SYSTEMS Of COST CONTROL OF CAPITAL PROJECT IN NIGERIA ANALYSIS AND PROPOSALS

BY

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DECLARATION

I hereby declare that this thesis has been prepared by me and that it is a record of my review of some literature and my own research work. It has not been presented in any previous application for a higher degree.

All quotations are indicated and the sources of information are specifically acknowledged by means of references.

A.O. Sulymon. 16/11/71

DIGITIZED

DEDICATION

This thesis is dedicated to:-

My Husband - Femi

My son - Biodun

My Daughter - Tara

For their love, understanding and sacrifice.

ACKNOWLEDGEMENTS

I will like to use this medium to express my gratitude and appreciation to my family, without whose support and encouragement, I will not have, successfully, undertaken the post-graduate studies. Special thanks go to my parents Alhaji & Mrs. Malik for their kindness, generosity and co-operation. I wish them long life.

I am especially grateful to the Director of Engineering Services (N.A.A.) Alhaji Mamman for giving me official support and approval to undertake this course. Also, my gratitude goes to Engr. Haruna for his encouragement and understanding.

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I am indebted to some of my classmates whose friendship and moral support pulled me through the course. I am greatly obliged to the following families:-

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I wish you all goodluck and success in all your endeavours and God's guidance.

ABSTRACT

Despite the built-in allowances in the estimate of the tender sums, the final costs of most capital projects exceed the estimated costs by very wide margin. As a result the costs of capital projects in Nigeria are relatively higher than what are obtained in other countries of the world. The large sums of money involved necessitate the need for proper and effective control of costs and public accountability since most capital projects are financed with public funds. The construction industry is not shaded from the effect of the socio-economic and political pressures facing other facets of life in Nigeria.

This study concentrates more on cost control at the construction stage because it is at this stage that money is actually committed and it is a stage that requires the involvement of all participants in the construction process.

It is discovered that the systems of cost control employed in the construction companies in Nigeria are not as technical as expected. The most logical reason that can be advanced for this is that the contractors' interest is properly shielded by the built-in allowances in the tender estimate and by the possible manipulations of the contractual arrangements. Therefore, it can be reasonably inferred that the cost problem

of projects does not start from lack of control but rather from escalated cost of projects.

It is on this note that it is recommended that costs of capital projects in Nigeria should be drastically reduced by minimizing or completely eliminating irregularities within the contractual arrangements. If and when this is done, it will be highly essential for the contractors as well as the clients to establish effective and more technical cost control system which will help in achieving the required technical specifications within the prescribed cost limits with minimum delay or interference.

Based on the assumption that sooner or later cost reduction of capital projects will be embarked on, a proposal is made on a dynamic and applicable system of cost control which can be adjusted to accommodate unpredictable and uncontrollable conditions that are constantly encountered during execution. The system cannot be effective without the participation of the contractors, client and consultants.

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GLOSSARY

ACCOUNTING is the art of recording, classifying and summarizing in a significant manner and in terms of money, transaction and events which are, in part at least, of a financial character, and interpreting the results there of.

BANKRUPTCY is a legal procedure for formally liquidating a business, carried out under the jurisdiction of courts of law.

BUDGET is a plan stated in terms of specific expenditure for specific purposes. It is used for both planning and control.

CLIENT is the person (or persons) who wants a project, who commissions the project and is responsible for paying for it.

CONTRACTOR is the person, along with his employees, who normally executes a construction work in several different skills and trades.

COST is the amount, measured in money, of cash expended or other property transferred, services performed or a liability incurred, in

COST CONTROL	is a continuous and ever present activity of restraining expenditure within predetermined levels while providing a project of the desired quality within the time limit specified.
COST ENGINEERING	is the area of engineering practice which seeks to achieve effective control of project costs.
COST ESTIMATE	is an approximation of the expected final capital cost of a project.
DEPRECIATION	is a loss in value of plants and is expense.
DESIGN CONSULTANT	is an architect, engineer or other specialist who translates the clients' needs into specific project proposals.
DISCOUNTED CASHFLOW ANALYSIS	is a method of ranking investment proposal included are:- 1. Internal rate of return method. 2. Net present value method and 3. Profitability index or benefit/cost ratio.
EXCEPTION PRINCIPLE	States that recurring decisions should be handled in a routine manner by lower level management, whereas problems involving usual matter should be referred to higher

FIXED COSTS MONITORING	are costs which remain relatively constant
	is the exercise of direction, guidance or restraining influence in evaluating.
PROJECT SCHEDULE	is the timing by which the plan is to be executed and is developed from the project plan, recognizing such factors as delivery time, availability of construction labour, practical limitation of effecient use of labour and so on.
RISK	is the variation in the possible outcome that exists in nature in a given situation.
STRAIGHT-LINE METHOD	is the method of allocating depreciable cost uniformly throughout the life span of the equipment.
SUBCONTRACTOR	is resposible for only part of a project and whose direct responsibility is to the main contractor.
VARIABLE COSTS	are costs which depend on production.

KEY OF BASIC SYMBOLS

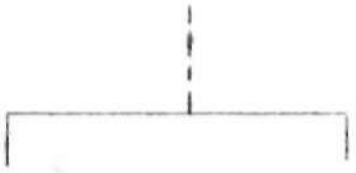
1.  Statement box

2.  Sub-routine box

3.  Question signal

4.  Connection signal

5.  Stop/Start signal

 Annotation signal

CHAPTER ONE

INTRODUCTION

1.1 GENERAL BACKGROUND

The Nigerian construction industry has been experiencing a persistent upward trend since 1960 except during the civil war years 1968 and 1969. The contribution of the industry to the Gross National Products (GNP) rose from ₦7.4 million in 1960 to ₦821.4 million in 1975. Proportionately, the contributions have fluctuated between 3% and 5.7% during the period 1960 to 1975. The industry, also, had a mean annual rate of growth of 19.4%.

During the era of oil boom, there was considerable stride in terms of investment on capital projects. And during the 1975-1980 plan period, the investment in the construction industry accounted for as high as 30% of the total fixed capital formation of over ₦9 billion. By the period 1960-1975, serious shortages of construction capacity disturbed the economy and the upward turn in investment on construction, both building and civil engineering, gave way to the entry of new contractors and the accompanying complications and tendering anomalies that have plagued the economy. The contribution of construction industry to the Gross National Product GNP for the period 1960-1975 is shown on Table 1.1

YEAR	CONTRIBUTION OF CONSTRUCTION INDUSTRY (₦ MILLION)	PROPORTION IN PERCENTAGE from (a)	GROWTH RATE PERCENTAGE from (a) & (b)
1960	67.8	3.0	-
1961	77.3	3.3	15.4
1962	90.0	3.4	15.7
1963	115.0	4.4	27.8
1964	122.8	4.4	6.8
1965	126.4	4.3	2.8
1966	161.2	5.2	27.5
1967	165.4	5.1	2.6
1968	148.4	4.9	-10.3
1969	146.8	4.9	-1.1
1970	152.6	5.0	4.0
1971	328.0	3.5	113.6
1972	460.0	4.1	41.2
1973	567.1	4.7	23.2
1974	710.8	5.4	25.3
1975	821.4	5.7	15.6
			Mean 19.4

Table 1.1 Contribution of the construction industry to the Gross National Product (GNP), 1960-1975

Sources:-

1. Federal Office of Statistics, Annual Abstracts of Statistics, Lagos, Nigeria.
2. Federal Ministry of Information, Second National Development Plan, 1970-1974, Lagos, Nigeria, 1970.
3. Central Planning Office, Third National Development Plan 1975-1980, FMEDR, Lagos, Nigeria, 1975.

Major capital projects are, mostly, undertaken by the Government since it is the Government, like in many developing nations, that provides infrastructures, social welfare services and so on. Usually, most of the big projects are awarded to multinational companies probably because of the complexity and the speciality of the projects or probably because there are not companies in Nigeria that have technological and managerial expertise necessary to execute such big projects. Despite the expertise of the multinational companies, the costs of most of those projects always exceed the estimated cost by no small margin.

1.2 NEED FOR THE STUDY

One tends to wonder what the cause of the large deviation between the estimated costs and the final costs of projects could be. It is obvious that there is an element of risk in all forms of contracting, be it highway or airport paving or large dam construction. Some of the risk factors that readily come to mind include weather, location and soil conditions. But because of the frequency of change in government sanctions and the public's attitude in Nigeria, the contractors prepare estimate of tender sums on the basis of the conditions which they expect to meet during the execution of the project. Consequently, allowances are made for any possible disturbance arising from variations,

government actions as well as public attitude. Despite these allowances, deviation still exists.

Accountability on capital projects and management of project costs have posed a big problem in Nigeria. There are a lot of anomalies right from the conceptual stage, through tendering and contracting stages to the execution stage.

Furthermore, it is evident that presently the construction industry in Nigeria generally has no good reputation because of various reasons such as abandoned project, delayed completion of project, escalated costs of projects, poor quality of work, corrupt practices in the industry and so on. All these reasons usually have cost consequences.

It is against this background that the study of systems of cost control is considered to be a worthwhile effort towards improving the performance of the construction industry.

1.2 OBJECTIVES OF THE STUDY

This study will attempt to find out those factors which influence the costs of construction projects in Nigeria and the role of every participant in the construction industry with respect to the function of cost control. Furthermore, an attempt will be made to identify the systems of cost control in use by the construction companies in Nigeria and

the effectiveness of the systems as means of controlling costs of projects.

Most of the published information presently available on cost control are not particularly adapted to the Nigeria condition. This study has an objective of filling the informational gap by creating an awareness among the professionals involved in construction as to the existence of cost control systems that are particularly applicable in Nigeria.

The function of cost control is presumed to be the contractors' responsibility alone but it should not be so. Thus, the study is aimed at diverting the attention of the clients in particular, especially the government, to their responsibility in ensuring that project costs are effectively controlled.

Finally, it is hoped that by this study the reason for large deviation between the final costs and the estimated costs of projects can be diagonized. And, ways and means of rectifying the problem and improving the performance of the construction industry in general can be determined.

1.4 SCOPE AND LIMITATIONS

Although cost control at various stages of construction cycle, is discussed, more emphasis is placed on the construction stage of the cycle in this presentation. This

is not to say that it is the only stage at which costs can be controlled. Cost control is supposed to be a continous activity, commencing from the conceptual stage of a project till the maintenance stage, aimed at improving efficiency and quality by ensuring that the right resources are efficiently used. In order to make a thorough study, attention is paid to a particular stage. Moreover, this stage is the most practical stage that needs the involvement of all participants in the construction, that is, the consultants, the client and the contractor. It should be noted that cost control is not only concerned with meeting anticipated levels, it is also concerned with understanding how and why costs change. It is concerned with the setting of performance standards (Planning) and monitoring of actual results against these standards and finally, it is concerned with the people's attitude and motivation when handling money in form of resources.

However, this presentation does not claim to have exhausted all the systems of cost control that can be employed in construction industry in Nigeria. Although the proposed system might need some adjustments or adaptations here and there to make it perfect, however it is a framework for improvement. It is not an end in itself but a means to the end.

1.5 METHODOLOGY FOR THE WORK

The methodology adopted for this study is:-

1. to do a literature review of the topic of cost control so as to know its nature and principles, its values, and other necessary information about the topic.
2. to investigate the systems of cost control in use in a sample of three construction companies handling capital projects in Nigeria.
3. to compare the cost control systems employed in the three companies investigated so as to determine their usefulness and effectiveness.
4. to review three cost control systems that can be usefully employed in construction industry.
5. to look into human aspect of cost control.
6. to propose a system of cost control that can be employed by both the client and the contractor for the improvement of cost control of construction projects in Nigeria.
7. to suggest ways and means of improving the performance of the industry in general.

1.6 SYNOPSIS

The thesis comprises of six chapters. The first chapter is the introductory chapter which consists of general

background, need for the study, objectives of the study, scope and limitations, methodology of the work and synopsis. The second chapter deals with the discussion on construction cost control which includes nature and principle of cost control, values of cost control, factors affecting costs of projects, cost control at various stages of construction pr process, political involvement in construction industry and finally a resume of the chapter.

The third chapter contains a report of the investigation carried out on three construction companies.

In the fourth chapter, the systems of cost control in use by the three companies investigated are analysed comparatively, three systems of cost control that can be us usefully employed in construction industry are reviewed and the human aspect of cost control is discussed.

A dynamic system of cost control that will be useful to both the clients and contractors is proposed in chapter five. And chapter six which is the concluding chapter carries the summary of the study, conclusions and recommendations.

CHAPTER TWO

DISCUSSION ON CONSTRUCTION COST CONTROL

This chapter covers general discussion on cost control of construction projects and it is divided into six sections. The sections include:-

1. Nature and principles of cost control
2. Value of cost control
3. Factors affecting cost of projects
4. Cost control at various stages of construction process
5. Political involvement in construction industry
6. Resumé of the chapter

2.1 NATURE AND PRINCIPLE OF COST CONTROL

Control system generally requires two pre-requisites. These are planning and organization structure. It is obvious that before a control system can be devised, there must be a plan. It is the plan that gives the sense of direction. The clearer, the more complete and integrated the plan is, the more effective can the control system be. Apart from planning, there must exist an organization structure. This structure ensures the organizational responsibility. The knowledge of who is responsible for deviation makes the system effective since the system operates through people.

As in the case of planning, the clearer, more definite and more integrated the structure, the more effective can the system be.

The basic control process involves establishing standards, measuring of performance against the established standards and correcting variances that might occur. This process is depicted in Fig. 2.1 and it should be noted that the process is a feed-back system.

The nature of cost control system is similar to that depicted above. But for cost control, mere feed-back is not good enough. A cost over-run is not correctible. So, the system of cost control should be capable of anticipating deviations. This system can be referred to as anticipatory feed-back or feed-forward control system. It is a kind of feed-back system but information feed-back is at the input side of the system (Fig. 2.2) so that corrections can be made before the system out-put is affected.

The fundamental principles of cost control are numbered three, although they can be expanded considerably. For the purposes of this thesis only these three will be considered and they are:-

1. Establish and maintain control base
2. Monitor, analyse and report performance
3. Eliminate adverse variances.

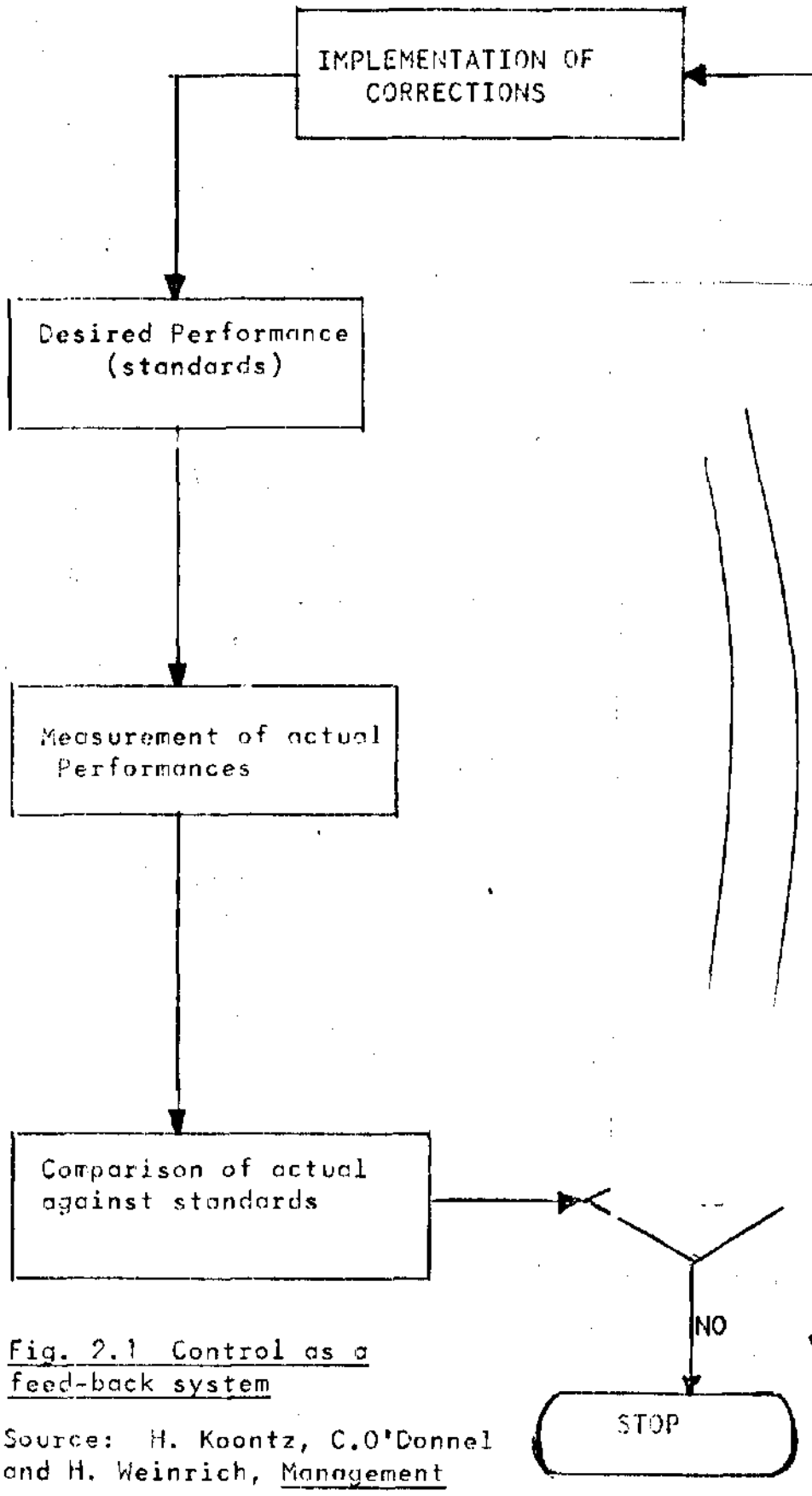


Fig. 2.1 Control as a feed-back system

Source: H. Koontz, C.O'Donnel and H. Weinrich, Management (New York, McGrow Hill Book Company Inc., 1983) P. 727

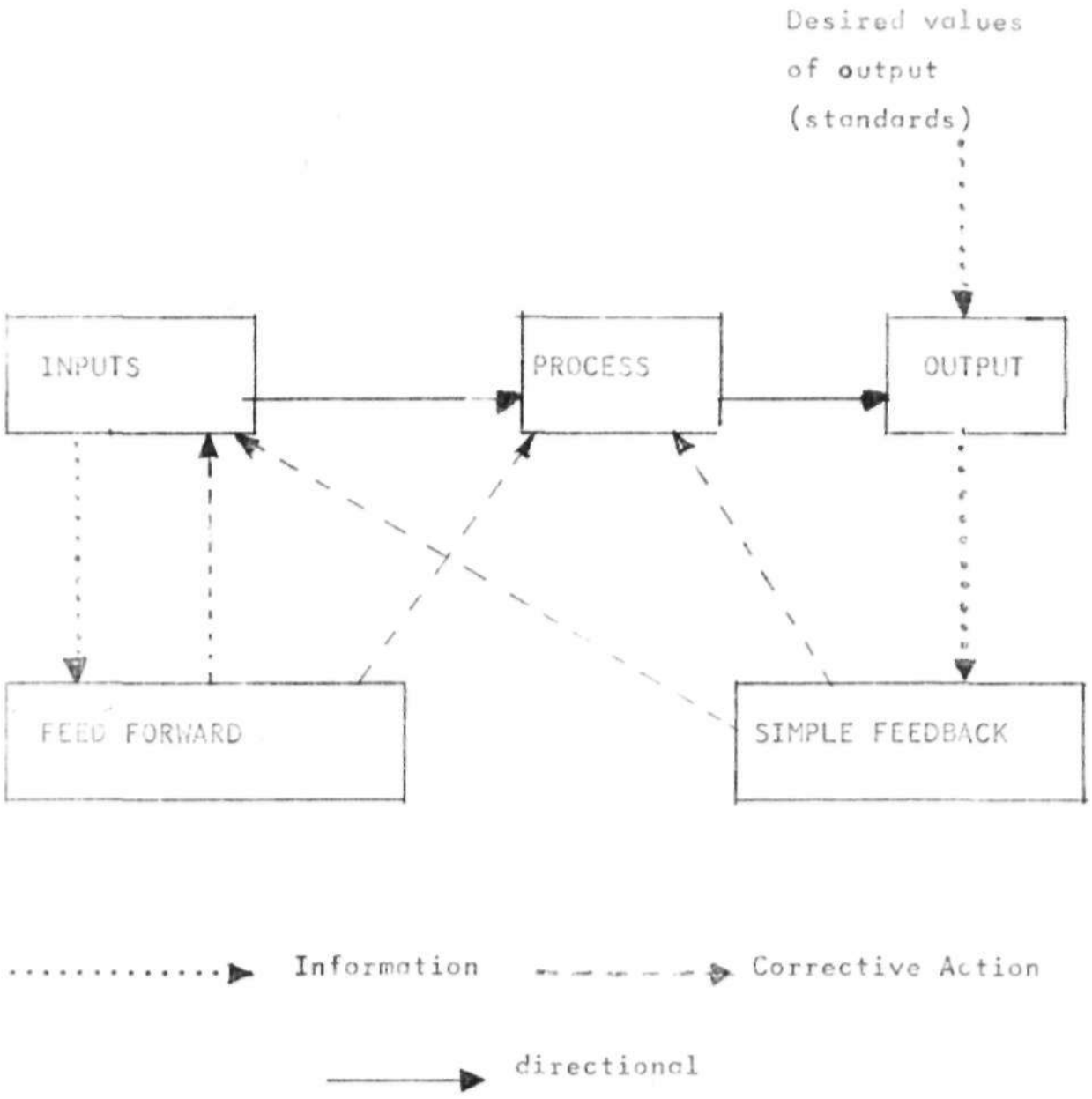


Fig. 2.2 Comparison of simple feed-back and forward control systems.

Source: Ibid P. 730

It should be noted that all three principles must be present in any cost control system. Each one of them will now be considered individually.

2.1.1 Establish control base

The control base is an estimate of the costs to be incurred. It is the best estimate at the time, and is prepared with some care and in as much detail as possible. This established control base is variously referred to as 'control estimate', 'target budget' or 'budget estimate'. Adjustments to the estimate are made as necessary throughout the life of the project, so as to reflect all changes that may occur in the original basis. Thus the control base is established and maintained at a current level, consequently, the base against which actual costs are controlled is always defined.

2.1.2 Monitor, Analyze and Report Performance

At the start of operations, a close and continuous watch is kept on what is happening. Actual performance is monitored, and by performance is meant those activities and events which result in cost. The performance is analysed and frequent checks are made to ascertain that the resulting costs are not likely to exceed the target amount in the control base.

Trends are noted and forecasts are made, the probable final cost is computed. Actual commitments and expenditures

are recorded. Finally, cost reports are prepared on a regular basis. In the reports, all potential over-runs on cost are highlighted in sufficient time to enable any necessary remedial or corrective action to be taken. Monitoring, analysing and reporting continue throughout the life of the project.

2.1.3 *Eliminate adverse variances*

By the first two principles, potentially adverse situations are detected well before they actually have impacts on project cost. The process of control comes into fruition by means of the third principle. The principle provides the elimination of the potential adverse situation if its likely occurrence is known in sufficient time.

In other words, potential cost over-runs are detected by means of the first two principles and their impact is prevented by the third principle. Corrective action is taken to bring the expected final cost back into line with the previously established control base. The alternatives are considered, corrective action is initiated and a watch is maintained to ensure that such corrective action is effective.

2.2 VALUE OF COST CONTROL

Cost control is essential in all quarters of construction industry. It is also essential for all participants in a project, be it the client or design consultants or

the contractor, each with their respective concerns for investment of capital and for profitability of operations and it is essential whether such concerns be related to design engineering, material procurement or to field construction.

Cost control has never been more important and necessary as it is now because never before has the economic climate been so severe as to virtually demand effective control of costs in order to survive. The value of cost control can be summarized as follows:-

1. to help keep to budgets
2. to aid completion on time
3. to give accurate cashflow projections
4. to increase accountability and aid subsequent audit investigation.
5. to provide information on cost for use in future estimating.

These will be considered further in detail.

2.2.1 Keeping to budgets

The selection of a project commences from a strategic front end planning function and terminates at decision-making. Often a particular project is chosen because it forms a part of an overall plan of optimum cost effectiveness. The choice of an alternative over another can be seriously

affected if projects overspend the original estimated costs that made up the economis analysis. A good control system can give early warnings as to whether that budgetted figure may be exceeded.

2.2.2 Completion on time

In planning how the costs of the project will be expended over the period of execution, programming of the project is also done. A contractor implementing a control system builds up and maintains a comprehensive project plan. After a blue print to work from has been established, the progress as well as the cost of the project is monitored and controlled. However, a general over-view of all factors affecting the project has to be considered in developing such a plan.

2.2.3 Improving cashflow projections

A firm undertaking a large programme of capital investment projects must find the necessary funding especially in a situation where financial contractual obligation between the firm and the client might not be honoured due to lack of funds. The borrowing requirement is arrived at from forecasts of cashflow derived from the cost control system.

In this time of economic restraint and capital rationing, the need to get an accurate prediction of project expenditure has increased. A firm that has to borrow to finance its project may find itself in an embarrassing position if its

budgetted expenditure is under or over the level of loan specified and with the current cost of borrowing the problem is aggravated.

A cost control system can help to continually update future project expenditure. It will also, if applied vigorously, maintain the planned expenditure rate. The monitoring of expenditure is just as vital to project completion as pure physical progress.

2.2.4 Increasing accountability

The increasing emphasis on accountability of capital investment projects within the management hierarchy and from outside the organization makes a cost control system necessary. Post-contract audits and project 'post-mortems' are made easier as there exists on record a detailed account of cost and progress on the project.

Through good cost control system any factors affecting either the capital investment aspects of the project or the final availability of the project are conveniently reported to the top management which exists in the capacity of overseer/ of the direction and objectives of the organization and the client.

2.2.5 Proving information on cost

Cost data are usually accumulated in the process of cost control. These data are updated and maintained at current level. The cost information derived from these data

are very helpful in preparing cost estimates of similar projects or the cost components of other projects.

2.3 FACTORS AFFECTING COST OF PROJECTS

There are various factors that contribute or affect the estimated cost of projects. There is a variety of opinion regarding what factors influence the cost of project. O'Brien and Zilly (1971) gives a list of factors affecting estimates which include:-

1. Material Escalation
2. Labour Escalation
3. Weather conditions
4. Job location
5. Over-time schedule requirements

Helyer (1979) in his book gives the condition affecting cost of project as the economy. The economy is considered at three levels which are:-

1. At the national or International level
2. At the industry level
3. At the level of individual construction

In this book, the third level of economy consists of factors such as:-

a. The type of project
b. The location
c. The type of contract

d. The size

e. The shape

f. The design consultant

All these factors, and even more, might definitely affect the cost of project, however in this presentation, the economy and economics of the country is presented as the major factor affecting cost of project. This will be elaborated on later. All other factors are those factors which are particularly affecting cost of projects in Nigeria as of now and actually they are somehow related to the economy of the country.

These other factors are:-

1. Non-availability of materials and spare parts.
2. Non-payment or delayed payment
3. Financing
4. Delay by sub-contractors and supplier
5. Contract Change Orders
6. Kick-back
7. Location
8. Method of estimation.

2.3.1 Economy of the country

The construction industry is an important segment of the national economy and changes in the economy can

substantially affect the industry. For instance, when money becomes scarce as it were today, and the future is not being viewed with any great optimism by enterpreneurs, there is a tendency for the private sector to reduce capital formation. Since construction forms such a large part of capital formation, Volume of construction will drop tending to lead to a reduction in tender prices as contractors start looking desperately for work and cut their profit margins to obtain it. This may inevitably be followed by an increase in the number of bankruptcies and a general depression in the construction industry.

On the other hand, a period of inflation will increase the cost of wages and materials, construction costs will rise and this may lead to a reduction in the volume of construction.

In Nigeria today, the situation is a combination of money scarcity and inflation. The volume of construction has dropped considerably and tender prices are relatively lower than they might have been.

As excerpt from a report written by Economic Council of Canada about construction instability (obtained from the book 'Construction, Estimating and costing by F.N. Helyer) goes:-

> 'Construction instability is an integral part of the large process of economic expansion and construction occurring locally, regionally and' nationally. Since

> construction firms primarily are marketing highly specialized site-preparation and assembly skills, they carry no inventories instead, they respond - as do service agencies - to the immediate demands of other sector of the economy i.e. to business demands for additional industrial or commercial plant capacity, to government spending on schools, energy facilities, roads, sewers and other special structures and to family requirements for new or replacement housing'.

Apart from effect of economy on costs at national level, also there is an effect at the industry level. This is due to the structure of the industry itself. The industry is such that availability and costs of labour and materials are vital to its operation and consequently will affect the overall cost of construction. Construction industry creates capital goods by production and assembly processes. The production process is done by converting raw and semi-finished materials into their final form and the assembly process by assembling manufactured components into the final product. Production is usually undertaken on an open site rather than in an enclosed factory and this poses unique problems of organization and management. It also makes production dependent to a certain extent on the weather, and it requires a high degree of mobility of labour and materials.

Having discussed the major factor that affects the construction costs, other listed factors, though minor but having big impact on construction costs in Nigeria, are

considered.

2.3.2 Non-availability of materials and spare parts

The scarcity of construction materials and spare parts has resulted in prices of these commodities being prohibitive if they are available. Although there are clauses in the contract document which entitled the contractor to claims due to material price escalation from authorized suppliers but in most cases, these materials are not available and when they are, are very difficult to obtain from the authorized suppliers. Hence, the open market is the only available alternative. This problem can be said to be responsible for high costs of capital projects in Nigeria. Because in order to beat the situation, some contractors build certain percentage for escalation and other risks into their tender estimates.

2.3.3 Non-payment or delayed payment

Major capital projects in Nigeria are financed by either the Federal Government or the State Government. Usually before the present military administration, a 10% mobilization fee is paid to the contractor at the on-set of the contract. With this fee, the contractor can mobilize his plants and labour to the site and commence work. Payment Certificates are usually sent to the client at the end of each month for payment. Before the era of economic crisis, there used to be little or no delay in paying the amount due to contractor after processing

but in these days of economic strangulation, the payment of outstanding certificates takes quite a long time. For this reason, contractors experience cashflow problem resulting in delay in the completion of the project which consequently influence the final cost of the project. However, as in the case of price escalation, there are clauses in the contract document which entitle the contractor to claims due to delay in payment. These claims are even more difficult to collect.

2.3.4 Financing

If it were that payments were made as due, the contractor might be able to finance projects with the equity shares but as it is, the need for financing is imperative. The difficulty of obtaining bank loans for construction and the high rate of servicing the loans may effect the costs of projects in that this will inevitably increase the fixed costs incurred by the contractor.

This, also, contributes to the high cost of capital projects in Nigeria in that most contractors make allowance in their tender estimates for cost of financing to off set the extra costs that might be incurred due to financing.

2.3.5 Delay by sub-contractors and suppliers

The sub-contractors' failure to mobilize on site as scheduled by the main contractor and failure to execute according to the contractors' programme will often results in

delay and might disrupt the whole programme of work. This adversary relationship between the main contractor and the sub-contractors might consequently influence the final cost of the project.

Because of scarcity or non-availability of materials, the suppliers, most often, fail in carrying out their contractual obligation to the contractors on time. The delay will, most probably, cause the contractors extra money. Infact, there had been situations in which contractors had to purchase the required materials from open market at highly escalated prices.

2.3. Contract Change Orders

Changes in design or work during construction would surely influence construction cost especially if they are substantial. Change orders are one of the major causes of disputes and claims because they often fail to provide for timely evaluation and negotiation of time and cost impacts. Contract Change Orders, if not for technical reasons, occur mainly because the design consultants, who are usually foreigners, are not familiar with the culture and attitudes of the peoples of the country. They usually design without much adaptation to Nigeria condition. Most of the time, the change orders end up increasing the final costs of the project.

2.3.7 Kick-back

Kick-back is a polite colloquialism of bribery and it is a household word in Nigeria. From the evidences given to the Military Tribunals trying ex-politicians charged with enriching themselves or parties with public fund while in office, it is obvious that the bulk of the money came from kick-backs demanded from construction companies. This goes on to show how deep-rooted, the idea of securing certain percentage of the contract sum from the contractor before a contract is awarded, is.

In cases where the deal is a common knowledge and understanding between the contractors and the officials awarding the contracts, a percentage of the estimated tender sum is added to the actual tender sum to give an inflated tender price. A major cause of high costs of capital projects in Nigeria. But in a situation where the contractor is not aware of the kick-back before tender price is submitted, the money still has to be paid. This may eventually erode the contractor's profit margin and increase the contractor's budgetted estimate of the cost that will be expected on the project.

2.3.8 Location

The location of a project can have a considerable influence on the construction cost. It is well known that the cost of labour together with the fringe benefits will

vary from location to location (or from zone to zone as classified by the Federal Government) and so will the quality of labour. Usually, the most productive labour is found in the major urban areas. Also labour is more readily available in major urban areas so there is less likelihood of labour shortages and consequent delays.

Moreover, materials at competitive prices are relatively readily available in large towns but are obtained with more difficulty and hence at higher costs in rural areas.

2.3.9 Method of estimation

There are various estimating techniques available for estimating cost of a project ranging from an initial feasibility 'guesstimate' to a detailed estimate prepared from complete drawings and specifications with accuracy depending on how much is known about the project and how much time and effort is spent on the preparation of the estimate.

Edmunds (1965) gives six basic types of estimates. These are:-

1. Quickie
2. Original
3. Preliminary
4. Official of budget
5. Final or definitive
6. Revised

The American Association of Cost Engineers proposed five classifications of estimating types:

1. Order - of - magnitude (ratio estimate)
2. Study (factored estimate)
3. Preliminary (budget authorization estimate)
4. Definitive (project control estimate)
5. Detailed (firm estimate)

Hackney (1965) in his book gives five classifications of estimate types based on probable accuracy:

1. Detailed unit cost ± 3%
2. Material take off ± 6 %
3. Defined equipment ± ratio 12%
4. Preliminary equipment ratio ± 25%
5. Capacity - cost curve ± 40%

The type of estimates used in calculating the project cost will determine the degree of accuracy of the estimated cost - which will consequently determine the degree of accuracy of the target cost. So, while estimating cost of project the limitations of the technique used must be recognised before the cost can be used as the target price.

2.4. COST CONTROL AT VARIOUS STAGES OF CONSTRUCTION PROJECT

The traditional approach to construction basically starts from the awareness of a need for a facility and terminates at the commissioning stage (Fig. 2.2).

The various stages are as follows:-

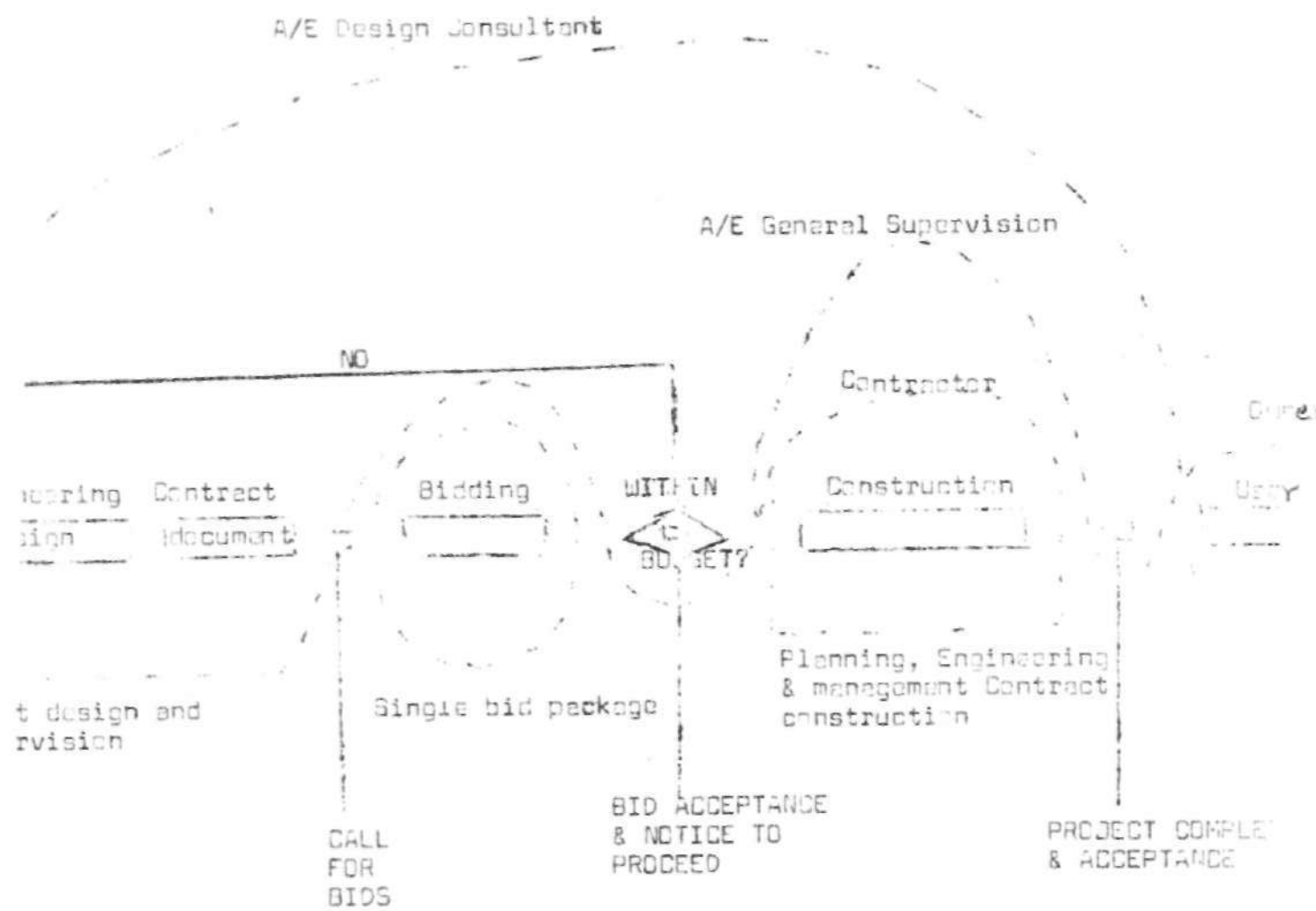
1. Concept or feasibility stage
2. Schematics or design stage
3. Procurement stage
4. Construction stage
5. Commissioning stage

The function of cost control goes beyond these five stages of construction process. It is also necessary to control cost during the maintenance stage so as to ensure the serviceability of the project within the estimated level of expenditure. This stage is often, either by design or ignorance, neglected in Nigeria. The importance of this stage of project cycle cannot be over-emphasized since it is the stage that determines the fulfilment of the purpose for which the project is undertaken as well as the attainment of the projected life span of the project.

There is a number of participants involved in the realization of the construction project, each playing his role at different point in time and with different point in time and with different interest. These participants are responsible for carrying out the cost control function at each stage. This will be discussed further in detail.

2.4.1 Concept or feasibility stage

Cost control during feasibility stage of a construction



3 Traditional Organization of Construction process

programme has two distinct objectives which are estimation and evaluation. The purpose of estimation is to develop in successive attempts, as design evolves the best estimates for various project options. Evaluation is the analysis of the financial implications, the purpose of which is to assess the relative viability of these project options in order to eventually select the most financially attractive and technically acceptable.

Various traditional techniques of evaluation exists, their use and application depend on the capital investment criteria preferred by the client. However, in general, for a capital intensive project with a long construction period, and an operating life, say 40 years, long-term discounted cashflow analysis is necessary. For industrial project, this acquires projection of operating costs and revenue over the economic life of the project, in turn giving projections of profit and loss accounts, funds flow analysis, balance sheets and other vital data in selection of most financially attractive project alternative.

It is particularly important to test the chosen alternative under varying economic scenarios such as variation in prices, time over-runs or changes in technology. With all these pieces of information, the real financial viability and associated risk are assessed.

The clients and the consultants work very closely during

this stage of construction process.

2.4.2 Schematics or Design Stage

Cost control during the main engineering design stage is of up-most importance and is necessary for effective cost control at other stages of the construction process. This is so because of the fact that an economic design can considerably reduce the possibilities of wastes and of the forces or factors, which tend to escalate costs. That is to say that an un-economic design paves way for all sorts of practices which tend to increase construction costs. At this stage, it is the consultants' responsiblity to regulate construction costs through proper design decisions by ensuring competent designs and closing all avenues for cost inflation.

Cost of project at the design stage is influenced by three main factors among others. These are the functional, technical and aesthetic requirements. These requirements are inter-related and have influence on each other. In essence, cost control at this stage is essentially a cost optimization function. The objective is to attain the right balance between technical design quality, ease of construction, aesthetic satisfaction as well as overall cost minization, and the results are fedback into the estimation and the evaluation processes discussed in the feasibility stage.

2.3.4 Procurement Stage

For capital projects that may require installation of certain machinery, the procurement stage might be included in the construction process. The purpose of cost control during this stage is to ensure that all materials, machinery and equipments are purchased within budget. This is achieved through procurement control, monitoring and reviews and the responsibility lies on who is handling the purchasing. The client, if the procurement is done directly and the contractor, if it is contracted.

2.4.4 Construction stage

At this stage of the construction process, it is the s stage of execution. The five objectives listed under the value of cost control can be realized if all participants involves in the construction process play their parts effectively. These objective are:-

1. to help keep to budgets
2. to aid completion on time
3. to give accurate cashflow projections
4. to increase accountability and aid subsequent audit investigation
5. to provide information on cost for use in future estimating.

Cost control at this stage is the responsibility of all

the participants i.e., the client, the consultants or designers and the contractor. Through sins of ommission or ignorance, the function of cost control at this stage is left in the hands of the contractor in Nigeria. Although his primary role in the construction process is that of a resources manager, resources which include men, machinery, materials, money and time but unfortunately, he is a late comer in the process. Usually he comes in after the important cost decisions must have been taken by the consultants and the client.

Although the responsibility for controlling costs lies mainly with the contractor, the effect of the ineffectivenes of his cost control system is suffered more by the client who has to honour claims (i.e. additional costs) cropping up due to factors affecting construction costs mentioned earlier in the chapter. The consultant is not shielded from the effect of the ineffectiveness of the contractor's cost control system. The effect is harmful to the dignity and reputation of the consultant. For these reasons, it is highly essential for the client as well as the consultants to establish effective cost control system which will be co-ordinatedwith the contractor's. By so doing, the factors which might have cost consequencies on the project can be identified sooner by all concerned and their effects can be minimized, if not completely

eliminated.

On the part of the contractor, cost control can be achieved through proper contract control. This involves good contract administration which requires highly efficient project management, whose brief is to steer the optimum course through the quadrangle of objectives-minimum cost, shortest time, adequate quality and good industrial relations.

The last three of these objectives can be attained by good planning, sufficient technical supervison and diligent personnel management. Lack of proficiency in any of these will quickly generate cost consequencies. The cost objective can be achieved by estimating attainable cost and by tight but equitable control of all variations and extra among other things. Proper contract monitoring and reviewing are essential.

The consultants' role in performing the function of cost control does not end with the design and placement of a contract. It is the duty of the consultants to provide adequate technical supervision and to conduct regular checks on the estimated and actual costs, adjusting prime cost, provisional sums, variations and so on. The consultants have the responsibility of ensuring a sound, functional project constructed at economic price level with the minimum deviation from the accepted tender figure, entrusted on them.

The client has the responsibility of providing the required funding of the project and sufficient, efficient and effective technical supervision. The time value of money should be considered among other things such as co-ordination, coperation and understanding between the client, the consultants and the contractor.

2.4.5 Commissioning Stage:

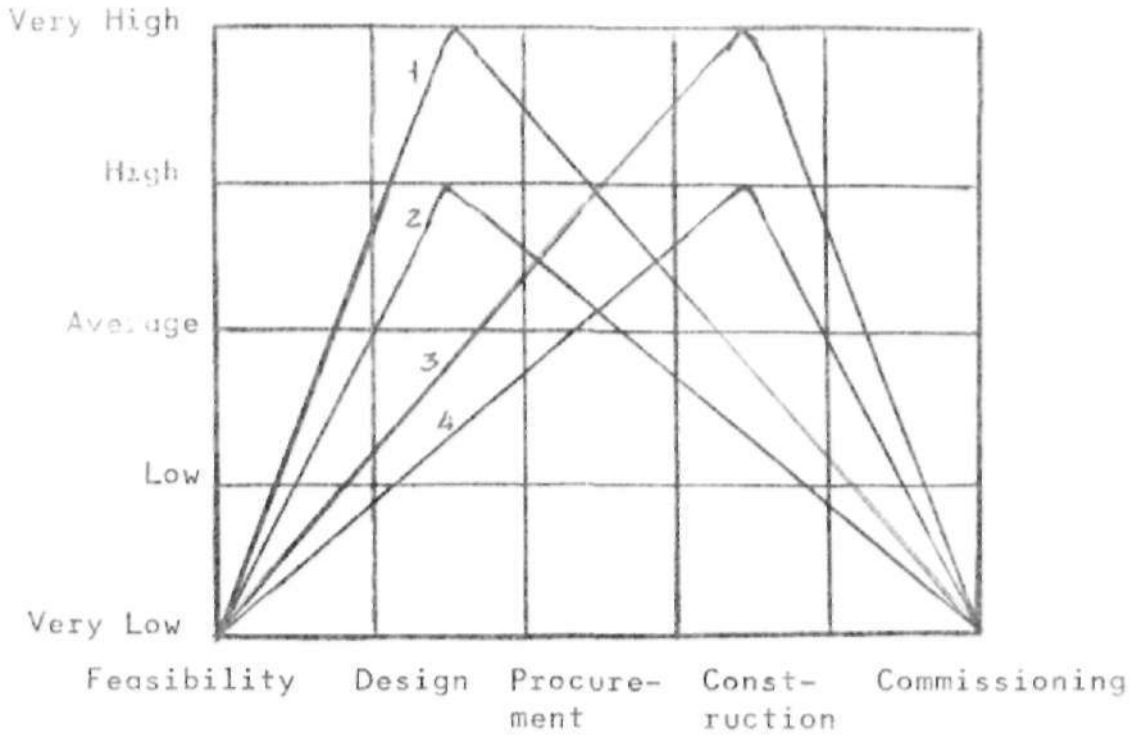
Commissioning is the last stage in the project construction chain (Fig. 2.3), and in cost terms, the completion of construction of activities against precise technical, time and budget constraints. Cost control at this stage is under a much tighter rein and is the time of the truth as to the correctness of the original budget.

Effort and ability to control costs at the various stages of construction process is depicted on Fig. 2.4

2.4.6 Maintenance Stage

After the project is completed and accepted, the facility is then put to use. For continuing serviceability of the facility, maintenance has to be carried out periodically. This aspect requires attention and is considered to be critical to design cost since the amount spent on facility maintenance on yearly basis constitutes a substantial proportion of recurrent budget of the client or the user.

Design decisions in many ways, affect the design



1 - Effect to determine cost 3. - Effect to contain costs

2 - Ability to achieve costs 4. - Tendency to cost over-runs

Fig. 2.4 Effort and ability to control costs.

Source: S. Tangney, R.J. O'Brien and M. McMahon, 'Cost Control in the construction of cement plants', Association of Cost Engineers 7th Int. Congress, Pg. E6-11.

characteristic of projects and the quality of their construction. This is the more reason why cost control should start right from the design stage. Cost control at design stage enables the consultants to take into account the continuing technical and economic consequences of design decisions and also to evaluate the future operating costs of the project.

Cost control at the maintenance stage is in essence, maintaining the serviceability or continuing use of a project within the estimated operating costs.

2.5 POLITICAL INVOLVEMENT IN CONSTRUCTION INDUSTRY

In Nigeria, like most developing countries, capital projects are embarked upon by the government with the objectives of providing basic infrastructures and social welfare services. Usually, contracts are awarded to corporate bodies or individuals to fulfil these objectives. From conception to commissioning of these projects, there exist political involvement and corrupt practices which created the bad image and smeared the reputation of the construction industry in Nigeria.

More often than not, the initial conception of a project is the prerogative of political office holders (be it civilians or military) and the top civil servants. From many indications, a lot of projects were initiated not out of necessity or publicly motivated but in order to fulfil varying unviable motives such as propective monetary/material gain, nepotism, ethnocentricism or combination of these. Projects were initiated without considering the necessary funds. It is a common knowledge that a lot of construction companies are affront for politicians or their associates. Some bad consultants, government officials and contractors

also collude to enrich themselves by increasing construction costs through claims.

Although this paper is not concerned with the high cost of capital projects in Nigeria but it is worthwhile to consider the influence of the political involvement in the construction industry having in mind that one of the objectives of cost control is to increase accountability.

2.6 RESUMÉ OF THE CHAPTER

In summary, this chapter has attempted to discussed the general aspects of construction cost control. The chapter tries to answer the following questions:-

1. What is cost control and how is cost controlled?.
2. Why control cost?.
3. What factors affect cost?.

Apart from anwering these question, the chapter looks into cost control at various stages of construction process and the role played by various participants involved in the process. Mention is made of the influence of political involvement in construction industry in Nigeria.

. Having discussed the general background of cost control, the next chapter carries a report of the investigation carried out on three construction companies in Nigeria with regards to how cost is being controlled in reality, that is to say, the

systems that are applied practically to control costs of projects.

CHAPTER THREE

INVESTIGATION OF COST CONTROL SYSTEMS IN USE

The aim of every contractor is to make profit and to keep costs within the budgetted level as much as humanly and practically possible. If costs get out of hand, there is a possibility that the estimated profit margin might be eroded and even the hope of making profit at all might be thrown overboard. In order to have a better insight and a clearer understanding of how cost of construction is being controlled in practice, three construction firms handling civil engineering projects in various parts of the country are investigated.

These three companies are referred to as Companies A, B and C respectively. Below is the report of the investigations.

3.1 CASE STUDY I

Company A is one of the subsidiary companies of an Italian firm with over thirty years experience and expertis in bridging, road, building, hydro-electric projects, airports, hospitals and all forms of major civil engineering and building construction. The company's reputation and interest have developed to a point where turnover is now in excess of two hundred million United States Dollars ($200,000,000) per annum.

The company's head-office is in London and its technical

office in Rome. It has 14 subsidiary and associated companies all over the world. Comapny A has been in Nigeria for about twenty years.

3.1.1 The discussion

A personal discussion was held with the Commercial Director of the company on the topic of cost control of construction projects in Nigeria. The issues discussed range from preparation of tender sum, cost and time planning and scheduling tools to administration of projects. It is noteworthy that this company is one of the few companies in Nigeria that have a Cost Control Department which has the function of establishing the standards, monitoring and controlling the cost of projects as well as reviewing the cost to update the estimate.

3.1.1.1 Estimating the Tender Sum

The company's estimate of the tender sum of a project usually comprises the following costs:-

Direct Operating Cost

Overhead cost

Profit

The direct operating cost is the prime cost of the project which is made up of cost of wages and salaries of labour that is directly involved in the project, cost of materials, depreciation of plants and cost of/sub-contractors.

This cost is variable.

The overhead cost is a percentage of the prime cost of the project and is made up of administrative expense, insurance cost, financial charges, travelling, risks and sundry. The magnitude of the percentage is obtained from quarterly Management Accounts and annual balance sheet. This cost is presumed to be fixed.

Profit, like the overhead, is a percentage of the prime cost, the magnitude of which is rather political depending on the prevailing situation, competition and desirability of the project.

3.1.1.2 Planning and scheduling

The control base of a project is established by use of both time planning and scheduling tool and cost planning tool. These are:-

A. Production chart

B. Budget

A. The production chart

This chart is a political representation of the volume of work planned to be executed in a year, quantified in monetary terms (Naira). The chart is a vertical bar chart with the forecast of annual production for each project represented. There are two bars on the chart for each project

one for the forecast of production and the other for the actual production at the end of each month.

B. The Budget

There are two types of budget in use in this company and they are:-

- Financial budget or Annual projected cashflow
- Profit and Loss budget or Annual forecast of profit or loss.

The financial budget contains only those items involving the payment and receipt of cash. From this budget, the monthly cash in-flow and out-flow in a year is projected.

The profit and loss budget contains the forecast of revenue to be generated by the company in each month of the year and the expenses to be incurred during each month. The profit or loss which is the difference between the revenue and expense is computed for each month and the cumulative profit or loss on the profit for the year can then be projected.

3.1.1.3 Monitoring and Reporting

Apart from the site agent who monitors the progress of the project in respect of time and cost, there are periodic visits to the site by the Project Manager. At the end of each week, the financial costing reports are prepared and sent to the head-office for analysis. Because of the large number

of projects being handled by this company, electronic computers are used for monitoring purposes.

3.1.1.4 Controlling

The company employs two techniques or systems in controlling the cost of construction of projects and they are:-

A. Technical cost control by financial accounting technique

B. Administrative cost control by centralizing financial and administrative functions.

A. Financial Accounting Technique

The direct operating cost which is the prime cost is the estimate used for controlling the construction resources. With the programme of work and the production chart, the expected production in terms of Naira for each month can be assessed. If what is expected to be produced physically is above what is actually achieved for any month (from the analysis of the costing reports), then the project manager is informed, who in turn, brings it to the attention of the site agent.

The site agent usually makes out a full report on the activities on the site, from this the cause of the variance can be deduced. In this company, variance, when it occurs,

is usually due to mismanagement on site.

B. Centralized financial and administrative functions

There is an operations department in this company which handles solely all the financial and administrative functions of the company. Purchasing and hiring are among the responsibilities of the department. By this, clear-cut responsibilities have been mapped out for everybody. As a matter of fact, all financial transactions are done in the head-office only petty cash and bank accounts to pay wages and salaries are handled by the site agent.

3.1.1.5 Reviewing

Every three months, the actual position of the company is summarized in a statement referred to as Management Accounts. The estimate of cost is up-dated and with the information gothered from the Management Accounts, the budgets are revised quarterly.

3.1.2 Effectiveness of the systems

According to the Commercial Director, the systems of cost control employed by the company are quite effective considering the fact that throughout the twenty years of activity, the company never experienced loss. However, profit margin had been eroded now and then due to unforeseen factors and uncontrollable costs.

Appendix A contains photographs of some of the projects executed by Company A in Nigeria.

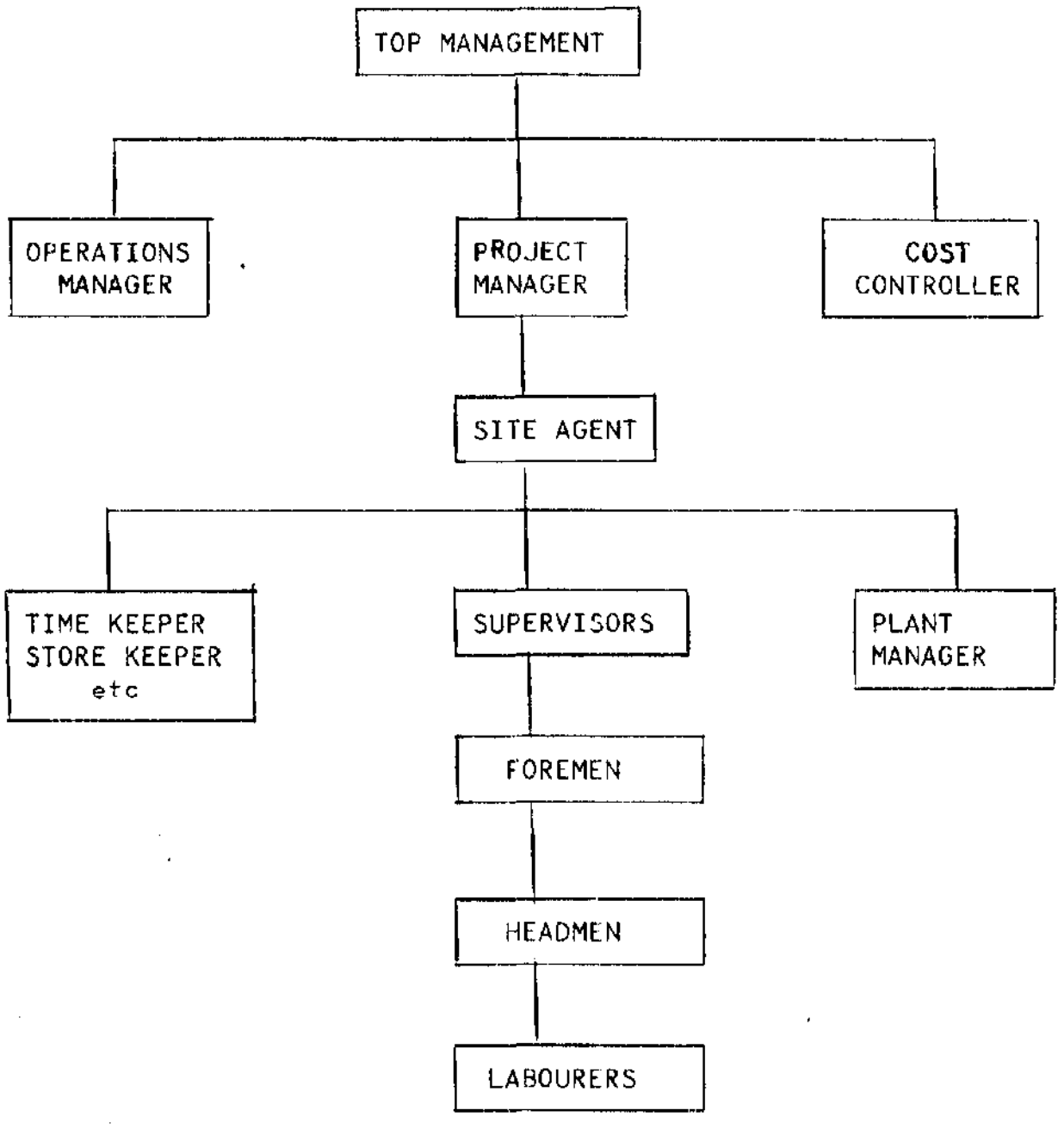


Fig. 3.4 Organization Structure/Control Chart for Company A.

3.2 CASE STUDY II

Company B is a subsidiary company of a Dutch Company with its head-office at Rotherdam, Netherlands. The company gives services in infrastructure and transport, marine engineering, off-shore, urban development, environmental engineering, energy, materials/mining, rural development and agr -industrial engineering, sports and recreational facilities and fabrication.

Company B started operations in Nigeria in 1958, since when it has spread its wings to other countries of Africa. The company has been involved in various civil engineering projects for Federal and State Governments. Among the projects executed so far are 3,100 kilometres of surfaced and asphalted roads, 135 bridges, numerous culverts, three airports and a dam.

The parent company of Company B operates in twenty three countries all over the world and has three subsidiary companies in Nigeria.

3.2.1 The discussion

A personal discussion was held with the Contracts Manager of the company. He is the man responsible for all contracts and the Area Managers report to him. Various issues concerning the control of project costs in Nigeria were discussed. The bulk of the function of cost control lies

with the Contracts Manager since there is no cost control department.

The discussion went along the same line as for the first case study.

3.2.1.1 Estimating of Tender Sum

In estimating the tender sum the company includes the following cost:-

Prime

Risk

Management fees

Financing Cost

Profit

Prime cost is the direct cost of wages and salaries of labour, materials and plant.

Risk is a percentage of the prime cost and is mainly a provision for unfavourable weather condition, location, late payment and other forms of uncertain event.

Management Fees is also a percentage of the prime cost and is the cost of over-head i.e. administrative expense e.t.c.

Financing cost is the cost of borrowing to finance the contract i.e. financial charges. The percentage of prime cost to be charged depends on the current bank interest on loans.

Profit, also a percentage of prime cost, depends on the prevailing situation, competition and desirability of the projects.

3.2.1.2 Planning ans scheduling

Like the other company, this company employs time planning and scheduling tool as well as cost planning tool to establish the control base. The tools in use are:-

A. Bar charts

B. Budget

A. Bar charts

For repetitive projects, like road construction, bar charts are usually employed for scheduling of time and cost because the charts are more workable especially in Nigeria. But for complicated projects, like dam construction, in which there are a lot of activities, the Programme Evaluation and Review Technique (PERT) is employed.

B. Budget

Budget is prepared annually on the basis of the prime cost of the project which is referred to as 'Budget Cost'. The budget cost for each operation is what the Project Manager uses as a base for cost control. From the budget, the monthly cash outflows and inflows are projected.

3.2.1.3 Monitoring and Reporting

The Project Manager monitors the progress of the project

with respect to time and cost and there are always p riodic visits to the site by the Area Manager for monitoring purposes. Reports are compiled at the end of the month by the Project Manager. These reports are analysed at the head-office.

3.2.1.4 Controlling

Cost control function is performed in this company through the use of two systems which are:-

A. Financial Accounting Technique

B. Existence of plant division

A. Financial Accounting Technique

The financial accounting technique is the main system of cost control of project in use. In this compnay, the Project Manager has the authority to purchase materials, hire labour and plants necessary for the execution of the project he is handling. As mentioned before, the budget cost or price of materials, labour and plants, which are the prime costs of these resources, are used as the base for control. However, if the Project Manager feels that the budget price of a particular item is unrealistic, he informs the Contracts Manager through the Area Manager and a realistic price is generally agreed upon on.

Record of costs are compiled daily and the information herein are used in making up the monthly reports. Apart

from reports, monthly meetings are convened to discuss the cause of variances (after analysis of the reports by the Contracts Manager) and the actions to be taken. For projects handled by the company abroad, computers are used for monitoring, reporting and analysing. The reports are presented weekly. The company is of the opinion that computer might not work well in Nigeria for this purpose.

B. Existence of plant division

Control of cost of project is indirectly achieved by the direct control of cost of resources i.e., materials, labour and plants. In Nigeria, not much can be done about cost of materials because the supplier do not give discounts on bulk purchasing. Tactical purchasing is not effective in Nigeria. Also, not much can be done about cost of labour other than controlling productivity of labour since wages are fixed by the Federal Government. This situation leaves plant as the only resources whose cost can be effectively controlled. Hence this company pays a lot of attention to the utilization of plants.

There is in existence a plant division which is a kind of associated company. This division purchases, maintains and hires out the plants to various project sites of the company at prices lower than those obtained outside. With the aid of a computer, the division is able to monitor the

plant requirement and utilization at various sites.

Actually, the division operates on zero-level i.e. no profit, no loss. It takes care of maintenance, depreciation and sundry, the total cost of which must be equal to the hiring cost. In this company, depreciation is on straight-line method and it is a cash outlay which is also a sinking fund for the purchase of additional plants. Because of limited management capability, the number of plants that can be owned and managed at a time is limited, so excess depreciation cash outlay is kept in bank for other uses.

3.2.1.5 Reviewing

Meetings are held every two months with Contracts Manager and Project Managers in attendance to discuss the progress of progress of projects and to review costs with the aim of up-dating the budget. Apart from this meeting, there is also a meeting convened every quarter of a year between the Contracts Manager and the Area Managers.

3.2.2 Effectiveness of the systems

According to the Contracts Manager, the company is satisfied with the result of operations so far i.e. the cost control system is effective as far as he is concerned. Like Company A, this is so because the company has been making profit which is within the range of $\pm$ 10% of what

was estimated in the tender sum.

Appendix B contains photographs of some projects handled by Company B in Nigeria.

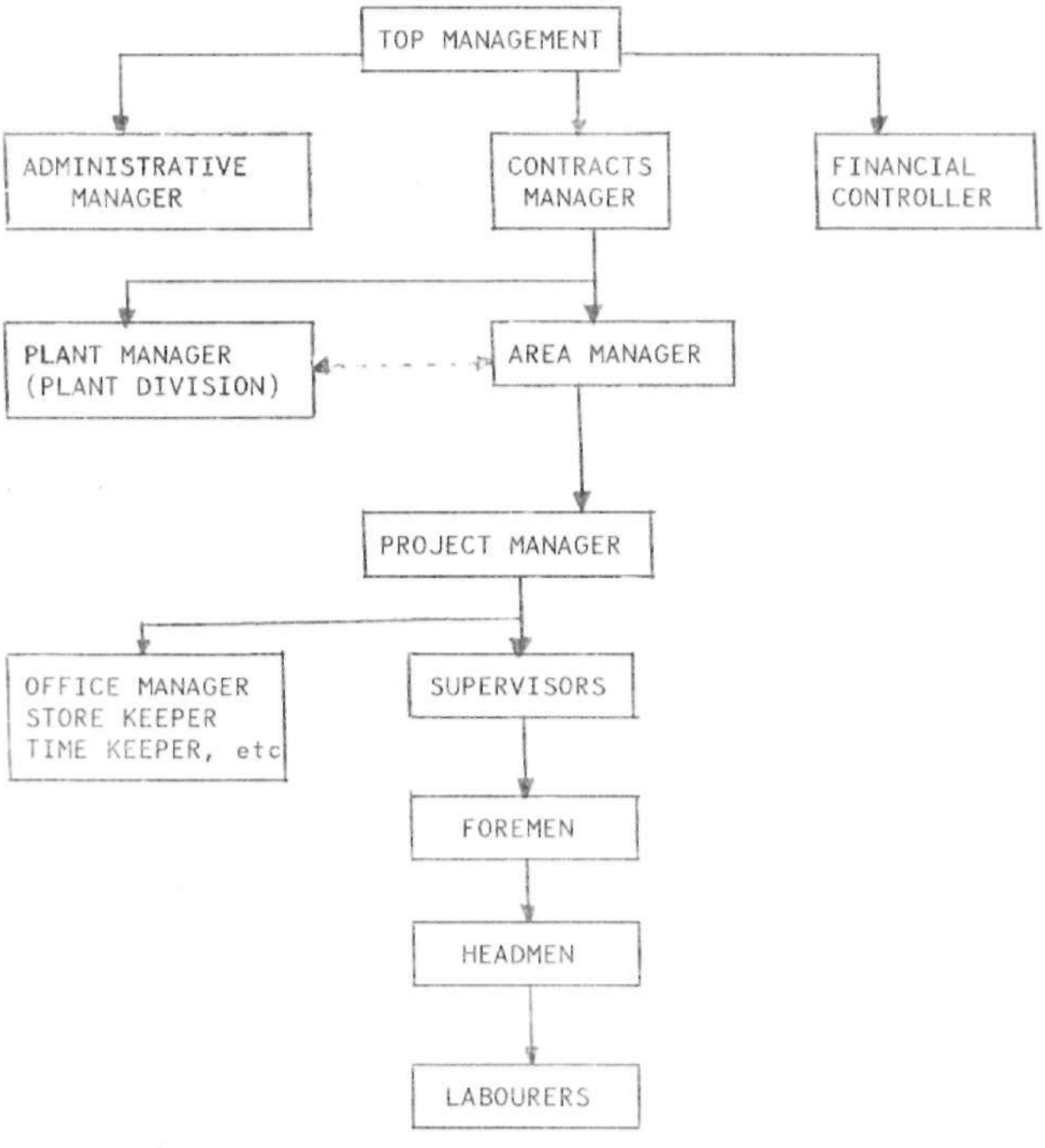


Fig. 3.5 Organizational structure/control chart for Company B.

3.3 CASE STUDY III

Company C is a relatively young company established by some Nigerians and a British partnership in 1974. Its basic activities are in quarrying and the manufacture and laying of asphalt for road and airfield. With the benefit of the support available from its United Kingdom associated company, it can carry out design, manage, produce and construct on a much wider basis. Among the civil engineering projects executed by this company in Nigeria are airport construction, bridge and road construction.

3.3.1 The discussion

The discussion was held with the Project Manager of the company. He is responsible for all projects being handled by the company and the Site Managers report to him.

The discussion followed the same format as for the other two companies investigated.

3.3.1.1 Estimating the Tender Sum

The estimate of the tender sum is obtained in this company by summing up in the following items (Table 3.1):-

Prime cost of main contractor's work, sub-contractors' cost, site over-head cost and cost of preliminaries.

Risk

Head-office over-head cost

Profit

TABLE 3.1 : FINAL SUMMARY

MAIN CONTRACTOR'S WORK	LABOUR	PLANT	MATERIALS	TOTAL	CASH DISCOUNTS
	₦	₦	₦	₦	₦
ADJUSTMENTS ADD					
ADJUSTMENTS DEDUCT					

OWN SUBCONTRACTORS	AMOUNT	ADD	DEDUCT	
	₦	₦	₦	
NET				
%DISCOUNT				
%DISCOUNT				

NOMINATED SUB CONTRACTORS (%)	
NOMINATED SUPPLIERS (%)	
PROVISIONAL SUMS (NET)	
CONTINGENCIES (NET)	
SITE ON COSTS AND PRELIMINARIES	
Deduct Cash Discounts *(If Required by Company Policy)*	
₦	

ADD

RISK		
PERFORMANCE BOND		
PUBLIC LIABILITY		
EMPLOYERS LIABILITY		
CONTRACTORS ALL RISK		
FEES		
INTREST		
HEAD OFFICE OVER HEAD %		
PROFIT %		
TURN OVER TAX %		
CONTINGENCIES %		
TOTAL ₦		

TENDER FIGURE ₦		SIGNED	

Turnover Tax

Contingencies

The prime cost of main contractor's work is obtained from the addition of prime costs of labour, material and plant for the part of the project that will be executed by main contractor.

Sub-contractor's cost is the cost of the part of the project that will be executed by nominated sub-contractors and suppliers and their provisional sums and contingencies.

Site over-head cost and cost of preliminaries is the cost incurred on site apart from the prime cost.

Risk is the cost due to weather, location, delayed payment, performance bond, public liability, fees, interest e.t.c. This cost is a guesswork.

The head-office over-head cost is a percentage of the sum of the first three costs.

Profit is also a percentage of the first three costs - and its magnitude depends on management decision.

Turnover tax is the sum of money that should be paid to the Government on the contract.

Contingencies is the cost that is usually set aside to off-set unforeseen items and is about 10% of the first three costs above.

3.3.1.2 Planning and scheduling.

The tool used in planning and scheduling of time and

cost are:-

A. Bar chart

B. Budgets

A. Bar charts

These charts are employed in planning and scheduling of time and cost. The company is of the opinion that most projects in Nigeria are not complicated enough to call for the use of techniques such as Critical Path Method (CPM) or Programme evaluation and review technique (PERT). According to the Project Manager, bar charts are adequate for about ninety percent of projects executed in Nigeria.

B. Budgets

With the programme of execution drawn up by the use of bar charts and the bill of quantities, the budgets are prepared. Monthly expenditure on materials, plants, labour, sub-contractors, site salaries and other over-heads are prepared on Table 3.2. On the same table, the projected monthly income (cash receivable) is entered. The profit and loss as well as the cashflows into and out the company monthly are projected.

3.3.1.3 Monitoring and Reporting

Apart from the Site Manager who is permanently on site to over-see and monitor the progress of the project, the Project Manager pays bi-monthly visits to sites for monitoring

purposes. Financial reports are prepared monthly and they are analysed at the head-office.

3.3.1.4 Controlling

There is no elaborate cost control system employed in this company, the only system is the financial accounting technique. It is noteworthy that in this company financial transactions are not restricted to the head-office, the Site Manager too is involved depending on where and how the required resources can be obtained.

After the analysis of monthly financial reports, variances especially negative ones are referred to those responsible for them. For example, if from analysis, a Site Manager is responsible for a variance, he is expected to furnish the management with the possible causes of the variation Management then takes decisions on the corrective action to be taken. This decision is passed back to Site Manager for implementation.

3.3.1.5 Reviewing

Every three months, costs are reviewed and the budgets are revised accordingly to current level.

3.3.2 Effectiveness of the systems

The company is satisfied with the level of cost control achieved so far. Since its inception, the money had been making profits except on one project where it suffered losses.

enditure
rred and
Received
gets

Original start date . . . . . Revised finish date. . . . . .

Original finish date . . . . .

However, that was blamed on mismanagement by the Site Manager responsible.

After the terrible experience, the company tries very hard to keep and maintain its reliable work-force and to employ very responsible individuals as Site Managers.

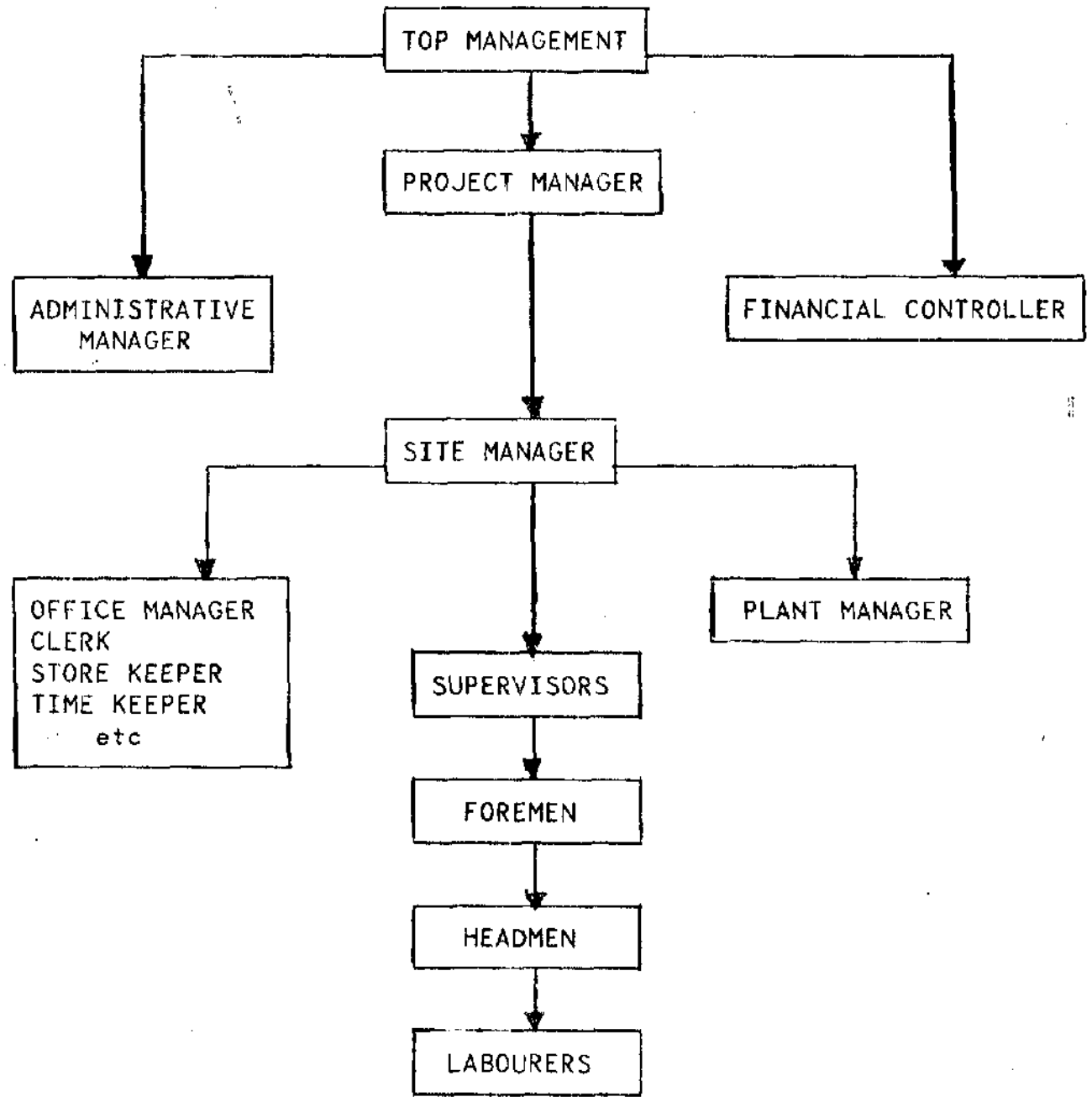


Fig. 3.6 Organization structure/Control Chart for Company C.

3.4 RESUMÉ OF THE CHAPTER

The chapter reports the various cost control systems employed by three construction companies involved in the construction of some airports for the Nigeria Airports Authority. These cost control systems are also used for other forms of construction projects.

The next chapter will go on to analyse comparatively the cost control systems of the three companies, to highlight the systems that can be used in the construction industry and to look into the human aspects of cost control.

CHAPTER FOUR

ANALYSIS AND COST CONTROL SYSTEMS REVIEW

The chapter is in three parts with the first part dealing with the comparative analysis of the cost control systems employed by the three investigated companies.
The second part contains a review of systems of cost control that can be employed in the construction industry. The third part deals with the people involved in the function of cost control without whose cooperation and goodwill, the cost control systems cannot be effective.

4.1. COMPARATIVE ANALYSIS OF COST CONTROL SYSTEMS INVESTIGATED

The comparative analysis will follow the same format as the discussion in the previous chapter. But before them, the organizational structure will be discussed briefly.

All the three companies are international organizations with expatriates running the affairs of the companies. They have all been involved in Civil Engineering projects especially Airport construction projects. The designation of the man in charge of the site is variously referred to as Site Agent in Company A, Project Manager in company B and Site Manager in Company C.

The Site Agent in Company A is only reponsible for the usage of materials, labour and plant. The only role he plays in the cost control function is to ensure effective usage of

the construction resources and to provide information for the control process. The main cost control function is handled by the cost control department within the company. Whereas in Company B, the Project Manager has a wider scope of responsibility and authority commensurates with the responsibility. He participates in the determination of target costs to be controlled. As a means of control and competitiveness Company B has a plant division which hires out plants to the sites at lower prices. This has an overall effect of keeping the prime cost of projects lower than it would have been. While company C has neither cost control department nor plant division, control of costs in this company is the respon ibility of the Site Manager with management's participation if there is variance.

4. 1. 1. Estimating of the tender sum

Most civil engineering projects in Nigeria are awarded as unit-price contracts with complete engineering specifications, drawings and site surveys. The technique of detailed estimate is used by the three companies in estimating the tender sum. With this technique, accuracy is within 6 percent. But the differences in tender estimates of the three companies for the same project will arise from the amount of percentage of the prime cost allowed for overhead cost, risk and so on and the number of items making allowances for. The items allowed

for by companies A and B in the computation of their tender estimates are reasonable enough but Company C goes further to make allowance for turnover tax that will be paid to the Government. This overloads the tender sum and consequently leads to high cost of construction projects.

In the three companies, the prime cost and the overheads are the costs that are closely controlled so that they do not exceed the estimated.

4. 1. 2. Planning and scheduling

The three companies investigated use some form of bar charts for planning and scheduling of the project execution. With the use of the bar charts, the companies project monthly productions and the budgets are formulated from the programme.

The cost planning technique used by the three companies is budgetting. The master budget is further broken down to labour budget, materials budget, plant budget and site overhead budget. The cashflow requirement is also projected.

4. 1. 3. Monitoring and Reporting

While Company A monitors progress and costs on weekly basis and by frequent visits to sites by Project Manager, Companies B and C monitor the progress of the project on monthly basis. The reports prepared, in the three companies, are analysed at the head offices and decision on actions to be taken, if variance occurs, are fed back to the men on site

for implementation.

4. 1. 4. Controlling

Cost control of projects is given a high priority in Company A. This is evidenced by the existence of a cost control department which will definitely aid in effective control of costs. In addition, Company A centralizes almost all its operations. This will peg down the number of people involved in financial transactions and this will permit the site agents to concentrate more on the management and control of site operation.

On the other hand, Company B decentralizes its operations and relies more on the project manager to keep costs within the stipulated target. By so doing, the project managers are motivated to put in their best since they are part of the decision-making body of the company. The existence of plant division in the company will, at least, reduce the burden of controlling the costs and utilization of plants and the project managers can concentrate more on costs and usage of labour and materials.

Company C has no special system of cost control except the financial accounting technique which is common to all the companies. The only difference is that Company C uses coded accounts. In addition, the company solicits the cooperation and goodwill of its workers by maintaining its workforce in

a sort of permanent employment.

4. 1. 5. Reviewing

All the companies review costs and revise the budgets so as to have realistic standards. While Companies A and C review on quarterly basis, company B does so on two monthly basis.

4. 1. 6. Effectiveness of the systems

Although all the systems in use can be said to be effective, definitely one will be more effective than the others. But comparison cannot be made in this case because not much quantitative information was given out by the companies.

4. 1. 7. Comments

In the final analysis, it is observed that the cost control systems are very simple. The reasons for this might be that the companies adapt the systems for understandabilty by the people that will use them or because in the estimate of the tender sum, allowances have been built in to take care of factors that might cause deviation from the estimate and might erode profit margins, if not effectively controlled or might be a combination of the two reasons given above.

The second reason given above seems to be the most logical of them, considering the constituent items of the tender sum estimates of the companies investigated. Because

of the attitudes and corrupt tendencies of the Government officials, justifiable and unjustifiable claims are usually approved for the contractor. These claims are source of extra money to offset the extra costs incurred due to ineffective cost control systems. One thing is sure, the profit margin of these companies on the projects handled is not seriously threatened, so why should they waste money to establish and maintain complex cost control systems as they do abroad?

It is a common knowledge that costs of capital projects in Nigeria are excessively high and higher than what is obtained in most parts of the world. Obviously, one of the major causes of high cost of capital projects is the built-in factors in pricing.

At this juncture, it is identified that one problem that should be tackled first in Nigeria with regards to casts of construction is the reduction of cost of capital projects. When this is done, it will be very essential to have cost control systems that will be technical as well as simple. With the hope that this problem will be solved, systems of cost control that will be useful to the construction industry in Nigeria are reviewed.

4. 2 SYSTEMS THAT CAN BE EMPLOYED IN CONSTRUCTION INDUSTRY

There are various systems of cost control in existence

but three systems that can be applied effectively in the construction industry in Nigeria are described in this chapter. These systems (Fig. 4.1)are:-

1. Financial Accounting System
2. Network Analysis system
3. Quantitative system

4. 2. 1. Financial Accounting Systems

The system can vary from those which control the work on a sectional or stage basis to those which control it on a unit basis, and in some systems only certain section of the project are selected for control. It is usual to limit site cost control to the direct control of cost of labour, materials and plants as these are resources that are likely to experience the greatest amount of variability. In this presentation, two systems will be discussed and they are:-

1. Unit cost control system
2. Operational cost control system

4. 2. 1. 1 Unit cost control system

The unit cost control system is applicable to non-repetitive construction projects. In this system, the estimates in the bill of quantities are broken down into its component cost i.e prime costs, overhead, miscellaneous cost and profit. From the breakdown, the unit costs of operations are compiled. These unit costs serve as the target values or the control base with

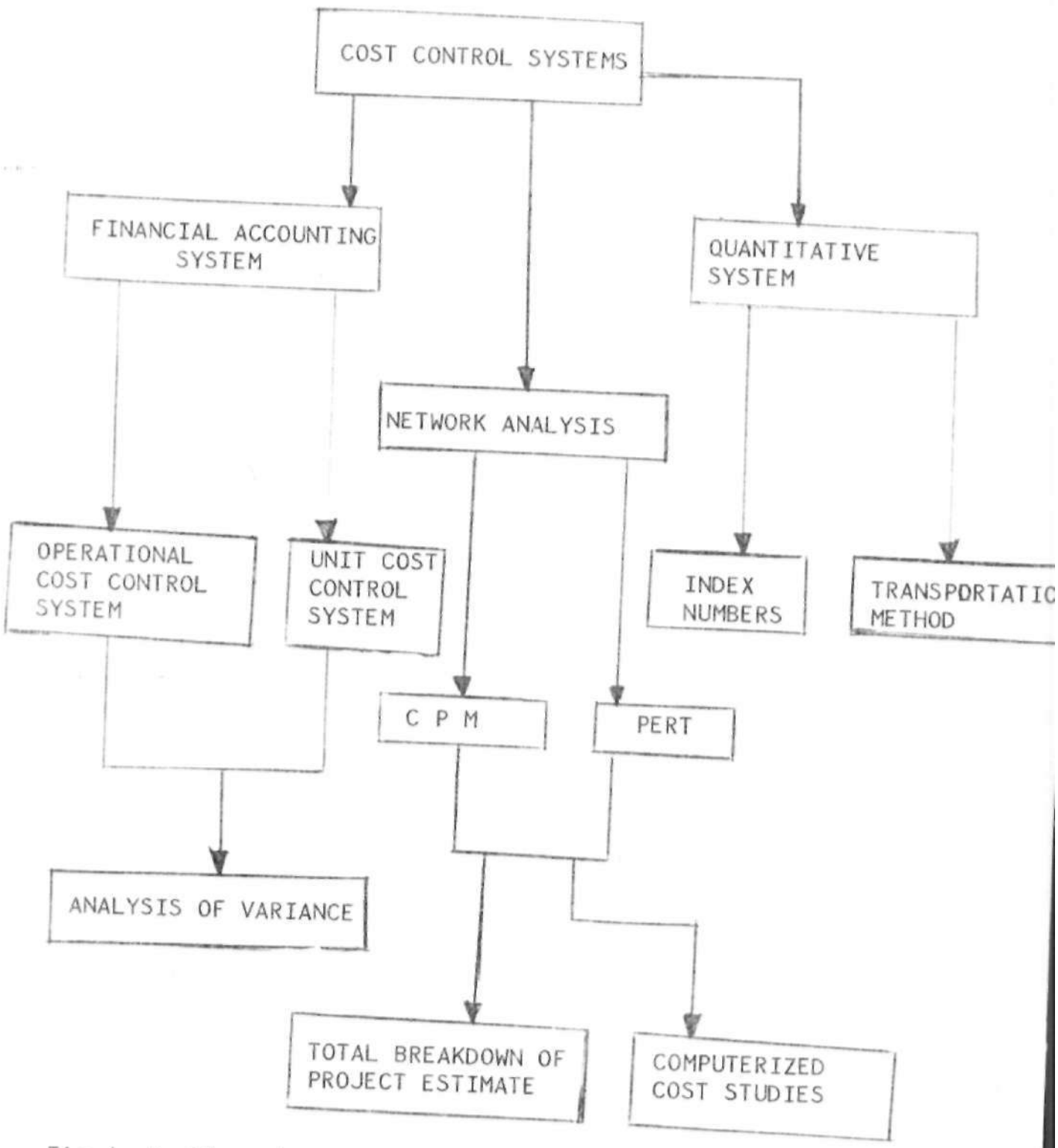


Fig 4. 1 Flow-chart of the topics discussed under the cost control systems that can be employed in Construction Industry.

which actual costs are compared. A deviation in excess or below the target by more than a predetermined margin requires further investigation, and this has to be brought to the attention of management (Principle of Management by exception).

The information on the actual costs of operations is collected by means of allocation sheet, the weekly summary sheet and the actual measurment of the volume of workdone.

Allocation sheet is a daily record of the hours worked by an operative or gang. The number of hours spent on an operation can be obtained from this record. The sheet are the basis of the cost control system and should, therefore, be accurately compiled.

Weekly summary sheet is used to summarize all the information on operational hours recorded in the daily allocation sheet at the end of each week. The allocation sheets contain both the ordinary hours and net overtime spent on operations by men and plants. The weekly summary sheet presents the total basic hours spent on each operation on weekly basis.

Measurement of workdone should be carried out by a competent individual who fully understands the demarcation between operations so that the measure can be directly related to the costs arrived at through the allocation sheets and summary sheet. The cost of materials used for each

operation can be computed from the quantity of materials used in carrying out the operation and the costs of each material involved.

The weekly cost control sheet (Table 4.1) contains the information on the costs of operations collected through the other sheets. The unit cost of each operation can then be computed. Then comparison of the actual unit cost and the target unit cost for each operation can be done.

If there is a variance, the variance has to be analysed so as to know who and what is responsible for the variance and the corrective action that might be required. In the last sub-section of this section on financial accounting systems, the analysis of variance is discussed.

4. 2. 1. 2 Operational cost control system

The operational cost control system is suitable for repetitive construction projects, for example, housing units, road construction. In this system, the project is broken down into operations that are repetitive e.g. laying of sub-base for a kilometre of road, sub-structure of a building in an estate. A target cost, with which the actual cost is compared, is set for each operation.

As with the previously discussed system, information is collected by the use of allocation sheets, weekly summary sheets and measurement of volume of workdone. Physical

CONTROL SHEET

COMPILED BY:-

SHEET NO:-

BONUS TRADE RATE	HRS LAB RATE	PLANT HRS	PLANT RATE	LAB COST	ADJOST MENT	PLANT COST	ADJ MAT COST	TOTAL COST	UNIT COST	REMARKS

	WEEKLY			COMULATIVE		
	TARGET	ACTUAL	+ or-	TARGET	ACTUAL	+ or -
NCIAL JR HRS T HRS						

measurement of the work done is not necessary. Instead, the repetitive operations should be of known work content (ascertained by drawings) and the measurement is carried out by observing the number of operations completed. The information presented in the weekly summary sheet with respect to completed operations is converted to monetary terms in the weekly operational cost sheet. The cost information is then transferred to the project cost record (Table 4.2) in which the cost of every operation completed to date is recorded. The actual cost of completion of each operation is then compared with the target cost.

The analysis of variance in the next sub-section can be applied in analysing the possible cause or causes of the variance.

4. 2. 1. 3 Analysis of variance

The variance analysis is a most widely used feedback control tool. The system can be used along with the two cost control systems discussed above to analyse the variance between the actual costs and the target cost. There are many types of variance (Table 4.3) but for construction resources, there are the price/rate variance and the usage/efficiency variance.

These variances are quite significant and management should

COST RECORD

COMPILED BY:-

SHEET NO :-

ST PER OPERATION									TOTAL COST PER OPERATION	AVERAGE COST PER OPERATION
7	8	9	10	11	12	13	14	15		

	WEEKLY			CUMULATIVE		
	TARGET	ACTUAL	+ or -	TARGET	ACTUAL	+ or -
NCIAL						
UR HRS						
T HRS						

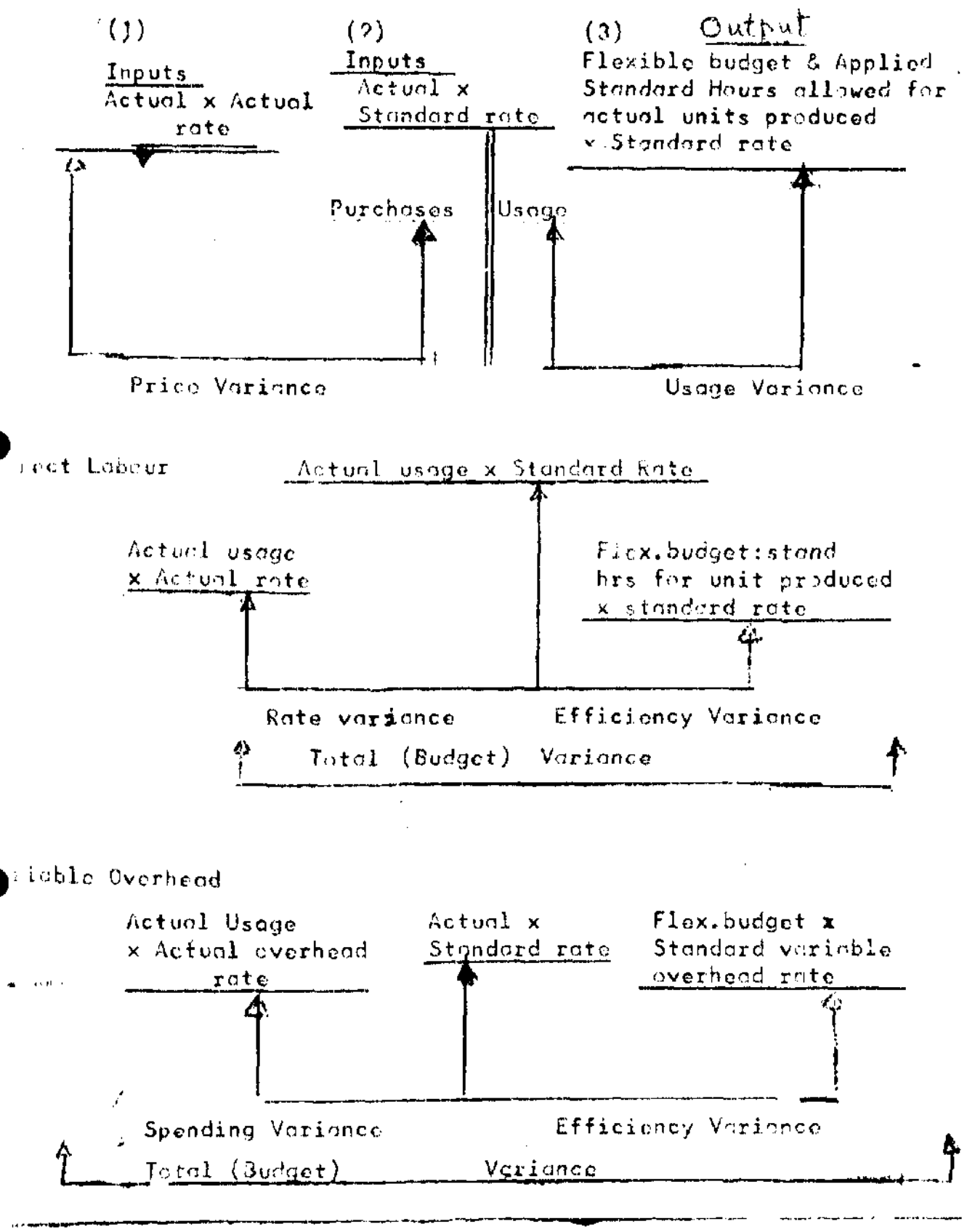


TABLE 4.3 ANALYSIS OF VARIANCE FOR DIRECT MATERIALS, LABOUR AND VARIABLE OVERHEAD

identify or at least attempt to identify an assignable cause for the variance so that proper remedy can be taken. Variances are quite helpful in feedback process by directing attention to the areas most in need of investigation. Usually, the variance analysis is corducted to:-

(a) decide on any necessary action to improve the implementation of a given decision model

(b) decide on whether to change the model itself or the prediction method

4.2.2. Network Analysis System

The network analysis technique is a dynamic and forward looking technique of planning and controlling of projects in Construction Industry i.e. it is a system that can be reviewed to fit the prevailing condition and that will tell Managers in time to take corrective actions. Although it cannot correct deficiencies in estimates, it can disclose them early enough for reassessment. The complexity and uniqueness of individual projects makes the construction industry inherently receptive to logical planning and scheduling benefitted from network analysis. This system has been modified to include additional factors such as costs.

Project cost is a product of time and resources and as such naturally its analysis follows the time and resource analyses. However cost control methods may be used independently of resources analysis depending on the approach of assigning cost estimates to the activities making up a project. Two systems will be discussed under this technique and they are:-

(1) Critical Path Method (CPM)

(2) Programme Evaluation and Review Technique (PERT/COST)

Both systems are very similar except for some features. The CPM is concerned basically with the actual task (activity), whereas the PERT is geared towards the important events in the programme. These major events are referred to as 'milestones or macro events' which identify the start or completion of major operations essential to the on-schedule completion of a particular project. Moreover, while the CPM has single activity time estimate, the PERT has three time estimates assigned to the activity times that join the milestone events. These times are:-

Optimistic time (a) - the shortest time in which the operation could reasonably be expected to be completed.

Most likely time (m) - the same estimate that would be applied in CPM work or probably average of many qualified opinions

Pessimistic time (b) - the longest time in which the operations could reasonably be expected to be completed.

The three time estimates can be used to compute an activity time as in CPM networks.

The single activity time is derived from the equation.

$$t_e = \frac{a + 4m + b}{6}$$

This is called the expected mean time

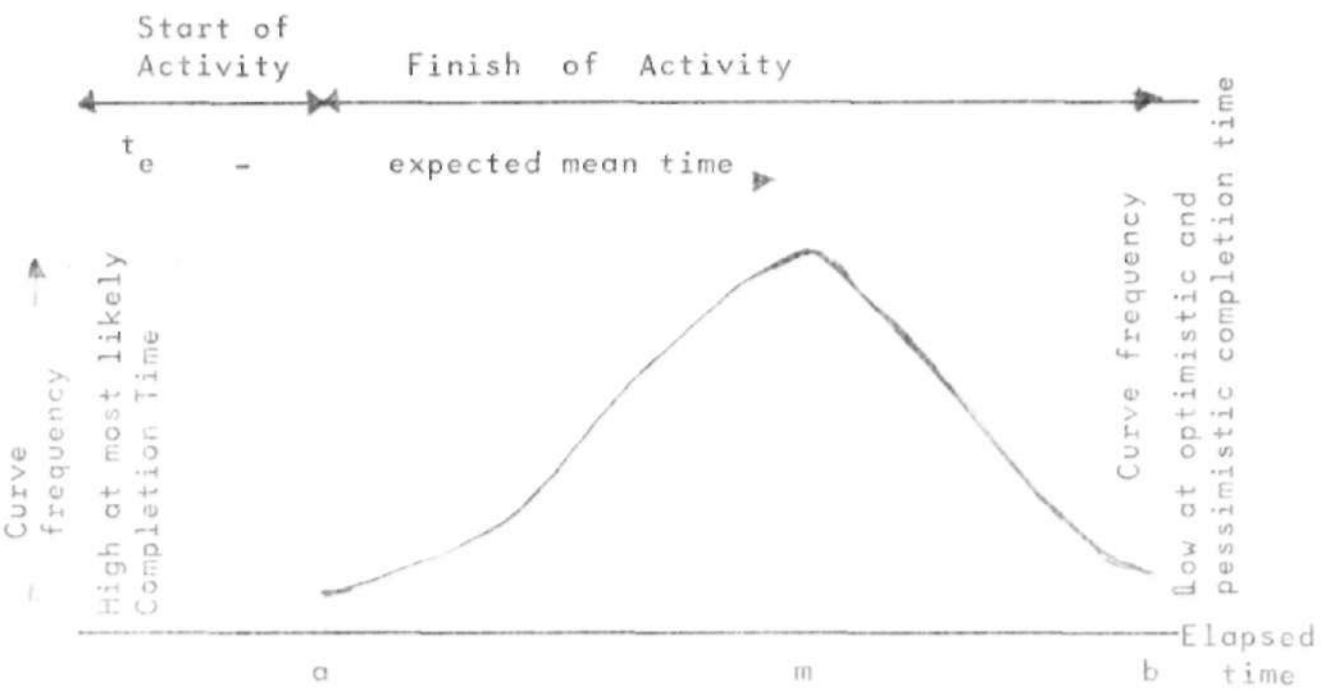


Fig. 4.2 Frequency distribution of estimated event times

Since the expected mean time t_e is statistically computed, an amount of uncertainty must be associated with it. The uncertainty is relative to the degree of variation between optimistic and pessimistic activity times. The wider the variation the larger the degree of uncertainty.

The expected variance of each or any particular activity is represented by the formula

$$\text{Activity variance } \sigma^2 = \frac{b - a}{6}$$

The variance is computed for each activity in the project and is used to determine the probability of meeting any management - scheduled event completion dates. The probability is calculated from

$$\text{Probability function for events (Z)} = \frac{\text{Scheduled event Time-Expected event tim}}{\sqrt{\left(\text{Sum of variances for activities used to calculate expected event time}\right)}}$$

The probability of meeting the scheduled time can be read off the statistical table for values of standard normal distribution function. This information can be used by management to evaluate costs incurred due to scheduled dates not being met and any other associated penalties as a result of late performance. The level of risk on a project is indicated by the probability of meeting the scheduled times - high level of risk if probability is low. In such a situation, the network plan or resources would have to be re-evaluated to produce a more acceptable solution.

However, CPM and PERT have developed such that there is, perhaps, only one basic difference which is the activity time estimate. In construction work, the computed expected mean

time t_e can be applied as a single activity time estimate.

As stated at the beginning of this section, the method of cost control used depends on the approach of estimating costs to be controlled. Two approoches of activity cost estimates are discussed.

1. Total break down of the project estimate
2. Computerized Cost Studies

4.2.2.1. Total breakdown of the project estimate

This approach is the quickest and most suitable for manual cost analysis. It involves the breaking down of the total estimated project cost into a number of work packages, which include all overhead and other indirect project costs. The work packages are extracted from the Bill of Quantities for the project. The cost of the work packages would equal to the total estimated cost of the project.

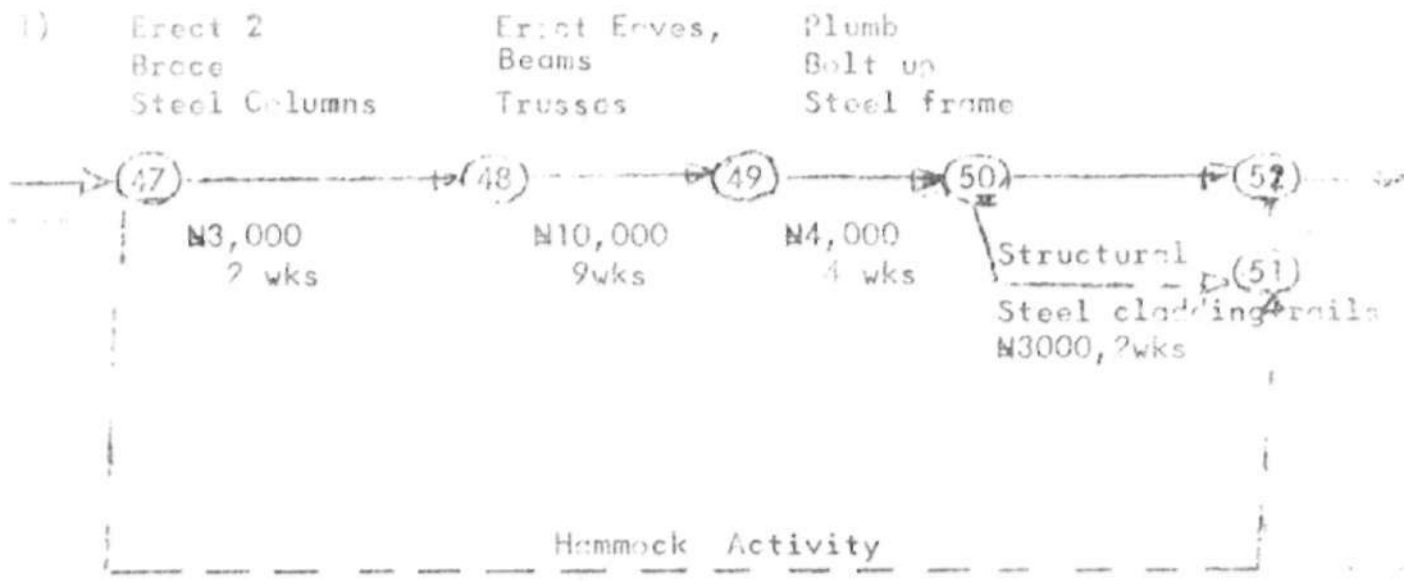
If it is possible, the work package cost is individually assigned to the group of activities that it represents. In network where the activities making up a work package cannot be easily individually cost estimated, they may be integrated as a package by means of a sling or hammock activity which is used solely to express costs and contains no other resources. If necessary, overheads can also be separately represented by hammock activities. In effect, each activity is allocated a share of the cost directly according to the relative time span. Often activities

making up a work package may be at various points throughout a network. Here the work package cost is broken down and allocated proportionately to the activities concerned usually on the basis of an approximate quantity and unit price. The sum of the individual cost of activities will then be equal to the work package cost.

For example, part of the network of a construction project is shown in Fig 4.3. The work package consists of structural steel which involves all steel frame activities spanning from event 47 to 51. The total estimated cost is ₦20,000 and the overhead cost of site engineer supervising the steel erection is ₦510.

4.2.2.2. Computerized Cost Studies

This is a more accurate and more detailed approach to activity cost estimate. The activity resources (Labour, Material, Plant) requirements are stated on the activity and a normal unit cost (per activity time period) is given along with threshold unit cost which is utilized only when threshold resources are required. The threshold cost represents the premium involved in applying threshold resources i.e. added overtime payments, loss of production efficiency etc. The applicability of this approach depends on the type of detail used in the estimate preparation.



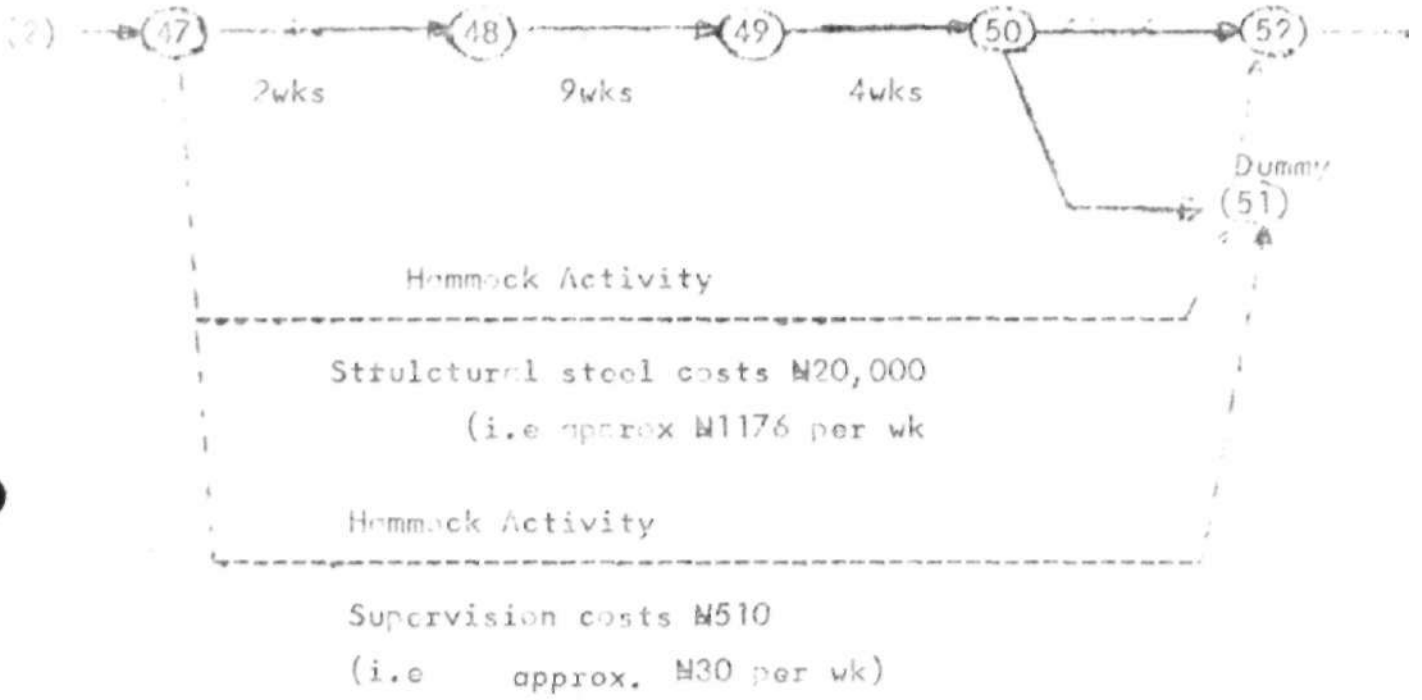


Fig 4. 3 - Example of work packages and hammock activity in activity cost estimate.

(1) Activites individually costed and hammock activity used for overhead cost

(2) Hammock activities used for both direct and overhead costs

4.2.2.2 Computerized Cost Studies

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These two approaches of activity cost estimates provide a good degree of cost control, the first approach is quite suitable when resource analysis is not contemplated and the latter where both resource allocation and costs are being studied. The cashflow prediction can also be compiled either manually or by computer. If manual approach is adopted the network diagram is drawn to a time scale and the planned cost is applied to activities and hammock activities as well. Cost is expressed in units of the particular time period adopted e.g. Activity 1 - ₦30 per week, Activity 2 - ₦45 per week etc. Both the early and late start time- scaled diagrams are used to develop the planned cost curves for the project (Fig. 4.4).

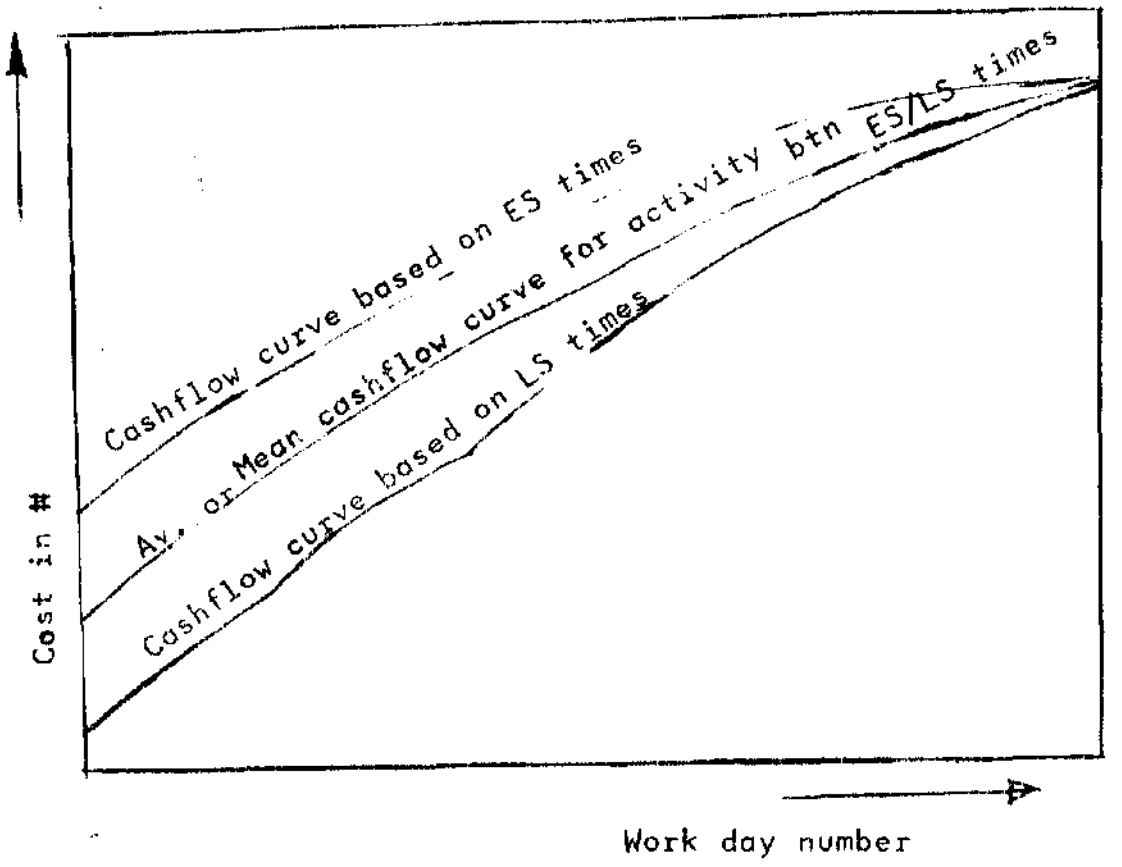


Fig. 4.4. Composite graph of anticipated cashflow.

Source: W.R. Martin, Network Planning for Building Construction (

It is highly essential that cost control element of a project functions dynamically. As a project gets under way, this is achieved by comparing actual reported costs to date with the planned expenditures. From this information, the future outlook is predicted, based upon the difference between original planned expenditure and actual performance to date. Financial reports and prediction (reviewing) can be numerically presented either manually or by computer.

4.2.3 Quantitative System

As mentioned several times in this presentation, the cost of a project can be controlled by directly controlling the costs of construction resources and other associated costs e.g. overheads. Control of costs, as discussed before, is among other things, the achievments of planned or estimated costs. So to be able to do this effectively, the estimate must be correct and attainable. In order to arrive at accurate and adequate estimates, quantitative technique which is one of the tools of management in the control of any business undertaking can be considered when setting up the function of cost control. Statistical and linear programming techniques are very useful for the purpose of forecasting and controlling.

For the purpose of this research, statistical technique of index numbering and transportation method of linear programming will be considered for use in Construction Industry. This presentation will not attempt to go into details of these techniques. If more information is required the reader is referred to the References at the back.

4.2.3.1 Index Numbers

Index numbers are a means by which the related movements of statistical variables can be estimated. This system is

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4.2.3.1 Index Numbers

Index numbers are a means by which the related movements of statistical variables can be estimated. This system is

particularly useful where it would be difficult to measure actual movements and provide in a single term an indication of variation against time of a group of related values. The index numbers indicate the trend.

The variability of cost of materials from year to year can be arrived at by compiling index numbers for the costs of all materials for each year and comparing them with some base year. Compilation of the index numbers is done by ascertaining the year and the relative importance of each of these materials (weight) in the construction work. The index for the base year is given the value of 100 and a table is constructed to find the index number for the next year. By building up these index numbers over a period of years, it is possible to work out the trends in the cost of materials used and thus to forecast the possible cost at some point. These forecasts should be tempered with the statistician's or manager's experience. The table below show the computation of index number (see next page).

This process is repeated for each year so as to build up a list of index numbers.

4.2.3.2. Transportation Method

In construction industry, big companies handling civil engineering projects have quite a number of branch offices and workshops where plants are maintained and stored,

Base year + 1

e.g. 1984 + 1 = 1985

Material	Percentage rise in price over base year	Weight	Producer (Weight x % rise)
A	5	25	125
B	17	14	238
C	13	10	130
D	20	12	240
E.	11	8	88
F	9	5	45
G	10	20	200
		94	1066

Therefore the increase = $\frac{1066}{94}$ = 11%

Hence the index number for year: x + 1 = 100 + 11 = 111

Source: R.Oxley and J. Poskit, Management Techniques as applied to construction industry.

scattered all over the country in which they operate. Since a company might be handling several projects at a time at different locations, economical transportation of these plants to the various locations is imminent. Plants consume quite a percentage of the project cost, hence particular attention has to be paid to the factors contributing to the costs of plants such as transportation, maintenance etc.

The transportation method is a search and evaluation process of allocating required plants and even materials at

different workshops and warehouse to the various sites in the most economical manner. The process of this allocation involves five steps as shown in Fig. 4.4.

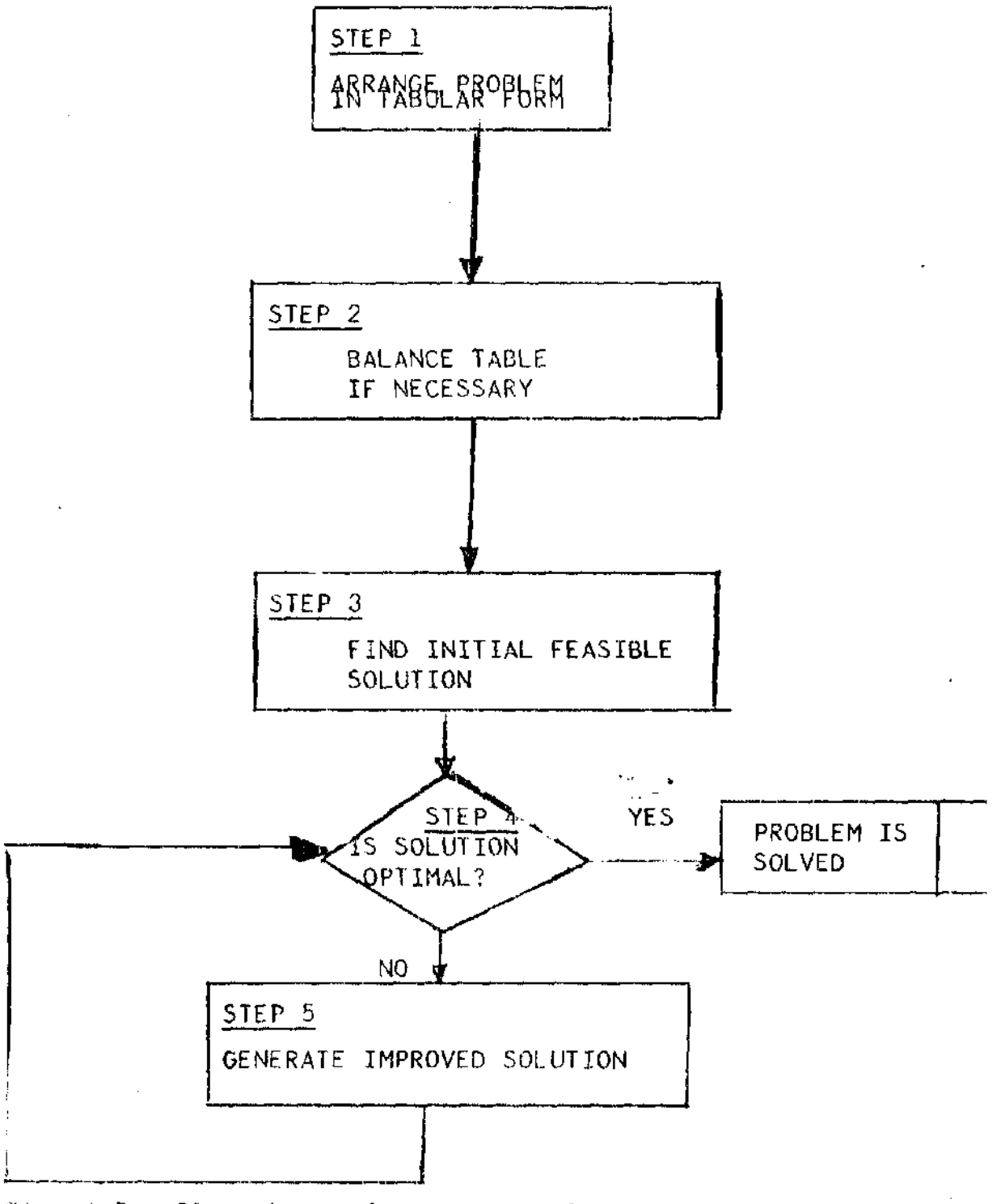


Fig. 4.5. Flow-chart of steps in solving transportation problem.

4.3 HUMAN ASPECTS OF COST CONTROL

This section deals with the human aspect of the cost control systems. It is an undisputed fact that management at whatever level achieve objectives through human beings with the help of inanimate resources like machines, materials and so on. To do a good job, the labourers must use the machines and materials skillfully. And so it is with any control systems; they must be administered astutely to obtain management objectives in an optimal fashion.

In many cases of inefficient systems, the technical aspects of the system are not to blame. The weaknesses are inept administration, neglet of communication, ignorance of motivational impact of the system and probably, most important, lack of active top-management support. Unless management at all levels participate in setting standards and the top management uses the feedback reports as well as consider subordinates' views when making decisions, the likelihood is remote that the subordinates will view the system as a key to their success.

The importance of these human aspect cannot be over emphasized. In preparing budget estimate, the project manager who will be responsible for implementing and attaining the result should be involved and his approval of the final budget estimate is quite necessary. Apart from him, the supervisors and foremen will be responsible for

different sections of the Budget should be consulted when drafting the budget for their various sections. For the generality of the labour force, incentive schemes should be considered. The incentives could be monetary or non-monetary. Each employer has to study what kind of incentives can motivate his employees and as such use them for increased productivity.

Though out of content, it is considered worthwhile to mention that preventive maintenance should be carried out on machines and tools periodically so as to avoid breakdown and hence unproductive standing time.

4.4 RESUMÉ OF THE CHAPTER

The systems of cost control of construction projects employed by the three construction companies investigated are analysed and found to be too simple without much technical touch-ups. Weighing all the possible reason for this, it is identified that actually the problem of construction costs does not lie first with lack of control of costs but with high costs of construction projects.

The chapter goes on to review systems of cost control, which are technical as well as being simple, that can be employed in construction industry, if the problem of high costs of projects in Nigeria is solved. The role that the goodwill and co-operation of the employees and workers can play in making a system effective is also discussed.

The next chapter contains a proposal of cost control system that can be very useful to construction industry in Nigeria.

CHAPTER FIVE

PROPOSAL OF SYSTEM OF COST CONTROL

Having discussed various systems of cost control that can be usefully employed in construction industry in the last chapter, in this chapter an attempt is made to propose a system of cost control that can be particularly effective in the Nigerian situation. Because of variability and escalation of prices, a dynamic system is very essential to be able to control costs of project effectively. And to be able to communicate information with respect to work and cost progress to management at various levels, the system has to be simple and easily understandable. The basic idea of the cost control system to be proposed is obtained from the book written by O Brien and Zilly (1971), adjustments and adaptations are made to make the system suitable for Nigerian construction industry. The system is:-

1. mainly for cost control at construction stage. That is to say it can be employed by both the contractors, the clients and consultants.
2. for capital-intensive investment
3. for medium and large size construction projects with a large number of activities.

The system might require the use of electronic computers. The objectives of the system are mainly:-

a. Control and management of construction costs of project

b. Forecasting of finan al outcome (Profit or Loss) of the project.

c. Projecting accurate time and cashflow requirements.

In addition, there are ancilliary objectives which are:-

e. Collection of data in relation to exact cost price calculations of sections of the project i.e extra works, comparison of prices from third parties etc.

f. Also, collection of data for taxation declarations.

5.1 PRE-REQUISITES OF THE SYSTEM

Before the system to be proposed can be used, the following pre-requisites have to be fulfilled.

These are:-

i. Project definition by work breakdown structure (WBS)

ii Work package identification by cost-coding system

iii Network model by critical path method

5. 1. 1 Work Breakdown Structure

This structure is a means of project definition which aids in the process of cost control. For easy control of a

project's cost and progress, the work should be broken down into small manageable elements or groups. These elements can then be quantified in terms of time and cost.

The work breakdown structure can be formulated on whatever basis suits the purposes and organization for which it is intended. In some instance, a further breakdown may be created by using sub-elements or sub-groups. However, the following points should be borne in mind when breaking down work into component parts:-

i. The structure should be compatible both cost and progress monitoring.

ii. The smallest unit of cost should be set at a lower limit (say ₦10,000) or not less than 1% of the project cost. Any item with cost below this amount should be conglomerated to make a sum higher than the lower limit. This helps keep down the number of work packages and hence the time required for monitoring and controlling

iii. Work packages should summarize work elements in logical categories.

5.1.2 Cost-coding system

For estimating and cost-control purposes, the components of the work breakdown structure are tied to a cost code system. A coding system is used on a project for various reasons, among which are to guarantee fast and efficient administrative

procedures, to enable all costs to be allocated to sections or items to which they are applicable in such a manner as to be easily traceable later, and to provide, early in the inquiry and order stage, a simple means of identification and allocation of materials etc.

The coding system ought to be set up as simple as possible. It must be flexible and must be able to fulfil the control requirements in the simplest manner possible. It is apparent, also the nature and type of work will play a role in the choice of a coding system. For illustration, simplified coding systems are drawn up:-

A. Coding system for large projects

Main Group Identification

6.1 General Overhead

6.2 Mobilization

6.3 Production

6.4 Non-productive (Stores, Offices, Camps)

6.5 Demobilization

Note: The figure 6 identifies the contract costs as a fixed number in the chart of accounts

Sub-group classification

1x Headoffice

2x Charge (Insurance, bonds)

3x Prefab yard (Block yard)

4x Batching plant

5x Quay wall

6x Break water

7x Quarry

8x Plant

9x Site Office

0x Camps

Cost types

01 Salaries and related charges

02 Wages and related charges

03 Tempuraty materials

04 Permanent materials

05 Depreciation

06 Spate parts

"

"

etc

An example of coding

6.3.xx. xx Production

6.3.30. xx Blockyard

6.3.30. 02 Wages

B. Coding system for small project

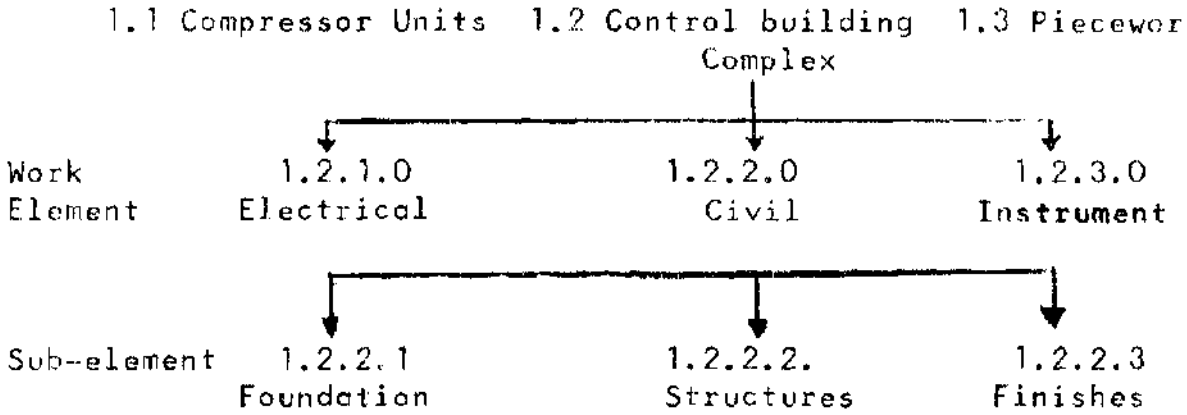
6.1.0 Wages Sub-total

6.1.1 Productive hrs

6.1.5	<u>Salaries</u>	Sub-total
6.1.6	Expatriate Staff	
6.1.7	Local staff	
"		
"		
6.2.0	<u>Equipment</u>	Sub-total
6.2.1	Own equipment	
6.2.2.	Hired equipment	
6.2.3	Small tools	
"		
"		
6.3.0	Materials	Sub-total
6.3.1	Concrete	
6.3.2	Steel	
6.3.3	Wood	
"		
"		
6.4.0	Sub contractors	Sub-total
6.4.1	Steel work sub-contractor	
6.4.2	Excavation sub-contractor	
6.4.3	Services, design costs	
"		
"		
"		

C. Coding system for a process plant construction project

Work Package



In Nigeria, cross-coding must be avoided in view of many errors that can be made and the incorrect conclusions that can be derived from these.

5.1.3 Network Model

After breaking down the project into work packages or activities and a coding system is established the activities can been be scheduled by arrow network which depicts the time requirements diagramatically. Each component activity is described and identified by its i-j pair of node numbers. The network of interconnecting arrows indicates the interrelationship among activities in accordance with CPM graphic rules. The i-j node pair indentification system forms the basis upon which the cost system to be proposed will be structured.

5.2. THE TIME-COST SYSTEM

The proposed cost control system is termed the Time-cost

system. This system provides an excellent basis for a simple, yet dynamic system for scheduling cashflow and monitoring control of direct costs of resources (labour, materials and plant) for construction projects. The nature of the system is as shown diagramatically on Fig. 5.1

A. The system is used first by breaking down the project into activities which can be depitcted diagramatically by means of arrow network. Fig. 5.2 is an example of part of network diagram of a hypothetical project.

B & C Quantity survey and Cost Estimating.

The cost of individual activities will next be estimated, requiring that the detailed survey of items for which component costs (labour, materials, equipment, overhead costs) are to be computed be listed according to their i-j node number pairs of appropriate activities. It is necessary that a cost-code system be used that is compatible with the entire time-cost system. Table 5.1 shows how the cost estimate are summarized. Grouping of similar cost items required by each activity is made by cost-code, cost estimates are determined by applying appropriate unit.

The sub-totals for estimated costs within each cost-code are shown in the last row. These amounts are called the 'Budget for corresponding cost-code groupings'. The column at the far right of the table contains CPM activity sub-total

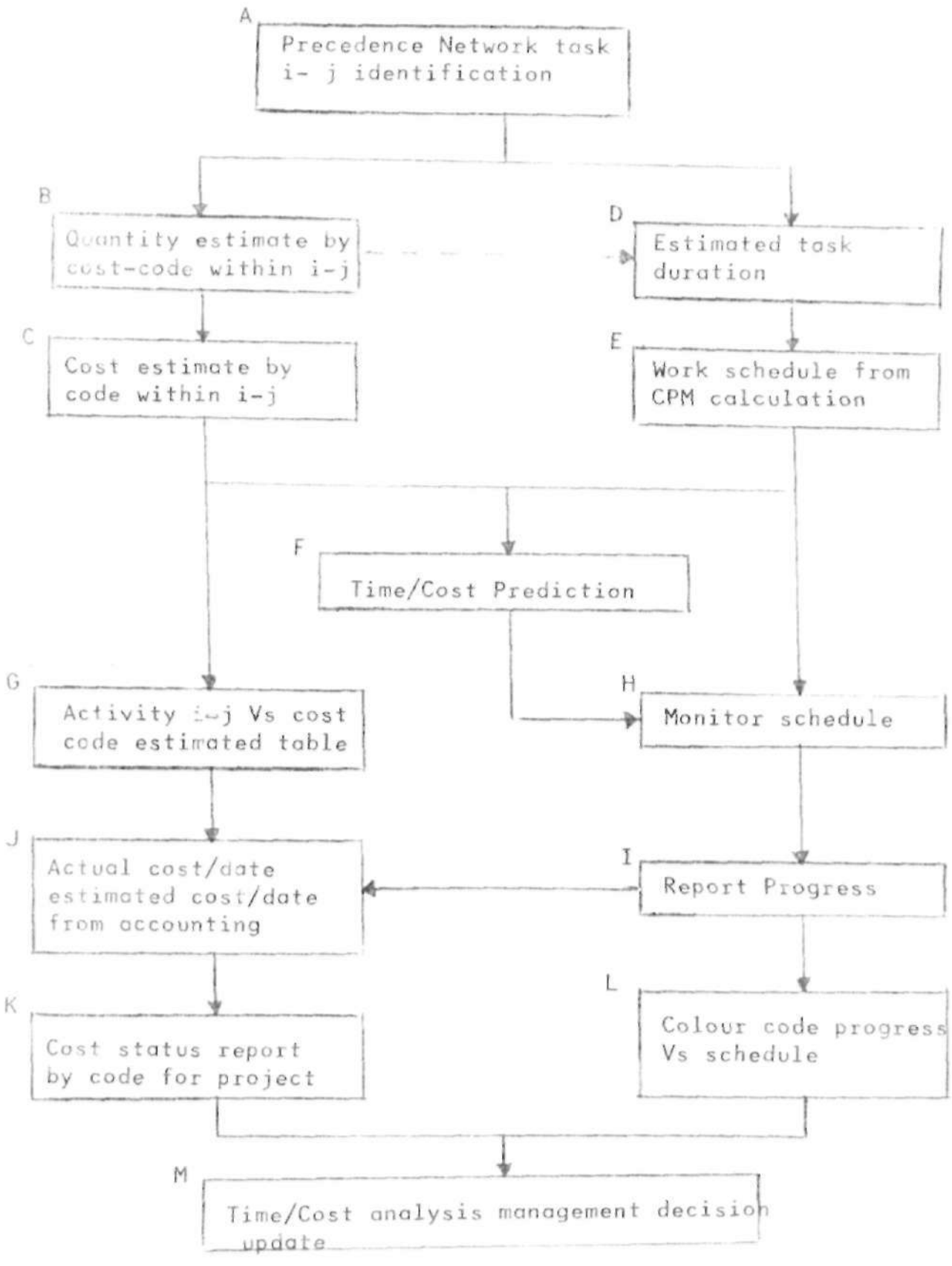


Fig. 5.1 Flowchart showing the nature of Time-cost system

Source: J.J. O'Brien and R.G. Zilly, Contract's Management Handbook, (New York Mc-Graw Hill Company Inc. 1971) P. 7-22

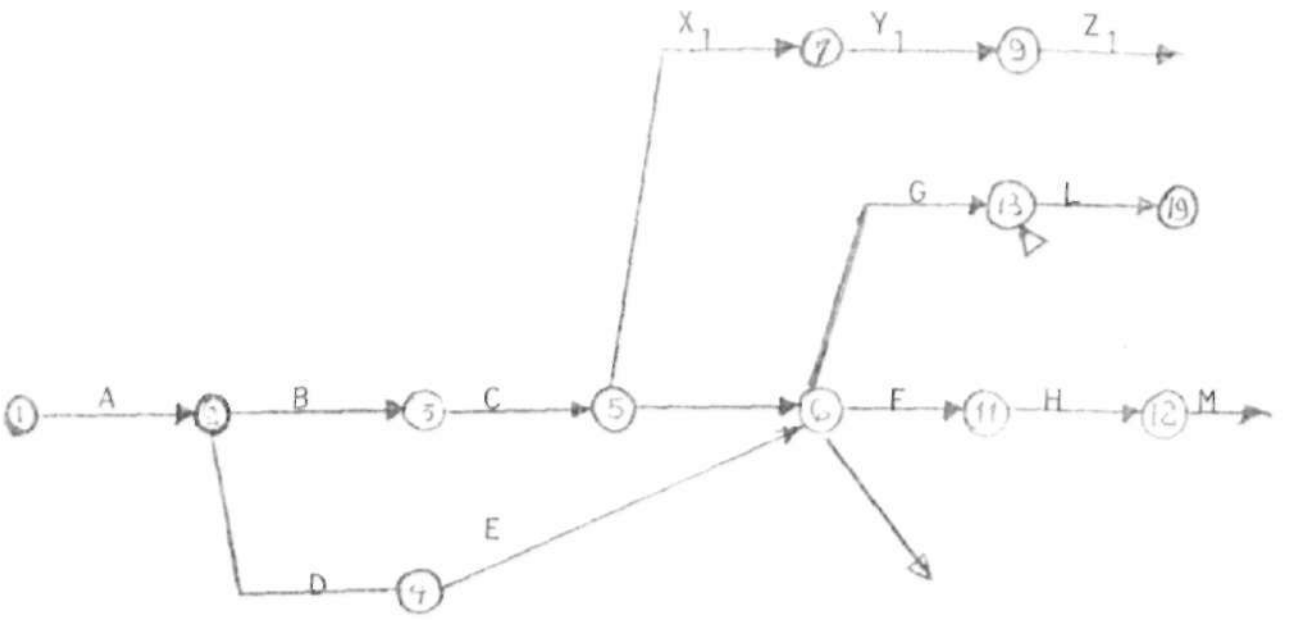


Fig. 5.2 Part of a network of a hypothetical project.

costs. The last row of the right hand column contains the total estimated cost for the entire project. This is the project budget.

D&E Time-duration estimate and CPM time calculations.

The detail of calculating the time estimates and the technically of the CPM calculations are not within the scope of this presentation. However, by inspection the latest starting (LS) and the earliest finishing (EF) times for each activity may be found.

The earlier starting times are related to calender dates with completing dates equivalent to earliest finish times.

In actual application, resources might need to be levelled to meet the constructions that might have been imposed by management, money, time e.t.c. In this situation, advantage of float time might need to be taken.

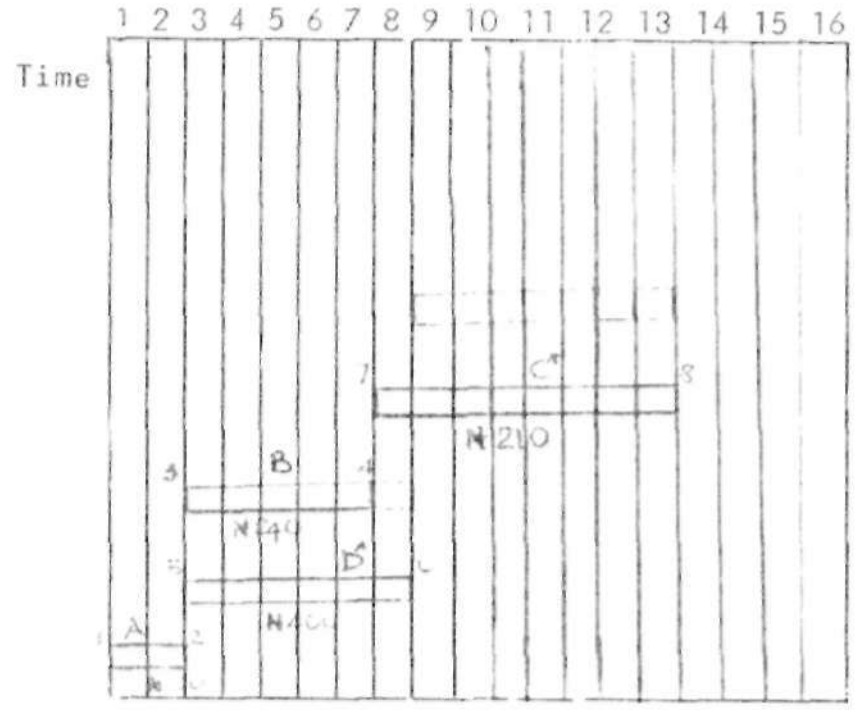
F. Time-cost prediction.

The common activity number i-j for both time and cost provides very simple exact means of predicating cashflow requirements of the project. A convenient, simple and understandable method of time-cost analysis is by the use of bar charts (fig. 5.3).

i-j	Activity Description	Cost by cost-code within task (activity) 6.1.1	6.1.6	6.3.0	6.4.1	6.4.2	Total Cost
1-2	A	x			x		xxx
2-3	B						
3-2	C					x	xxx
2-4	D						
4-6	E	x			x	x	xxx
⋮							
⋮							
Total		xx			xx	xx	xxx

Table 5.1 SUMMARY OF COST ESTIMATES

Source: Ibid P. 7-25



* Critical Activities

Fig. 5.3 Analog bar chart for cashflow analysis

In the diagram above, the length of each bar represents the duration of each activity, starting at the earliest starting time (BS) and finishing at the earliest finishing time (EF). The cost per each activity as estimated earlier is presented under the corresponding bar for each activity. The cost of each activity per working day is computed by dividing each estimated cost by the duration time for each activity. Then the cost per working day for the project is found by adding vertically all costs per activity per day for all bar portions which are scheduled at that time. Table 5.2 will be useful for recording the cashflow forecasts.

An accumulated estimated-cost-to date prediction may

then be found by continuous summation of costs per day in a left to right direction. The final figure computed would be the project budget. The results may be represented in the form of the traditional cost ogive (Fig. 5.4).

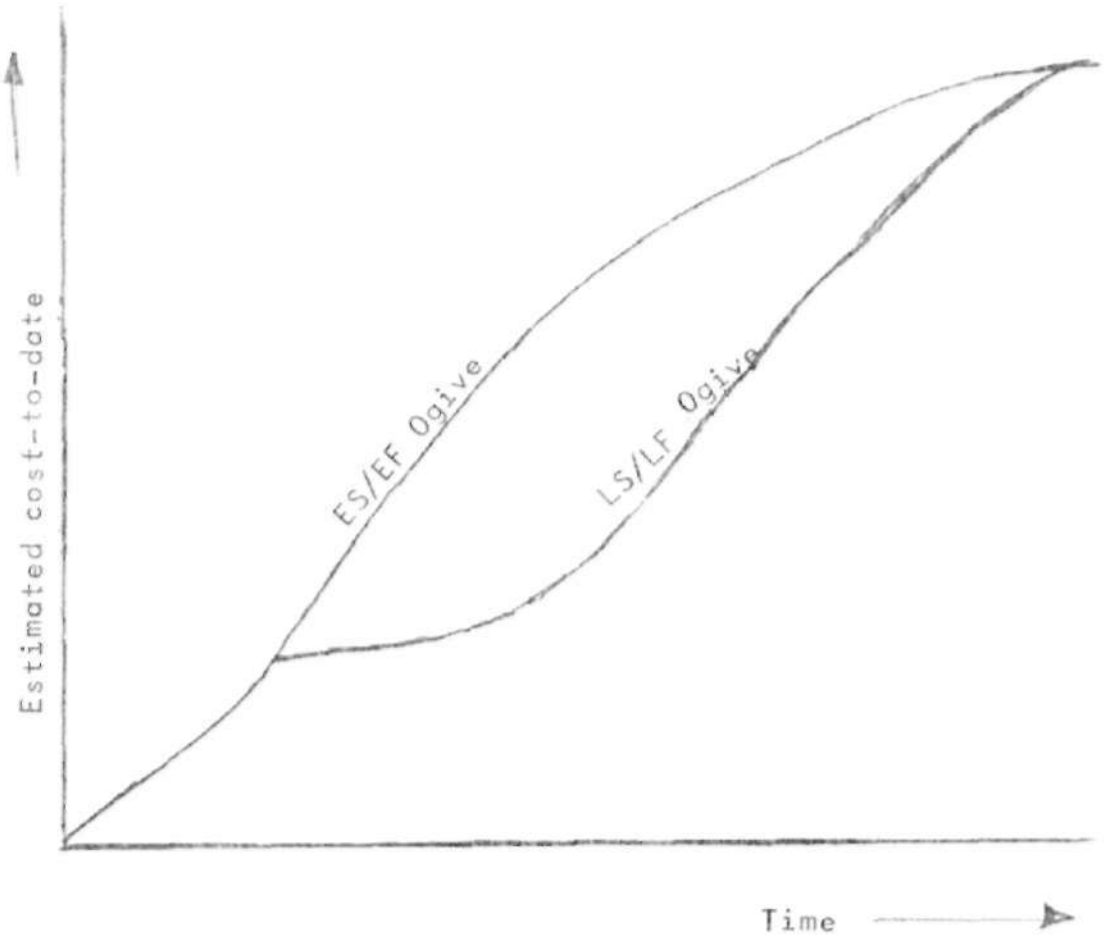


Fig. 5.4 Cash flow Vs time ogive

The ES/EF curve corresponds to the schedule given in the bar chart and the LS/LF ogive represents the case where all the tasks will be scheduled at the other extremes of the time limit. In a situation where the resource have been levelled

CASHFLOW FORECAST

Project No

Issue date

1st	Mar 1st	Apr 1st	May 1st	June 1st	Aug 1st	Oct 1st	Dec 1st

1st	Jun 1st	Aug 1st	Oct 1st	Dec 1st	Feb 1st	Apr 1st	Jun 1st

ıe period
ıat two months

as desired, the cost prediction will lie somewhere between the two extremes.

These same results can also be obtained directly from tabulated time and cost date. The many uses of type of analysis for both planning and monitoring of the economics of the project are obvious.

Having gone so far in the flow-chart for time-cost system the foundation of the system is complete. The actual process of cost control will now proceed.

G. i-j Vs Cost Matrix

The components of estimated cost by cost-code breakdown given in table 5.1 referenced to particular activities i-j. The same activities i-j are used in CPM-based schedule of time. Thus the i-j designation becomes a common denominator for both sub-systems, allowing direct inter-relation of time and cost.

As activity i-j complete reports are made, the appropriate cost components by cost-code groupings are extracted from Table 5.1. The dimensions of time and activity description are lost in the matrix since cost indexes involve cost values.

H Monitor schedule

In order to set up a reasonable schedule of monitoring the progress and cost expenditures for any project, the nature of the work and the financing alternatives involved have to be

known. It is necessary to prespecify monitor period and schedule definite times at which cost and progress date would be gathered and reported regularly.

i. Progress reporting

Reporting of progress for the time-cost system involves the provision of two kinds of information which are necessary as input to the system in order to produce a cost-status report.

The 2 kinds of information are:-

(1) The i-j designations for activities in progress during the monitor period and percent of completion for each

(2) The actual costs to date incurred during the monitor period from accounting records.

The 1st kind of information is not difficult to gather since progress is being monitored continually on the CPM network plan. The monitoring can be done by some means of "Colour Coding". A scheme of marking the diagram and indicating exactly where the last progress report was made is required. The degree of accuracy for determining percent complete (fractional portions of activity) should be realistic i.e. a practical breakdown should apply.

The second kind of information required must relate only to project work, materials or whatever category is being

monitored, which are actually commited to the project. The actual costs incurred should be the actual costs committed (in place) to the project for the report period. These amounts must be reported by cost-code grouping.

J Actual and Estimated costs to date

As discussed above, the actual costs to date records by cost-code designation are input from accounting directly. Thus at any monitor time, the accrued total costs to date within each cost code are available and the sum of all cost-code amounts is also available for calculating total project cost status.

The estimated costs to date are determined. Table 5.1. When an activity i-j is reported partially or totally complete, the costs of the percent complete by cost-code breakdown are computed from the estimated costs in the table corresponding to the i-j row of the activity. By so doing, the estimated costs to date are accrued within cost-code groups (and in total for the project as a whole).

These data are input into the cost-status computation sub-system, block K of the flow chart.

K Cost-Status reporting

Having obtained date of estimated costs to date and actual costs to date, then the various cost-analysis

indexes can be calculated. The system requires that both estimated and actual costs to date be cumulative. At this point, the i-j reference can be dropped. In most applications, cost control within cost-code categories is adequate. Cost control for the entire project is in effect the integral analysis of cost-code component considerations.

As mentioned earlier, the totals within cost-code categories from the cost matrix of original cost estimates represent the Budgets within cost codes.

For each of the cost-code categories, and/or for the project as a whole, the following indexes may be found directly.

$$\text{Percent complete by cost (P)} = \frac{\text{Estimated Cost to Date (ECD)}}{\text{Budget (B)}} 100\%$$

$$\text{Deviation or ratio of actual to estimated costs (D)} = \frac{\text{Actual Costs to Date (ACD)}}{\text{Estimated Costs to Date (ECD)}}$$

Profit or loss to date (g/l) = ECD - ACD

where profit (g) is positive and loss (l) is negative.

Predictive indexes

Revised cost to complete R = D (B-ECD)

Revised cost estimate (B revised) = D x B

$$\text{Profit or loss at completion G/L} = \frac{g/l}{P}$$

As mentioned above, any of these indexes may be computed for each cost-code category individually or for

the entire project. Application as in table 5.3 for hypothetical example.

L Progress Vs schedule

This is the function of monitoring actual project progress on the network-plan schedule usually be means of colour coding in a way augmented by dated notations on the diagram. By monitoring progress, the activities which are on time or ahead or behind schedule can then be determined. As mentioned before, the physical progress situation and the cost status of a project are two different sub-systems with the use i-j designations being the only link between them. And this link is dropped after serving the purpose of data communication. It is possible that a project could be on time but in trouble financially or actual costs could be right on estimated target but the work not on schedule.

M Time-Cost Analysis

Before making decisions regarding updating and revising the working schedule and cost prediction for a project, it is very necessary that the progress, reports and the cost-status reports be considered. Action taken to change either time or cost plan will definitely affect both of them. Hence, it is necessary to find the best solution which involves trade-off concessions from optimum cost or time considerations for the optimization of the time-cost system as a whole.

Table 5.0 Cost Status (on Labour, for example) Project Monitor on a particular day

Activities in Progress			Estimated costs by cost code							Projec
i-j	Description	%Completed	0201	0354	0602	1366	1597	1615	.....	Status
1-2	A	100	50	---	20	30	---	---		
2-3	B	100	40	100	100	--	---	---		
3-5	C	100	110	----	----	--	----	100		1450
2-4	D	100	---	40	---	----	300	60		
4-	E	100	---	100	40	----	---	----		
4-10	F	30	120	---	----	---	40	40		
5-7	X	70	35	---	105	----	---	----		

	Cost Code						
Cost Indexes	0201	0354	0602	1366	1597	1615	Proje
Budget	510	1310	1930	390	1110	930	6,040
Estimated cost to date(Cum)	355	260	265	30	340	200	1,450
Actual cost to date (cum)	380	290	410	30	380	300	1,790
% complete (cost base)	70	20	14	8	30	20	18
Deviation	1.07	1.11	1.55	1.00	1.12	1.50	1.23
Gain-loss to date	-25	-30	-145	0	-40	-100	-340
Revised cost to complete	167	1165	2,580	360	960	1170	9830
Revised estimate budget	545	1450	2990	390	1,240	1470	11900
Projected gain or loss	-35	-150	-1,060	0	-130	-500	-2,15

There are various time-cost trade-off methods but it is beyond the scope of this presentation them.

5.3 RESUME OF THE CHAPTER

So far, a dynamic system of cost control has been proposed. This system can be employed by both contractors and clients (and consultants) alike for monitoring and controlling of project costs, preparing of annual budget and cashflow projections among other objectives. It is highly opined that this system of cost control will have tremendous impact on the construction industry in Nigeria if an when the exhorbitant costs of capital projects are cut down.

The need for use of computer for processing the time cost analysis cannot be overemphasized especially for large projects. The speed, accuracy and economy of computer utilization are definite advantages over manual methods.

The next chapter contains a summary of the presentation, conclusions and suggestions on ways and means of improving the poor situation of the construction industry with regards to costs. Possible areas of further research are also highlighted.

CHAPTER SIX

SUMMARY: CONCLUSIONS AND RECOMMENDATIONS

This chapter is the last chapter of the presentation and is made up of four sections viz:-

1. Summary
2. Recommendations
3. Conclusions
4. Possible areas of further research

6.1 SUMMARY

The investigation of cost control systems in use in a sample of three construction companies handling capital projects in Nigeria revealed that the systems in use are not highly technical rather they are very simple. The logical reason that can be deduced for this simplicity is that most of the factors that can affect the costs of the projects have been made allowances for in the tender estimates. Hence, no serious, highly technical systems of cost control that will cost money are required. Cost control or no cost control, the profit margins of the companies are well insulated from deviation.

This revelation makes this presentation to be a means to the end and not an end in itself. The consequent effect of making allowances for factors that can affect costs of projects is escaloted costs of construction projects. So, the first

bone to be cracked is the reduction of high costs of construction projects. If this is successfully done, then, the contractors' profit margins are exposed to deviation, then technical, effective and efficient systems of cost control will be essential.

Three systems of cost control that can be employed in construction industry are reviewed and the "Time-cost system" is proposed for the construction industry in Nigeria. This system of cost control is simple, dynamic and effective and will be very useful to both the clients and the contractors in Nigeria. The system is strongly believed to be applicable in Nigeria if extra efforts are exerted.

6.2 CONCLUSION

It is well known that profit motive is the primary objective of most firms in a capitalistic and even mixed economy and is the basis for the continuous operation of an enterprise. Suffice it to say that this objective should not be attained by strangling the clients with high costs of construction projects but rather by quoting reasonable costs with comfortable margin of profits coupled with effective and efficient control of costs.

Considering the state of economy of the country, it is highly essential that project cost reduction exercise be embarked upon as soon as possible. Cost control will then

be the ultimate determinant of success or failure in a project. It can be achieved by sustained effort through all stages of construction process. Generally speaking, earlier efforts of cost control give greater rewards. Successful and effective cost control cannot be achieved without good project management and in particular, good planning.

From all indications, socio-political influence on construction industry in Nigeria has not been very favourable to the industry. It has created more problems for the industry than any other factor. In addition, there are various clauses in the contract conditions that give room for manipulations and abuse.

Clients' ineffective participation and non-chalant attitudes have gone a long way in landing the industry in the mess it finds itself today. It is hoped that with more efforts exerted by the clients, the industry's performance will consequently improve considerably.

The consultants, through non-compliance with the ethics of the profession contribute their quota to the problems facing the industry today.

Finally, the human beings involved in the control system should be taken into consideration while establishing the system. There are various incentive schemes that can be

used as motivating factors for the workers so as to win their goodwill and co-operation.

In conclusion, every individual in the construction industry should come together under the spirit of the War Against Indiscipline (W.A.I) to bring sanity into the construction industry.

6.3 RECOMMENDATIONS

As observed earlier, the problems relating to the costs of construction projects are in two parts. One is the problem of cost reduction and the other is that of cost control. Hence the recommendations are sub-divided into two parts. The implementation of these recommendations will definitely bring about positive changes to the reputation of the construction industry and will restore the much eroded public confidence in the affairs of the industry.

6.3.1 Recommendations on cost reduction

The following are identified as some of the factors affecting costs of construction projects in Nigeria:-

1. Estimating method
2. Corrupt practices
3. Certain clauses in the contract conditions
4. Lapses from the client especially Governmental institutions
5. Lapses from the consultants

6.3.1.1 Estimating method

As revealed in chapter three, the constituent items of the tender estimate vary from company to company and the estimate is excessively loaded with exaggerated allowances. It is recommended that there should be a generally acceptable method of estimating costs. The Government, in collaboration with relevant professional bodies, can decide on the constituent items that should make up the tender estimate.

6.3.1.2 Corrupt Practices

A lot has been done by the present Military Government to reduce the influence of corruption in contract management. But this is a very difficult task bearing in mind the casual socio-economic context of corruption in almost all facets of life in Nigeria.

More efforts should be made to block all the loopholes that are susceptible to corrupt practices in contract management.

6.3.1.3 Clauses in contract conditions

There are certain clauses in the contract conditions which are being misused by the contractors. With the help of unscrupulour parties to contracts, the noble objective of contract conditions is being abused by way of claims despite the allowances that have been made for these claims in the tender estimate. Some of the clauses that are prone to claims are:-

i. Variation clause

ii. Fluctuation clause

iii. Delay clause

iv. Loss and expense clause

It is impossible to eliminate these clauses but it is possible to prevent the factors that give rise to the claims by identifying them on time and correcting them promptly throughout the period of the construction. This calls for effective participation by both clients and consultants.

6.3.1.4 Lapses from client

The clients, especially Government establishments should be more involved in the design as well as the construction stages of the project. Proper supervision and frequent monitoring of construction projects will go a long way in reducing costs of capital projects in that client will, along with the contractor, identify the factors that will lead to claims and correct them promptly. Also the clients should, by all means, meet their obligations and commitments as stated in the contract conditions promptly. In addition, it is recommended that Government establishments should start considering external sources of financing construction projects. The sources of finance that are available are Mortgage Bank, Commercial Banks and National Provident Fund.

It is highly essential that time value of money be considered in any cost reduction exercise.

6.3.1.5 Lapses fron consultants

Design consultants should endeavour to undertake thorough and detailed study of the client needs during the planning stage. They should also try to substitute the high use of imported materials by locally available materials, for as long as most construction materials are imported so shall the costs of construction projects remain high. The consultants should also try to give more protection to the interest of their clients, and not to be overly lenient and patronizing to the contractors.

6.3.2 Recommendations on cost control

Sooner or later, more effective control of cost of projects will be essential. Hence, the following recommendations are tendered:-

1. There should be massive training of cost engineers. As of now, no University in Nigeria is running a course on Cost Engineering.
2. The clients should involve themselves, right from the concept stage, in the control of costs of the project. The involvement is

more critical at the construction stage so as to be able to identity factors that can increase costs and eliminate them, to be able to project the cash-flow requirements and to be able to give better assessment of claims submitted by contractors.

3. In this climate of high inflation and possibility of construction delays, it is highly recommended that a price variation clause be adopted which will lessen the risk for both contractor and the client. It is highly desirable that post-contract inflation is calculated on an agreed inflation formula rather than relying on continual assessment of invoice differentials.

6.4 AREAS OF FURTHER RESEARCH

The following are possible areas of further research:-

1. Use of local construction materials as alternative to imported materials.
2. Minimization of loopholes in the contract conditions.
3. Cost reduction of construction projects.

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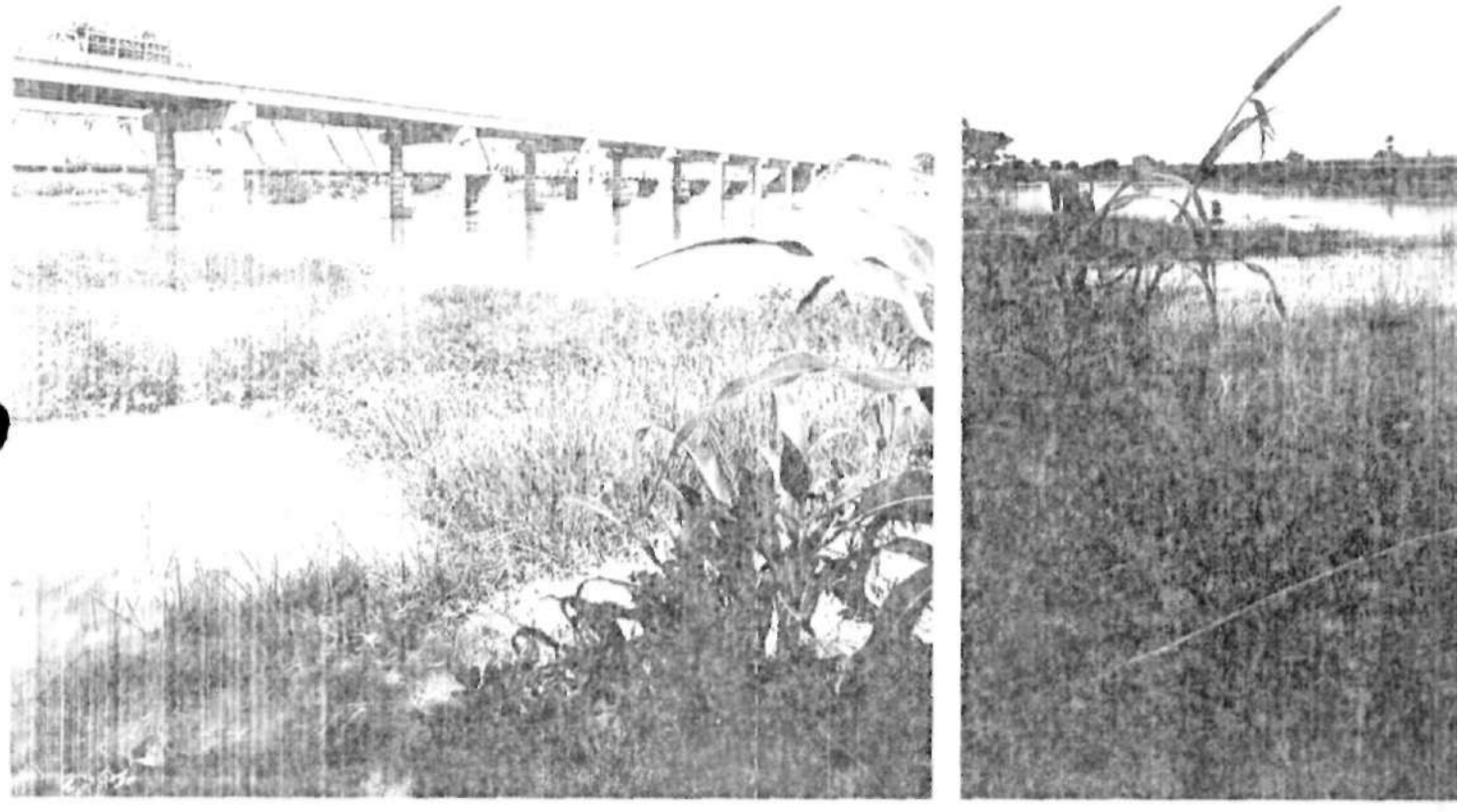
Appendix A

Major bridge construction

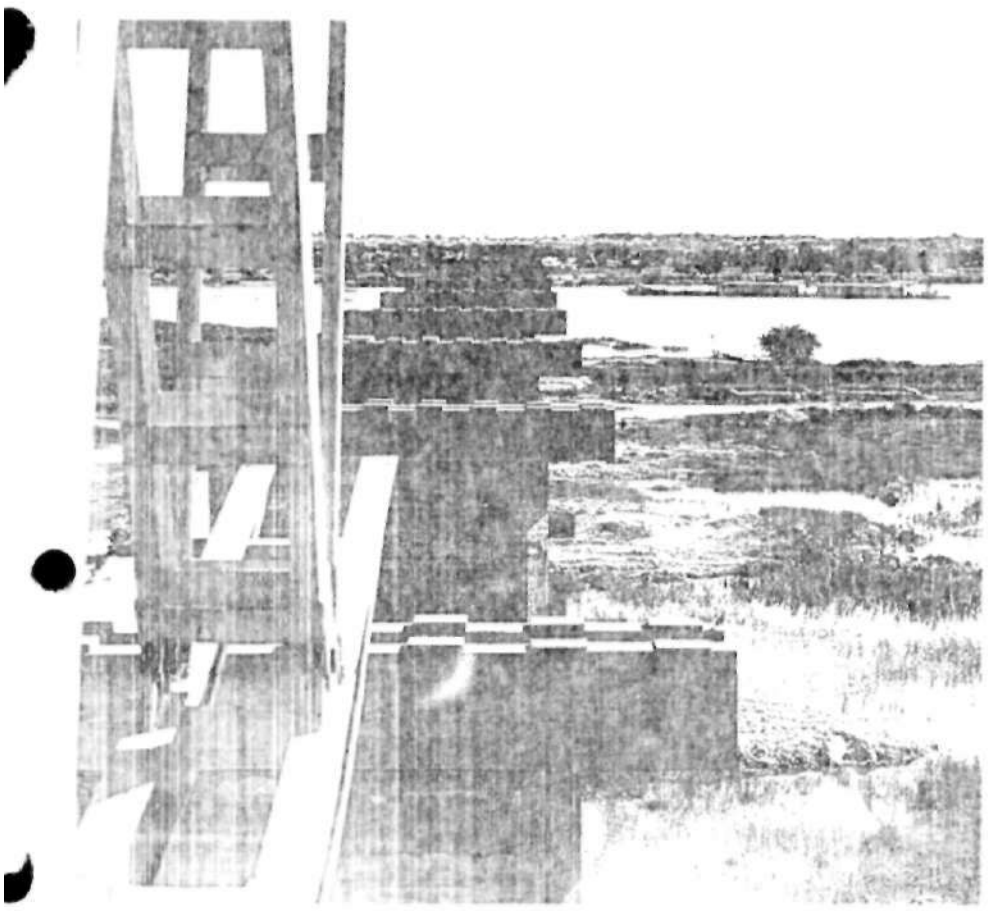
Appendix A

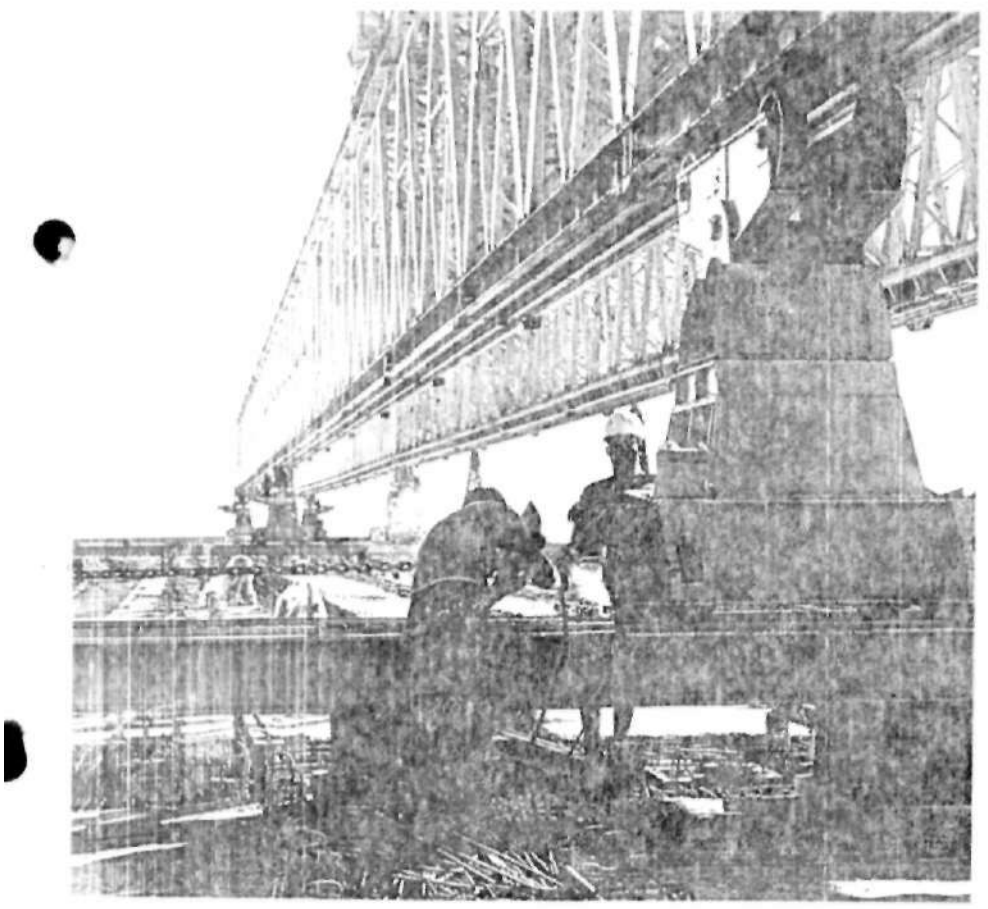
Bridges form a major and essential part of International's road construction programme. Almost ten thousand metres of bridging have been built, using a variety of construction methods.

Fabricated steel work, pre-stressed concrete, pre-cast concrete, or a combination of these techniques have been used in building these bridges. The foundations have been constructed in mass concrete, in steel or concrete piling, or under compressed air conditions.



JIMETA BRIDGE

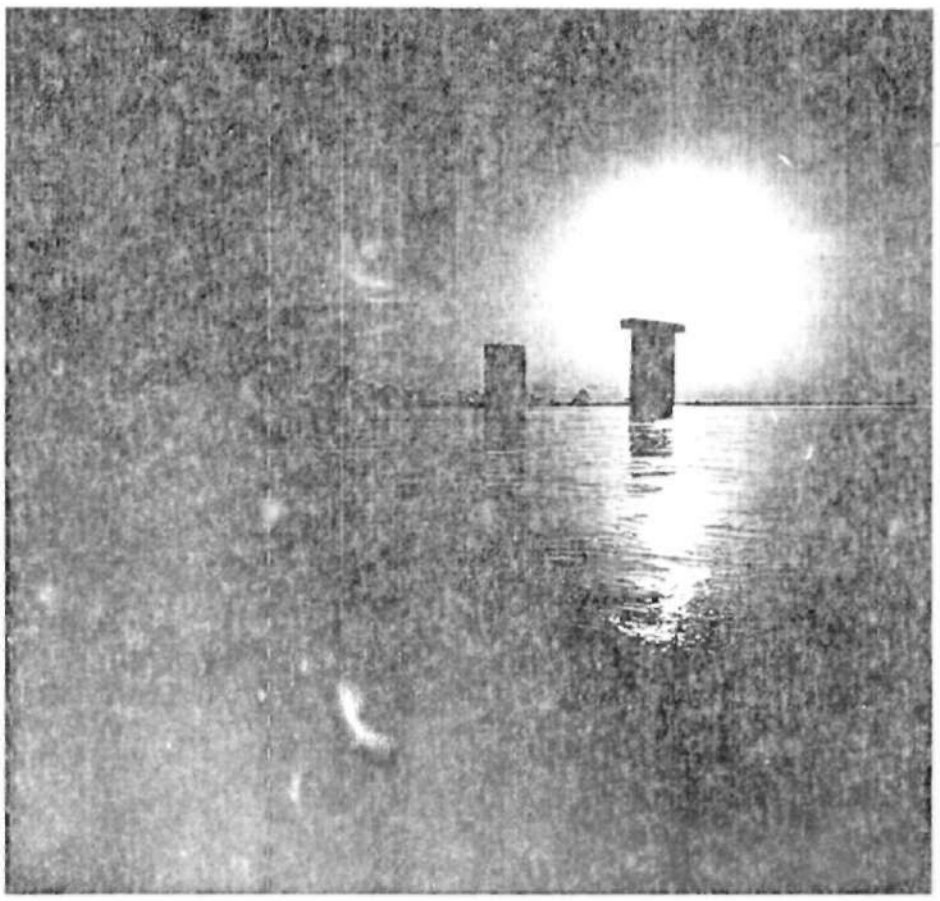


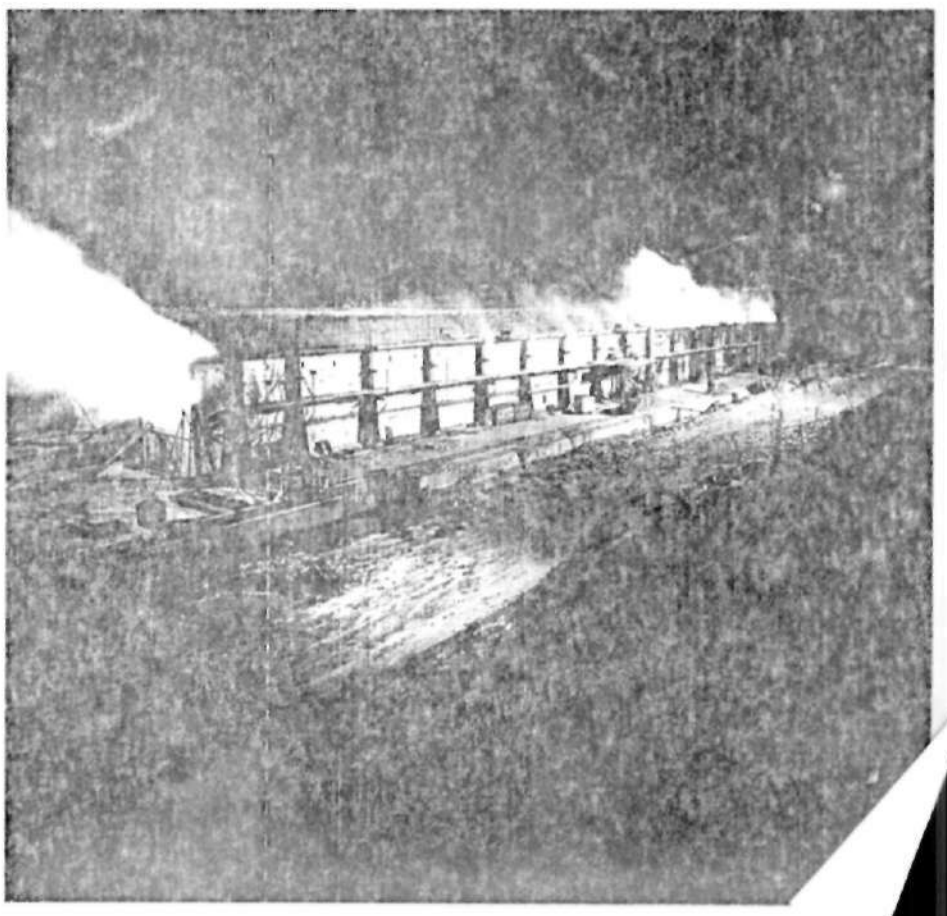


Major bridge construction

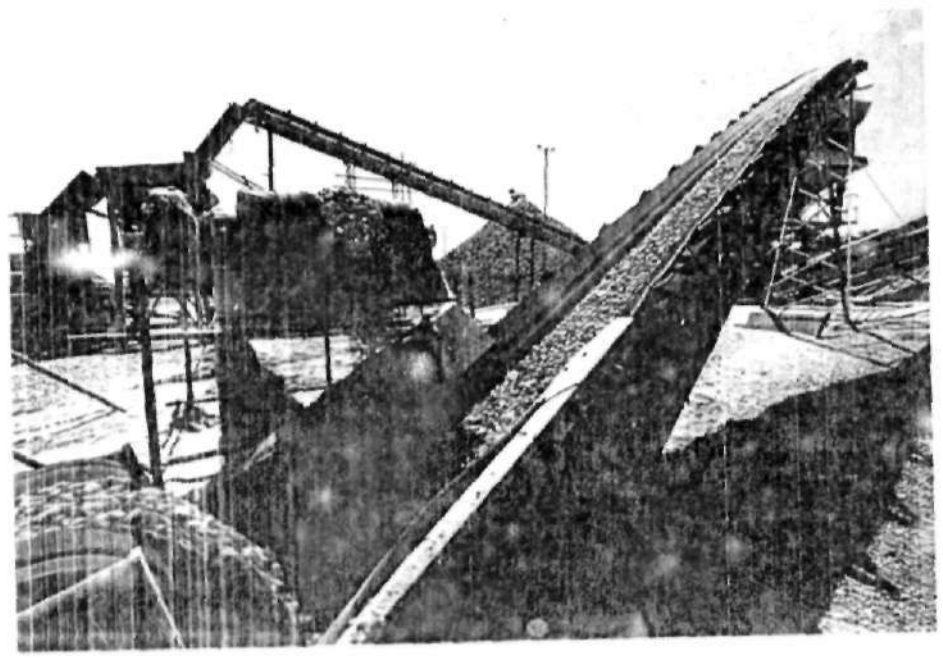
[illegible] typical of [illegible]'s [illegible] programme, [illegible] by the [illegible] company for the [illegible] Government at a [illegible] dollars, the [illegible] was put in [illegible] and is [illegible] of publication.

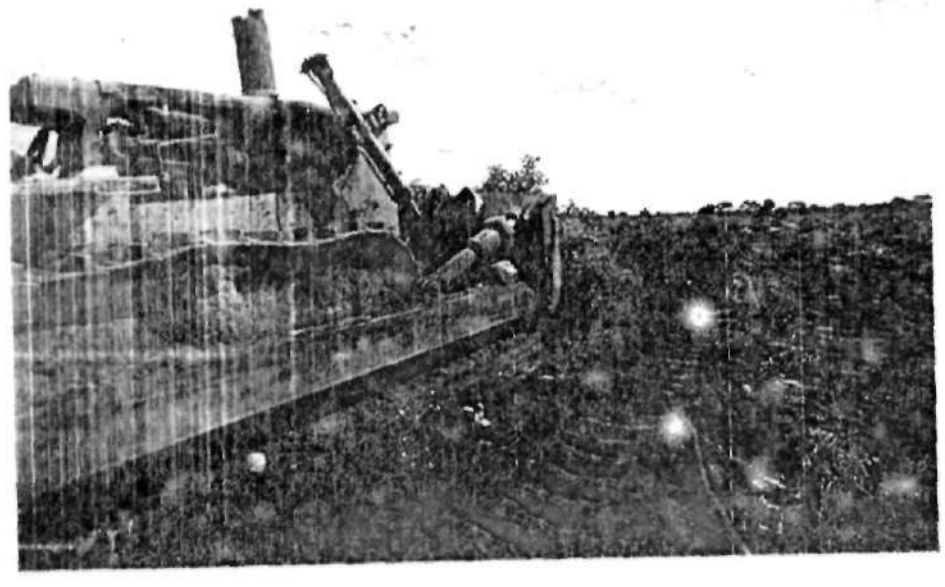
[illegible] Pierce Bridge [illegible] tributary [illegible] Niger, the bridge has an overall deck length of 1422 metres, and is 20 metres wide. The pre-cast, pre-stressed beams of the bridge deck are divided into 29 spans of just under 50 metres each.





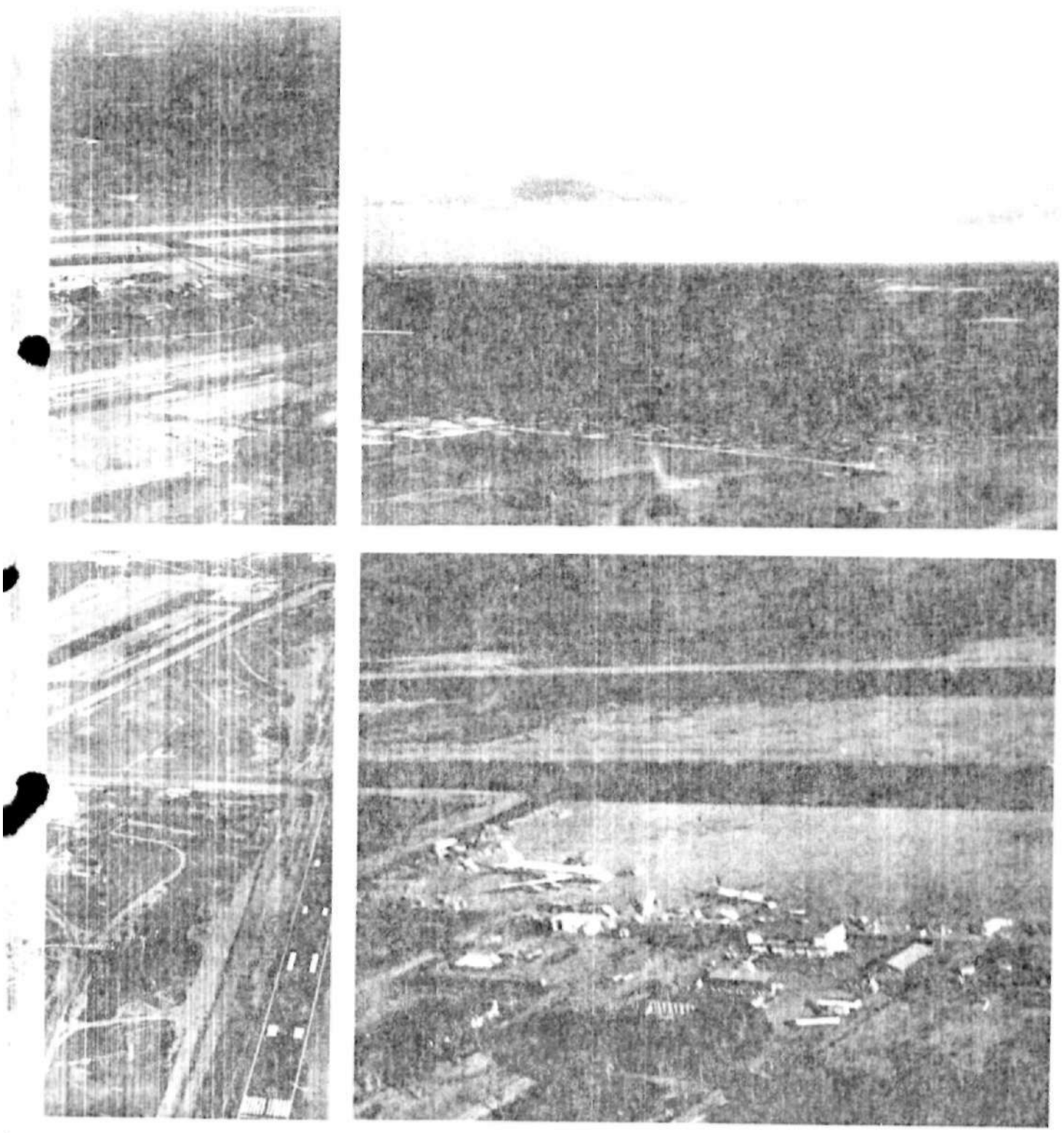
Roads in Nigeria





(Nigeria) Ltd., a subsidiary of International, has undertaken for the Federal Nigerian Government and for several of the Nigerian State Governments, a massive road building programme which is continuing at the time of publication. Listed below is a selection of bitumen surfaced roads completed:

From	To	Length in Kms
Aba	Port Harcourt	64
Onitsha	Enugu	102
Mokwa	Kaiama	96
Bauchi	Yola	375
Biu	Gombe	132
Ilorin	Bokani	160
Damaturu	Little Gombi	222
Bukuru	Shendam	230
Kano	Kafin	454
Bokani	Kachako	424
Kafin	Dadin	118
Damaturu	Gashua	227
Funtua	Maradi	164
Yelwa	Katsina Ala	211
Jaredi	Kontagora	174
Daki Takwas	Biri Yauri	191
Kari	Bena Shuak	241
Wukuru	Abinsi	123
Gombe	Nafada	120

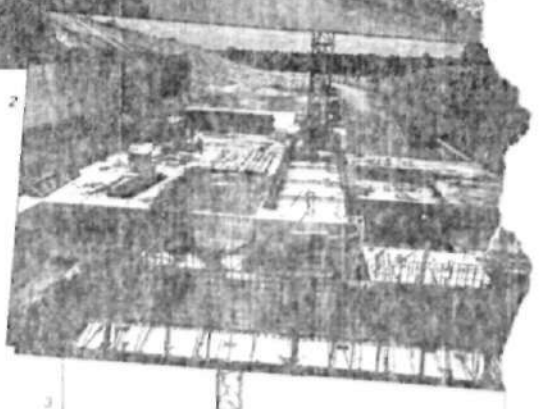


KANO AIRPORT

Appendix B

Appendix B





from the intake tower, the open conduit and stilling basin, and the outlet channel.

The Ogun River has been diverted to allow construction operations on the river bed. The cofferdam – part of the main structure – is largely completed. The preparation and sealing of the dry river bed was completed in 1983, after which the construction of the actual dam could begin.

The [illegible] tower is ready for the intake [illegible] and electromechanical preparatory work. [illegible] of the powerhouse and [illegible] the part of the [illegible] which will [illegible] excavation [illegible] the pouring of the concrete foundation slab and the anchoring of the two penstocks in the open conduit, and excavation for the tailrace.

Auxiliary spillway [illegible] preceding [illegible] with [illegible]. Work is going ahead on the service spillway 2 kilometres from the side of the main dam, while the earthmoving work required for the auxiliary spillway has been completed. The network of roads, the culverts and the two-span and four-span bridge specified in the contract are now at an advanced stage but final completion will be finished towards the end of the entire project.

That will be in 1985, when [illegible] Nigeria Ltd, the main contractor for the civil engineering operations, has completed its part of the project. Then 600 million cubic metres of water will flow into the reservoir to meet agricultural, urban and industrial needs and provide a much needed source of electricity.

1 Work on the dam. Right to left: intake tower, cofferdam (now completed), closed conduit and open conduit
2 West and first stilling basin of the service spillway
3 Intake tower
4 Cross section of intake tower
5 Cross section of the dam

