed in the literature review thus becomes only ideal for that part of the project to be executed during t_1. For t_2, however, the distribution of likely changes in variable factors must be found, and the realationship between such changes and U_i established.

We know that U_i will remain as in t_1 during t_2 only when no change occurs in the variable factors in t_1. If we assume that

the rate of changes in variable factors generally follow a poisson distribution, then the probability that U_{it2} (the U_i applicable to t_2) will be the same as U_{it1} (the U_i applicable to t_1) and is given as

$$P_r(U_{it2} = U_{iti}) = e^{-m}$$

where m is the average number of changes in variable factors as observed from past periods. Otherwise

$$U_{it_2} = f(U_{it_1}) = \frac{m^r e^{-m}}{r!}$$

where r is the number of changes expected to occur during t_1.

No attempt is made to formulate a new model in this work. But in the light of the foregoing discussion, it will be expected that any acceptable model must be of multi-stage variables with objective function given as

$$\text{Min } Z = (P_i d_{i1}^{+} + P_i d_{i1}^{-} + P_i d_{i2}^{+} + P_i d_{i2}^{-} \text{ etc}).$$

where $d_{i1}^{\pm}$, $d_{i2}^{\pm}$, ... $d_{in}^{\pm}$ represent deviations from goal i during time t_1.

From the data collected, the common methods of analysis in use are found to be NPV, PBP and IRR with 40.5%, 29.7% and 21.0% rate of usage respectively. However most of the companies (60%) that often record higher profit than earlier expected do not

attribute their success to the method of analysis they use. On the other hand, 52.4% of companies experiencing lower actuals than expected strongly think the methods in analysing projects are to blame. It was also discoverd that most of the companies have the capability to analyse and select most viable projects by forecasting more correctly, given the most relevant model of analysis.

5.2 Limitations

In conducting this research, a lot of problems were encountered. In the first place, the relevant literature needed for the work was not readily available. Several libraries and, in fact, bookshops had to be visited. Due to lack of transport and freedom, such visits were carried out over relatively long period.

A more important problem, however, is the response from the questionnaire circulated. Initially, the collection of data was planned from about one hundred companies from all over the country. But this was not possible because of the constraints on time, finance and unwillingness on the part of some companies to respond. In the end useable data was collected only from 37 companies.

The third, and parhaps the most important limitation in this work is the inability to obtain the kind of data needed to

be applied to the models reviewed.

The research had intended to get a kind of data that would be useful in actual modelling of the capital budgeting decisions. Because these companies do not use any of the mathematical programming models, they therefore supplied information/data that tilted towards the kind of models they use. This has made the use of mathematical programming models together with the intended computer analysis impossible.

5.3 Conclusions

The main conclusions can now be summarized.

First, the methods of analysis being used by companies in Nigeria to evaluate projects are by far improper for the circumstances of the decisions. This act of putting 'square peg in a round hole' lead to more than 50% failures in huge investments.

Second, among all the models of analysis discussed, Stochastic Goal Programming Model appeared to be the only model that could accomodate most decision problems in Nigeria and give better results. However, even this model has to be adjusted or reformulated to allow for the influence of changes in one variable factor on another, which in turn disturbs whatever probability distribution is envisaged for constraint variables in future periods.

The importance of capital budgeting, and in particular the choice of a technique of analysis has been found to be enomous. Most investment and growth problems faced by our companies are due to lack of appropriate model for analysing investment projects. But these problems will be solved if a variation of the Stochastic Goal Programming Model is formulated as suggested.

Finally, further work could be carried out in this area when time and finance are less constrained. This will hopefully bring about other scientific techniques that might be acceptable to some of the Nigerian companies for optimum decision process and consequent improvement in production and output.

APPENDICES

Appendix I

Department of Accounting,
Institute of Administration,
Ahmadu Bello University,
Zaria.

Dear Sir/Madam,

Reappraisal of Mathematical Programming Approach To Capital Investment Decisions

ALI OTHMAN AHMED is an M.Sc. (ACCOUNTING AND FINANCE) student conducting research on the above subject.

The attached Questionnaire is for your kind response so as to enable the Rsearcher have enough information to analyse.

We pledge that information given will be treated in the most CONFIDENTIAL manner.

It will be our pleasure to share our gains from this reseach with you if you so desire.

Thank you for your co-operation.

Yours faithfully,

(Sgd.)

(A. SILVA)
CO-ORDINATOR
M.Sc. Programme

M.Sc. (ACCOUNTING AND FINANCE

RESEARCH QUESTIONNAIRE

SECTION 1: GENERAL INFORMATION ABOUT THE COMPANY

01. What is the nature of your company's business?

011 Manufacturing [ ]

012 Construction [ ]

013 Commercial (Trading) [ ]

014 Service [ ]

015 Other (places specify) .....

02. For how long has the business been in existence?

021 Not more than five years [ ]

022 Not more than ten years [ ]

023 Not more than fifteen years [ ]

024 Over fifteen years [ ]

03. What is the percentage of foreign shares in your company?

031 Not more than 25% [ ]

032 Not more than 40% [ ]

033 Not more than 60% [ ]

034 Over 60% [ ]

04. What is your company's average turnover per year?

041 Not more than ₦25 million [ ]

042 Not more than ₦50 million |____|

043 Not more than ₦100 million |____|

044 Over ₦100 million |____|

05. What is the number of Top Executives in your company?

.....

06. How many of the Top Executives are Professional Accountants or qualified Finacne experts? .....

07. Does your Company from time to time undertake long term investment in Capital Project?

071 Yes |____|

072 No |____|

08. If 'Yes' in 07, how much, on the average, do such expenditure cost?

081 Not more than ₦25 million |____|

082 Not more than ₦50 million |____|

083 Not more than ₦100 million |____|

084 Over ₦100 million |____|

09. If 'No' in 07, why? (Also you need not proceed further.

091 No competent staff |____|

092 No project in view |____|

093 Lack of finance |____|

094 Legal constraint |____|

095 Other (please specify) .....

SECTION 2: **CAPITAL BUDGETING TECHNIQUE**

01. Does your company undertake feasibility studies before embarking on a project?

011 Yes [____]

012 No [____]

02. If 'No' in 01 state why .....

.....

03. If 'Yes' in 01, who carrys out the feasibility studies for the company?

031 Independent consultants [____]

032 The management staff [____]

033 Consultants and the management [____]

034 Other (please specify) .....

04. Who, in your company, has the last say as to whether a new project should be undertaken or not?

041 The Financial Controller [____]

042 The Managing Director [____]

043 The Board of Directors [____]

044 The Division/Unit Manager [____]

045 The Shareholders [____]

046 Other (please specify) .....

.....

05. What is the typical capital investment decision problem in your company?

051 To decide whether to accept or reject one project at a time without regard for alternative ones ☐

052 To select the most viable project (or combination of projects) from a number of alternatives ☐

053 Others (please specify) .....

.....

06. How would you, in a decision context, describe the role of project evaluation in your company?

061 Very Important ☐

062 Important ☐

063 Less Important ☐

064 Not important ☐

07. Does your company have any standard method of analysing projects?

071 Yes ☐

072 No ☐

08. If 'No' in 07, please state how you chose projects

.....

09. If 'Yes' in 07, which technique does your company usually employ in project evaluation?

091 Pay Back Period [ ]

092 Not present value [ ]

093 *Internal Rate of Return* [ ]

094 Linear Programming [ ]

095 Others (please specify) .....

.....

10. Why is the company using the particular method indicated above?

101 It is simple to use [ ]

102 Commonly used by similar companies [ ]

103 Better than other methods [ ]

104 Other methods are not well understood [ ]

105 Others (please specify) .....

.....

11. Which of the following is true with the company's previous investments?

111 Actual returns are greater than expected returns [ ]

112 Actual returns are about equal to expected returns [ ]

113 Actual returns are less than expected returns [ ]

114 Others (please specify)

.....

12. To what extent does the technique of analyses employed account for the answer in 11?

121 Not more than 25% ☐

122 Not more than 50% ☐

123 Not more than 75% ☐

123 Over 75% ☐

13. "In project evaluation some variable factors are often taken into mind." What is the relationship between number of factors considered and the accuracy of the final investment decision in your company?

131 The less the number of factors the better the decision ☐

132 The more the number of factors the better ☐

133 No any relationship ☐

134 Other relationships (please specify)

.....

14. Does subsequcnt change in one factor affect other factors?

141 Yes ☐

142 No ☐

15. If 'Yes' in 14 how are such changes taken care of?

.....

16. How frequent do changes occur in the factors?

161	Very often	
162	Often	
163	Rarely	
164	Never	

17. How can you describe the general relationship between the various factors?

171	Very strong	
172	Strong	
173	Weak	
174	None	

18. Is profit maximization the only objective your Company has for undertaking investments?

181	Yes	
182	No	

19. If 'No' in 18, indicate, in ranking order, which of the following objectives are also important to your company?

191	Providing employment opportunity	
192	Diversifying investment base	
193	Increasing market share	
194	Improving social welfare	
195	Others (please specify)	

.....

SECTION 3: **EXTERNAL FACTORS**

01. How would you describe the Nigerian economy with regards to long term investment?

011 Very Volatile |____|

012 Volatile |____|

013 Stable |____|

014 Very Stable |____|

015 Other (please specify) .....

.....

02. To what extent do changes in government policies affect investments in the company?

021 Not at all |____|

022 Not more than 25% |____|

023 Not more than 50% |____|

024 Not more than 75% |____|

025 More than 25% |____|

03. Indicate, in ranking order, the areas of conflict between your company's interests and the interests of the government.

031 Employment and Training |____|

032 Foreign Exchange |____|

033 Import Restriction |____|

934 Project Location |____|

035 Indiginisation of Control |____|

036 Social Responsibilities |____|

037 Others (please specify) .....

.....

04. How does your company resolve these conflict?

041 Avoid completely projects that lead to conflicts [ ]

042 Compromise position and take maximum advantage of incentive offered by the government [ ]

043 Disregard any unwelcomed government policy [ ]

044 Others (please specify) .....

.....

05. How satisfactory is the means of resolving conflicts adopted by your company?

51 Highly satisfactory [ ]

52 Satisfactory [ ]

53 Unsatisfactory [ ]

54 Highly unsatisfactory [ ]

Appendix II

THEORETICAL INVESTMENT PROBLEM

Do-more (Nig.) Ltd. is considering three mutually exclusive proejcts for investment. Management had obtained the expected Net Present Value for each proposal and a configuration of funds outlays for the two periods, t_1 and t_2, which the projects will last. The data is as follows:

Project	Outlays (₦ millions)		NPV (₦millions)	
	t_1	t_2	t_1	t_2
1	15	8	11	15
2	18	6	15	10
3	17	9	18	25

The company strongly believes it could raise ₦30 millionf for investment in t_1 and ₦15 million in t_2. These are however intended to be done by issuing shares to both indigines and foreigners.

Since it is not possible for the company to undetake all

the three investments, the Management of Do-More wishes to select a combination of the projects such that will be most favourable to the company.

In a resent Board of Directors' meeting the following guidelines were set out regarding the interests of the company in these investments.

1. The project as a whole must yield a net present value of at least ₦25 million in period 1 and ₦40 million in Period II.
2. In order to increase the market shares of the complany, the first period should have as close to ₦70 million sales generated by the investements selected and at least 40% increase int he second period.
3. The projects are desired to require about 450 man-hours of labour per day to maintain the level of employment demanded by the Government.
4. At least 60% of total outlay for period 1 and 80% of outlay for period II should be spent on local raw materials.
5. The investments must not be financed by more than 40% foreign capital in both periods.
6. The company should not, on account of the invetsment, spend more than ₦5 million in each period as compensation for societal inconveniences.

Expert study carried out by the Management of Do-More revield that

1. An estimate of the portions of the projects that could be met by local purchases are

Project	Period 1	Period II
1	₦10 m	₦5 m
2	₦ 7 m	₦3 m
3	₦14 m	₦7 m

2. The following amounts could only be raised by issuing shares to foreign investors

Project	Period 1	Period II
1	₦8 m	₦2 m
2	₦5 m	₦3 m
3	₦7 m	₦2 m

3. It is possible that the following amounts will have to be spent on social responsibilities

Project	Period 1	Period II
1	₦3 m	₦2 m
2	₦2 m	₦3 m
3	₦4 m	₦3 m

Other information gathered are

1.

Project	Sales Estimate Pd I	Pd II	Man-hour per day Pd I	Pd II
1	25	65	280	200
2	30	50	350	230
3	48	52	230	250

2. All the estimates made are subject to change int he future. The Management, however, believes that the outcomes for Period I would most likely be normally distributed with a certain mean, and variance-coveriance. For period II, however, the random values could not be determined as at the time of making the decision. This is because changes in some factors, particularly government policies could

take place during period 1 and affect any projected outcome for period II. But the Management was able, from past records and other assessments, to conclude that r number of such changes may occur in period I. Generally, the average number of changes in factors affecting capital budgeting in Nigeria is believed to be m.

Appendix III

LIST OF COMPANIES STUDIED

1. A.B.G. Electronic Manufacturing Ltd., Kaduna.
2. Alif Construction Coy. Ltd., Maiduguri.
3. Amana Construction Coy. Ltd., Jos.
4. Arewa Bottlers Ltd., Kaduna.
5. Arewa Hotels Ltd., Kaduna.
6. Bagauda Textiles Mills Ltd., Kano.
7. Balmore Trading Coy. Ltd., Kano.
8. BELAC Construction Company Ltd., Lagos.
9. Chemical & Allied Products Ltd., Lagos.
10. Costain Nigeria Ltd., Lagos.
11. Dantata & Sowoe Ltd., Kano.
12. Elf Oil Marketing Company Ltd., Lagos.
13. Fan Milk Ltd., Kano.
14. First Bank of Nigeria Ltd., Lagos.
15. Garmart Industrial Development Company Ltd., Kaduna.
16. International Merchant Bank Ltd., Lagos.
17. J. K. Chellarams (Nig.) Ltd., Lagos.
18. John Holt (Nig.) Ltd., Lagos.
19. Leventis Stores (Nig.) Ltd., Lagos.
20. Leventis Technical Ltd., Lagos.
21. Mandillas (Nig.) Ltd., Lagos.

22. Messrs Boroni Prono (Nig.) Ltd., Lagos.

23. Mobil Oil (Nig.) Ltd., Lagos.

24. NASCO Group (Nig.) Ltd., Jos.

25. NICON (Nig.) Ltd., Lagos.

26. NITEL Shoes Ltd., Maiduguri.

27. Northern Breweries Ltd., Kano.

28. Northern Oil Marketers Ltd., Kano.

29. P.Z. Industries Ltd., Lagos.

30. R. Morrits (Nig.) Ltd., Lagos.

31. Seed Cotton Company Ltd., Kaduna.

32. Standard Construction Company Ltd., Kano.

33. Sterling Civil Engineers Ltd., Lagos.

34. Umar Adam Kolo & Sons Ltd., Maiduguri.

35. United Africa Company Ltd., Lagos.

36. United Trading Company Ltd., Lagos.

37. Zaria Industries Ltd., Zaria.

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