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ESSENTIALS OF PROJECT MANAGEMENT:

A PRACTICAL MANAGERIAL APPROACH

T. A. Ngerebo-a

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A PRACTICAL MANAGERIAL APPROACH

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Dedication

To

Jehovah El-Shammah

PREFACE AND ACKNOWLEDGMENT

Several human activities have had various degrees of studies in the academic and non-academic spheres. These activities have been seen as projects especially in recent entrepreneurial world. Professionally, there have been various bodies that have their bases and identity around project management. However whether academic, professional or practice, project management overlaps management, engineering, information and computer technology, and several other areas of knowledge and ownership. Each body of knowledge seems to treat project management in a peculiar way, which makes the practice of project management sometimes conflicting instead of complementary.

This book tries to harmonies these various considerations and peculiarities, with emphasis on the human aspect of project management. It focuses on the essential aspects of planning, organizing, directing, controlling, monitoring and evaluating of the project, with simple but practical examples drawn around the south-south geopolitical zone of Nigeria. This means that it is useful for any department, professional body or area of knowledge where project management is studied or practiced.

The synthesized work done in this book would not have been possible without the efforts of the followings persons namely Professors A. N. Gbosi, B. A Fubara, C. B. Ezirim, S.A. Jaja and Willie Obone-Abbey. Others that the author is indebted to include Dr. P.U.C. Agundu, Dr. Barisua Nwinee, Dr. D. I. Hamilton, Ms Ogbukah Juliet, Mr. Chukwu Gospel, Blessing Afinidi Samuel, and Mr. Patimi Ebikeyeiseye.

I must eternally thank the support of my beloved wife (Mrs. Ngozi Ngereboa) and above-all Jehovah God (my Way Maker)

FOREWORD

The implementation phase of the strategic management process often involves projects. A book on project management written by a senior academic is therefore an important addition to strategic management thought.

This eight chapter book starts with an introduction in which project concepts were examined and ends with post project appraisal methodologies.

The chapterization of the book displays the authors experience and dexterity by tackling issue relevant to the management of complex organizations in a rapidly changing world.

Dr. T. A. Ngerebo-a, the Author, holds a Ph.D in Finance and Banking from the prestigious Rivers State University of Science and Technology at which he has taught for several years in the Department of Banking and Finance. He has published extensively in reputable foreign and local refereed journals touching on Finance, Banking, Public Finance, Financial Markets and Institutions, Investment, Project management etc.

I sincerely commend the author's efforts in writing a book on project management.

Donald I Hamilton (Ph.D, FIIA)
Associate Professor of Policy and strategy

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Chapter 1

INTRODUCTION

1.1 OVERVIEW

Human existence is predicated on one form of activity or the other with the aim of making a sustained, surviving or growing living. These activities are usually embarked upon with the ultimate aim of generating reward. This is true for the accountable and unaccountable, payable or non-payable, tangible or intangible and private or social activities. For instance, a person can use his natural gift of humor to entertain people with or without the exchange of money (payment). The basic goal of this person could be to make people happy and relaxed. In the process of entertaining the people, this person must have some basic inputs such as stories, jokes and communication skills. He must have taken some time to prepare based on anticipated audience and also worked on himself especially his attire per audience. The synopsis of this little social illustration is that the entertainer has to use his inputs to create an output.

Ordinarily, every human being survives by embarking on economic, social, religious, scientific or political activity and these activities involve different processes and inputs.

When the inputs are coordinated, assembled, and "futuristically" used with an anticipated returns, which would be better (in value) than the value of the inputs in their original states, and the ultimate is to satisfy societal need(s), a project results. Simply stated, a project is a set of activities involving the use of inputs for the satisfaction of needs as well as satisfying the owners of the inputs.

It is the set of activities, limited in space, time and scope which is to achieve specific objectives. Inputs here will refer to man, material, money, moment and mind (5Ms). And the more complex and complicated the set of activities is, the larger the project. This could be one of the reasons why modern projects require more attention. A simple groundnut frying and selling business will require less inputs, less activities and less attention and processing, than computer assembling/ manufacturing outfit like DELL or ZINOX or even government. This is why some authorities have asserted that projects can vary widely in size, character and complexity (Fubara, 1998). One characteristic with all projects is that they are meant to achieve objective(s) by ultimately providing product(s) or the rendition of service(s), within a defined time and funding scope or limitation.

In order to provide the anticipated product/service, the promoter(s) of a project (also known as owners) engage

the 5Ms which most times are financially heavy, implying that commensurate preparation, coordinated assembly and utilization of the inputs, *to-the-letter* implementation, and proper feedback (control) must be instituted to attain the objective of the project. This set of activities is referred to as project management. Project management is a special aspect of corporate management (especially systems management) by which corporate problems involving the efficient, effective and time conscious commitment and control of scarce resources are solved.

The **objective or essence** of project management is to plan, organize, coordinate and control all the activities relating to a project from conception of the project idea to the successful completion and handing-over of the project including change in technology, considering the difficulties and risks involved. This is why project management can easily be said to be the planning, and monitoring/ implementation of a project and, involves, in the main:

a) Determination or estimation of the requirements
b) Determination or estimation of the scope and size of work
c) Determination or estimation of the requisite resources
d) Tracking of various aspects of work during implementation
e) Feedback and variance analysis

f) Impact analysis
g) Restart with observed/accepted adjustments.

Although, the above-listed seven (7) points could ordinarily suffice for project management, there are in reality just two aspects that are too essential to the success of Project Management namely PROJECT PLANNING AND PROJECT EVALUATION. That is , the first three (a – c) are basic aspects of project planning while the last four (d – g) are for control or evaluation. This implies that there are other aspects of project management not mentioned here. Comprehensively, and being a special part of corporate management, project management would therefore be defined as the planning, organizing, directing and controlling of investors' resources for the attainment of set objectives (usually for short-term, as a phase in the long-term investment objective of project owner/investors). Note that projects are the short achievable forms of programmes, which are medium-term forms of plans which in turn are break-downs of corporate strategies, as shown in fig 1.1 below

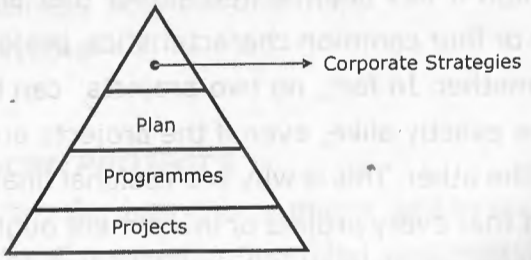


Fig. 1.1 Organizational Hierarchy of tasks Implementation

In fig 1.1 above, it could be seen that the four stages are part of the comprehensive corporate hierarchy that flows from vision to product/service. Of course, it is known fact that promoters of an organization will state their organizational vision and mission. The shareholders handle policies, the directors (Top management) breakdown the policies to strategies, middle managements break strategies down into plans, plans are broken down to progrmames which give rise to projects and end-up with products/services, depending on the size and complexity of the organization involved.

In this study, efforts shall be made to create understanding on the various aspects of a project (irrespective of the type) from conception to completion, the organization of men and materials for the successful completion of a project, and the economic and social aspects of projects.

1.2 TYPES OF PROJECTS

Although it has been stated earlier that all projects have three or four common characteristics, projects differ from one another. In fact, no two projects can be the same or can be exactly alike, even if the projects are repeated one after the other. This is why professional financial managers assert that every project or investment ought to be treated or appraised distinctly, separately and independently to know the future of the projects vis-à-vis their objectives,

hence every project is novel in itself. The novelty spans across its conception, inputs, timing/life span, management, risks, uncertainties and other environmental factors associated with it.

The three or four common characteristics are

a) Every project has a set objective, which might ultimately be the provision of a product or rendition of service.
b) Every project has a defined life span
c) Every project has a defined source and limits of funding
d) Every project has peculiar set of inputs.

Given these common characteristics, projects can be identified and classified on five (5) main bases namely:

i) micro, macro, and hybrid projects
ii) technicality of input and output involved.
iii) level of management involvement or closeness to normal business activities of firms.
(Iv) Completion time
(V) Others

MICRO AND MACRO PROJECTS

Projects can be classified into micro, macro and hybrid on the basis of scope of ownership, intended customership, and profitability. A MICRO PROJECT is a project mostly owned by an individual or group of individuals, with the

Intension of satisfying a particular set of consumers who can pay for the product/service and with the sole aim of making private profit. Micro project concepts are implemented after funds to finance the project have been sourced, hence the size of available, or estimated size of, funds is a major determinant to the size of the project. Micro projects are commonly referred to as private sector projects, more so when the finance to fund the projects are from private sources of owners equity and credits (which could cover bank loans, individual credits, unpaid items/services and even international financial institutional loans).

MACRO PROJECTS are on the other hand commonly referred to as public sector projects. A macro project is one that is owned by the generality of the citizens through the government (national, state, local and community). By this nature, it is usually funded by budgetary provisions or acts of parliament. The outputs are for everybody without the application of the principle of excludability. Most times a macro project is a conglomeration of several micro projects which means that the funding could be more than the capability of private individuals, and given their usually longer tenure (from conception to completion) and the almost zero return on investment (except social benefits), they are executed by governments. Most macro or public projects are not subjected to the conventional investment

appraisal or capital budgeting techniques, as is the case with micro projects. Macro projects are usually for the production of public goods. In modern times, the scope of macro projects has been reducing as government revenue dwindles and more private investors invest in hitherto social projects at fees and for profit. In the recent past, macro projects like schools (primary, secondary and tertiary), health, electrification, stadia, ports, telecommunication and news media have been invaded by private investors forcing governments to privatize their shareholdings in such projects.

HYBRID PROJECTS are projects that have combination of some of the characteristics of both the micro-projects and macro-projects. This means that an hybrid project could be for the benefit of the generality of a given community but owned or established by a person or group of persons for marginal profit-making purposes. It could also be owned by the people (government) but for profit making. For instance, the government of a state in Nigeria can enter a Memorandum of Understanding (MoU) with a private property developer or real estate merchant to build a residential estate. The government provides the physical infrastructural facilities, while the Estate Merchant provides the needed financial requirements for the buildings, the expertise for the construction and the professional management acumen for the effective and efficient running

of the estate. This kind of arrangement has a singular purpose of provision of residential accommodation for the citizens, but at a rental value that must enable the private partner to not only recover his costs but make competitive profit. Most of the public private partnership (PPP) arrangements or concessionings could therefore be classified as hybrid projects.

TECHNICAL LEVEL

Technically, there are four (4) main types of projects namely engineering, manufacturing, management consultancy and research projects.

An ENGINEERING PROJECT is one that is conceived with a model (analog, iconic, or mathematical) based on a hypothetical space outside the point of conception or modeling. Such a project has its actual implementation spot or site, where the realities of environmental factors will act on, different from the place of conception or modeling. Engineering projects generically include civil, mechanical, electrical, construction, petrochemical, mining and quarrying projects. The projects require massive funds investment sometimes before the actual project kicks off, through exploration, search and pilot surveys. Sometimes the implementation could be in phases with special financial arrangements like leasing. They are hazardous and are required by law to maintain certain health, safety

and environmental standards. In most cases, an environmental impact assessment (EIA) is conducted in advance with the EIA report clearly showing how the negative externalities will be tackled. Given the enormity of resources required for the execution of this category of projects, more than one contractor is usually engaged in the implementation.

A MANUFACTURING PROJECT is one that produces tangible outputs from a fabrication or manufacturing process. Here job, batch and process costing could all be applied in ascertaining the cost of the output. Usually at a complete cycle, such projects will produce finished goods, work-in-progress, waste/spoilages, and raw materials. The finished goods can be generally made or custom-made. Although, they could involve pilot survey (test-runs), such pilot schemes are not as entailing as engineering projects. Manufacturing project could vary on the basis of complexity.

A complex manufacturing project will involve the breaking down of the process into departments whereby the output of one department is the input of another. In this case, transfer pricing and other internal management controls take place. In some most complex manufacturing projects the different parts of the output could be manufactured in different countries e.g. motor vehicles, computers, aircrafts, etc.

A MANAGEMENT CONSULTANCY project is actually a service oriented project by which changes (existing or intended) are analyzed and effected on institutional, structural, managerial, etc composition of organizations and governments. They are mostly in the forms of workshops, seminars, training, campaigns, exhibitions, feasibility and other forms of studies. Management consultancy projects are most times preludes to successful engineering and manufacturing projects. Again such projects are mostly contracted to and conducted by professional/specialist bodies either within or outside the premises of the organization contracting them.

RESEARCH PROJECTS are projects embarked upon most times blindly or on hindsight. They are conscious attempts to expand human knowledge about the environment or existing phenomenon or way of life. Research projects cover academic and pure scientific researches whose end-products may not result in any tangible product/service creation. Sometimes, they end inconclusively, while at other times they could lead to major breakthroughs. Research projects could be continuous e.g space shuttle/missions. Since they appear to be unending and large amount of resources are committed into them, the best way of controlling them is periodic management reviews, assessments and reassessment exercises by such means as **"PULLING THE PLUG"** and **STAGE-GATE CONTROL.**

LEVEL OF MANAGEMENT INVOLVEMENT

By level of management involvement, we mean identifying and classifying projects based on the level of commitment of the owners and/or management to the design and execution of the project. If the project will involve the participation of owners and management in the day to day running or implementation of the project, such classification will be different from the ones that the owners would design and allow the management to oversee its completion. In the latter case, the overall design could be for a long time and will therefore require that the project be broken down into phases for implementation. In the course of implementation of the broken- down short-run projects, it is possible that some adjustments could be incorporated which could diversify the original concept from the main objects of the owner-firm. This is why this type of classification is also known as ***"CLOSENESS TO THE NORMAL ACTIVITY OF THE FIRM".*** By this classification therefore projects can be group into Strategic and Tactical. A strategic Project is one that involves huge amount of investment, a major departure from the normal activity or objects of the firm, mostly involving new areas with potentially higher risks and higher profit expectations. For instance, a firm that is incorporated for road transportation business may decide to venture into upstream petroleum and gas exploration. This diversification would normally

take a long time to be actualized, with higher risks and huge amount of investible funds.

On the other hand, a tactical project will involve a small or minor departure from the main object or the normal activity of the business or firm. For instance, where the transport firm diversifies into parcel delivery or the business of air transport, it could be said that the new areas are ancillary to the normal activity of the firm.

COMPLETION TIME

This is the identification and classification of projects based on the potential challenges of completing the project within scheduled time and cost. In this case, as would be seen later, projects can be classified into two namely normal and crash. A normal project is one that has little or no challenge that will result in the overshooting of the scheduled time of completion, especially with the prompt availability of required resources for the execution of the various tasks or activities that make up the project.

A crash project is one that encounters some challenges especially the prompt and adequate supply of the required resources for the timely completion of the project, such that either the time is reduced at the expense of added cost or vice verse.

OTHER TAXANOMIES

Other ways of identifying and classifying projects will include:

1. Expansion projects
2. New projects
3. Modernization projects
4. Replacement projects
5. Forward Integration Projects, and
6. Backward Integration projects

1.3 THE PROJECT MANAGER (PM)

The Project Manager (PM) is a member of a Project Team. The project team is the make-up of all the persons or personnel involved in the execution of a project. The team comprises of the following:

(a) the project sponsor,
(b) the project manager,
(c) the project financier (if different from the sponsor),
(d) the client (the same as sponsor except that in some cases the client can be the second party that originally secures the job or agrees to execute the project from the project owner/sponsor),
(e) the technical, managerial, etc. specialists and general staff,

(f) the assessors (especially external auditors or evaluators), and

(g) the end users.

The PM is a coordinator or link between the members of the project team and must ensure that the objectives of each member of the team is achieved, and hence the achievement of the corporate or organizational or overall project objectives. This is why the Project manager is seen as agent of Management-By-Objectives (MBO). Again, it explains why some people consider the PM as superior to other members except the project sponsor/client. However, it must be stated that there is hardly any hierarchical order of importance for members of the team, rather a functional order of relationship exists between members of a good team.

The Project Manager is the person(s) that oversee the execution of a project or programme. The PM can just be one person or a firm with management responsibilities. The PM is variously known as project coordinator, project engineer, project coordinating engineer, project leader, project team leader, or contract manager. The roles and responsibilities of the PM vary from project to project, programme to programme, and organization to organization.

It is the duty of PM to motivate all members of the project team and it is expected that the PM will be part of the planning of the project, and will have some degree of power and authority. The PM is the key person that provides the company management with relevant facts concerning the financial, technical, and other aspects of the project. Hence, the PM is expected to have a fairly general knowledge of the project so that he can interact and interface with other line managers, suppliers and colleagues.

In summary, the following will be the attributes of an efficient and effective project manager:

1. he must possess competence in planning and organizational skills
2. he must have positive personnel management skills
3. he must have the capacity to originate and effectively manage change
4. he must be ambitious in attaining higher goals
5. he must be a good communicator
6. he must be able to carry others along, while solving problems
7. he must be open to suggestions and views of other team members
8. he must be brisk and sharp in developing alternative actions

9. he must be a good time manager,
10. he must have the ability to appraise himself from time to time
11. he must have a clear idea of the end users and their expectations
12. he must be prepared to make personal sacrifices for the outcomes of the project
13. he must clearly understand the requirements of the project, and
14. he must be prepared to take convincing risks and deliver the deliverables of the project within the constraining time and cost.

1.4 PROJECT PLANNING

Project planning is the art of producing a road-map (plan) from the commencement to the completion of a project. Project planning is a special type of planning which is expected to be continuous and involves all aspects of the organization. This is why, depending on the type of project, projects generally are not domiciled with a particular line management because the features of almost all departments/units of an organization will be reflected in a project. This consequently makes the experience of the project manager wider than that of a line manager.

Again, depending on the level of information about the project planning, a project could be very detailed or be very

simple. That is, if a project is repetitive, then planning will be detailed because informative experiences would have been incorporated. But if a project is virgin, most aspects of the plan will be based on assumptions. This is why it is commonly said that the more information available about a project, the more detailed the project plan. In essence, project planning must cover all the "cycles" of a given project.

There are certain qualities of an ideal project plan, some of which are:

1. It must cover all major tasks of the project.
2. It must be detailed enough so that work list can easily be extracted.
3. It must present all tasks in a logical chronological order
4. It must insist that task interdependences are complied with.
5. It must be simple to understand and encouragingly/practically effective.
6. It must be flexible.
7. It must indicate stages of completion or milestones.
8. It must ensure that chronologies are achievable, especially with respect to the timing of tasks.
9. It must emphasis priority and urgent tasks.
10. It must be accepted as responsibilities by relevant managers and supervisors.

11. It must provide avenue(s) for performance appraisal in the shortest possible time.
12. It must recognized the amount of resources available.
13. It must recognize the resources needs of the project.
14. It must satisfy the expectations of all stakeholders.

Exercise 1.1

Your Local Government Area (LGA) Council is considering erecting and equipping a Modern Library in your village within 6 months. The LGA Chairman has approached you to draw up a plan for the execution of this project. Draw up a project plan therefore.

Exercise 1.2

Draw up a project plan for the siting of a branch of Cinfores IT Centre in Yenegoa within 2 months, chronologically.

Exercise 1.3

The administration of Rivers State University of Science and Technology in 2009 promised the visitor of the University that all professional courses would be accredited by the National /International bodies so that the students could begin qualification while in the University. The Head of your Department has appointed you as the Chairman of the committee for the accreditation of your department by

the Chartered Institute of Bankers of Nigeria. Propose a plan for this project chronologically. The plan should not span for more than 45 days.

The three assignments given above have one particular characteristic which is that their target completion period (time) is already established. Project planning that commences with set estimated completion time is known as TOP-BOTTOM planning as against BOTTOM-TOP planning. It means there are two approaches to project planning even though adjustments could be made as the plan is implemented.

BOTTOM-TOP planning is an approach by which all the tasks relating to the successful completion of a project are detailed out with appropriate and respective estimated duration and without any environmental pressure to compress the time schedules. In this way, the planners could draw up work schedules and milestones, without overstretching the 5Ms because the plan has been made carefully given the quantum of the 5M available to the project owner(s). By this therefore the comprehensive project plan is built from the smallest task and its estimated time schedule, in such a way that the comprehensive plan will be a summation of all the tasks and their combined time durations. This is why Bottom-Top planning is also known as TASK-DRIVEN PLANNING. In the public sector of Nigeria,

the task-driven or task-led planning is evidenced by the new development planning approach known as the Integrated Development Programme, which is the basis for NEEDS, SEEDS, and LEEDS or even the Local Government Integrated Development Planning (LIDP) in Rivers State.

Exercise 1.4

Find out the details about NEEDS, SEEDS, LEEDS and LIDP and explain the place of Bottom-Top project planning.

The most outstanding disadvantage of the Bottom-Top approach is that it could be costlier than normal as there is no pressure to expedite completion time duration given the fact that planners are expected to amalgamate the time schedules for the various tasks. That is Top management are forced to accept the planners time duration and may not impose their own conceived time schedule.

A TOP-BOTTOM planning approach is one that has a predetermined completion duration within which the various tasks are fitted into. The predetermined delivery time requirements and outputs are set by top management. Most times this approach is used to cut costs and attract customers/clients, with the danger of deception and inability to complete as estimated. The approach could leave projects plans with no room for errors and corrections or even changes during implementation. A possible way to circumvent this shortcomings is that more resources are

allocated to the project and tasks are executed concurrently than consecutively.

For instance, if the reconstruction of the Azikiwe Road project is to be completed before next May-ending from December this year when it commensed, as against December- November schedule, government must commit more resources so that tasks are executed day and night.

It is this idea of working towards attained predetermined target completion time that makes Top-Bottom approach to be also known as TARGET-LED planning.

PLANNING ENVIRONMENT

There are usually two basic planning environments (sometimes called environmental factors) that affect the project, namely controllable and uncontrollable factors. Controllable environment refers to the factors that could affect the outcomes of project even though they are within the scope of the project organization. The control or reduction of the effects of these factors may not be completely under the project manager but with other managers, and internal circumstances and structures of the organization. This is why the project manager could be someone with high communicative and interpersonal skills, with good general knowledge of the operations of the various departments /units of the organization, and very familiar with the technology in vogue both for the execution

of the project and as adopted by the organization. With these essential qualities, the project manager would be able to negotiate with high-level management cadre as well as some line/functional managers who may command more authority than the limited or no authority of the project manager. Again, in most cases, projects are executed for clients who may be different from the project manager's organization. In such cases, the project manager's responsibilities are compounded. However, it is required that the project manager must therefore assume the role of interface manager, i.e. interfacing between the resources (including human resources) of the project, the client's dictates and the project organization's expectations. It is therefore expedient that the project manager must acquire both technical and managerial skills to overcome the difficulties or internal environment associated with a project. The internal environmental factors would include technical competence, managerial ability, workers' attitude and culture, procedures and systems (at the three points) and resources and capacities available.

Uncontrollable environment, on the other hand, refers to the external factors that are completely out of the control of both the project manager and the project organization. The impact of uncontrollable factors is so monumental that they can render planning useless and even lead to the

abandonment or cancellation of projects. They include government social economic and political decisions/ policies, natural phenomena, statutory regulations and even corporate strategies (especially those made by more influential organizations than the project organization).

1.5 PROJECT EVALUATION

This is the systematic method of collecting, analyzing and using information to answer basic questions about projects. It is a post-completion assessment of the efforts, strategies and resources committed into a task or project, and the consequential outcome vis-à-vis the original and/or adjusted objective(s) for the project. In most real cases project evaluation takes the form of post-audit. Project evaluation is not very common especially in the private sector, and the idea of project evaluation has been imported from the public sector that undertakes program evaluation. Programme evaluation was made very popular in the 1960s in the USA under the administrations of Kennedy and Johnson, following the quest for assessment of the impacts of the investment of extraordinary sums into social programs that had very minimal effects.

Project evaluation is the unbiased (consistent alignment with the original point of view), sometimes intensive, detailed description and analysis of a project in the context of its environment, within a defined period of time agreed for the performance of specified task.

It is the control of the planning and implementation of project activities with regards to the objectives to be achieved. It puts normative assessments (i.e by asking basic questions relating to how the project has performed or how the project has been performed, how much was achieved given the set-out objectives, is the executed project good and beneficial or not, or how beneficial will the project be) into the content of planning and management and hence the context of intentional actions and cycles of action.

It can also be described as the step-by-step process of collecting, recording and organizing information about project results, including short-term outputs (immediate results of activities, or project deliverables) and immediate and longer-term project outcomes (changes in behaviour, practice or policy resulting from the project). The implication is that, like any other human endeavour that demands accountability, evaluation must commence with planning. That is, planning must anticipate and make provision for evaluation; hence the basic parameters for the evaluation must be clearly identified in the project plan. These parameters are commonly referred to as SUCCESS FACTORS. In the process of evaluating a project, there is the need for the identification of areas of realistic Improvements and where expected outcomes are

unrealizable. Since it is a step-by-step process, there must be a mechanism to track down and document actual changes and progress made in the execution of the project. These changes must be compared to targets and must demonstrate effective, efficient and equitable use of the resources billed for the project. It is the basis for validation or the evaluation of staff and partners.

REASONS FOR PROJECT EVALUATION

1) It is a means of ascertaining the extent of expected changes or successes or progress achieved by the project.
2) It is a way of assessing the extent of attainment of the objectives of the project given (1) above.
3) It is a means of ascertaining the variances, whether positive or negative, given (2) above, and which and how the areas of variances can be refined or reemphasized for better results or performance.
4) It is a way of assessing the justification of inputs used given the outcome of the project.
5) It is therefore an assessment of the status, process and design of a project or activity. This means that project evaluation covers status review, process review and design review.
6) It enables management decide on how to proceed/progress with a project, programme or activity.

7) It enables a revelation of the developing problems at the earlier stage for necessary actions.

LIMITATIONS TO PROJECT EVALUATION

The limitations to project evaluation (and by extension, monitoring of projects) are the very challenges confronting the appraisal of a project at its completion. The limitations or challenges include:

1) The difficulty in understanding the project concept and the niche to *committedly* accomplish the project.

2) The ability of the planners to establish success measurement parameters or baselines for the project *ab initio*.

3) The ability to identify these parameters by grouping them into quantitative and qualitative indicators.

4) The ability to set a time-table and ensuring that the schedule is adhered to.

5) The ability of the project planners and the promoters to get contributions from stakeholders and reporting back to the stakeholders.

Given these and other limitations, and given the interests of employees of both the project owners and project

implementers, project evaluation is best done by consultants.

The aim of project evaluation is the determination of the relevance and level of achievement of project objectives, development, effectiveness, efficiency, impact and sustainability.

Evaluation lies between project monitoring and project impact assessment. Ordinarily these two terms are used interchangeably. In reality there are very slim and overlapping differences between these terms. For instance, monitoring answers the questions: what has been invested, what has been done/produced, and does the output achieve or justify the objectives? Evaluation answers the question: what progress, in-road or contributions has the project made in achieving the objective of the project? Impact assessment, on its own, answers the questions: what are the long-term sustainable changes that the project has brought about and to what extent has the project contributed to these long-term changes? In effect, monitoring considers inputs and outputs, while evaluation considers outputs and outcomes, and impact assessment considers outcomes and impacts.

TYPES OF EVALUATION

According the ILO and OECD, there are four types of evaluation namely;

1) **Self-Evaluation** done by staff of the project clients or promoters or owners, which would include those that have been involved in the project execution such as project management team, technical specialists and back-stoppers. The essence of this self-evaluation is for the direct implementers or those who have had one role or the other during the project execution to rate the activities with regards to the spelt out expectations.

2) **Internal Evaluation** done by project owners' employees not involved in the design, management, execution or backstopping of the project they are evaluating. This is like an internal auditing of a project. Most times, this is done by synthesizing all reports from the various self-evaluation exercises, and comparing the combined/synthesized evaluation report with the original plan (as amended) as well as the physical work achieved.

3) **Independent Evaluation** managed by independent employees of the project client but led and conducted by external evaluators who have no previous links to the project. This means that the evaluation team will be a combination of employees, managers, directors and external assessors. Usually, each group of person will express their views, which will eventually be compared with that

of the external team member and the project deliverables.

4) **External Evaluation** managed from outside the project owner and conducted by external evaluators who have no previous links to the project being evaluated.

THE EVALUATION REPORT

Evaluation report will contain the following aspects for it to be considered as a minimum formal and comprehensive process review report:

1) The current project status
2) The critical task status
3) The future status
4) The assessment of risk
5) The limitations of the project evaluation
6) The areas of benefits for other project

EARNED VALUE ANALYSIS (EVA)

This is one way of controlling a project such that the project is completed within the costs scheduled, within the time specified, at the required quality and to the right specifications. It was introduced in the 1960s by the government of the USA to conclude on whether a contractor qualifies to be paid a progress payment (milestone payment) for work done. It is a way of

conducting status review such that where variances occur, they are properly analyzed, hence the other name of Earned Value Analysis is VARIANCE ANALYSIS. In its strictest application EVA is an analysis of Budgeted Cost of Work Performed (BCWP), which is one out of 5 aspects of Variance Analysis. The other aspects are:

1) Cost Variance: comparison of deviations and work performed;
2) Schedule Variance: comparison of planned and actual work completed;
3) Budgeted Cost of Work Scheduled (BCWS) : the cost of work scheduled to be completed as budgeted within a range of time or the proportion of effort employed within a time period;
4) Actual Cost of Work Performed (ACWP): the actual amount of money or effort utilized in completing the work within a period.

EVA or BCWP refers to the actual cost or effort of work expended within a time period as budgeted. It is the monetary value of actual accomplishment of the project/task in the referenced period.

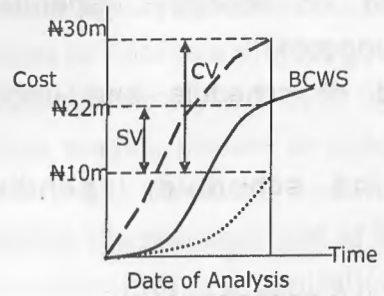
From the five (5) aspects of Variance Analysis, two (2) types of variance can be easily identified namely

Cost Variance = BCWP – ACWP

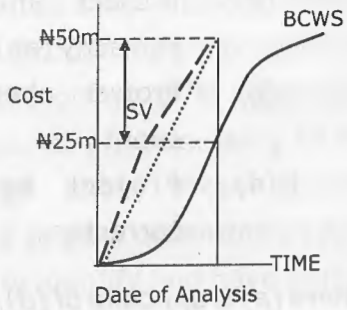
Schedule (Time) Variance = BCWP – BCWS

Graphically, the two (2) variances can be shown thus

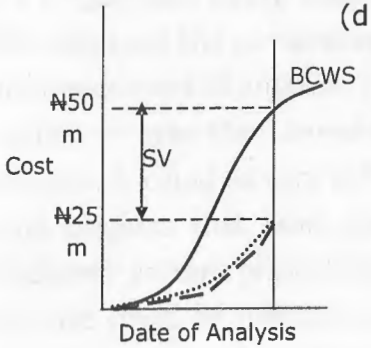
(a)



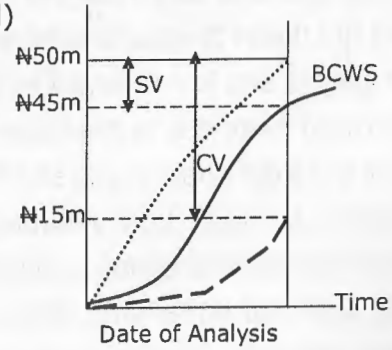
(b)



(c)



(d)



------- = ACWP

..... = BCWP

_____ = BCWS

The combination of these variances resulted in the four (4) graphs above, which shows the following relationships:

(a) Project behind schedule and overspent
(b) Project ahead of schedule, spending correctly (as budgeted)
(c) Project ahead of schedule and under-spent
(d) Project behind schedule, spending correctly

where *(a) is apposite of (d), (c) is opposite of (b):*

Chapter 2

PROJECT LIFE CYCLE

Project life cycle refers to the different interconnecting stages or phases a project goes through before or up to its completion and hand-over to the owner or is restarted. These stages, phases or milestones are necessary to be understood because knowledge about these phases enables the management of the project organization and the project-owner organization to identify and have better control over the corporate resources to be committed into the project to achieve desired goals. The complete phases of a project are easily called project cycle because more often than not the completion of one project results in the commencement of another. The transition of one project to another, or even the commencement of a project up to its completion, could be very definite or unclear. There are also some projects that start gradually and face-out slowly. Whichever pattern projects take, a comprehensive project life cycle could be defined as the time or period, and the complete interlocking stages of activities, between the beginning and the end of a project. To some, it refers to the period between the beginning of a project up to when the project results into a product and when the product is reviewed, redesigned and reprocessed for another product

to result. Whichever way project life cycle is considered, mention must be made of certain generic phases like the following:

1. Project conceptualization
2. Project definition
3. Project preparation
4. Authorization
5. Project assessment
6. Implementation
7. Test run
8. Divestment

2.1 PROJECT CONCEPTUALIZATION

Everybody (individuals and corporate bodies alike) has different competing ideas to meet a need (public or private). But not all ideas are achievable. In project conceptualization phase, all possible ideas are brought to the centre stage for consideration. Such consideration could cover the operational modalities, the basic requirements, the financial implications and the life span of each idea *viz-a-viz* the recouping of the capital to be invested or the realization of the objectives of the idea. This is why this phase is usually called the **preliminary evaluation stage**. At this stage, all ideas appear possible and attractive. It may not be concerned with the amount of resources available (actually or potentially) or at the

disposition of the promotes of the ideas. However, the most important issues here would be the agreement that a need-gap exists, that this gap can be covered by certain strategic arrangements or engagements of resources, the general understanding or mention of alternative strategies, the initial (tentative) cost, gestation period, ultimate benefits, and what quantity and quality of personnel will be required, among others.

2.2 PROJECT DEFINITION

Given generally established possible ideas, the second phase is to do an indepth exposition of the basic elements mentioned in phase one, particularly in the areas of the required resources, technicalities, operational systems, risks, time duration and performance evaluation yardsticks. Other areas for indepth definition would include the business plan, the magnitude of benefits, organizational and managerial structure, intrasystem and intersystem interfaces and scheduling/milestoning of the projects. One basic outcome of this phase is the justification of each project for managers and promoters to decide on any one to embark upon.

2.3 PROJECT PREPARATION

Most organizations have research and development, or corporate strategies, or business development departments where the complex issues in phase II are

professionally mapped-out, else some management consultants will be employed to produce a report. Project preparation phase is where the promoter decides on a particular project out of the many business ideas/concepts studied in phase II. Since one of the possible projects has been accepted, the promoter systematically appraises the viability, feasibility and profitability of the project. The most outstanding tool for this appraisal, which can easily be accepted and used by third parties, is the FEASIBILITY STUDY REPORT. The feasibility study is usually broken to parts namely executive summary, introduction, market analysis, technical analysis, financial analysis and conclusion/recommendation. (Feasibility studies will be treated later).

2.4 AUTHORISATION

Authorization is the approval given by the directors for the commitment of resources to a project, after a thorough appraisal of the project, so that the directors can be adjudged to have justifiably executed their agency function in the management of corporate resources. This approval will be given by the contractor and the promoter. The contracting firm can originate the project/product idea, or could be outrightly engaged by the promoter (project-owner or client). When the contracting firm originates the project, the contractor might commit minimal resources

into the project and wait for a formal approval (award) by the client, or complete the project and sell to a customer as a product. In this latter case, the contractor could still be engaged by the client for installation. In the former case, the commitment of the minimal resources into the project could be detrimental to the contractor or project-firm because it could jeopardize the bargaining power of the project-firm. This is because the golden rule in project management would have been broke". The golden rule states: Do not commit any resources into or incur any cost on, a project unless and until the project owner, customer or client has given a written authority to proceed. This written authority could be in the form of Letter of Award of Contract, or Purchase Order.

Given that the Letter of Award has been issued by the project-owner upon agreed terms, the contracting firm can issue its authorization, usually in the form of works order. A works order is a formal document issued by the management of a project-firm in conjunction with the project manager, detailing the approved costs (in total and break-down) of a project viz-a-viz the customer's price, purchases and other cost centre budgets, the commencement and completion dates, milestones, invoicing and delivery instructions/procedures, etc. It is the micro-summary of this works order that is posted at the

project site especially for public construction/installation projects.

It means that project authorization is a chain reaction, commencing with the approval of the commitment of money in the project by the project-owner and the appointment of project-firm or contracting firm(s), who in turn make their authorization including the appointment of subcontractors, etc. There are certain basic reasons for project authorization, such as

1. It is used for the control of capital expenditure for the ultimate best interest of project-owners (shareholders).
2. It announces the commencement of a project
3. It informs on the detailed composition of the project, the project nature and the nature of the project, to all members and employees of the project-owner organization.
4. It publicizes the financial value of the project, the milestones for payment, and the creation of the project account and reports
5. It publishes the identity of the project-firm/contractor
6. A complete authorization necessarily shows the expenditure limits.

2.5 PROJECT ASSESSMENT

Now that the project proposal or business plan has been prepared (by way of feasibility study), properly appraised, and appropriately approved/authorized by the directors, the project can commence especially if it will not have any impact on the society or environment, or will not be funded in part by external financiers. But, since most outstanding projects, no matter the type, have some impacts, there must be independent assessment(s). These assessments can delay the implementation of the project. It therefore follows that three main types of assessment could be conducted namely,

a) Financial assessment
b) Environment Impact Assessment (EIA)
c) Other assessments

(a) Financial Assessment:

This is usually conducted by external providers of financial resources or even technical expertise to the project. They may be partners or creditors, or even donors. These assessors could even have same nationality with the project-owners or could be foreigners (including international financial institutions). External assessors subject the feasibility studies report to further scrutiny and critically re-examine the assumptions made, the reasons for the location of the project, the socio-economic benefits

of the project, the life-span of the project and the possibility of the product successfully living out its life span, etc. These assessments could cover environmental impact assessment, depending on the size and nature of the project. However, EIA is so delicate to project implementation and success that modern world standard gives it special treatment. Particularly, for financing, assessors would want to know and be satisfied with the 7Cs (capital, capacity, creativeness, competency, condition, collateral and character). Assessors here would refer to Micro Credit Institutions, Deposit Money Banks, Development Banks, Lease Firms, Government Agencies, World Bank, IFAD, IFC, EU, etc. And the basic questions behind the assessment would include:

i. Does the intending borrower (project-owner, or contractor) have the legal power (capacity) to borrow the amount of money sort for?

ii. Will the amount of money requested by the project owner or contractor be sufficient to execute the project? (Capital)

iii. How much is the potential borrower's capital viz-a-viz the intended outside funding? (Capital)

iv. On what conditions and terms should the intended funds be requested after negotiation?

v. On what will the requested funds be secured? Who sureties or guarantees the repayment? (Collateral)?

vi. What are the experience(s) of the potential borrower or how has the potential borrower performed in similar situations in the past, or what are the testimonies of other persons and corporate bodies in the proper utilization and prompt return of other peoples funds? (Character)?

vii. Does the potential borrower's business have the ability to create or earn sufficient income to repay borrowed funds, instead of the other sources of credit repayment like refinancing, debt financing, disposal of collaterals, sale of assets and sale of stocks/shares? (Creativeness)?

viii. Is the purpose of the loan in line with legally declared areas of business and businesses where the potential borrower has shown competence, so that approved monies will not be misapplied? (competence).

The end result of these assessments, if satisfactory, is the preparation, approval and signing of financing (loan) agreement by the financier and the project-owner or contractor, and subsequent draw-down for implementation of the project.

(b) **Environmental Impact Assessment (EIA):**

EIA is an assessment work done by natural scientists for the identification and x-raying of all significant environmental effects of a course of action like the siting and operation of a project. The aim of this exercise is to trace out and describe (by type, magnitude and timing of) the physical impacts of projects or programmes on the ecosystem. EIA is similar to externalities and in actual sense form part of externalities associate with a project or programme. However, EIA is more science and environment-related than externalities. EIA is a legal requirement that precedes the approval, authorization and implementation of a project. The legality of EIA as a prerequisite to the commencement of a project emanates from the National Environmental Protection Laws of the country and states. The outcome of such assessment is the issuance of an Environmental Impact Assessment Statement or Report, which usually will indicate or address issues like:

(I) The impact of the project on the immediate environment and the entire ecosystem within a reasonable geographical range.

(II) The classification of the impacts, especially the negative impacts, into avoidable and unavoidable

(Iii) A recommended alternative to the project or adjustment to the structural plan of the project in order to reduce the negative impacts

(Iv) The classification of the impacts into short-term and long-term impacts on the productivity or otherwise of the land, sea, water, air, living standard, life span of man and animals, etc.

(v) How best to improve on or maintain the existing standard of living (man and others) in the long-run as the project is implemented.

(vi) Outline of irretrievable and irreversible resources that can be committed if the alternative is recommended.

(c) **Other Assessments:**

It is worth noting that, though natural scientists are the main set of assessors involved in EIA, economists have become very necessary assessors. The role of the economists is to translate the opinions of the natural scientists into economic (monetary value) and hence the impact of such projects on the living standard (or cost of living) of the affected people. Consider the following examples:

1. The siting of an Oil and Gas flow station in an hitherto serene community with tick forest.
2. The building of bridge to link Bonny to Ogoniland
3. The location of a plastic-making industry in Bondu-Ama, Port Harcourt.

The natural scientist can easily conduct their assessments and produce a Statement (EIS). But the question will be, what effects have these projects on the income generating power, the cost of living and the source of livelihood of the people in that immediate and remote vicinity, for example. On a large scale, the assessment could be expanded to cover the whole economic system such as on certain macroeconomic variables like employment, price movement, production output and industrial capacity utilization, foreign trade, changes in transport and changes

in recreation industry. This kind of assessment is known as Economic Impact Assessment (or Analysis).

On the other hand, the implementation of a project can cause some significant changes in existing rules, statutes and regulations of a state or country. For instance, the expansion and reconstruction of Port Harcourt-Aba Express Road, undertaken by the government of Rivers State. Assuming this road is a Trunk A road, but Federal Government of Nigeria (FGN) has not considered doing anything on the road, no matter its state, and there is no law allowing state governments to execute projects under the jurisdiction of FGN and getting refund at source. RSG can execute this project and legally demand for a refund or recoup the cost of the project from any of the piggy- backy revenue sources. This can set the stage for a legislation to formalize this kind of action. However, before such projects are embarked upon, it is therefore necessary to assess its impact on existing set of rules and regulations. This kind of assessment is known as REGULATORY IMPACT ASSESSMENT or ANALYSIS. Basically, these other forms of assessments will have essential ingredients or factors mentioned under EIA, but most importantly alternatives to the proposed projects.

2.6 PROJECT IMPLEMENTATION

This is the practical visible action phase. There are a lot of intertwined activities that take place at this stage. From the

project manager's point of view, this is the action stage that combines the growth and maturity stages in a four-stage production cycle. But, from the project owner's point of view, this is the production phase. The phase involves the following activities (though not listed in the order of occurrence):

i) It usually commences with the official appointment and announcement of the project manager by the project owner.

ii) The provision of office space and accommodation for the project team.

iii) The updating of existing detailed plans given current realities

iv) The identification and management of required and approved resources including staff.

V) The design, procurement, manufacturing/ construction and/or installation of plants, project, etc.

vi) Production of operational manuals (including technical, maintenance, safety and trouble-shooting)

vii) Test-run

viii) Commissioning and hand-over or change of management.

2.7 Production

This phase is actually outside the scope of projects because once a project has been completed, commissioned and management has changed, it transforms to be a PRODUCT. Production is simply the making of products. Production is included in the project life cycle here because of a more comprehensive treatment of life cycle, which some have claimed to be in three (3) or four (4) stages namely introduction, growth, maturity and decline stages. In the same vein, project management is actually expected to commence with authorization and end with implementation. However, applying the product life cycle to projects, there will be one more phase which is the divestment phase.

2.8 DIVESTMENT

Whether by way of product classification or from a comprehensive type 1 project sense, divestment is the phase where the project owner considers discontinuing with the project or transforming the project into another project. Divestment is the phase where the project has fulfilled its purpose and/or is no longer producing beneficial outcome. In the latter case, the marginal revenue falls lower than the marginal cost, such that the project

becomes unprofitable. At this stage, most project managers easily consider cost-cuts in order to turn-around the fortunes of the project. Where, however, this attempt fails, it could be a point for as restart or the start off of another project completely and the remaining resources reallocated/reassigned to other systems, projects, or supporting organizations.

Chapter 3

PROJECT COSTING

Project costing is the act of evaluating or summarizing the costs of the various components of a project. It is important for several reasons, three of which are:

a) Cost estimates determine the magnitude of the financial commitment into a project.
b) The relationship between a project cost and the financial involvement has reasonable impact on the successful or otherwise completion of the project.
c) Project failure can result from unrealistic cost estimates by causing cost over-runs.

One basic precondition to realistic cost estimate for a project is the comprehensive list or itemization of the components or resources to be used in the project. It follows that inaccurate or inadequate list of resources can lead to project failure because there will be unrealistic, inaccurate or under-costing of the project. The list of resources must cover both short-term and long-term resources, whether or not the project itself is a short-term or long-term project.

Project cost items can be grouped also into capital and operating or running resources. Even among these two

classes, there could be voluntary and mandatory costs. Hence, we conclude that project costs can be:

i) Short-term or long- term
ii) Capital or operating
iii) Voluntary or mandatory
iv. Direct or indirect

Mandatory costs refer to costs that are mostly exogenous to the project owner but must be incurred if the project is to be executed.e.g permits, levies, rates, insurance cover, EIA cost, etc.

Voluntary project costs are costs mostly within the manipulative powers of the project owner or implementer. All other non-mandatory costs, whether capital or running, are consumed or incurred voluntarily. The classification of project costs into direct and indirect is largely discretional. However, this classification unavoidably depends on the industry or sector where the project belongs, as well as on the type of projects themselves. For instance, a researcher must recognize the cost of transportation, and printing and administration of questionnaire (data gathering costs) as direct cost of the research project. This could be treated as indirect in a manufacturing project. It is therefore, advisable for project managers or owners to clearly define the rules for classifying project costs into direct and indirect as well as exceptions to the rule.

SOME COMMONLY USED COSTING TERMS

1. Direct cost, sometimes also called variable costs, are costs that are incurred as a result of the project tasks or attributed directly or relating to the activities of the project. They are sometimes referred to as variable because they depend on the magnitude of work or activity.

2. **Indirect Cost:** This refers to costs which cannot, or are difficult to, be attributed to a particular activity in a project. The claim for responsibility to an indirect cost is by different tasks, functions or departments. Since no particular activity or department can definitely generate indirect costs, the best way to assimilate or incorporate an indirect cost is by allocation or apportionment. And, because they do not change with change in the volume of operation of either the entire project or an activity, they are synonymous to fixed costs.

3. **Overhead Rule:** This is the ratio of a firm's expected total overhead expenses to expected direct cost. It is used to calculate the overhead recovery amount included in the price since direct costs are consummated by price.

4. **Below-the-line costs:** A generic name for allowances added to total basic cost estimate. They

include exchange rate differentials, provision for cost escalation, contingencies.

5. Cost escalation– increase in all costs above original estimates due to changes in prices of commodities generally.
6. General and administration costs - usually costs added to direct and below-the-line costs in recognition of head office inputs.
7. Labour Burden -cost of labour idle times paid by project manager unavoidably, e.g. wages and salaries paid for holidays and when workers are not engaged.
8. Materials Burden-provisional cost added to actual cost of materials bought for the project, such that the provision recovers purchases made administration.
9. Cost of sales-usually called above-the-line costs and is the sum of Direct Labour, Direct Material and Direct Expenses. But some times fixed indirect costs are also added.
10. Absorption costing- the method of apportioning indirect costs so that they form part of cost of sales.

FACTORS AFFECTING PROJECT COST

1. Size - i. The basis for cost analysis is to determine optimum operation

ii. Refers to capacity or volume of output.

iii. Determines the capacity to be installed

iv. It is important because of the difference between large capacity but varying scale of operation, and installing different machines with varying capacities.

2. Location - Generally, two locations can influence the cost of project, namely the source of inputs and the market place. Hence we could have cost of conveying inputs to the project site, cost of processing inputs, and cost of conveying the products to consumers/users.

TYPES OF ESTIMATES

1. BALL PARK ESTIMATES

These are estimates made blindly with vague outline information about a project. It is usually without detailed engineering data or details of work. It is also called ORDER-OF-MAGNITUDE or Rough Estimate. It is possible that there could be detailed information available but with no time to organize and draw-up proper estimation especially in emergency situations. Most times faint-idea or past experience (not necessarily similar) is used. On an

asymmetrical construct, this type of estimates might achieve ±25% - 35% accuracy.

2. APPROXIMATE ESTIMATES

This type is usually applicable to top-bottom planning hence is also known as Top-Bottom Estimates. It is also made without detailed information necessary for a more detailed estimate. It relies mostly on past records or information about previous projects similar to the one under consideration in scope and capacity. It uses more qualitative bases for estimation. Most times it is used to entice project promoters to embark on the project or even discourage them. This is because estimates are made by proportions or percentages of a previous similar project e.g. "50% cheaper than last year's". This is why it is also referred to as Analogical or indexed cost adjustment or COMPARATIVE ESTIMATES. Comparatively, proper estimates could be made after the commencement of the work, meaning that at inception there may not be reliable lists of inputs nor work schedules. The strongest elements used are ability to identify key elements, fairly grounded assessment of the degree of complexity and size, and access to cost and technical archives. Accuracy level is ±15%.

3. FEASBILITY ESTIMATES

These are near-definitive because there is a level of certainly in some aspects of project estimate. These

estimates are usually made after a reasonable pilot design, engineering specification, site data, quotations from potential supplier of major components of the project and initial schedules of work and supplies have been made. Confidence level is ±10%.

4. DEFINNITIVE ESTIMATES

This is also known as DETAILED ESTIMATE. These estimates are prepared from well-defined detailed engineering and commercial analysis, using professional quotations, fairly complete plans, specifications, and unit prices. Confidence or accuracy rate is about ±5%. This is best for construction or engineering projects. Most times this type of estimate is done when the project work has commenced. This is why it is best made from updating approximate or feasibility estimates routinely.

5. LEARNING CURVES ESTIMATES

These are graphical presentations of repetitive activities that can form part of the project in such a way that time and money can be saved. This is most common with commercial or manufacturing projects.

6. ESTIMATING MANUALS

These are standardized collections of estimating procedures and estimates developed and instituted by firms. This manual is used for costing and pricing better than industrial standards but not better than definitive estimate from where the estimate manuals emanate.

PROJECT COST ITEMS

Here, we refer to the specific expenditure heads or items that need to be estimated using any of the above-stated methods of estimation. Most times, these items appear in the project proposal or feasibility report and might just be a generic name covering various similar small items that might be immaterial if considered individually. The cost of an item, like any of the fixed assets, will be the summation of all acquisition and preparation costs (costs incurred to freight and set the assets in usable mode). This means that each asset total cost will be an embodiment of the total cash flow made before the usage of the asset. This will include the following

i) The purchase (market) price of the asset,
ii) The brokerage charges to acquire the asset,
iii) Freighting, transport, insurance charges,
iv) Installation, and
v) Change in working capital requirement directly relating to the asset.

Given the above, the following will constitute project cost items (though not limit to the list):

a) Land and Building
b) Plant and Machinery
c) Motor Vehicles

d) Furniture, Fittings and Fixtures
e) Equipment
f) Working Capital
g) Pre-operational Expenses
h) Other Overheads/Services/Utilities
i) Labour

In order to be sure of the quantum and costs of these project items, it will be necessary to know the shortest and longest time/scheduling of the project. And even after the drawing up the project plan and cost, there must be avenue for review from time to time. This could be as a result of price fluctuations or changes in the socio-economic conditions/assumptions premising the project plan.

PROJECT SCHEDULING

This refers to the logical chronological laying or listing of the actual activities of the project, in the order that they are to be performed

PROJECT SCHEDULING METHODS

The essence of project schedule is to optimize the utilization of the 5Ms so that the project cost will be minimal while maintaining the quality of the project and maximizing the returns from the project. This could be another way of optimizing the total project completion time after a very clear pictorial presentation of the activities of the project.

Note that in a way to optimize the project time, there are normal and crash times. NORMAL TIME of an activity is the time of completion beyond which any increase is not likely to result in cost reduction. CRASH TIME of an activity is the completion time which cannot be reduced any further even if there are chances that a reduction could be compensated by an increase in costs due to the quest for speedy/earlier completion of the activity. This means that for proper scheduling or crashing, a proper analysis of the time-cost relationship should be made as shown in figure 3.1 below.

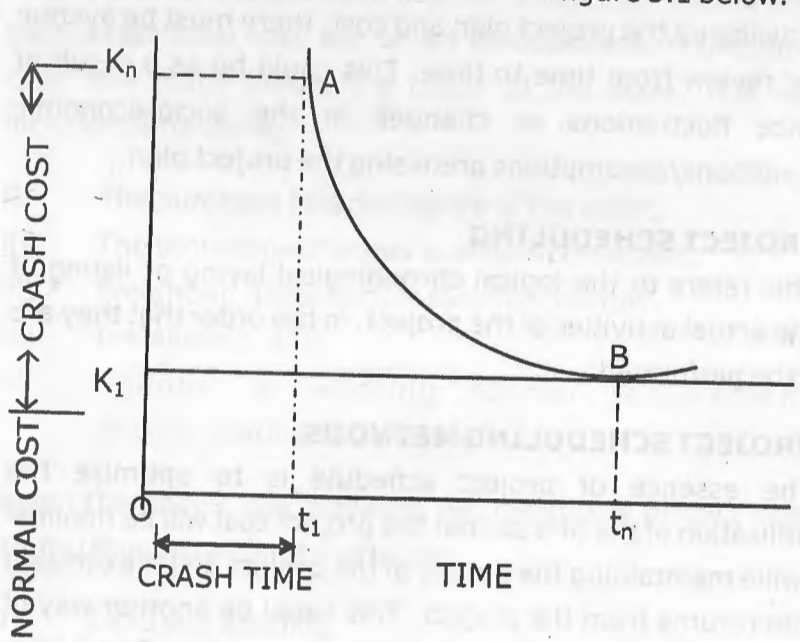


Figure 3.1

In figure 3.1, time cannot be reduced below Ot_1, which is the CRASH TIME. At this point anywhere from A upward the time-cost curve will be parallel to the cost-axis. By extending t_1 to meet the curve on the vertical side will determine the CRASH TIME. Similarly the Normal Time will be Ot_n and by extension from point B to the cost-axis will give the NORMAL COST. Anywhere from point B (or Ot_n) the curve will be straight and parallel to the time-axis. The slope of the curve is called COST-SLOPE and is given as:

$$\frac{\text{CRASH COST - NORMAL COST}}{\text{NORMAL TIME - CRASH TIME}}$$

CRASHING, as distinct from Crash, means the reduction of project completion time with the aid of reducing the time of one or more activities contained in the project.

METHODS OF PROJECT SCHEDULING

There are two (2) basic methods of project scheduling namely charts and networks. There are however, various brands of each of these methods as shown below

A ***CHARTS***

I GANTT CHART

The most popular chart used in scheduling and project planning is the GANTT CHART which is a horizontal bar chart where time for each activity is shown on the X-axis while the Y-axis represents the activity. The life span of the

project therefore is from the beginning of the first bar to the end of the longest or the last bar. It is possible that some bars will be preconditional to some other bars, meaning that the preceding activities must be performed before the following or dependent activity. It follows that certain activities could be overlapping (completely or in part) or subsumed in a preceding activity.

EXERCISE 3.1

Given the 1st assignment on the building and equiping of the modern library for your LGA chairman in your village, plot the bar chart showing the activities and their time span.

(b) How long from the chart do you think the project would effectively last.

EXAMPLE 3.1

A project has the following activities with respective time and precedence relationship between the activities. You are required to draw up a Gantt chart and to state the comprehensive completion time.

Activity	I	II	III	IV	V	VI	VII	VIII
Preceeding Activity	None	None	I+II	II	III	II+III	VI	VI
Time (days)	35	15	20	15	10	25	15	20

SOLUTION 3.1

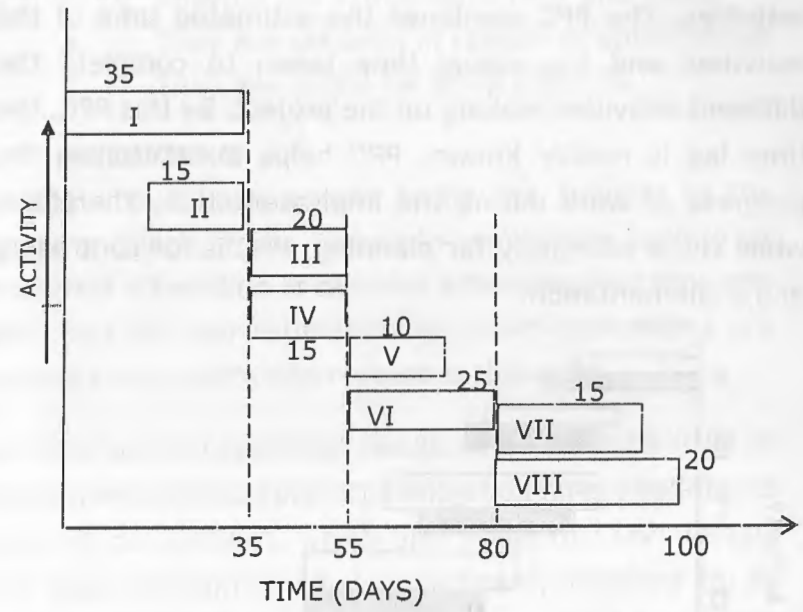


Fig. 3.2: Gant Chart

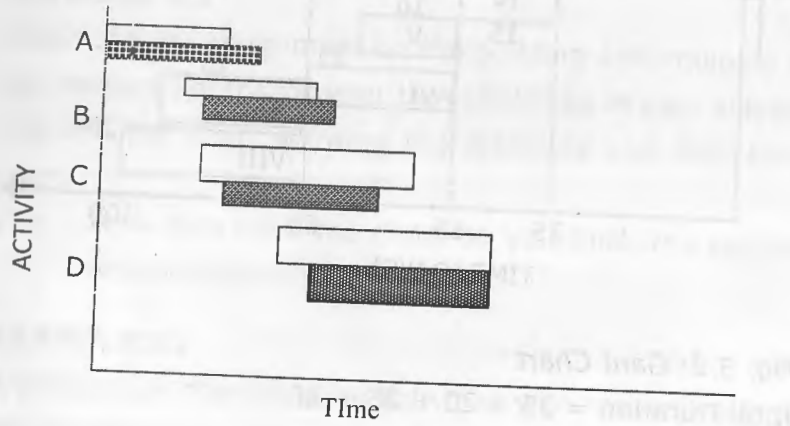
Total Duration = 35 + 20 + 25 + 20

= 100 days

II PROGRAMME-PROGRESS CHART (PPC)

While a Gantt chart is for the proposed activities that aid the estimation of the project's time duration as well as the logical sequence of operation of the activities involved in the proposed project with a demonstration (pictorially) of the interrelationships between the these proposed activities, a Programme-Progress Chart in addition to being

like a bar chart, shows the actual progress of the different activities. The PPC combines the estimated time of the activities and the actual time taken to complete the different activities making up the project. By this PPC, the time lag is readily known. PPC helps in controlling the progress of work during the implementation. Therefore, while GC is outrightly for planning, PPC is for controlling and implementation.



NOTE: ▭ Estimate Time/progress ▩ Actual Time/Progress

Fig. 3.3 Programme-Progress Chart

Difficulties of Bar Charts

1. If there are many adjustments/changes, bar charts become handicap
2. Bar charts are easily forgone with changes between plans and implementations

3. They do not synchronize time and costs
4. They are deficient in resources optimization
5. They are useful for small projects.

B. NETWORKS

Networks have been proven to be the solution to the defects of Gantts charts. Networks provide the avenue for the correct scheduling of complex activities given time and costs, so that over-estimation or under estimations are avoided, hence optimizing resources allocation.

Note that under-estimation results in TIME OVER-RUN (a situation where actual project completion time > estimated period of completion), which also leads to COST OVER-RUN. Cost overrun is what is ordinarily referred to as variations, which if not provided for can lead to project abandonment.

Network diagrams do not use scale (as in Gantt Charts). Network diagrams are logical sequencing and juxtapositioning of the various project tasks. Network diagrams give a more comprehensive notation (though not on timescale as applicable to the Gantt Charts) of all the logical interdependencies between different jobs or different aspects of the project(s), thereby eliminating logical mistakes. These interdependencies between events and activities are clearly identified by network diagrams which aid the development of a master plan that provides

an up-to-date picture of the operations at all times as well as being understood by everybody. By this, information about planning, integration of plans, time series, scheduling and resources management are easily provided.

Methods of Drawing Networks

There are two (2) ways networks are drawn, namely:

(a) Activity-on-Arrow notations, and

(b) Activity-on-Node notations

Activity-on-Arrow notation is the method of drawing network by which arrows are used to represent the work (activity or task) to be done and the events are shown as circles. The arrows are labeled with capital letter alphabet, while the circles are labeled with arabic numbers. In computer language, the events are BINARIES. In this chapter the explanations on networks are mostly based on the Activity-on-Arrow notations while in practice Activity-on-Nodes notations are mostly used. Activity-on-Node notation, on the other hand, is the method by which works or activities are shown in Boxes called NODES, while arrows are used to show the sequence of activities. In this case, events are not shown except where they (events) will be used as indicators of MILESTONES (particular points in the project work where significant activities have been accomplished).

The two (2) methods are shown below in figure 3.4(i) and (ii).

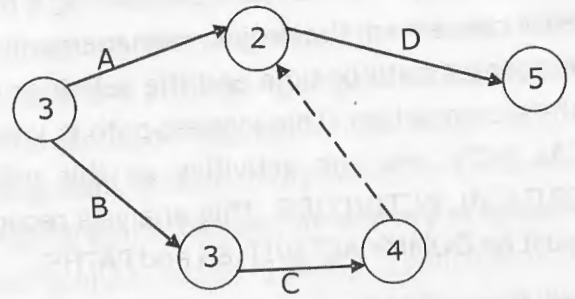


Fig. 3.4(i) Activity-On-arrow Notation

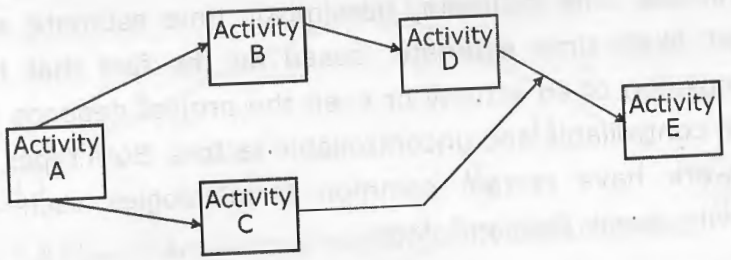


Fig. 3.4 (ii) Activity-on-Node Notation

TYPES OF NETWORK

I CRITICAL PATH ANALYSIS

II PROGRAMME EVALUATION REVIEW TECHNIQUES (PERT)

These two types of network are very similar and developed almost at the same time in history. Critical Path Analysis (CPA) was developed by M.R. Walker and J.E. Kelly in Europe in 1957, while Programme Evaluation Review Technique (PERT) was developed by the United States of

America Navy in 1958. CPA uses an optimistic approach to show the different paths and time of completing a project. As far as CPA is concerned, the project management should focus on the longest path or time and the activities on the longest path to completion. This longest path is known as the CRITICAL PATH and the activities on this path are known as CRITICAL ACTIVITIES. This analysis recognizes that there must be DUMMY ACTIVITIES and PATHS.

On the other hand, PERT uses three time estimates to complete a project. These three time estimates are optimistic time estimate, pessimistic time estimate and most likely time estimate, based on the fact that the completion of an activity or even the project depends on both controllable and uncontrollable factors. Both types of network have certain common terminologies such as activity, event, float and slack.

An ACTIVITY refers to any identifiable job or task or time difference between two events in a project that occur or take place in successive (ie. one after the other) manner. An activity consumes the 5Ms, has a definite beginning and a definite end, and is shown by a straight arrow line that has circles at the two ends, especially with CPA as shown below.

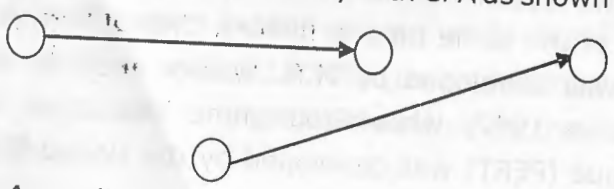


Fig. 3.5 Arrow lines

It is therefore the work required to move from one event or point in time to another. Most often, the direction of the arrow shows the direction of the movement (called Flow) of the events or the project. Again, the direction is from left to right. The circle on the left of the arrow line shows the beginning point of the activity while the circle to the right is the finishing point. Usually, an activity is symbolized by an Alphabet (capital letter A, B, C,...) which is written above the arrow line, and the duration of the activity is written below the arrow line as shown below.

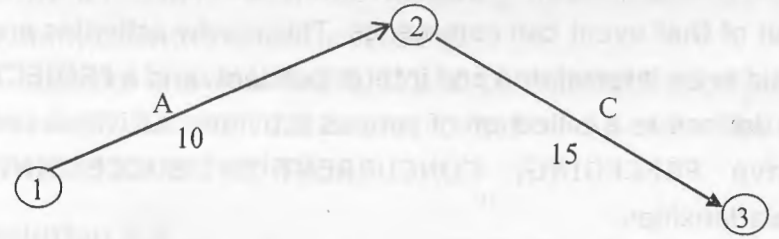


Fig 3.6 Flow of Arrow lines showing activities of events.

In the above, two activities are displayed (A and C) with circles, 1 and 2 showing the starting and ending of activity A, while circles 2 and 3 show the starting and end point for activity C. Activity A has 10 days duration, while activity C has 15days. It is worth noting that the circles are also known as NODES and the arrows ARCS.

An EVENT is the beginning point or the ending point of an activity and is shown as a circle at the two ends of an activity (arrow line). It is also known as NODES and is

usually numbered (1, 2, 3...) sequentially. Since it is not an activity, it does not consume any of the 5Ms. Sometimes, the node that indicates the commencement of an activity or that appears at the tail of the arrow line is called I-node, while the event at the arrow head is the J-node. This is why arrow-networks are sometimes referred to as "IJ Networks". Since they are numbered sequentially and systematically, an event cannot be taken as complete or achieved until all the activities leading into the event have been completed. It is at this point that any activity leading out of that event can commence. This is why activities are said to be interrelated and interdependent, and a PROJECT is defined as a collection of various activities. Activities can have PRECEDING, CONCURRENT or SUCCEEDING relationships.

A preceding relationship exists between activity A and B if activity A must be completed and leading to the starting of activity B. If activity B and activity A can be carried out at the same time without either affecting the other, then activity A and activity B have a concurrent relationship. Just as activity A precedes activity B earlier, activity B and activity A have a succeeding relationship in the sense that activity B succeeds activity A.

Sometimes, there could be activities in a network that are imaginary (not real activity), and do not consume any of

the 5Ms, but is only incorporated in the network for the maintenance of logical flow and elimination of ambiguity in the network. This kind of imaginary activity is known as DUMMY ACTIVITY. Dummy activity is shown as a dotted or broken arrow line with I-node as well as J-node. Dummy activity arrow line can move from top to bottom, bottom to top, straight vertical, slanting forward and/or slanting backwards

Example 3.2

Draw a network with the following information, using dummy activities where necessary:

A precedes a concurrent B, C and D. Activity F succeeds Activity D. Activity E follows Activities B and C. Activities E and F are the last activities.

Solution 3.2

If the activities are plotted in a network without any dummy activity, then the network will appear thus:

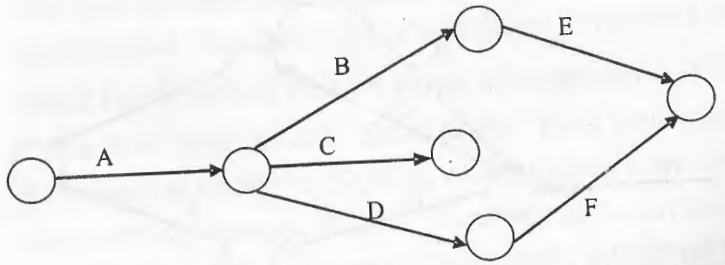


Fig 3.7 Incomplete Network showing preceding, concurrent but without Dummy activity, and succeeding activities

From the above it is clear that Activity C has no succeeding activity and that Activity E succeeds only Activity B which is wrong.

If a dummy activity is introduced for B and C then the network will be as follows:

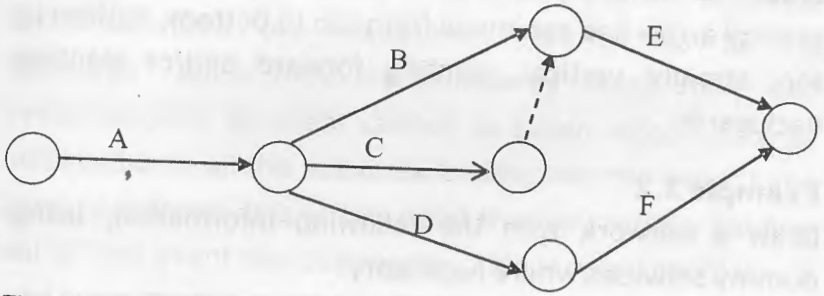


Fig 3.8 Network with Dummy Activity

The dummy activity arrow heads upward, but this is actually of no significance. That is the dummy activity arrow could run from top to bottom so that the network will be like.

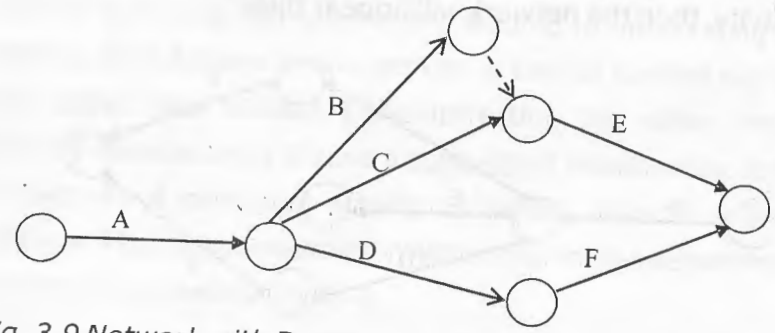


Fig. 3.9 Network with Dummy Activity arrow pointing down

FLOAT is the Free Time available for an activity or a project to be completed. It is also known as SLACK to an extent especially when referring to events. It is the extra time within the critical time of completing an activity or project which will not cause a delay in the scheduled completion time. Most times, floats are seen as provisional free times that can cause, or that can occur when, an activity is not started at the EARLIEST POSSIBLE START TIME but will not affect the LATEST POSSIBLE END TIME of a task or project. Float can easily be noticed with NON-CRITICAL ACTIVITIES. Note that Non-Critical Activities are activities that lie on other paths apart from the critical path. This means that activities with float have elastic time or latitude, and these latitudes or elastic time within which delay can be allowed without delaying the longest completion time is what is called FLOAT. In networks, as will be seen later, where the Earliest Start and the Latest Start times are the same for an activity or task, then that activity or task has no float and is taken as a critical activity. Another way to identify float is to use the Earliest Start Time (TE) and the Latest End Time (TL) for an event in a network. If $TL \neq TE$ then a "free time" exists. Specifically "Free Time available" in an event is known as SLACK, whereas free time available for an activity is called FLOAT. This means that an event will have only one (1) estimate of slack which will either be zero (0) or a value. The advantage of studying Activity Float Analysis will include:

1) It is a means for providing for any delay whether for scheduling, rescheduling or proper assessment and assemblage of resources, without affecting completion time. This means that critical completion time (or Latest End Time) will be the sum of scheduled time and float time.

2) It implies that critical tasks or activities must be managed to be within the scheduled time, by either adjusting (mostly by increasing) the resources applicable or working overtime reasonably without affecting the work plan.

3) It means that all members of the project team must ensure that float times are maintained or used as feel-gap measures (i.e. reserves against unforeseen).

4) Overall the analysis or the study contributes to better control of project implementation and allocation of available resource.

TYPES OF ACTIVITY FLOAT

There are basically three types of activity float based on estimation of float. These are Total Float, Independent float and Free Float.

TOTAL FLOAT(TF) is the maximum amount of time an activity or task can be delayed if all the activities/tasks preceding it are implemented, executed or completed at their earliest possible end time but the activities/tasks succeeding it are allowed to wait or delayed until their latest permissible start times, and so the delay does not affect the project completion time. When an activity/task is delayed by a total float time that activity becomes a critical activity and consequently all activities following that activity and lying on the completion path are known as critical activities.

Total Float is calculated as follows:

Total Float (TF) of an activity = Latest permissible End Time (TL) minus the Earliest possible Start Time (TE) minus Estimated duration of Activity (t).

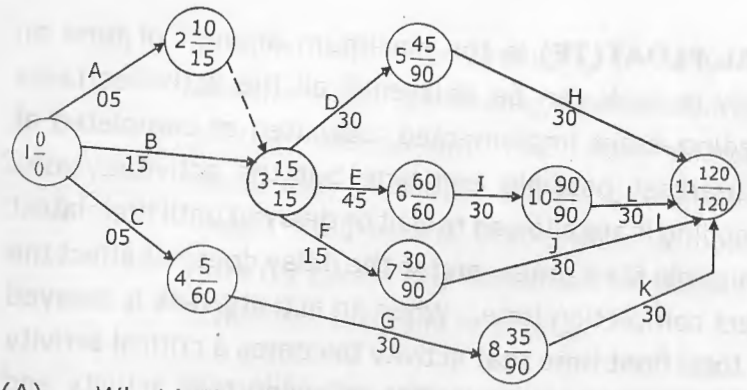
i.e. for activity denoted as mn

$TF_{mn} = TL_n - TE_m - t_{mn}$

If the Total Float is completely used in activity (say mn), then the completion time for activity mn will be delayed by TF, making the TL_n (latest permissible end time) to be TF plus t. This will invariably make the TL and TE of the event at the head of the mn activity to be equal. [See example 3.3].

Example 3.3

A schedule of activities relating to a Project is as shown in the network below:



(A) What is the critical path?

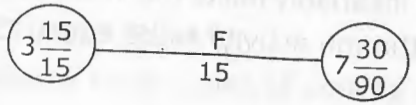
(b) Calculate the TE and TL of activities F and G.

(c) Calculate the Total Float of activities F and G

Solution 3.3

(a) The Critical Path in Forward Pass activity-on-arrow network is the set of activities whose Earliest possible Start Time (TE) and the Latest permissible End Time (TL) at each event are equal or the same. This occurs on the set of activities B, E, I, and L where the TE and TL are equal at events 1, 3, 6, 10 and 11.

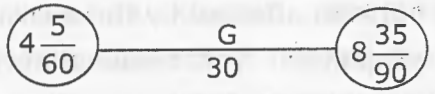
(b) Activity F can be extracted and shown as



Here, $TE_f = 15$

$TL_f = 90$

Similarly, Activity G will be



$TE_G = 5$

$TL_G = 90$

(c) Total Float of Activity F$(TF_F) = TL_F - TE_F - t_{3,7}$

$= 90 - 15 - 15 = 60$ days.

This means that the start of Activity F can be delayed for 60 days to 15 + 60 = 75 days but still be completed in 15 days to make 90 days (which also is the difference between the Earliest End Time of 30 days and the Latest End Time of 90 days). The latitude here is 60 days.

Similarly, Total float $(TF_G) = TL_G - TE_G - t_{4,8}$

$= 90 - 5 - 30 = 55$ days

In this case, the latest completion time (60) for the immediately preceding activity was different from its Earliest completion time (5), and this has to extend to activity G.

INDEPENDENT FLOAT, on the other hand, refers to the amount of spare time available for an activity to start as late as permissible but ends as early as possible. The activity will be started as late as permissible because the activities preceding that activity were completed at the most delayed permissible completion time. It means that the spare time does not affect the earliest possible start

times of the activities following that particular activity and that the activity is not also affected by the available time with respect to its completion. This means that the spare time is completely independent of all surrounding activities or tasks.

Mathematically, Independent Float (IF) is given as:

$$IF_{mn} = TE_n - TL_m - t_{mn}$$

Where IF_{mn} = Independent Float

TE_n = Earliest possible Start Time of the event at the arrow head

TL_m = Latest permissible End Time of the event at the arrow tail

t_{mn} = Duration of the Activity

Note that it is possible to actually have a negative value for IF_{mn}, but floats are not expected to be negative, therefore such negative values are taken as **Zero Floats**. In reality, however, both negative floats and zero floats can occur. **NEGATIVE FLOATS** can be caused by the imposition of impossible target end times, which can be longer than the time allowed by the target completion date. For instance, in a bite to reduce the completion time, project implementer can decide to set a shorter target time than earlier programmed. This can cause some unnecessary hurriedness by which mistakes are made and in an effort to

correct the mistakes the project or task or activity completion time is exceeded. Negative floats can occur because of the euphemism created by float which makes progress in the project implementation to be delayed, thereby making some activities to be completed after their latest permissible end times. Sometimes, negative floats can result from inadequate resources which make some activities not to be completed at scheduled dates or times. **Zero Remaining floats** are the floats in activities yet to be executed in a project and which must be adequately, precisely and conscientiously managed because of their critical nature.

Example 3.4

Using the network in example 3.3 above, identify the independent floats from Activity A to G.

Solution 3.4

Calculation of Independent Float

Activity	TE_n	TL_m	t_{mn}	Independent Float
A	10	0	5	10 - 0 - 5 =5
B	15	0	15	15 - 0 - 15 = 0
C	5	0	5	5 - 0 - 5 = 0
D	45	15	30	45 - 15 - 30 =0
E	60	15	45	60 - 15 - 45 = 0
F	30	15	15	30 - 15 - 15 = 0
G	35	60	30	35 - 60 - 35 = 0*

FREE FLOAT is the spare time available in an activity by which the activity can be delayed but the delay will not affect succeeding activities on the path of the activity. It is the available amount of time in an activity by which if all preceding activities are accomplished at their earliest possible time (TE_m), the succeeding activities can still be completed in their earliest end times (TE_n). By this therefore a relationship between the TE at the arrowhead and the TE at the arrow tail is drawn.

Mathematically, $FF_{mn} = TE_n - TE_m - t_{mn}$

Example 3.5

From the network in example 3.3, calculate the free float of activities A to G.

Solution 3.5

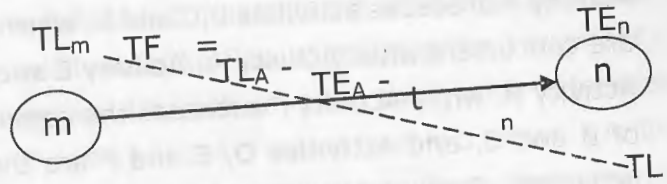
Calculation of Free Float

Activity	TE_n	TE_m	t	Free Floats
A	10	0	5	10 - 0 - 5 =5
B	15	0	15	15 - 0 - 15 = 0
C	5	0	5	5 - 0 - 5 = 0
D	45	15	30	45 - 15 - 30 =0
E	60	15	45	60 - 15 - 45 = 0
F	30	15	15	30 - 15 - 15 = 0
G	35	05	30	35 - 5 - 30 = 0

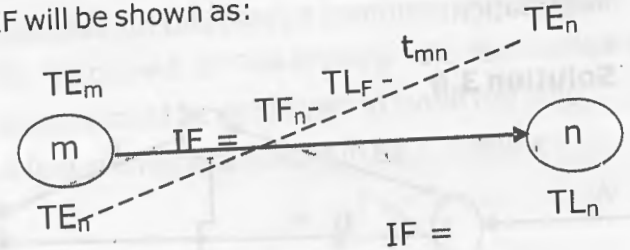
In summary therefore,

(i) Total float relates TE_m to TL_n
Independent float relates TL_m to TE_n
Free Float Relates TE_m to TE_n

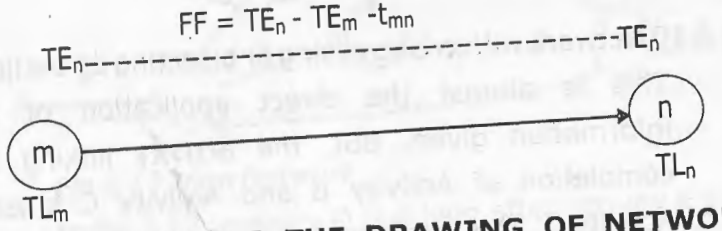
(II) Diagrammatically, TF will be shown thus:



IF will be shown as:



Free Float (FF) will be shown as:



RULES GOVERNING THE DRAWING OF NETWORK DIAGRAMS

1. All arrow lines, representing activities, point towards and move from left to right
2. Arrow lines do not intersect or bisect each other. This means that activities cannot criss-cross or overlap each other's path.

Example 3.6

Activity A precedes activities B,C and D, which three are concurrent after Activity A. Activity E succeeds Activity B, while Activity F succeeds the completion of B and C, and Activities D, E and F are the last activities. Draw up a network from the above information.

Solution 3.6

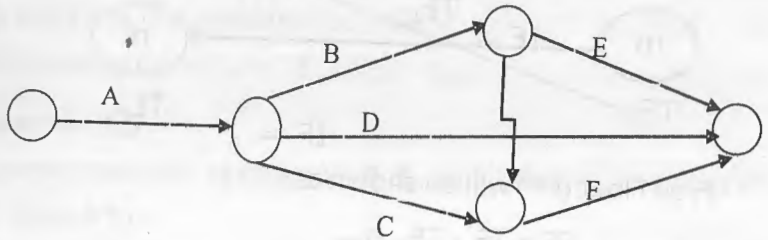


Fig 3.10 Network with crisscrossing or bisecting arrow lines

This is almost the direct application of the information given. But, the activity linking the completion of Activity B and Activity C crosses Activity D. This crisscrossing is not possible and not allowed. The implication is that the network can be drawn differently as follows:

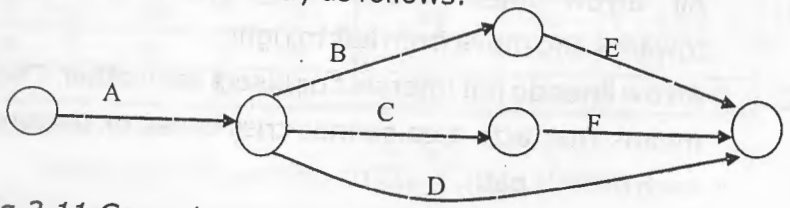


Fig 3.11 Correct version of fig. 3.10

3. Activity arrows do not form loops. If a loop occurs in a network it means there is an error and that there will be circular flow of activities for a segment of the project that will not allow the J-node to be reached. One way of the creating loop in a network is illogical numbering, especially when the project is large and complex. In this case, a computerized network could be employed or Fulkerson's rule for numbering of events could be employed to avoid the loop.

A loop network can be as in fig 3.9 below

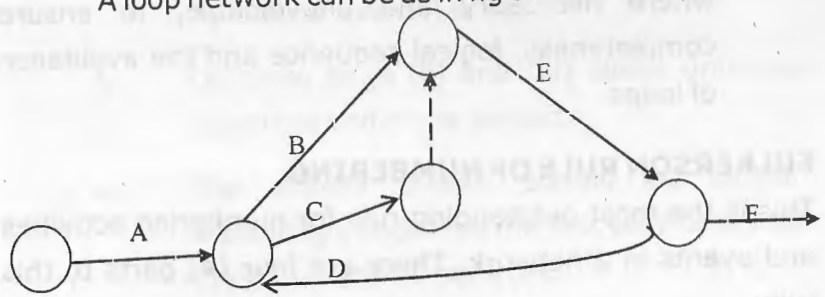


Fig 3.12 Loop Network

In fig 3.12, activity D is a loop after activity E such that activity F cannot be reached to end the project. It will then be that instead of activity E to empty into activity F, it loops back to activities B and C through activity D, hence forming circular flow. A loop network means a circular unending flow. Ordinarily, this is seen as impossible since a project is a set of activities that involve the use of input to achieve set objectives/target (in the form of output). A loop

therefore would mean continuous flow. Loop can be avoided by strictly following the logical chronological sequence of activities especially for small projects. Another way to avoid loop is to dutifully number the events and label the activities accordingly using dummies where necessary. Finally, loop can be avoided by applying systematic methods such as the use of computers.

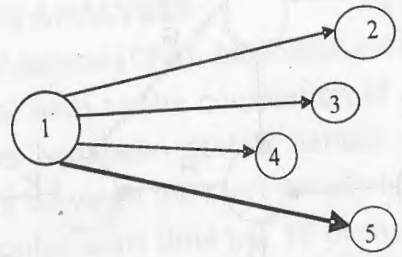
4. Dummy activities should be used in the network where necessary and unavoidable, to ensure completeness, logical sequence and the avoidance of loops.

FULKERSON RULE OF NUMBERING

This is the most outstanding rule for numbering activities and events in a network. There are four (4) parts to this rule:

i. All initial or commencement events are numbered "1". An initial or commencement events is an event that has no preceding event or activity but from where succeeding events or activities emanate.
The numbering of a commencement events as (1) is only applicable to Activity-On-Arrow notations.

ii. Number the next set of events at the end of the activities from (2), (3), (4) to (n), from top to bottom of the network.



iii. Remove the arrow lines emanating from (1) and start the next arrows (activities) in their logical forms beginning with the lowest number of event (i.e. (2).

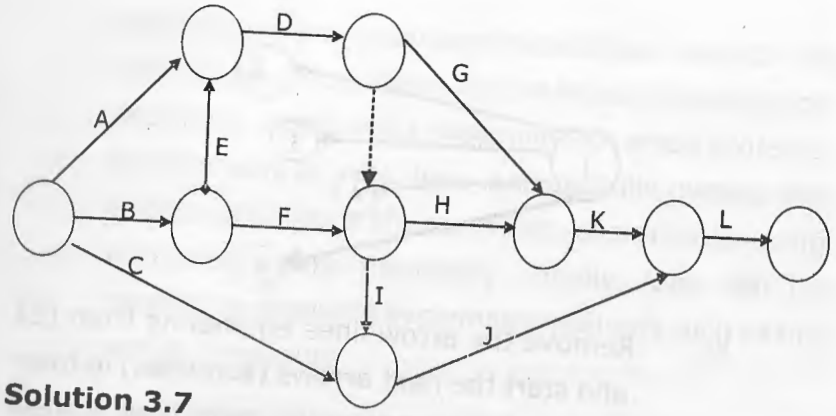
iv. Continue as in (ii) and (iii) above until you reach the end of the project

v. The activity arrows should be labeled accordingly such that the first set from event (1) should start from A to D.

Example 3.7

Answer the questions below from the following network diagram.

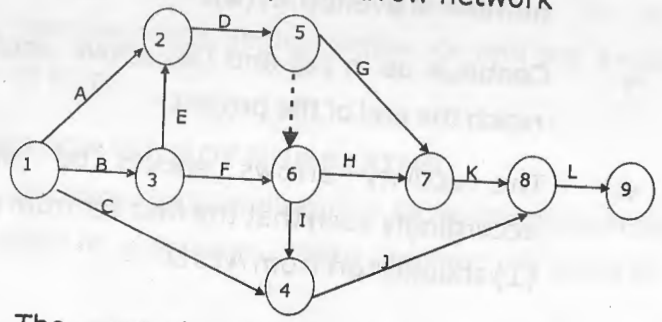
(a) What kind of notation is the network
(b) Assign numbers to the events
(c) Convert the network to the second kind of network



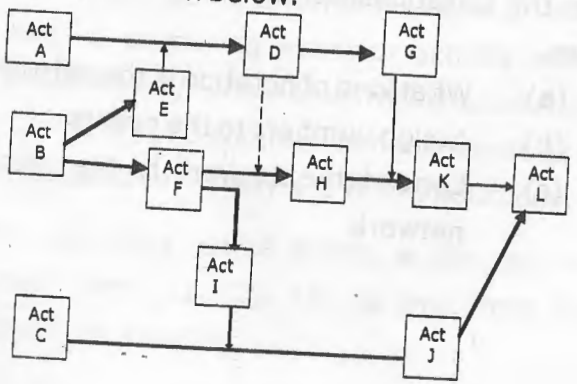
Solution 3.7

a) This is an Activity-On-Arrow network

b)



C) The second notation is the Activity-On-Nodes network as shown below.



CRITICAL PATH ANALYSIS

In Critical Path Analysis (CPA), networks are used to decide the most critical path to the completion of a project. The critical path, as had been stated earlier, is the longest duration or time between the start time (most times called the earliest possible start time i.e. TE of the first event) to the end time (that is the latest permissible end time, TL, of the last event). The CPA helps to identify the activities that will be used to decide the completion/finish date of a project. The importance of this exercise is to guide the project implementer or project manager on the management of available resources. Where the project manager/implementer is different from the project owner, such as in construction contracts in Nigeria, the project manager/implementer can use the critical activities and the activities' floats to manage the project better than the original submission/bill of quantity or proposal. This does not mean that after the proposal and the scheduling that produced the critical path, that the scope and priorities will not change with realities on ground. However, to avoid time wasting as a result of incomprehensive plan that will give rise to changes in scope because project owner or designer/planner forgot certain activities, enough time and attention should be invested into the planning stage by project owner or planner. Again to avoid over-bloated cost because of changes in priorities, project owners and

planners should have detailed amount of resources available before embarking on the project. This will also help to avoid "biting more than can be chewed" and consequent abandonment of the projects.

In critical path analysis, a comprehensive schedule that can produce a critical path network can be developed in two (2) ways namely.

(a) Identify and build the schedule beginning from the end of the project and then working backwards until the starting point or activity(s) are reached.

(b) Begin with the starting point and work to the end. This second is the commonest of the two ways.

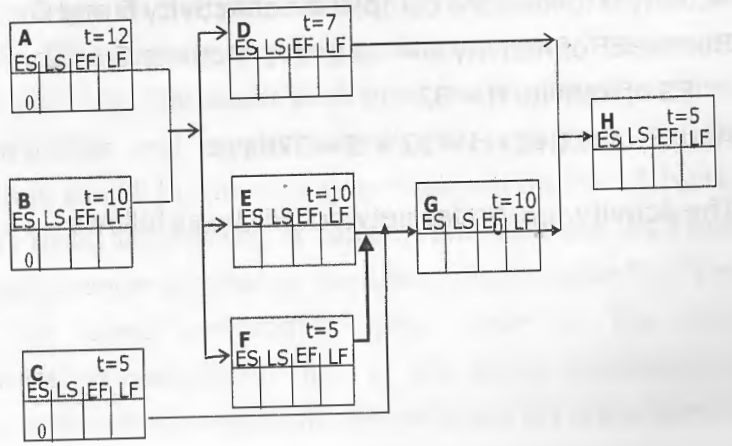
And, the critical path in the network can be computed either by FORWARD-PASS or BACKWARD PASS. The difference between these two computations is the existence of floats, whether total, independent or free float. A FORWARD-PASS is made by computing the length of time between the earliest start time of activities and the earliest end time of the activities. That is to obtain the earliest start times of all activities at every event so that the earliest end time or duration is obtained. Note that the earliest start time of an activity will be the latest finish time of the preceding activities to that particular activity being considered. It

follows therefore that where 2 or more activities precede an activity, the activity with the greatest time will determine the earliest start time of the following activity. For example if activities A (10 days), B (12days) and C (8 days) must be completed before activity D (20days). The earliest start time for activity D will be 12 days while the earliest end time will be 32days.

It therefore means that it is the method of computation that begins from the initial event and moves towards the final events, such that the earliest start time of all events is obtained.

Example 3.8

Find the earliest possible start time (TE) for all the activities in the following network, where ES = Earliest Start Time; LS = Latest Start Time; EF = Earliest Finish Time; LF = Latest Finish Time; and t = duration.



Solution 3.8

ES of Activity A = 0

EF of Activity A = 0 + 12 = 12

ES of Activity B = 0

EF of Activity B = 0 + 10 = 10

ES of Activity C = 0

EF of Activity C = 0 + 5 = 5

Activity A, B, and C are concurrent and precede D, E and F.

Therefore the earliest start (ES) for Activities D, E and F = 12

EF of Activity D = 12 + 7 = 19

EF of Activity E = 12 + 10 = 22

EF of Activity F = 12 + 5 = 17

Activity G is preceded by Activity E, F and C

The greatest Finish Time is with Activity E = 22

Therefore the ES of Activity G = 22

EF of Activity G = 22 + 10 = 32

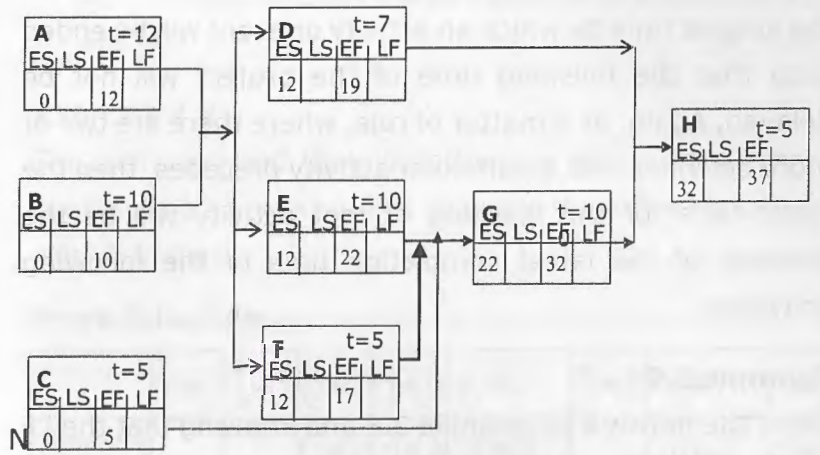
Activity H follows the completion of Activity D and G

But the EF of Activity D = 19 and for Activity G = 32

∴ ES of Activity H = 32

And EF of Activity H = 32 + 5 = 37days

The Activity -on-Nodes network will be as follows



ES = TE_m = Earliest Start Time

EF = TE_n = Earliest End Time

LS = TL_m = Latest Start Time

LF = TL_n = Latest End Time

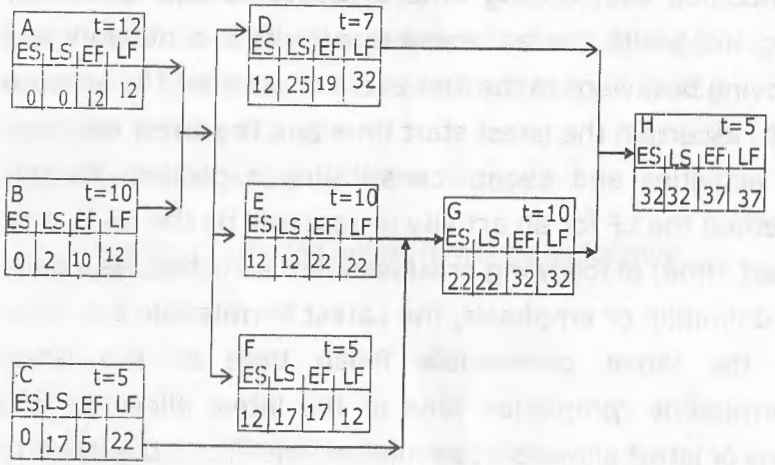
A BACKWARD PASS computation is the method that is concerned with ending time of activities and events by beginning with the last event or activity in a network and moving backward to the first event or activity. The essence is to ascertain the latest start time and the latest end time of activities and events constituting a project. By this method the LF for an activity or task will be the LS (Latest Start Time) of following or subsequent activities. As a point of definition or emphasis, the Latest Permissible End Time or the latest permissible finish time or the latest permissible completion time or the latest allowable end time or latest allowable completion time (TL) is the latest or

the longest time by which an activity or event will be ended such that the finishing time of the project will not be delayed. Again, as a matter of rule, where there are two or more activities that a particular activity precedes, then the latest time for the finishing of that activity will be the smallest of the latest completion time of the following activities.

Example 3.9

Using the network in example 3.8 and knowing that the LF of the final event or activity and by extension and completion time of the project is 37days, find all the latest permissible end time and the latest permissible start time of all activities.

SOLUTION 3.9



b) The critical path will be made up of Activity A, E, G and H.

Exercise 3.2

The activities and their durations as well as the events constituting a project are as shown in the following table or work schedule.

Work Schedule

Activity	①→②	①→③	②→④	③→⑤	④→⑥	⑤→⑥	⑥→⑦	⑤→⑦
Proceeding Activity	-	-	①→②	①→③	①→③ & ②→④	③→⑤	④→⑥ & ⑤→⑥	③→⑤
Duration (Days)	5	15	4	6	10	5	8	14

(a) Construct on activity-on-arrow network
(b) What are the critical activities?
(c) Determine the latest start time of the project
(d) Calculate all total floats
(e) Calculate all independent floats
(f) Calculate all free floats

PROGRAMME EVALUATION AND REVIEW TECHNIQUE (PERT)

In planning the possible or permissible duration of a project, attention must be paid to the planning environments likely to influence the project. In as much as

there are uncontrollable environmental factors outside the manipulative reach of the project owner or implementer, estimating the longest completion time as have been seen under the critical path analysis (CPA) method of scheduling might be faulty. This is because the CPA uses one time estimate, and does not make provision for unforeseen external factors. Where external environmental factors are considered in estimating the completion time of a project or activity, three (3) time estimates will be made namely:

(i) Most optimistic time estimate
(ii) Most likely time estimate
(iii) Most pessimistic time estimate

Therefore, Programme Evaluation and Review Technique (PERT) is a type of network analysis which uses the features of the CPA and in addition makes provision for doubtful project or activity completion time. PERT networks use probability techniques in calculating the activity completion time, on the assumption that if mistakes or errors are made, such mistakes or errors will fall within a normal distribution curve.

By this therefore the completion time of any activity in a network (project) is calculated as:

$$te = \frac{t_o + 4t_m + t_p}{6}$$

Where te = Expected time estimate
to = Most optimistic time estimate
tm = Most likely time estimate
tp = Most pessimistic time estimate

t_o is the shortest possible time within which an activity will be completed given that the conditions for the execution of the activity are normal, realistic and ideal.

t_m is the possible time of completing an activity under normal conditions such that the duration will be between t_o and t_p.

t_p is the maximum possible time for the finishing of an activity given the worst unfavourable conditions. In this case, such unfavourable conditions that can lead to delays, rescheduling and re-planning are taken into account before arriving at the most pessimistic time (t_p). However, unavoidable conditions like flooding, heat-waves, earthquakes, workers' industrial disputes/strikes and wild fire are excluded.

The calculation of te is done for all activities constituting the project before using the expected time estimates (te) to calculate the TE_m, TE_n, TL_m, TL_n,TF, IF, and FF associated with the project. The calculation of TEs and TLs can also be done on activity basis or on event basis, using the forward-pass and backward-pass computations. Finally, from the

network so drawn, a critical path (and by extension the critical activities) can be determined.

Example 3.10

A building project has the following components with the corresponding most optimistic time, most pessimistic time, and most like time of completing the components

Activity	Proceeding Activity	Most Optimistic Time (t_o)	Mostly Likely Time (t_m)	Most Pessimistic Time (t_p)
A	-	6	7	8
B		7	8	9
C	A	5	7	9
D	B	3	5	7
E	C & D	4	7	10
F	C & D	6	6	12
G	E	8	7	12
H	E	10	8	12
I	F & H	10	9	14

Note: Activity G and I are the last activities that end up in the last event.

(a) Calculate the expected completion time of each activity.

(b) Draw a PERT network

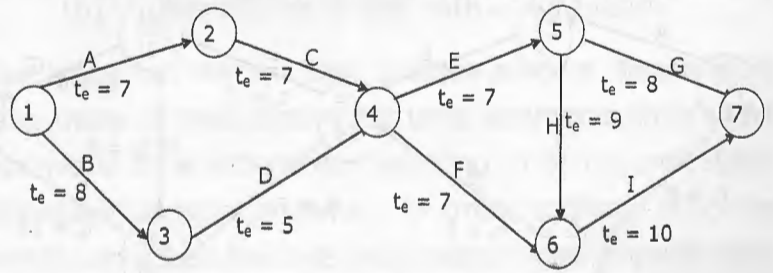
(c) Determine the critical path

Solution 3.10

(a) Expected Completion $(t_e) = \dfrac{t_o + 4t_m + t_p}{6}$

Activity	t_o	t_m	t_p	t_e
A	6	7	8	7
B	7	8	9	8
C	5	7	9	7
D	3	5	7	5
E	4	7	10	7
F	6	6	12	7
G	8	7	12	8
H	10	8	12	9
I	10	9	14	10

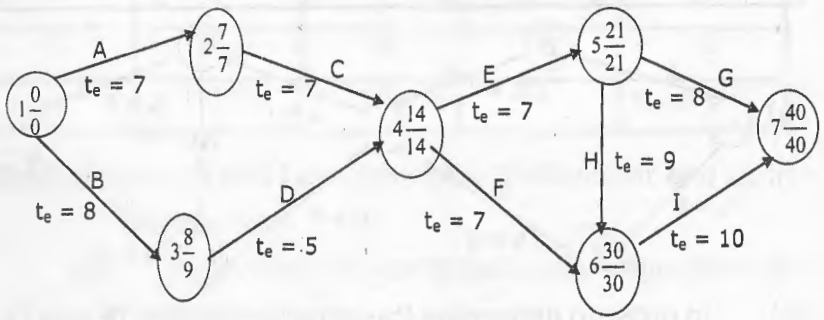
(b)



(c) In order to determine the critical path, the TE and TL for the activities must be obtained by means of Forward-Pass and Backward-Pass computation as follow:

COMPUTATION OF TEs AND TLs

Activity	TEm	TLm	TEn	TLn
A	0	0	0 +7 = 7	7
B	0	1	0 + 8 = 8	9
C	7	7	7 + 7 = 14	The smallest TL mof E and F = 14
D	8	9	8 + 5 = 13	The smallest TL mof E and F = 14
E	The longest TE n of C and D = 14	14	14 +7 = 21	The smallest TL mof G and H = 21
F	The longest TEn of C and D = 14	23	14 + 7 = 21	30
G	21	32	21 + 8 = 29	40
H	21	21	21 + 9 = 30	30
I	The longest TE n of F and H = 30	30	30 + 10 = 40	40



Critical Activities are those activities that have $TE_m = TL_m$ or $TE_n = TL_n$. These are A, C, E, H. and I. The path that

passes through A, C, E, H, and I is the critical path with a duration of 40 days.

Another way to find out the critical path is to identify all the paths with their respective durations and choose the one with the longest duration.

A → C → E → G = 29
A → C → F → I = 31
A → C → E → H → I = 40
B → D → E → G = 28
B → D → E → H → I = 30
B → D → E → H → I = 39

Critical Path is A → C → E → H → I

EXERCISE 3.3

Using the information in Example 3.10 above, calculate:

(a) TEs and TLs for all events
(b) Identify the critical path using events

Experience has shown that project owners or planners make more of Most Optimistic time estimates than most pessimistic time estimates, resulting in some unrealistic estimate of completion time. In order to avoid this, the normal curve idea has been suggested to be skewed such that the t_e will be;

$$t_e = \frac{t_o + 3t_m + 2t_p}{6}$$

Interestingly, however, the two statistical methods of calculation will produce the same critical path and critical activities, even though some t_e will record marginal differences.

Exercise 3.4

Using the data in example 3.6, calculate:

(a) t_e for all activities
(b) TEs for all activities
(c) TL's for all activities
(d) Identify the critical path and the critical activities.

The calculation of t_e depends on the discretion of the planner or owner of the project. This is why there can be unimaginable disparity between the t_o and the t_p. In order to adjust for or correct this over-pessimism, a reliability test can be conducted using either the variance or standard deviations of the variability between t_o and t_1. It means that as long as the activity completion time (and by extension, the project completion time) is not definite and given the possibility that more than one path can produce zero slack time of events or equal TE and TL for an activity, the critical path will be the one that has the smallest sum of the standard deviations of all activities or events. By this, the level of uncertainty surrounding the activities on the critical path as well as the project completion time is seen

to be the lowest amongst the possible paths.

This is where PERT appears to be more useful than CPA because it recognizes the chances of variability in completion times and incorporates such into the management decision process.

Mathematically, the variance and standard deviation of completion times are given thus:

$$\delta^2 = \left[\frac{t_p - t_o}{6}\right]^2$$

$$\delta = \sqrt{\left[\frac{t_p - t_o}{6}\right]^2} = \frac{t_p - t_o}{6}$$

A note of caution must be made that project owners or implementers must watch the closeness of the durations of activities on the critical path against those on the non-critical path. When the length of time of finishing the project using the critical path is marginally different from that of the non-critical path, any lackadaisical handling of the activities on the non-critical path can negatively affect the critical path duration.

Example 3.11

From the data below;

(a) Calculate the variance of and standard deviations of each activity and for the entire project.

(b) Do you think the choice of the critical path is justified using the variance and standard deviation, if management chooses A, C, E, H, I as its critical path?

Activity	t_o	t_m	t_p	t_e
A	6	7	8	7
B	7	8	12	9
C	5	7	9	7
D	3	5	12	6
E	4	7	10	7
F	6	6	18	8
G	8	7	24	8
H	10	8	20	10
1	10	9	20	11

Solution 3.11

Computation of Variance and Standard Deviation

Activity	t_o	t_m	t_p	t_e	δ^2	δ
A	6	7	8	7	0.11	0.33
B	7	8	12	9	0.69	0.83
C	5	7	9	7	0.44	0.67
D	3	5	12	6	2.25	1.50
E	4	7	10	7	1.00	1.00
F	6	6	18	8	4.00	2.00
G	8	7	24	8	7.11	2.67
H	10	8	20	10	2.78	1.67
1	10	9	20	11	2.78	1.67

(b) Using all the possible paths, the variance and standard deviation will be as follows:

Path	δ^2	δ
A → B → E → G	0.11+0.44+1.00+7.11 = 8.66	2.94
A → C → F → I	0.11+0.44+4.00+2.78 = 8.33	2.87
A → C → E → H → I	0.11+0.44+1.00+2.78+2.78 = 7.11	2.67
B → D → E → G	0.69+2.25+1.00+7.11 = 11.05	3.32
B → D → F → I	0.69+2.25+4.00+2.78 = 10.72	3.27
B → D → E → H → I	0.69+2.25+1.00+2.78+2.78 = 9.50	3.08

The correct critical path is as management's choice: A → C E → H → I, with the smallest standard deviation of 2.67.

PRICE FLUCTUATION AND CONTRACT REVALUATION

The price of a resource is the amount of sacrifice borne in order to beneficially make use of it, expressed in monetary terms. It is the expression of the anticipated, agreed or imposed utility, in terms of money, derivable from the consumption of a resource. In project management, each of the 5Ms has its price and therefore in planning a project, adequate attention must be paid to these prices. The emphasis on the prices of the 5Ms becomes imperative because of the unsteadiness of prices over time. In some economies, or sectors of the economy, prices change unpredictably and very volatile too. It is this volatility and unpredictability that is simply referred to a price fluctuation. This is why price fluctuation is defined as the

volatile and unpredictable changes in price such that equilibrium price is difficult to be maintained, and planning is made difficult.

The implication is that planners and financiers must make sufficient provisions for price fluctuation, else be prepared to doom or abandon the project.

CAUSES OF PRICE FLUCTUATION

There are two main arms of group of causes of price fluctuation namely;

(a) Supply-side reasons
(b) Demand-side reasons

The supply-side causes of price fluctuation are those factors that are mostly external or uncontrollable. These factors will affect the process of completing the project in the forms of the provision or supply of raw materials, and the outsiders' sources of funding the resources required for the execution of the various activities making up the project. They also include the cost of the factors or the technical know-how to be employed in the project. For example, if a building project is to be handled by a contractor (project implementer), the cost of cement and iron rods could suddenly skyrocket such that executing the project becomes exorbitant. The contractor can suspend the project until the prices of these materials fall, else the

contractor must apply for VARIATION of the project cost. Another example can be the technicalities involved in building in wetland like Bayelsa State. A building designed and cost in Abuja for implementation in such wetland must require some expertise. If the expertise cost is not accommodated in the costing of the building project, then price fluctuation must occur at the point of execution.

On the demand side, price fluctuation can occur when the project concept or idea, or design of the project-owner changes, or when the source/amount of funding the project changes. For example, where a building has been designed with iron-doors, then fashion changes so that after fixing the iron-doors, the owner of the building orders for the replacement of the iron-doors with sound/bullet proof doors. This will result in the price of the project changing. Other demand-side causes of price fluctuation will include changes in the population and the availability of substitutes.

Chapter 4

PROJECT FEASIBILITY ANALYSIS

INTRODUCTION

In life, not all ventures that appear attractive are actually feasible or viable. For instance, a scavenger might be seen as economically doing well because there is always something to be disposed off from his collection for cash. But the reality is that it is a very risky and deadly business. A commercial driver who owns his motor vehicle or riverrine transporter who owns a vessel that ferries fish-traders from an ocean-based fishing-port to the nearest city (like Port Harcourt) could be seen as making handsome gains. But, when the cash made from the business is subjected to the risk associated with the business and the cost of operation (both initial capital outlay and working capital), it might appear to be unattractive to an on-looker especially if the on-looker is risk-averse. The initial notion (hindsight) about a particular business venture (project) can be confirmed or otherwise when the detailed information relating to the project is thoroughly and critically studied and appraised. Even the various appraisal techniques and the depth of such appraisals or Studies depend on the nature/perception of the person(s) involved with respect to risk. In this regards, it is worth noting that

investors can be grouped into three namely risk-takers, risk-averse, and risk-neutrals. It is against this background that an in-depth study of the various components and operational processes that will culminate into a justifiable estimation of cost, revenue and scheduling of task and resources, becomes inevitable before the commencement of the project.

Estimation of the cost (cash outflows) and revenue (cash inflows) as well as scheduling of the various tasks that make up a project are major components of project planning. These two components, together with other aspects of planning form the basis on when project managers take their decisions on whether or not to commit resources into any project. The comprehensive study of the commercial, technical, managerial and financial soundness, feasibility, viability, and profitability is known as feasibility study. The evaluative reporting or compilation of the observations and findings of the feasibility study is known as FEASIBILITY REPORT. A Feasibility Report is therefore a technical write-up or paper covering or x-raying the various anticipated aspects of a project, on which investment decision is based/made at about 10% accuracy or confidence level. The feasibility study can be for new project or for the expansion or contraction(down-sizing) or even closure of an existing project. So, whether the study is conducted by the project

promoter/owner or by a consulting team or a consultant, the report should be such that it should reveal an independent appraisal or evaluation of the project from the point of view of the promoter/owner, other equity or debt financiers of the project and the public. A FEASIBILITY STUDY therefore is an in-depth exposition and study of the various aspects of a project such that the various cost elements are identified culminating into cash outflow estimates, the various revenue and funding sources and estimates' are made, the technical processes and requirement are established, and the scheduling of the various resources to accomplish the task are identified and appraised. Feasibility reports are sometimes referred to as project plans, or business plans at other times.

Usually, the report that ensues from the study is broken into not less than five (5) chapters just like any other research or technical paper/report. Feasibility report does not have any page limitations, meaning that the more complex a project is the more the number of pages and the appendices and models. Irrespective of the complexity of the project and the number of pages a feasibility report carries, the report will have the following generic layout:

1) Cover page
2) Title page
3) Acknowledgment

4) Table of content
5) List of tables
6) List of figures
7) Abstract
8) Executive Summary
9) Chapter One (Introductory Chapter)
10) Chapter Two (Market or Commercial Analysis)
11) Chapter Three (Technical Feasibility or Analysis)
12) Chapter Four (Financial Analysis or Justification)
13) Chapter Five (Summary, Findings, Conclusion and Recommendations)

COVER/TITLE PAGE(S)

These pages contain the same set of information. The page(s) will contain such information like:

(i) The title of the study: "A Feasibility Report on ... Project"
(ii) Name of Sponsor
(iii) Name of the Consultant(s) that Prepared the Report
(iv) Address of the Consultant(s)
(v) Date of the Report

The page(s) will appear like

A FEASIBILITY REPORT ON PROPOSED FISH FARM PROJECT AT OLOM-NKORO

FOR

OPOBO/NKORO LOCAL GOVERNMENT AUTHORITY

PREPARED BY: TANG NIGERIA
7 CHOBA ROAD
PORT HARCOURT
30TH OCTOBER, 2010

ABSTRACT/EXECUTIVE SUMMARY

An Abstract is a summary of the basic information contained in the report. It summarizes the work/study undertaken, the sponsor of the study, the objective of the study, the method(s) used in the study, the analyses made, the findings/results obtained, the conclusion and recommendations. It is a summary and should therefore not be more than a page.

An Executive Summary is a more detailed or precise brief of the study. It is like the abstract but more detailed than the abstract and therefore is usually more than a page but should not be more 3 pages. In most cases, especially where the feasibility study serves as a proposal, or business plan, only Executive summary is prepared instead

of both the abstract and executive summary. Some of the abridged details that make an executive summary longer than an abstract include the addition of assumptions of the study and the applicability and limitations of the results in the executive summary.

OTHER PRELIMINARY PAGES

The preliminary pages will include:

(a) Acknowledgment: Where the writer of the feasibility report acknowledges and appreciates the contributions of both professionals and non-professionals paid or not paid in the course of the study.

(b) Table of Content: This is an arrangement of the contents of the report according to the pagination so that parts of the report can quickly be accessed.

(c) List of Tables: Same as the table of contents but in the case of list of tables, only the tables and the pages on which the individuals tables appear are shown.

(d) List of Figures: Just like list of tables, the list of figures shows the various figures according as they appear in the report. The figures can be diagrams, pictures, and other forms of models.

CHAPTER ONE (INTRODUCTION)

Like any other introductory chapter, this chapter will be made up of the following items, among others:

(a) Background of the Study: This will state the existing situation with projects like the one proposed, the essence of the proposed project, the output/outcome of the project, and the essence of the study. The background should also highlight the problems associated with similar projects and how to address or solve the problems.

(b) Project Owner/Promoter/Sponsor: This is to show not only the identity (name and address) of the project owner, but the capability and capacity of the owner. It should also state the experience of the promoter in other ventures.

(c) Location: This is a detailed description of the place where the project will be sited. Such description will cover street, plot number or the street, the geographical location siting landmarks and measures of distance from such landmarks, the local government area, and the state. It should also justify the choice of the location in terms of proximity to raw materials, market, availability of labour, etc. It must contain the topography of the area, and other peculiarities such as the culture and the value system of the people the project is meant to serve.

(d) Objective of the Project/Study: This will answer two basic questions namely why the project or why the establishment of the project or why investing in the project, and why the feasibility study is being carried out.

(e) Contract Specification: This should state terms of the feasibility study as a contract.

(f) Legal Status: The report must indicate the legal and legitimate status of the proposed project vis-à-vis existing local, national and international laws and regulations. This is to ensure that the proposed project does not conflict with laws that will render the operation of the project void and impracticable.

CHAPTER 2 (COMMERCIAL OR MARKET ANALYSIS)

In this chapter a careful, detailed and accurate study of the pricing, product and promotional strategies to be applied for the handling of the project or outcome of the project will be made. It will also explore and expose the availability of raw materials and other essential inputs, the ways of minimizing the resources for maximum benefits. It will also x-ray the competitive advantage to be implored or gained over existing producers of the product of the project or similar products. The essence of these analyses is to arrive at the best price and high demand for the outcome of the project; so that a sustainable higher revenue/income will be achieved from where the costs will be off-set. Usually, a market survey is conducted for the purchases(supply-side) and the sales (demand-side) by professionals or through pilot survey or test-run. As far as the financial expert or consultant and the owner (of micro

projects) are concerned, the bottom-line of the commercial analysis is to produce:

(a) Sales and Trade Debtors Budget
(b) Purchases and Trade Creditors Budget

The chapter invariably shows the commercial viability and prospectus of the project. That is, an assessment of the marketability of the outcome of the project so that any reader (especially lenders or investors) would be convinced that there is an existing shortage in existing supply, hence the existence of potential market for the outcome to satisfy.

CHAPTER 3 (TECHNICAL FEASIBILITY OR ANALYSIS)

In this chapter all aspects of the technical, managerial, labour, and operational capacities, requirements and processes are detailed out, with their relevant/ corresponding cost implications. The chapter also covers the site description in terms of altitude, water level, soil texture/test and climatic conditions. The analysis will be made verbally (in writing), in drawings/pictorials and in prototype models. It will also produce operational manuals and instructions. The end-point is that the managerial and labour requirements obtained will be used to produce the Salaries and Wages (Labour) Budget, while the plant, equipment, machinery, fixtures, furnitures and fittings, land and building and motor vehicles will be used to draw up the fixed assets and depreciation policy/schedule, and the

periodic inputs for the day-to-day operations of the project will be used to build the working capital budget. In total the capital requirement would have been ascertained. And to be included in the chapter will be the implementation plan (in case there will be phased implementation) and the infrastructural facilities (e.g. water supply, transport and communication, power and energy supply, impact analysis and externalities to the immediate/remote host communities).

The chapter will give details on the technology to be adopted especially how current the technology is, and the volatility of change in technology. It will also state the cost of operating the project, splitting it into variable costs and fixed costs with respect to installed capacity and usable capacity of plants. It is because of the enormity and/or complexity of requirements that the technical analysis forms the nucleus of the feasibility study and must involve so many experts like the Quantity and Estate Surveyors; Estate Managers; Electrical, Mechanical and Structural Engineers; Organizational and Behavioural Management Experts; and Environmentalists.

Specifically, the chapter will specify the organizational structure, the *organi-gram*, the conditions of service, the different cadre of employees and the emolument structure progressively.

CHAPTER 4 (FINANCIAL ANALYSIS)

This chapter shows the financial implications of chapter 2 and chapter 3 at a glance. Remember that revenue/income projections are contained in chapter 2 while chapter 3 gives the cost/expenditure projections. In chapter 4, not only will the financials of chapters 2 and 3 be conglomerated, but the combination will be subjected to some accounting and financial management analysis like cash budget, projected income statement, projected balance sheet, capital budgeting analyses using the discounted cash-flow methods and the non-discounted cash flow methods. By these analyses, the profitability of the project is ascertained, the soundness of the financial policies obtained, and the viability or justification for the investment made. It can also suggest financing alternatives with corresponding implications on the cash inflows and cash outflows. Such alternatives will include the sources, forms and size of funding (capital structuring) and where long-term debts are to be employed, the amortization schedule(s) with tax implications must be worked out.

CHAPTER 5 (SUMMARY, CONCLUSION AND RECOMMENDATIONS)

This is the concluding chapter. It summarizes the findings from the market analysis, technical feasibility and financial viability of the project. Based on the findings, conclusion and recommendations are made.

It is after this chapter that all other attachments and models are included in the report as appendices.

EXAMPLE: *FEASIBILITY STUDIES REPORT ON FAST FOOD AND GUEST HOUSE FIRM*

PROPOSAL A

INTRODUCTION

As Nigerian workers get more pressured, the habit of going for fast food (snacks and drinks) gains more ground in the behaviours of people in Nigeria, especially when out of home. Precisely, people go for fast food at break-time, leisure times or when discussing business. Port Harcourt, the biggest oil city, the only Garden City in Nigeria and the 3rd most important business centre in Nigeria, is no exception. The inhabitants of Port Harcourt, apart from the various school communities, have chosen to go for fast foods as indicated in ever-increasing number of stalls, kiosks and cafeterias that sell fast foods and drinks.

It is against this background that this study is being undertaken by BAPOD SUPPLIES LIMITED (BSL) as the sole-owner and promoter to know whether an elaborate fast food division(to be known as BAPOD FAST FOODS), will be a worthwhile venture. To conduct a well articulated comparison, two (2) proposals are studied. The first is to manufacture and sell fast foods while the second will be the identification of major suppliers who will supply the fast foods for resale.

THE PROJECT AND ITS LOCATION

The project which shall be known as BAPOD FAST FOODS will be a division of Bapod Supplies Limited, with the Bapod Canteen as its operational base. (The catering unit shall be the only source of supply to the Subapod Cafeteria, University of Port Harcourt, College of Education, Federal Secretariat and Podium Block Branches of the Bapod Fast Foods. The project will involve the manufacture and sale of various ranges of fast foods, as well as drinks as against the present trend of buying snacks from suppliers. By this arrangement, Bapod Fast Foods will have two (2) units namely Catering and Cafeteria units. The Cafeteria unit refers to the selling outlets of the Bapod Fast Foods and this includes the existing outlets (University of Port Harcourt, College of Education, Federal Secretariat, Podium Block and the Subapod Head Office Cafeteria). While the catering unit will be concerned with the manufacture of the snacks and therefore shall be the only source of supply of the articles to the various selling outlets.

The choice of this site is precipitated by the need for effective monitoring and control of the activities and performance of the division. Secondly, the site will help tremendously in reducing overhead cost such as transport and rent.

LABOUR REQUIREMENT

Manpower required for effective and smooth operation of the project are reinforcement perse and so complimentary

to the existing staff strength of the firm. This re-enforcement will require the services of 7 more staff divided into 3 for catering unit, 3 for cafeteria and 1 Supervisor. See schedule below:

Schedule of Staff Strength and Cost

S/N	Items	Present		Additional	
		Qty.	Costs (₦)	Qty.	Costs (₦)
1.	Supervisor	-	--	1	840.00
2.	Caterers	-	--	3	1,584.00
3.	Cashier	1	432.00	-	--
4.	Attendants	2	768.00	3	1,152.00
5.	Cleaners	2	691.20	1	--
	TOTAL	5	1,891.20	7	3,576.00

TECHNICAL ANALYSIS

The project is a technical one in the sense that it needs special skill and equipment with reference to the catering/baking aspect. It needs sophistication which in this industry is synonymous with expensiveness. However, if able experienced hands are employed, such expensively sophisticated equipments can be dispensed with, until when desperately needed. In this regard, cleanliness, attractiveness and quality will be the basis of operation. A well laid out quantity of materials and the expected output shall be followed religiously.

The production will require an estimated ₦3,000.00 worth of materials per day or ₦72,000.00 per month with a

minimal cost of indispensable equipment as given below. Drinks are just a marginal increase on the actual figures. It is expected that purchases of materials and drinks shall increase by 5% in the 1st three months, 10% in the next four months and 5% in the remaining months. These increases are expected to cover the sales of the particular months as well as the price changes. It is also expected that stock of materials and drinks will be 5% of total purchase monthly (See Schedule below)

A.SCHEDULE OF PURCHASES

	1	2	3	4	5	6	7	8	9	10	11	12
Drinks	22,400	23,500	24,700	25,900	29,900	32,900	36,200	38,000	39,900	41,900	44,000	46,200
Material s	72,000	75,600	79,400	87,300	96,000	105,600	116,200	122,000	128,100	134,500	141,200	148,300
Total Purchase	94,400	99,100	104,100	113,200	125,900	138,500	152,400	160,000	168,000	176,400	185,200	194,500
Cum. Purchase	94,400	19500	297,600	410,800	536,700	675,200	827,600	987,600	1,155,600	1,332,000	1,517,200	1,711,700
Closing Stock	4,700	5,000	5,200	5,700	6,300	6,900	7,600	8,000	8,400	8,800	9,300	9,700

B. SCHEDULE OF COST OF GOODS SOLD

	1	2	3	4	5	6	7	8	9	10	11	12
	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00
Opening Stock		47	50	52	57	63	69	76	80	84	88	93
Add: Purchases	944	991	1,041	1,132	1,259	1,385	1,524	1,600	1,680	1,764	1,852	1,945
	944	1,038	1,091	1,184	1,316	1,448	1,593	1,676	1,760	1,848	1,940	2,038
Less: Closing Stock	47	50	52	57	63	69	76	80	84	88	93	97
Cost of Goods Sold	897	988	1,039	1,127	1,253	1,379	1,517	1,596	1,676	1,760	1,847	1,941

SCHEDULE OF SALE REVENUE

	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00
Drinks (15%)	258	270	284	312	343	377	415	436	458	481	505	530
Snacks (40%)	1008	1058	1112	1223	1345	1480	1628	1709	1794	1884	1978	2077
Total Sales	1266	1328	1396	1535	1688	1857	2043	2145	2252	2365	2483	2607

OVERHEAD ESTIMATE

Overhead costs are expected to be constant for at least the first one year, and the schedule below shows the envisaged cost.

C. SCHEDULE OF OVERHEAD

	₦
Salaries and Wages	3,600.00
Electricity and Gas	500.00
Transport and Traveling	1,000.00
Consumable Wrappers	2,000.00
Contingencies and Head Office Overhead Allocation	2,800.00
	₦ 9,900.00

D. SCHED ULE OF FIXED ASSETS

		₦
1	Deep Fryer	15,500.00
2	Electric/Gas Cooker	12,0 00.00
3	Deep Freezer	6,000.00
4	Electric Warmer/Display Case	10,000.00
5	Mixer and Pasty Brush	10,000.00
6	Frying spoons and Rolling pins	1,000.00
7	Frying Pans and Pots	2,000. 00
8	Tables and Chairs (for both Units)	5,800.00
9	Gas Cylinders with Gas	5,000.00
10	Plates, Cups and Cutleries	4,000.00
11	Carpets and Blinds	2,000.00
		₦ 73,300.00

DEPRECIATION: Depreciation is calculated at 20% of cost per annum or 1.67% per month

SOURCE OF FINANCE

The project shall be financed by 2 sources: loan and sales revenue. The loan is worth ₦150,000, to be repaid in 8 months at an interest of 13.3% p.a. Interest will be paid on reducing balance method, while the principal will be repaid latest in the 8th month with moratorium on principal repayment of the first 2 months.

FINANCIAL ANALYSIS

(i) Calculation of Installment payment:

$$\text{Installment payment} = \frac{\text{Loan Amount}}{PVIF_a}$$

$PVIF_a$ = Present Value Interest factor of annuity at $n = 8$, $r = 13.3/12 = 0.0167$

$= 5.664350017$

$$\text{Installment payment} = \frac{₦150,000}{5.664350017}$$

$= ₦26500$

ii LOAN REPAYMENT SCHEDULE

Month	Outstanding Principal	Installment Payment	Interest Payment	Principal Repayment
0	₦150,000	–	–	–
1	₦150,000	–	₦2,500	–
2	₦150,000	–	₦2,500	–
3	₦126,000	₦26,500	₦2,500	₦24,000
4	₦101,604	₦26,500	₦2,104	₦24,396
5	₦76,801	₦26,500	₦1,697	₦24,803
6	₦51,584	₦26,500	₦1,283	₦25,217
7	₦25,945	₦26,500	₦861	₦25,639
8	Nil	₦26,500	₦433	₦26,067
		₦164,000	**₦11,378**	**₦150,122**

The difference of ₦14,000 is the result of approximation and the deferment of repayment within which period ₦5,000 interest was paid to service the loan.

1) ***Projected Cash Flow Statement (N'00)***

	0	1	2	3	4	5	6	7	8	9	10	11	12
Sales		1,266	1,328	1,396	1,535	1,688	1,857	2,043	2,145	2,252	2,365	2,483	2,607
Loan	1500	—	—	—	—	—	—	—	—	—	—	—	—
Total Inflow	1500	1,266	1,328	1,396	1,535	1,688	1,857	2,043	2,145	2,252	2,365	2,483	2,607
Application of Funds : Fixed Assets	733	—	—	—	—	—	—	—	—	—	—	—	—
Mat & Drinks	—	944	991	1,041	1,132	1,259	1,385	1,524	1,600	1,680	17,645	1,852	1,945
Overhead	—	99	99	99	99	99	99	99	99	99	99	99	99
Loan Int.	—	25	25	25	21	17	13	9	4	—	—	—	—
Loan Repayment	—	—	—	240	244	248	252	256	261	—	—	—	—
Total Outflows	733	1,068	1,115	1405	1496	1623	1748	1888	1904	1,779	1,863	1,951	2,044
Cash Surplus	767	198	213	(9)	39	65	108	165	181	473	502	532	563
Opening Balance	—	767	965	1,178	1169	1208	1273	1381	1546	1727	2200	2702	3234
Cum Closing Bal.	767	965	1,178	1169	1208	1273	1381	1546	1727	2200	2702	3234	3797

2) ***Projected Profit and Loss Statement***

	1	2	3	4	5	6	7	8	9	10	11	12
Sales	1,266	1,328	1,396	1,535	1,688	1,857	2,043	2,145	2,252	2,365	2,483	2,607
Less: Cost of Sales	897	988	1,039	1,127	1,255	1,379	1,517	1,596	1,676	1,760	1,847	1,941
Gross Ma rgin	369	340	357	408	435	478	526	549	576	605	636	666
Less EXPENSES												
Overhead	99	99	99	99	99	99	99	99	99	99	99	99
Interest on loan	25	25	25	21	17	13	09	04	—	—	—	—
Depreciation (15%)	9	9	9	9	9	9	9	9	9	9	9	9
Total Expenses	133	133	133	129	125	121	117	112	108	108	108	108
Profit	236	207	224	279	310	357	409	437	468	487	528	558
Cum. Profit	236	443	667	946	1256	1613	2022	2459	2927	3414	3942	4500

3) *Projected Balance Sheet*

Profit & Loss A/C	450,000	Fixed Assets	(Less: Deprec)	58,640
		Stock		11,660
		Cash/Bank Bal.		379,700
	450,000			450,000

VIABILITY TEST

1) *Pay Back Period*

Period	Net Cash Flow (NCF) (₦)	Cumulative Balance (₦)
0	(150,000)	(150,000)
1 – 6	138100	(11900)
7	16,500	14,300

$$\therefore \quad PB = 6 + \frac{11,9500}{16,500}$$

$$= 6 \text{ months } 22 \text{ days}$$

2) *Accounting Rate of Return (ROI)*

$$\frac{450,000:12}{150,000} \times 100\%$$

$$= \frac{3750}{150,000} \times 100\%$$

$$= 2.5\%$$

$$= 30\% \text{pa}$$

3) *Net Present Value*

Period	₦		₦
1	24,500	0.820	20,090
2	21,600	0.672	14,515
3	23,300	0.551	12,838
4	28,400	0.451	12,803
5	31,100	0.370	11,507
6	35,400	0.303	10,726
7	40,200	0.249	10,010
8	42,500	0.204	8,670
9	47,700	0.167	7,966
10	50,600	0.137	6,932
11	53,700	0.112	6,015
12	56,700	0.092	5,217
			₦127,289
			(150,000)
		NPV =	**(22,711)**

3) INTERNAL RATE OF RETURN

i) Assuming Discount factor is 22%, NPV = (₦22,711), with present value of Inflows = ₦127,289.

ii) Assuming Discount factor is 15%, NPV = (₦27,178), with present value of Inflows = ₦177,178.

By interpolation

$$IRR = 15\% + \left(\frac{27,178}{177,178 - 127,289}\right) \times 7\%$$

$$= 15\% + \left(\frac{27,178}{49,889}\right) \times 7\%$$

$$= 15\% + 3.81\%$$

$$= 18.81 \text{ or } 19\%$$

Note:

1) Net Present Values or Discounted Cash flow computation is done with 2% above the cost of the loan (20%) according to the Investment Policy of the Company.

2) Net Cash flows is arrived at by adding depreciation, which is the only non-cash item, to the various monthly profits.

CONCLUSION:

The project, as conceived, looks attractively profitable and feasible. This fact is revealed by the market and technical analysis as well as the accounting projections. A total profit of ₦444,900 will be generated together with a total cash balance (inflow) of ₦372,700 in 12 months to the Central fund. The loan too could be liquidated by the 8th month as against the calculated pay back period of 5months, 12 days.

However, the present value of these inflows, at a marginal cost of capital of 22%, shows that the project is not worthy it, with an NPV of (₦22,696) and IRR of 19%. By these criteria, the project should be considered indifferent or rejected.

ALTERNATIVE II

1PROJECTED CASH FLOW STATEMENT (₦'00)

	0	1	2	3	4	5	6	7	8	9	10	11	12
Loan	200	—	—	—	—	—	—	—	—	—	—	—	—
Sales Revenue		570	599	629	692	761	838	922	968	1,017	1,068	1,121	1,177
Total Inflow	200	570	599	629	692	761	838	922	968	1,017	1,068	1,121	1,177
Less: OUTFLOW													
Purchases		464	487	512	551	620	682	750	787	826	867	910	956
Fixed Assets	160	—	—	—	—	—	—	—	—	—	—	—	—
Head Office Overhead		204	204	20	20	20	20	20	20	20	20	20	20
Int. on Lo an		—	—	—	—	—	—	—	—	—	—	—	—
Loan Repayment		—	200	—	—	—	—	—	—	—	—	—	—
Total Outflow	160	468	691	532	571	640	702	770	807	846	887	930	976
Cash Surplus	40	102	(92)	97	121	121	136	152	171	171	181	191	201
Cum Balance	40	142	50	147	268	389	525	677	838	1,009	1,190	1,381	1,582

2) **PROJECTED PROFIT AND LOSS STATEMENT (₦'00)**

	1	2	3	4	5	6	7	8	9	10	11	12
	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦00	₦0	₦00
Sales	570	599	629	692	761	838	922	968	1,017	1,068	1,121	1,177
Less: Costs of Sales	441	486	510	549	617	679	746	786	824	865	907	954
Gross Margin	129	113	119	143	144	159	176	182	193	203	214	225
Less: EXPENSES												
Head Office Overhead	20	20	20	20	20	20	20	20	20	20	20	20
Loan Interest	4	4										
Depreciation	3	3	3	3	3	3	3	3	3	3	3	3
Total Expen ses	27	27	23	23	23	23	23	23	23	23	23	23
Profit	102	86	96	120	121	136	153	159	170	180	191	200
Cumulative Profit	102	188	284	404	525	661	814	973	1,143	1,323	1,514	1,714

SCHEDULE OF PURCHASES:(₦'00)

Drinks	224	235	247	259	299	329	362	380	399	419	440	462
Snacks	240	252	265	292	321	353	388	407	427	448	470	494
Total Purchases	464	487	512	551	620	682	750	787	826	867	910	956

SCHEDULE OF SALES:(₦'00)

Drinks (15%)	258	271	285	314	345	380	418	439	461	484	508	533
Snacks (30%)	312	328	344	378	416	458	504	529	556	584	613	644
Total Sales	570	599	629	692	761	838	922	968	1017	1068	1121	1177

SCHEDULE OF COSTOF SALES:(₦'00)

Openi ng Stock	–	23	24	26	28	31	34	38	39	41	43	46
Purchases	464	487	512	551	620	682	750	787	826	867	910	956
Closing Stock	(23)	(24)	(26)	(28)	(31)	(34)	(38)	(39)	(41)	(43)	(46)	(48)
Cost of Sales	441	486	510	549	617	679	746	786	824	863	907	954

VIABILITY TESTS:

The following measures are used in evaluating the Projects' viability

1) **Pay Back Period**

Period	Net Cash Flow (NCF) (₦)	Cumulative Balance (₦)
0	20,000	(20,000)
1	10,500	(9,900)
2	8,900	600
3	9,900	9,300

$$\therefore \quad PB = 3 + \frac{9,300}{9,900} \text{ months}$$

$$= 3 + 0.94 \text{ months}$$

$$= 3 \text{ months, } 28 \text{ days}$$

2) ***Accounting Rate of Return (ARR)***

$$= \frac{171,400 + 12}{20,000} \times 100\%$$

$$= \frac{14,283}{20,000} \times 100\%$$

$$= 71.6\%$$

3) ***Net Present Value***

Period	NCF (₦)	DF (22%)	PV (₦)
1	10,500	0.82	86,100
2	8,900	0.672	5,900
3	9,900	0.551	5,455
4	12,300	0.451	5,547
5	12,400	0.37	4,588
6	13,900	0.303	4,212
7	15,600	0.249	4,034
8	16,200	0.204	3,305
9	17,300	0.167	2,889
10	18,300	0.137	2,507
11	19,400	0.112	2,173
12	20,300	0.092	1,868
			₦51,168
			(20,000)
		NPV =	**₦31,168**

CONCLUSION:

Even if the mark-ups are lowered to 10% for Drinks, the project will be profitable. The project if religiously monitored and adhered to is a very good investment. It is therefore the opinion that with a super-NPV of N31,168 and total profit of N171,400 the project should be accepted. This alternative comparatively is better than the first option.

Note:

1. Purchase and Sales:

These are expected to increase in volume by 5%, 10% and 5% in the 1st three (3) months, 2nd four (4) months, and the last 5 months respectively. Purchases are made to cover the expected volume of sales, and are just marginal increases of ₦1,000 on the actual volume of purchases. Sales value are obtained by marking-up purchases by 15% and 30% for drink and snacks respectively.

2) Stocks:

It is expected that 5% of all purchases will be unsold every month.

3) Overhead:

This is the assumed charge of the costs/expenses borne by Bapod Supplies Limited for and on behalf of Bapod Fast Food.

4) Fixed Assets Required:

Electric Warmer/Display case	10,000
Plates, Cups and Collieries	2,000
Table and Chairs	2,000
Carpets and Blinds	2,000
	₦ 16,000

5) Source of Finance:

The project is assumed to cost N20,000 and this will be financed by a loan with an interest rate of 20%, repayable within 1 years.

Chapter 5

PROJECT COST CONTROL

The approval of a sound and satisfactory plan or feasibility study is the beginning of effective implementation, monitoring and control of the constituent tasks making up a project or contract. The essence of such effective and efficient monitoring, evaluation and control is to ensure that the project is successful in the sense that the objectives are achieved in the earliest possible time without dilution of the expected quality and no significant increase in the budget.

This means that if the plan and schedules are properly made, and the corresponding costs appropriated, there may not be any cost overrun as a result of crashing the project time and schedule, or delay in completion. It follows therefore that a project manager and his project team would focus on completing a project within the time schedule so that cost overrun can be avoided and gains/profits maximized.

Earlier, it was stated that one of the essence of networking is to identify the critical path and critical activities (tasks) in a given project. This identification enables the project manager to concentrate on the deployment of resources

promptly and adequately such that the critical tasks are completed on schedule and within expected cost. This implies that, under normal conditions, cost overrun will occur when time of completing a project is exceeded. Hence, it is common parlance to note that time determines cost, and vice versa, in project management. It is also possibly true to state that when the scheduled time of completing a project is shortened, cost will increase because in order to reduce the scheduled time more resources and overtime will be employed. For instance, it will ordinarily cost more for someone to undertake a regular B. Sc. programme than a Part-Time programme. A regular B. Sc. (Accounting) programme normally requires a minimum of four academic sessions, while a part-time programme requires a minimum of 5 years. If the school fees for the regular student is ₦50,000 as against ₦80,000 for the part-time and the number of books and assignments are the same at ₦2,000 per course. Assuming there are 50 courses, the total cost of books, etc will be ₦100,000. However, the regular student is denied of an average monthly income of ₦20,000 (or ₦240,000 per annum). If the annual income foregone per session is added to the ₦50,000 regular school fees, less cost of leisure and other incidental benefits enjoyed by the part-time student (but not by the regular student) worth N60,000 per session, the regular student will incur a net cost of ₦350,000 as against

₦32,000 per session. If someone wants to crash the time to 2 years to obtain a B. Sc., the person would need to have expended at least the ₦320,000 already for B. Sc. or HND. Hence the cost of the B.Sc. (Accounting) will be ₦320,000 plus ₦175,000 (i.e. half of ₦350,000).

However, the Time-Cost Relationship may not be as simple as had been discussed earlier, in reality. The Time-Cost relationship can graphically be explained by the Time-Cost slope. This slope explains how the cost of a task or project will be impacted or affected by a change in time. For instance, if the slope is very steep, a small crash in time will require a big cost to be incurred as shown in the figure 4.1 below.

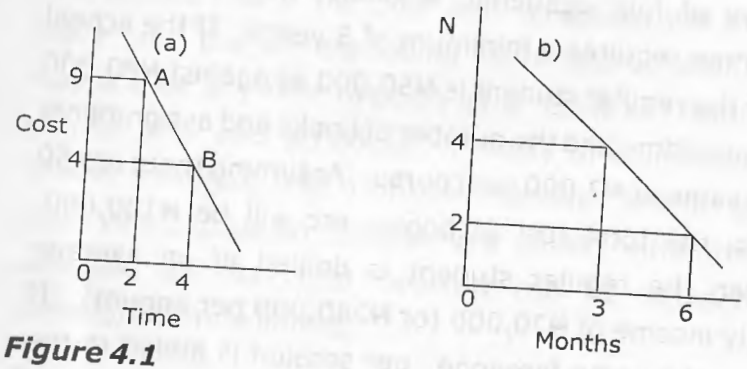


Figure 4.1

In figure 4.1(a), to reduce time from 4 to 2 (where 2 is the crash time), will mean incurring extra 5 units of cost. And in figure 4.1(b), to reduce time from 6 to 3 months means increasing expenditure from ₦2 to ₦4.

Project cost control is the management of the project time in the main such that resources and extra-resources are mobilized or deployed for the completion of a project or task at the earliest time and most optimum cost possible. Although the emphasis is on the management of time for quick earning of investment returns, the availability of funds and resources as well as the willingness/approval of functional management team of both the project owner and implementer are required. These will be especially required for all the tasks on the critical path. It means that any effort made to crash the completion time of the other non-critical (i.e. not on the critical path) tasks will only result in increased cost but not reduction in the project completion time. Note that non-critical tasks have floats, and that the critical path is ordinarily the longest path or the set of activities whose combined duration is the longest among alternative routes to the finishing node or event. Also note that a Sub-critical path is a critical path that has a shorter duration than another critical path in the same network.

OPTIMIZING THE TIME AND COST OF PROJECTS

It has been stated earlier that optimizing or minimizing cost of a project is a function of managing or minimizing the total duration for completing the project. It has also been asserted that if the duration for completing a project is

extended or reduced from its normal anticipate time, cost is most likely to increase because of the extra resources to be engaged. It is an axiom that a project is made up of tasks or activities which can be presented chronologically and sequentially in a flow called network.

Since reduction of project completion time has a great bearing on the cost of the project, ascertaining the best time duration and cost of completing a project must be carefully and systematically done. This process of reducing time of completing a project at the most optimum cost (i.e. least cost) is what is known as crashing of project.

In crashing a project, the following rules or steps (though not wholly limited to) should be applied:

1) ***Find the Critical Path:***
   - (a) This will be by employing Forward-pass and Backward-pass computation techniques.
   - (b) It is advisable to do the computations one event after another.
   - (c) Choose the path with the longest duration.
   - (d) Draw up the network showing all events, all tasks, and all the zero points (i.e. points on the network where $\frac{TE}{TL} = 0$)

2) Find out the Total Cost of all activities or tasks along the critical path using the direct costs and the overhead costs.
3) If direct or normal costs and crash costs of tasks are not independently given or not available, then use the cost of crashing each task and overhead expenses per time. In this case Total Cost (TC) will be:

TC = {Cost of Crashing Up to the Provisions Stage}+ {Cost of Crashing the Chosen Task by the difference between duration of critical path(s)}+ {Cost of Overhead for the Total Crashed duration}.

Let, TC* = Total Cost of the Crash Project

TC = Total Cost of Crashing up to the previous stage

dx_1 = difference between the duration of critical path and sub-critical path

Cdx_1 = cost of crashing the chosen task by dx_1

dx_2 = difference between normal time and maximum crash time of each chosen task

COH = Cost of overhead for the total crash duration

$TC^* = TC + Cdx_1 + COH$

Note:

(a) TC at the commencement is zero (0),

(b) Subsequent TC = TC of the immediate past stage + Cdx_1 of the immediate past stage.

i.e. If TC_0 = Initial TC

TC_0* = Cost of crashing + cost of overhead for the full duration of *uncrashed* critical path:

$TC_1* = (TC_0* - COH_0) + Cdx_1 + COH_1$

$TC_2* = (TC_1* - COH_1) + Cdx_1 + COH_2$

(c) Crashing of tasks begins with the tasks on critical path.

(d) Initially no activity on critical path is crashed and hence cost of crashing any critical task is NIL.

(e) dx_1 will change as task to be crashed changes

(f) Draw up a crashing table at the initial stage.

4) Find out dx_1 and crash any of the activity by dx_1

dx_1 = Duration along the critical path minus(-) Duration along the sub-critical path

i.e. Time Duration along the Critical Path = xxx

Less Time duration along the sub-critical path = (xx)

dx_1 = x

Use the dx_1 to crash duration of the critical path such that the cost of crashing is minimum.

5) With the initial dx_1, all tasks along the critical path

have equal chance to be crashed. However only:

(a) the activities which have $dx_2 \geq dx_1$ can be crashed (i.e. reduced);

(b) if there are 1 or more than 1 tasks with $dx_2 \geq dx_1$, then choose the task with the least cost slope (i.e. the activity with the minimum cost of crashing per time).

6) Calculate the second (2^{nd}) TC of crashing at this stage

(b) Draw up the latest network at this stage.

(c) The latest network will show that all paths are equal in total duration; hence all paths become critical paths.

7) When all paths on a network become equal, then the following rules and actions will be taken:

	Condition	**Action to be Taken**
(i)	If there is only 1 task originating from an event	Only that task can be crashed
(ii)	If there are more than 1 tasks originating from an event	All originating tasks must be crashed simultaneously
(iii)	If there are more than 1 tasks flowing to or meeting at an event	All meeting or flowing-in tasks must be crashed simultaneously
(iv)	If 2 or more tasks are crashed simultaneously as in (ii) and (iii) above	The cost of crashing per time is the summation of the cost of crashing per time of all tasks that are crashed simultaneously

8) Find out the cost of crashing and choose the crashed task with the least cost of crashing per time, given the application of rules in (7) above.

9) Crash the entire project duration by the maximum time that the chosen task in (8) above can be crashed.

10) Calculate the TC* given new crashed project duration obtained from (9) above, and draw the latest network.

11) Crash the remaining tasks further by applying the rules in (7) above:
   (a) If 2 or more tasks originate from same event, crash their respective durations by the least maximum time that any of the tasks can be crashed.
   (b) Calculate the new TC* given the application of (11a) and the latest reduced duration of the project.
   (c) Draw up the latest network given the crashed time of all tasks and the entire project.

12) Draw up the Table of Relevant Costs, calculated at the different stages of calculations.

13) Draw up a Time-Cost graph; choose the lowest point on the Time-Cost curve which will give the least or

most optimum Total Cost and corresponding duration of the project.

However, where the normal costs, crash costs, normal time and crash time are directly assigned to each of the tasks irrespective of the cost of overhead per time, the process of arriving at the optimum time and cost for the entire project will be very similar to Rules 1 – 13 spelt out above, though with minor difference.

In this circumstance, the following rules or steps would be very useful:

(I) Find out the Critical Path(s) using the Forward-pass and Backward-pass computations.

(II) Draw up the network showing the critical path especially showing the events where TE = TL.

(III) Compute the Total Cost (TC*)
TC* = Total Normal Cost + Total Overhead Cost

(IV) Identify all tasks that cannot be crashed because $dx_1 = 0$.

(V) Identify all paths that can be crashed by the dx_1 irrespective of IV above.

(VI) Apply the principle of crashing 2 or more tasks flowing from or to one (1) event simultaneously,

(B) Compute crash cost per time and maximum

duration that can be crashed for all *crashable* combination of tasks.

(VII) Choose the combination that has the least crash cost per time unit.

(VIII) Draw the latest network after the immediate past crashing.

(IX) Calculate the TC* after (VIII) where TC* = TC* of immediate preceding crashing plus cost of crashing the chosen task minus reduction in the fixed overhead for the minimum duration of the project.

(X) Crash the remaining combination(s) of crashable tasks logically, sequentially and applying the applicable rules.

(XI) Draw up the latest network after (X) above.

(XII) Calculate the latest TC* after (XI) above.

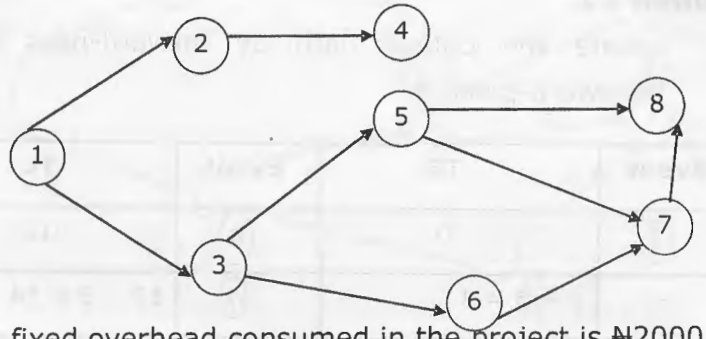
(XIII) Tabulate results of the project duration and Total Costs at the various points/stages of calculation and computation.

(b) Illustrate (XIIIa) graphically.

(XIV) Choose the lowest point on the graph showing the optimum Time and Cost of crashing.

Example 5.1

The network of a project is as shown below:



The fixed overhead consumed in the project is ₦2000 per week. The different activities and respective costs including crash cost and crash time are shown in the table below.

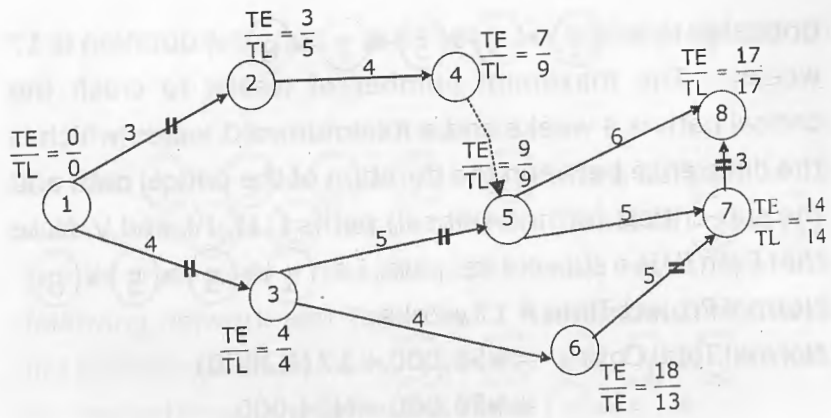
Task	Normal Time (WK)	Normal Cost (₦)	Crash Time	Crash Cost ₦	Maximum Crash Time	Crash Cost Per Week ₦
1→2	3	5000	3	5000	0	0
1→3	4	8000	4	8000	0	0
2→4	4	6000	2	8000	2	1000
3→5	5	4000	5	4000	0	0
3→6	4	7000	2	10000	2	1500
5→7	5	12000	3	15000	2	1500
6→7	6	5000	4	7000	2	1000
5→8	5	5000	5	5000	0	0
7→8	3	4000	3	5000	0	0

Find the least cost schedule.

Solution 4.1

(a) Locate the critical path by forward-pass and backward-pass.

Event	TE	Event	TL
(1)	0	(8)	17
(2)	0 + 3 = 3	(7)	17 - 3 = 14
(3)	0 + 4 = 4	(6)	14 - 5 = 9
(4)	3 + 4 =7	(5)	17 - 6 = 11 14 - 5 =9 } 9
(5)	7 + 0 = 7 4 + 5 = 9 } 9	(4)	9 - 0 = 9
(6)	4 + 4 = 8	(3)	9 - 5 = 4 13 - 4 = 9 } 4
(7)	9 + 5 = 14 8 + 5 = 13 } 14	(2)	9 - 4 =5
(8)	9 + 6 = 15 14 + 3 = 17 } 17	(1)	5 - 3 = 2 4 - 4 = 0 } 0



Paths:

I ⇒ 1 → 2 → 4 → 5 → 8 = 13 Wks

II ⇒ 1 → 2 → 4 → 5 → 7 → 8 = 15 Wks

III ⇒ 1 → 3 → 5 → 7 → 8 = 17 Wks

IV ⇒ 1 → 3 → 5 → 8 = 15 Wks

V ⇒ 1 → 3 → 5 → 7 → 8 = 16 Wks

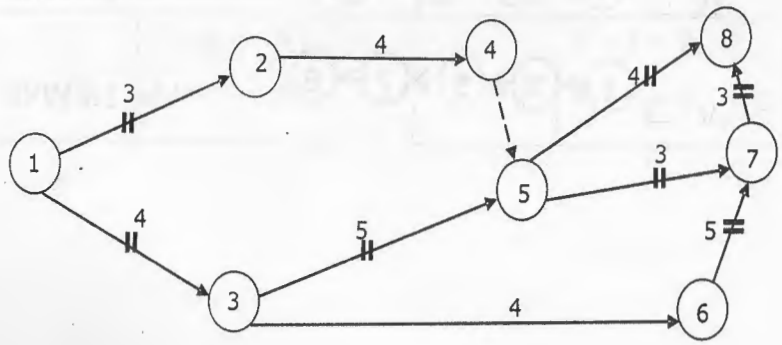
Critical path is (1)→(3)→(5)→(7)→(8), duration is 17 weeks. The maximum number of weeks to crash the critical path is 4 weeks and a minimum of 1 week, which is the difference between the duration of the critical path and the sub-critical (or non-critical) paths I, II, IV, and V. Note that Path IV is a sub-critical path, i.e. (1)→(3)→(5)→(8)

Normal Project Time = 17 weeks

Normal Total Cost = ₦56,000 + 17 (₦2000)
= ₦56,000 + ₦34,000
= ₦90,000

Applying the rules of crashing, Tasks (2)→(4), (5)→(8), (5)→(7) and (3)→(6) can be crashed but only (5)→(7) lies on the critical path. Task (5)→(8) can be crashed simultaneously with (5)→(7); if not it cannot be simultaneously crashed with (6)→(7) because task (6)→(7) is at its minimum duration.

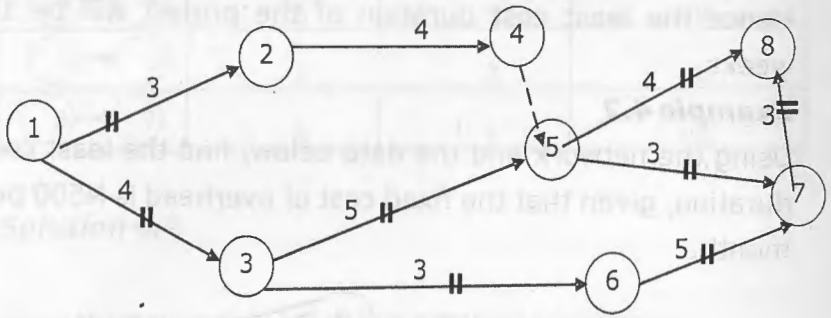
If tasks (5)→(7) and (5)→(8) are simultaneously crashed, the following network and Total Cost will result;



TC* = ₦90,000 + 2(₦1500) + 2(₦1000)- 2(₦2,000)
= ₦91,000

Project Duration = 15 weeks

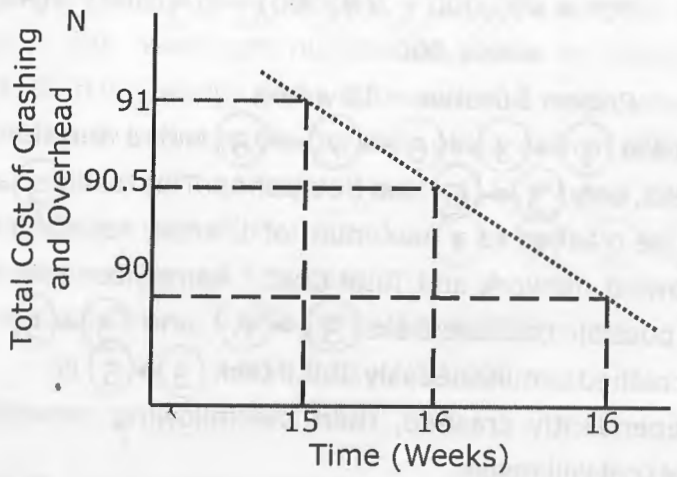
On path (1)→(3)→(6)→(7)→(8) with a duration of 16 weeks, only (3)→(6) can be crashed. This task (3)→(6) can be crashed to a maximum of 1 week, resulting in the following network and Total Cost. Remember that this is not possible because tasks (3)→(6) and (3)→(5) must be crashed simultaneously. But if task (3)→(5) is independently crashed, then the following network and total cost will result.



TC* = ₦91,000 + ₦1500 ₦2000
=₦90,500

Summary of Results of Crashing

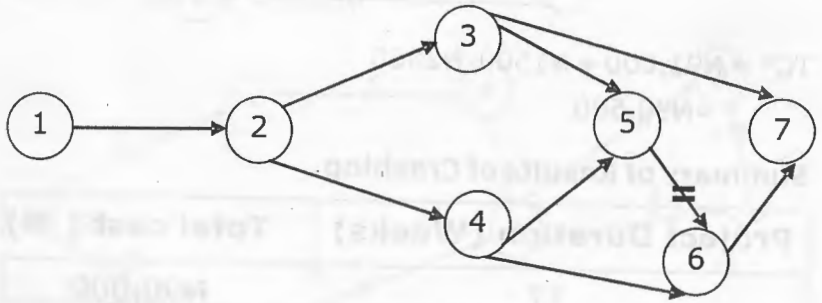
Project Duration (Weeks)	Total cost (₦)
17	₦90,000
15	₦91,000
16	₦90,500



Hence the least cost duration of the project will be 17 weeks.

Example 4.2

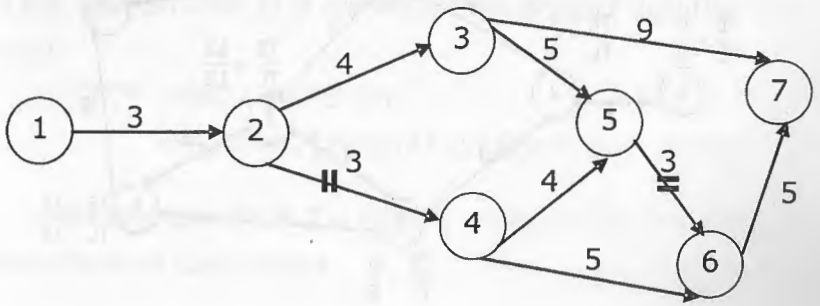
Using the network and the data below, find the least cost duration, given that the fixed cost of overhead is ₦500 per month.



Task	Normal Time (months)	Crash Time (Months)	Cost of Crashing (₦ Per Month)
1 → 2	3	1	400
2 → 3	4	2	500
2 → 4	3	3	NIL
3 → 5	5	2	300
3 → 7	9	7	300
4 → 5	4	3	200
4 → 6	5	5	NIL
5 → 6	3	3	NIL
6 → 7	5	1	200

Solution 4.2

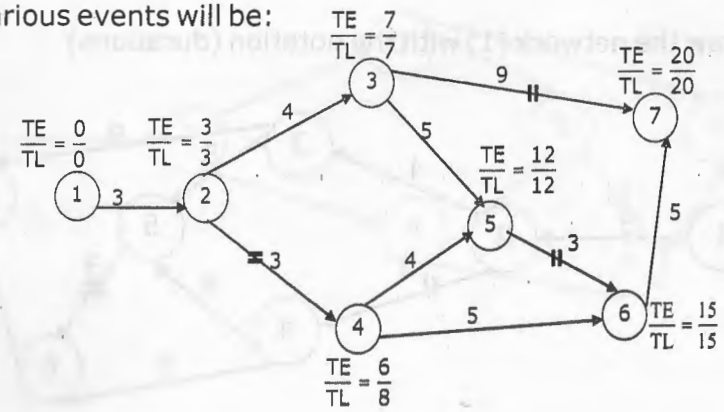
Draw the network (1) with the notation (durations)



Determine Critical Path:

Event	TE	Event	TL
1	0	7	20
2	0 + 3 = 3	6	20 – 5 = 15
3	3 + 4 = 7	5	15 – 3 = 12
4	3 + 3 = 6	4	12 – 4 = 8 15 – 5 = 10 } 8
5	7 + 5 = 12 6 + 4 = 10 } 12	3	20 – 9 = 11 12 - 5 = 7 } 7
6	6 + 5 = 11 12 + 3 = 15 } 15	2	7 – 4 = 3 10 – 3 = 7 } 3
7	15 + 5 = 20	1	3 – 3 = 0

The second network after ascertaining the durations at the various events will be:



The Paths are:

I ⇒ 1 → 2 → 3 → 7 = 16 months

II ⇒ 1 → 2 → 3 → 5 → 6 → 7 = 20 months

III ⇒ 1 → 2 → 4 → 5 → 6 → 7 =18 months

IV ⇒ 1 → 2 → 4 → 6 → 7 =16 months

Critical Path is 1 → 2 → 3 → 5 → 6 → 7 i.e. Path II.

Sub-critical Path is 1 → 2 → 3 → 7 i.e. Path I.

The non-critical Paths are III and IV.

Maximum #of months to Crash Critical Path activities = 4 months

Minimum #of months to Crash Critical Path activities = 2 months

Activities that must be crashed simultaneously are:

2→5 and 2→4; 3→5 and 4→5;

5→6 and 4→6 ; and 3→7 and 6→7 .

If the task on Path II is crashed, then project duration will be 20

TC* = ₦0 + ₦500 (20)

= ₦10,000 [Project Duration = 20 Months]

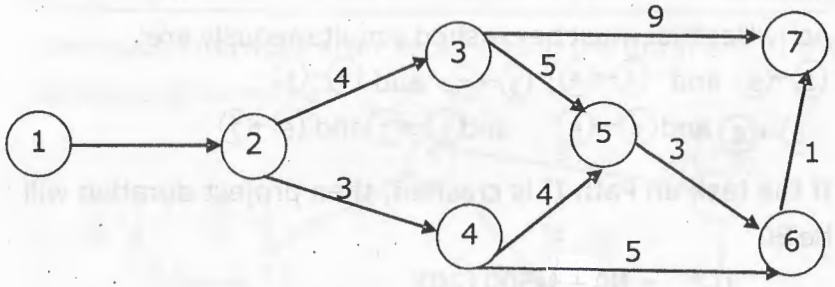
In order to make Path II = Path I, crash the task on Path II with the least cost, hence.

KEYS: NT = Normal Time; CT = Crash Time
M/CT = Maximum Time of Crashing
CC/mth = Crashing Cost per month
COH = Overhead cost of crashed project duration

Task (6)→(7) should be crashed since it has the least CC/mth, resulting in:

TC* = (CC up to previous stage)
+ (CC of activity (6)→(7))
+ (Overhead cost of Crashed project duration)
= N0 + 4(₦200) + 16 (₦500)
= ₦8,800 {Project Duration = 16 months}

And the new network (3) will be



Since Path II = Path I in duration (16 months each) from network (3), apply the rules of crashing.

Crash Options	**CC Per Months**
(1)→(2)	₦400
(3)→(7) and (6)→(7) simultanously	₦300 + ₦200 = ₦500

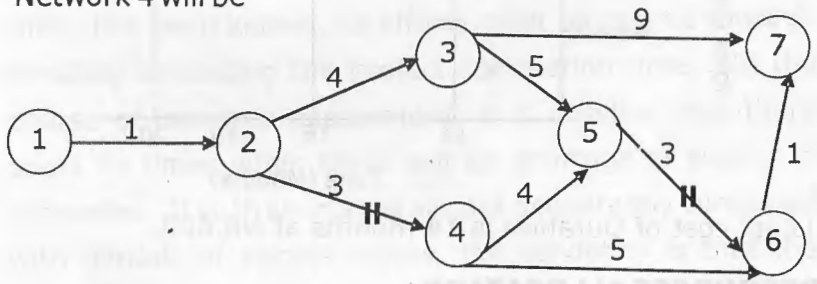
Crash Task (1)→(2) since it has the least cost schedule for a maximum of 2 months. This makes:

Project Duration = 14 months

TC*= {TC_{n-1} COH_{n-1}} + (CC of (1)→(2)) + COH for 14mths

= ₦800 + 2(₦400) + 14(₦500)
= ₦8,600 [Project Duration = 14 months]

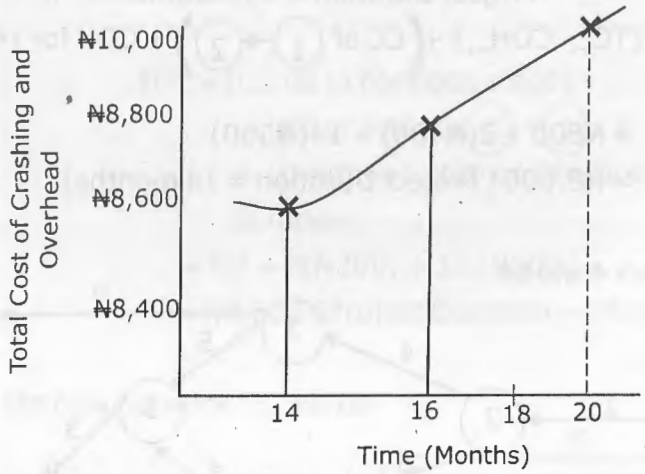
Network 4 will be



The only remaining task to be crash should be (3)→(7). However it cannot be crashed any further since (3)→(7) task which must be simultaneously crashed with (6)→(7) has been crashed to its minimum. This will be the end of crashing and the resultant Summary of duration and cost as well as the Time-Cost graph will be as below.

Summary of Project durations and Costs

Project Duration	Total Cost
14 months	₦8,600
16 months	₦8,800
20 months	₦10,000



Least cost of Duration is 14 months at N8,600.

RESOURCES ALLOCATION

This is the responsibility and duty of a project manager, by which he mobilizes resources needed for the completion of a project within scheduled time and cost, in order to ameliorate resource constraints. It is the technique(s) employed by a project manager to identify the critical activities together with the required resources such that

the resources are optimally utilized for a prompt completion of the project.

In allocating resources with the intention of tackling constraints, the manager must be able to plan and deploy the 5Ms so that times of shortage of supply can be covered by times of excess supply. This is a normal occurrence in most project execution and the focus of this allocation duty is the critical path and critical activities. This means that one of the most essential benefits of network analysis is the proper deployment of resources so that all the activities on the critical path are completed on schedule. That is, once the length of the critical path (or the project completion time) has been known, all efforts must be geared towards avoiding exceeding the project completion time. In the course of resource deployment, it is possible that there could be times when there will be shortage of supply of resources. If such shortages are not deliberately contained with periods of excess supply, the tendency is that the completion time will be exceeded. A project manager, will therefore not incur avoidable costs in times of shortage so that such avoidance can be compensated by extra costs to ensure that the latest permissible end time (TLm) is met.

A project manager that is faced with resources constraint, especially shortage of resource supply, can take one or a combination of two actions namely:

(a) Resource leveling, and/or
(b) Resource Limit Scheduling

These two actions will be necessary to enable the project manager crash the time and cost of an activity or the project, given the constraining factors. There are usually three constraining factors in project execution namely project completion time, the availability of resources and the costs of the project.

Project completion time becomes a constraint, when there is a fixed or scheduled time of delivering the project. This constraint is prominent when management of the project implementer adopts a top-bottom planning approach. That is target-let scenario, where for obvious reasons the project must be completed within an imposed time frame with or without regards to the managements' involvement or recommendation. This means that the emphasis will be on the due-date of completion irrespective of the cost of completion. It follows therefore that the project manager must employ more resources at extra cost and work more hours than normal in order to deliver. The concern of the project management in this kind of situation is to level the demand for resources (5ms) so that the project completion time will not be overshoot. One very important way of leveling resource with time constraint is by employing critical path analysis and the PPC analysis.

Availability of resources is another constraint because no matter how perfect the arrangement or plans may be, if the requisite resources are not available as and when needed the project will not be completed or there will be exceeding of the scheduled time. The project manager therefore must ensure that the time of excess supply of resources and times of short supply of resources are averaged out such that floats, idle times and wastage of resources are avoided. In the simpliest term, when there is excess supply of resources, efforts should be made to utilize them most effectively even if it means completing succeeding activities in advance. By this simple strategy, when resources run-out of supply some of the tasks would have been completed to reduce the time for waiting.

Finally under resource leveling is the cost constraint. There could be the imposition of the maximum amount that should be spent in the execution of the project. This means the whatever leveling actions taken by the project manager, cost overrun must be avoided for two particular reasons namely:

(a) Variations should be avoided in order not to cause disaffection between project manager, project teams, management of project executing firm, and the client/sponsor.

(b) So that the project managing firms will have a goodwill, a good image and make profit.

In this case, the project manager may employ the most optimum crashing technique to be within the scheduled project cost decided by any of the three project planning methods.

In resource limit scheduling, it is expected that resources should be scheduled in a way that even though the project completion time will be overstretched; the stretching should be very minimal, while satisfying the seemingly non-existent resource constraint. This case is most applicable to bottom-top planning and costing approach. This is why resource limit scheduling is also known as **resource smoothing.** The easiest way to tackle resource smoothing is the rule of thumb (heuristics). This trial-and-error approach will sometimes involve the introduction of artificial floats to one or more tasks in the project while apply a day-to-day trial-and-error computations. The pertinent rules in this heuristics will include:

(a) Allocation of all resources serially in time, starting with day 1 and scheduling all jobs for that day before moving to day 2, and following in that order.

(b) Where the available resources are to be deployed to competing or concurrent tasks,

the allocation must be made on the best of tasks with the least floats made on the best of tasks with the least floats.

(c) There should not be any breakage in the completion of any task, meaning that any task that is began must be continued to its completion.

(d) Only critical tasks should be emphasized because of their impact on the project completion time, while non-critical tasks can be postponed where necessary.

(e) There should not be any violation of any resource constraint in the performance of the above set of rules.

Chapter 6

PROJECT FAILURE/AILMENT AND REACTIVATION

Project failure is a common thing in Nigeria, especially in the public sector. It is as common as the change in administration. One of the basic arguments in government sector and among administrators is, "we are not the initiators of the project and therefore will not complete it for the glory of the previous administration". It is therefore not strange that inspite of the huge amount invested a project, or the duration or the proportionate completion, or the effective benefits of the project to the organization and the society, there are so many abandoned or failed projects dotting the length and breadth of Nigeria.

Sometimes, successors to the initiators of a project may want to complete the project by revisitation or reactivation, but such attempts are often at a very high cost than envisaged, hence another round of failure and wastage.

Project failure can be minor or major. A minor project failure occurs when either before the completion of a project or after hand-over, it is realized that there are some fundamental faults in the forms of designing, engineering, fabrication, funding, etc, such that the project will be at risk

if made functional or operational without review and correction. On the other hand, a major project failure occurs when in addition to the facts about minor failure, the review and corrective process either leads to a new project or too expensive and more time-consuming than the original project, hence the abandonment of the original project.

Interestingly, whether minor or major, project failure has more negative impacts on the project owner, project executor or implementer, the industry and the general society. Some of the negative impacts are:

1) Wastage of scarce resources;
2) Stunting of the capital formation process;
3) Loss of expected revenue;
4) Bad public image on the part of the owner and implementer;
5) High cost of executing further projects due to loss of confidence;
6) Loss of funds and income especially where funds are borrowed;
7) Dashed hopes and increase in unemployment;
8) Distress in both the banking and non-banking sectors;
9) Environmental deformation.

In Nigeria, especially since the present round of civilian democracy started in 1999, public projects have been used as barometer for dividends of democracy (DOD) even though they are part of the fundamental benefits of the citizens and/or also provided by the military administrations. Given these two comparable stakeholders' considerations, projects (especially public projects), have been adjudged executed successfully or otherwise from two different perspectives namely (i) the amount of money expended on the project; and (ii) the physical handing over of functioning project.

From the standpoint of most civilian rulers (President, Governors, Local Government Chairman, Ministers and Commissioners, etc.) the amount of money voted and expended on a particular project is a major decider for achievement. And the completion of such projects whether in workable form or not is something celebrated as the dividends of democracy (DOD). This contradicts the sense of value under the military, where the success or failure of a project is judged by the delivery (handing-over) of a functional project, within a scheduled duration and of course with little emphasis on the cost of the project.

The above means that there are criteria used to judge the success or failure of a project. These criteria can obviously be identified by grouping an expanded form of the various

activities discussed in Chapter 2 (project life cycle), under the following activity-groups:

(a) Project Definition
(b) Project Execution or Fulfillment
(c) Project Delivery or Benefits Realization
(d) Project Divestment or Disposal

Note that in real or technical terms, a product is the outcome of a project. The activities within the project lifespan will cover project definition, execution and part of project delivery. It follows that any other activities outside these will relate or concern the product, namely handing-over (part of delivery) and disposal. For example, before a bank introduces and advertises a promotional product (like the *Hi Fi* Savers Scheme of First Bank of Nigeria Plc), it must be developed from the conceptual stage to test-run. All the activities involved at these stages are known as product development activities or project activities. Anywhere after a satisfactory test-run, the project transforms to be a product which can be discontinued (diversified from) with after sometime. A Primary Health Center remains a project from conception to the equipping of the completed building with every necessary human and material gadget. But once it is commissioned (handed-over) it becomes a product.

PROJECT DEFINITION

From the above explanations, project definition stage will cover conceptualization, definition, preparation and authorization. It will also include the pre-operation impact assessment. This first stage in the graph figure (5.1) below is where the foundation for the success or failure of the project or product is laid, hence it is when the appraisal, strategy, manual writing, go/no-go decisions are made.

At this stage, if any incorrect, wrong, inadequate and insufficient definition decisions are made and taken; or the composition of the manual is faulty; or the strategy, staffing, risk and impact assessments are wrong/inadequate, the project/product will be in danger of failure.

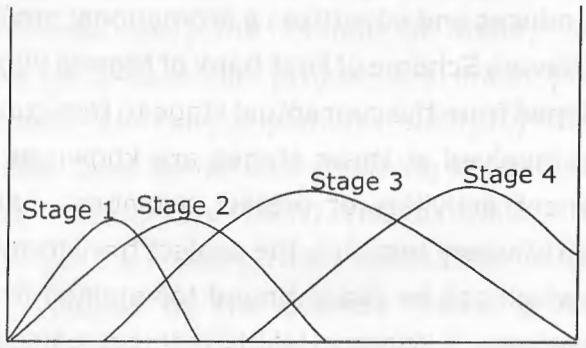


Figure 5.1: Cycles in Project Life

From the case study and the issues raised, the project definition success/failure factors will include:

- Quality of goals setting
- Quality and adequacy of definition of ideas

- Specification or Clarity of definition of expectations
- Poor or vague specification of scope of the project
- Adequacy or clarity of tasks identification
- Adequacy, competence and clarity of technical requirement assessment
- Adequacy of (especially the use of Ball-Park and Approximate) estimation of cost, milestones, scheduling, and benefits.
- Riskiness and impact assessment
- Appropriateness of the strategy for the project execution
- Quality of cash flow predictions and funds release plan
- Quality and adequacy of staffing and motivation
- Immeasurability and Verification of reason for authorization and approvals.

Some of these factors could be noticed during or before the next set of activities (i.e. the Project Execution Cycle). Where they are noticed, corrective measures can be taken to avoid major or complete failure by fixing the faults. It must be stated here that the factors appertain largely to the project owner and/or project consultant. Success could be measured by the precise time, the minimal cost

and the depth of professional details of the planned activities at this stage.

PROJECT EXECUTION SUCCESS/FAILURE FACTORS

Project execution activities are the actual implementation of the activities in the first cycle. Unlike the project definition success/failure factors that largely depend on the project owner or representative, the success/failure of project execution depends on the actions and competence of the project implementer (who can be a contractor) and project manager (if different).

For instance, the project manager/implementer/ executor or consultant can boast of success if the project is executed within the scheduled time (taking note of crash time and cost), within the estimated cost (budget, cash flows and funding), and at least at the technical specifications (quality and capacity). This means that in addition to authorization, assessment and implementation specified in chapter 2, organization, mobilization, procurement, designing and redesigning, and completion activities will make up this group of activities.

The success or failure of these activities will depend on the following points:

- Sound and clear definition of project concept and technicalities.

- Sound and clear feasibility study and business plan.
- Availability and prompt release of required funds and other resources.
- Choice of the strategies for the project implementation.
- Availability and accessibility to market
- Ability to control or minimize the impact of foreseeable and/or unforeseeable changes to the project.
- Adaptability of the organization structure to the project implementation.
- Level of technical competence and focus on quality delivery.
- Complexity of staffing and motivation imbedded in the system.
- The health, safety and environment (HSE) policy in vogue.
- Balanced flow of communication between staff and organization.

The summary of the points stated above is that a poor handling of any of the issues can lead to time over-run and cost over-run, especially when the definition stage has been delayed to the latest permissible time limit so that there may not be any avenue for floats to exists. Most projects that fail and are abandoned result from these

factors which still fit into the satisfaction of the three basic parameters of timeliness, performance (quality) and cost implication. As mentioned earlier, the success of most government projects is measured on the amount of cost incurred. Ordinarily, corporate organizational structure, staffing and sufficiency/timeliness of resources all boil down to funding. So if the funds are not released promptly, failure will be unavailable. The emphasis here on delayed funding will be on external funding, which most times will be outside the control of both the project owner and implementer.

Beyond these considerations, there have been different ways of measuring the success or failure of projects, such as the CHAOS Report measurement and the Critical Success or Failure Factor methodology.

PROJECT DELIVERY (PRODUCT UTILIZATION) SUCCESS/FAILURE FACTORS

The delivery or hand-over stage of the project-lifecycle can be concurrent with the product utilization stage. Failure can occur or can be noticed in the activities that are involved in the functioning of the product (machine, service, etc.). For instance, a successful project at the implementation stage can develop some defects and be handed-over with the defects unnoticed, or the defects or challenges noticed after the handing over. The implication of such projects will be on the benefits expected.

Where a product (i.e. successfully executed project) is not successful (that is not accomplishing its expections), then a re-visit to the definition and execution stages will be inevitable to realize the expectations of the project owner. The success, challenge or failure of a project or product actually depends on the operation of the executed project, hence this stage is also known as the Production Stage. And in a bid to reduce the magnitude of failure, project owners and/or executors will test-run the project before handing over or before real production process commences. This explains why this stage covers TEST-RUN and PRODUCTION. Indicators of or factors affecting the success or failure of the delivery of a project/product will include:

1) Structure of the product vis-à-vis provision for innovations.
2) Adequacy of the operational manual.
3) Cost of production vis-à-vis the completion cost of execution.
4) Quantity of production vis-à-vis the installed capacity and demand.
5) Quality of output vis-à-vis standards and expectation of customers and competitors.
6) The terms of payment vis-à-vis the milestones and the retention rate.

7) The benchmarks on operation, production, cash flows, and cost savings.
8) Adequacy of costing and pricing system.
9) Adequacy and practicability of recommended distribution/marketing channels.

Measurement of Success/Failures of Projects/ Products

Several methods are available in appraising the success or failure of projects, some of which are:

(a) The CHAOS Model
(b) The Critical Success Factors Model
(c) The Univariate Analysis
(d) The Multivariate Analysis
(e) The Altman Model

(a) THE CHAOS MODEL

This model measures the successfulness or failure of projects by classifying products into three (3) categories namely successful, challenged and failed. It uses a 10 factor rating strategy for each of these classes of projects. It is based on a biennial study of projects by the Standish Group International beginning from 1994. As at 2006 the percentage of success, challenged and failed (or impaired) projects is as shown in the table below.

CHAOS Report Classification of Project from Findings

	1994	1996	1998	200	2002	2006
Succeeded	16%	27%	26%	28%	34%	35%
Challenged	53%	33%	46%	49%	51%	45%
Impaired	31%	40%	28%	23%	15%	20%

CHAOS Report classifies a project as successful if the project is executed and delivered on time, within the financial estimation (budget) and satisfies all functions, features and qualities as specified. If on the other hand, a project is completed and operational after overshooting the cost estimate, over its scheduled time of completion and it has some areas for correction or variance from its original specification in its features and functions, that project is classified as challenged. Where, finally, a project is not completed or is cancelled within its execution stage, the project is classified as Impaired or failed.

The 10 factors or indictors considered for each of the three classes of projects are as shown below in order of importance.

Project success factors

- User Involvement
- Executive Management Support
- Clear Statement of Requirements
- Proper Planning
- Realistic Expectations
- Smaller Project milestones
- Competent Staff
- Ownership
- Clear Vision and Objectives
- Hard-working, Focused Staff
- Others

Challenged Projects Factors

- Lack of User Input
- Incomplete Requirement and Specifications
- Changing Requirements and Specifications
- Lack of Executive Support
- Technology Incompetence
- Lack of Resources
- Unrealistic Expectations
- Unclear Objectives
- Unrealistic Time Frames
- New Technology
- Others

Impaired Projects Factors

- Incomplete Requirement
- Lack of User Involvement
- Lack of Resources
- Unrealistic Expectations
- Lack of Executive Support
- Changing Requirements and Specifications
- Lack of Planning
- Loss of relevance
- Lack of IT Management
- Technology Illiteracy
- Others

(a) CRITICAL SUCCESS FACTOR (CSF) MODEL

By this success/failure indicator and/or measurement approach, certain quantitative and qualitative, human and material factors are identified and used to scale the success or failure of a project. Sometimes, these factors are called TARGET ENABLERS because they are basically elements that enable the project executor to attain pre-set organizational targets. The factors or variables have direct and overbearing impacts on the efficiency, effectiveness, and viability of the project, product, program or organization. These variables or conditions are so essential that they must be performed with the highest sense of completeness and excellence so that the targets

can be attained. . They are also known as KEY SUCCESS FACTORS or KEY RESULT AREAS, quite different from Key Performance Indicators (KPI). Whereas CSF refer to the causes or reasons for success, i.e. if not found to be existing in the execution process a project or product, that project or product can be termed to be impaired or challenged; KPI refer to the effects of the actions taken. KPI are like milestones to be completed, which means that if the CSF are rightly known or identified and execution actions religiously taken, then KPI must be met.

KPI are the effects of the actions taken in the execution stage of a project.

According to Austin (2002), CSF model is a guide for businesses to create and measure success. It was developed at the MIT's Sloan School by John Rockart. It is most widely used in technology and architectural planning or projects. There are four (4) types of CSF viz:

(a) Industry CSFs resulting from specific industry characteristics;

(b) Strategy CSFs - which are from some selected competitive strategies of a business;

(c) Environmental CSFs - which are common with economic or technological changes; and

(d) Temporal CSFs which result from identified specific needs and changes in the internal structure of a firm.

THE UNIVARIATE ANALYSIS

Most times, it has been proven that a well conceived project can fail if the funds are not released in the right amount and at the right time. Often times, this has been the complaint of many project owners and executors especially in the public sector of Nigeria such that public projects that would either require lumpsum investment to keep-start, or manageably started at the available level of investment if it was privately owned, would be discontinued with (i.e, FAILED or ABANDONED). Expectedly, finance is one of the most crucial factors in the success story of any project. It ranks pari-persu with the human factor. But most times, finance (funding plus other valuable materials) seems to be most emphasized. When only one factor is considered in measuring the success or failure of a project, such analysis is known as Univariate Analysis.

However, even when the single factor like finance or human capacity is considered, there will necessarily be a breakdown of the main factor. For instance, when finance is considered several financial ratios must be calculated

and interpreted in relation to the success, challenge or failure of any project. Financial ratios are usually classified into four (4) main groups, with several sub-groups, and ratios in the sub-groups. These can be summarized as follows:

A. Safety Ratio A_1 (Liquidity Ratios)
A_2 (Leverage Ratios)
A_3 (Coverage Ratios)

B. Management Efficiency Ratios
B_1 (Activity Ratios)
B_2 (Expense Control Ratios)

C. Profitability Ratios C_1 (Investment Profitability Ratios)
C_2 (Sales Profitability Ratios)
C_3 (Real Return ratios)

D. Market Value Ratios

Out of the 9 sub-groups of financial ratios, it is considered that A_1, A_3, and B_1 are the most relevant to the measurement of the success/failure of projects. According to Beaver, (1966) liquidity ratios (i.e. A_1) is most critical to the success/failure of 158 projects studied in equal groups of two (2) of 79 success and 79 failed (sick) projects. This study showed specifically that the ratio of cash flow to total debts has the highest capability to predict the performance (impending sickness) of projects.

THE MULTIVARIATE ANALYSIS

Multivariate analysis refers to the use of more than one parameter simultaneously to measure or predict failure or success of a project. Unlike the use of one (1) particular ratio in any sub-group or group of financial ratios in univariate analysis, any combination of different ratios will tantamount to multivariate analysis. In this case, financial and non-financial ratios could be combined or several financial ratios could be used. In most multivariate analysis, the analysis is done using experimental research methodology by grouping or selecting projects or firms of equal investment, capital and marketing capacities into success and failed projects. Several ratios will be calculated given the comparative data for the two sets of projects/firms/industries. A simple approach for predicting the fortune of a project is if the combined ratios will be less than or more than 50%. Where the value is less than 50%, the project is considered challenged or failed, else it should be taken for a success-project. An improvement on this simple aggregate multivariate model is the WEIGHTED AGGREGATE approach by which the various ratios are assigned weights in order of preference and considered relative importance to the success of the project/firm/industry. For instance, in order to evaluate a banking project (say a bank branch), liquidity, type of deposit mobilized and the core capital base could be

considered more critical than other factors hence could be assigned heavier weights like 5 or 4 on a 5-point likert scale. In this way, a cut-off point of 60% and above could be used for success, while a weighted average of less than 60% would be considered as challenged or failed. That is 3/5 of the total weighted score of the ratio.

Example 6.1

From the following set of financial ratios and weights of XYZ Micro Finance Bank, Eleme Branch, determine whether the establishment of the branch should be reconsidered or not.

Ratio	%	Wt.
Quick Asset	0.38	5
Savings Deposit – Core Capital	1.50	4
Core Capital –Risk Weighted Asset	0.73	5
Loans and Advances –Total Deposit	0.68	3
Interest Coverage	1.84	1
Loans Recovery	0.45	2
Loans—Total Capital	0.88	2

Solution 6.1

Computation of Weighted Average Cut-Off Value

Ratio	%	Wt.	%.Wt.
Quick Asset	0.38	5	1.90
Savings Deposit – Core Capital	1.50	4	6.00
Core Capital – Risk Weighted Asset	0.73	5	3.65
Loans and Advances – Total Deposit	0.68	3	2.84
Interest Coverage	1.84	1	1.84
Loans Recovery	0.45	2	0.90
Loans Total Capital	0.88	2	1.76
		22	18.89

$$\text{Multivariate Value} = \frac{18.89}{22}$$

$$= \underline{0.8586}$$

Since the multivariate score or value of 85.86% is greater than 60%, the establishment of the branch was wise and a success.

THE ALTMAN MODEL

The Altman model is a brand of multivariate analysis for evaluating whether a project/firm/industry is sick or successful. The model was based on a study of two sets of 33 firms (i.e. 33 bankrupt and 33 non-bankrupt firms) and 22 financial ratios. Out of the 22, the most outstanding 5 ratios were identified to have the power to influence

sickness (bankruptcy) of firms. The combined value of the 5 ratios is the discriminant factor or score called "Z" factor. The 5 ratios and their weights are as follows:

X_1 = Working capital ratio (working capital ÷Total Assets), 1.20.

X_2 = Retained earnings ratio (retained earnings ÷ total assets), 1.40.

X_3 = EBIT ratio (EBIT ÷ Total Assets), 3.30

X_4 = Market value gearing ratio (Market Value of Equity ÷ Book Value of total Debts), 0.60

X_5 = Turnover–Assets ratio (Sales ÷ Total Assets), 0.999.

The model is expressed in a multivariate equation as:

$$Z = 1.20x_1 + 1.40x_2 + 3.30x_3 + 0.60x_4 + 0.999x_5$$

A Z-discriminant score of 2.675 is the cut-off point for success or failure of a project/firm/industry.

From the above, it could be seen that project delivery must encompass an appraisal of the success/failure of the project whether at the completion or handing-over (delivery), and an appraisal of the benefits realized or realizable. It follows therefore that even after delivery, there are chances that a project can fail or be heavily impaired. It is after the appraisal or identification of the

project as successful or failed, and if it cannot be reactivated or revived, that the project divestment or disposal decision is made.

PROJECT DIVESTMENT

Project divestment is common in history (and even now) locally, nationally, internationally, personally or at corporate level. Divesting in a project means withdrawing control or possession from the project. This can occur at various stages of a project, meaning that a project owner or promoter can decide to disengage from a project at the identification stage, at execution stage, at handing-over stage or even at post- delivery stage.

Several reasons can cause divestment from a project, some of which are:

1) Project failure
2) Change in technology
3) Change in the location of owner
4) Political factor
5) Threat to continued existence
6) Incorrectable errors in design/execution stages
7) Loss of interest
8) Legal matters
9) Changes in policies
10) Destruction from natural factors

All the possible reasons for divestment in a project or product/firm can be grouped into two, namely voluntary and involuntary reasons. Often times, emphasis for divestment is placed on failure. Even when a project is sick, the owner can decide to divest voluntarily by:

(a) Selling off ownership stake
(b) Liquidation
(c) Filing for bankruptcy
(d) Bequeathal

On the other hand, an involuntary winding-up can be by court order where the creditors sue for liquidation, or through government clampdown or changes in policies which make on hitherto legitimate activity become illegitimate.

REACTIVATION OF AILING/FAILURE PROJECT

There are various ways of reactivating, rehabilitating or resuscitating ailing, challenged or failed projects, such as:

(i) Prevention
(ii) Tackling the reason for the challenge
(iii) Sale or liquidation of the project
(iv) Reorganization

(I) *Prevention*

Naturally, the best way to solve a problem is to prevent the possible causes of the problem. Impliedly, from the conception to the fulfillment of the project, there must be checking and cross-checking, and reappraisal of various tasks that make up a project and even the operation of the product. Where need be, every observed shortcomings or variances from set targets should be tackled promptly.

(II) Handling the Reasons for Ailing

Just as have been mentioned earlier, several reasons can account for the propensity to or actual failure of a project. Recall that ordinarily, a project is challenged or failed if the project is not delivered within the time frame, within the project's budget and outside the objectives of the project. This means that if the project's time of completion or delivery is necessarily extended by reason of revision to certain aspects of the project design/execution, the project would be revitalized and salvaged from total failure. Where this revitalization is undertaken by the project owner/promoter/executor, without any external party (e.g. an independently appointed consultant or innovator), it is said to be self-revitalized or self-reactivated.

However, whether self-reactivated or not, re-vitalization could just be to address the observed reason(s) for the challenge which will include the following:

(a) Where the challenge has been as a result of shortage of funds, the promoter/implementer must inject additional funds either through equity financing or debt financing. Equity financing could be in the form of rights issues, warrants, convertibles, or introduction of fresh owners' contribution by existing shareholders and/or by new shareholders.

Debt financing on the other hand, can be from the formal or informal money market, or from negotiated capital market or the stock exchange. Whichever method or combination of methods applied, the important issue is that the needed financial resources are provided in order to avoid a complete failure (abandonment).

(b) Where the activities so far executed suggest incompleteness for the objective(s) of project to be attained, the project owner/implementer may wish to re-design or re-appreciate the scope so that the uncaptured elements together with their respective time and cost schedules would be incorporated for completeness. This is what is commonly referred to as Scope Appreciation. It is an attempt to answer questions like: are there extra works to be done, which were not specified in the original design, but

are unavoidable if the project must function and achieve its objectives, hence requiring more costs and time?

For instance, if a block of flats were erected without a soak-away tank for sewage, the potential tenants may not be prepared to rent the apartments even after the contractors have handed the keys to the flats to the owner. It will take another time and cost to construct a soak-away pit as well as the necessary plumbing works before that block of flats can be adjudged to be ready for occupation. If the soak-away sewage pit was not part of the original design, then an observation at whatever time in the building contract will mean an expansion of the scope of activities and the budget, else the block of flats will be an impaired project especially depending on its location.

(c) The reasons for project failure or impairment could be the non-involvement of or non-consideration of the needs of users. For instance, if a portable water factory is to serve a community and the owners of this factory assumed that only bottled water will be produced and sold. If most of the members of the community cannot afford ₦100 for a bottle of water, the functioning of the water project will be challenged. To revitalize this project, the owners

must make fresh provision for sachet water production/sale. This success or reactivation factor is simply referred to as Understanding the Needs of Users. It implies that where a project owner/executor does not fully understand the needs of users of the output of the project or did not involve the expectations of the users, a project can be challenged or impaired through low patronage and poor profit levels.

(d) Lack of continuity in management and poor staff incentive/remuneration system can lead to the impairment or threaten the success of a project. Where this happens, the project owner/ implementer must exercise restraint if proper communication, reporting and accountability channels have been laid out so that the human (managerial) styles live-out their possible gestation periods. It is common saying that no two persons (managers) can be the same. Therefore each set of managers or executives must be given reasonable time to perform, and incentive system clearly established to enhance productivity and experience.

Where a product/firm/industry has become impaired (i.e. worse than challenged), then the

project reactivation models (among others) can be by reorganization or liquidation.

(III) *Reorganization*

Reorganization of the product/firm can be internal or external. Internally, the product/firm can be disaggregated, such that while some units/departments are closed or merged for optimal results, others can be leased or franchised. Often times, when the existence of a firm is threatened, what executive management easily adopts is staff rationalization, reduction, down-sizing or right-sizing. But, we must sound a note of caution here with respect to the cost-implication and the potential loss of experience.

Another aspect of internal reorganization could be reduction in earned allowances and benefits. This is ofter referred to as cost minimization or reduction. In this case, for instance, rent agreements could be reviewed and rationalized, executive management positions could be reduced, employment of new staff could be frozen, and a general staff and financial audit conducted. Another aspect of internal reorganization would be at the owners' levels, such that there could be share reconstruction and the demand for the payment of uncalled shares to the maximum of the authorized share capital

Externally, reorganization can take the form of mergers, acquisition, change of name, relocation, and change from private ownership to public ownership or even nationalization.

(IV) *Sale of Project/firm*

This is also known as liquidation as distinct from bankruptcy. Liquidation of the project can be by a holistic sale of the project to a third party or the breaking down of the project at its current state and disposing the dismantled parts in order to recover part of the cost already incurred. Liquidation at other times, especially for indivisible heavy duty items or projects, can be by abandonment after proper, investment appraisal. For instance, where a contractor has mobilized heavy duty equipments to construction site and it becomes impossible to execute the contract due to certain extraneous reasons (like war, change of government, liquidation of project financing bank, forced liquidation of either the contracting firm or the project owner/sponsor, or cancellation of the contract), the heavy duty equipments could be abandoned. However, where there are chances of returning the equipments to base, a proper analysis must be made to determine the best option between abandonment, sale, and return. This appraisal will be necessitated by the fact that the project has been terminally challenged or impaired.

PROJECT CLOSURE

Project closure is the termination of the life of a project, whether upon completion of all tasks and commissioning, or at any stage in the implementation of the project plan possibly because the project has become challenged or impaired. The closest similarity or analogy to project closure is project winding-up. However, project winding-up has some far-reaching legal and broad inter-party implications than project closure. In the simplest form, project closure would mean a friendly termination of the life of a project by the project executor or project owner before the complete execution of the project plan. This can be for several reasons such as:

(a) Incompetence of project implementer;
(b) Insincerity of the project team;
(c) Non co-operation and non-support of the project team by the project owner/sponsor;
(d) Disagreement between project executor and sponsor over variations and payment schedules;
(e) Change in economic policies and difficulty in procuring needed supply of resources;
(f) Natural factors like flooding, earthquakes, and fire; and
(g) Change in technology applicable (e.g. wheat-based manufacture to maize-based manufacture of food, beverages and breweries).

Where a project is closed before its completion, the project can be closed by one or a combination of the following measures:

(i) Complete evacuation of all moveable equipments, machinery, and tools, and the disengagement of existing labour force.

(ii) Sale to or acquisition by succeeding executor or host community, of existing structure(s) and resources.

(iii) Dismantling of existing structure and selling the parts that are saleable, hiring/leasing of the parts that can be hired or leased, and returning the ones that could be useful in the operational base of the project executor.

Where the project executor is a syndicate, or conglomerate firm created for the only purpose of executing the project, then the firm will be wound-up and the assets and liabilities disposed off accordingly, or they may be acquired by a successor firm.

Note that project closure, if not for adverse reasons of failure, is a confirmation that other processes and tasks have been performed appropriately and the various milestones conclusively and acceptably finished. Whether contract or project, the closure process is an indication of the execution of all the details involved in all tasks and interactions, and is an indication of the acceptance of the

project's outcome by the project owner/sponsor/market. Where the closure is at the end of the successful execution of the project:

1) A project termination schedule must be prepared and approved by managers.
2) There must be a plan to move the project team to another project site or head office.
3) There must be monitoring of the completion of all necessary contractual obligations.
4) All work orders must be closed and the project books closed also.
5) All concerned parties must be duly informed in advance of the date of closure.
6) All files and records must be delivered to the office for safekeeping.
7) All customers and sub-clients must be communicated.
8) All contract or project termination documents must be prepared, approved and released

Chapter 7

PROJECT COMPLETION REPORT

Upon the completion of a project/work/assignment, it is not enough that the product/outcome is seen or felt, but that a declaration be made officially of such completion. Given the different types and scales of project, completion report must be made as the last stage before any form of appraisal is made about the level of compliance and functionality of the product. Remember that a project is a generic term for all the expected outcomes of a project.

A Project Completion Report (PCR) is a structured report which explains the situation at the end of the execution of all tasks outlined at the planning stage after all the adjustments or interventions, the lessons learnt from the execution of the project, and the problems/prospects of the project. It is the responsibility of the project implementer. This attribute is one of the distinguishing factors between project completion report and post-project audit report. PCR is more of an accountability report which asserts that the project, work or contract has been conducted in accordance to the already specified and agreed terms, rules and standards, and that the result is fairly and accurately in tandem with the mandate specified in the plan. In a simple

language, a PCR is a report on the project story, i.e. what were expected, what happened, what was learnt, what were within and outside expectation, the milestones and measurement parameters, and the eventual final outcome/results. The single most important essence of PCR is that it is beneficial to the project owner, the public (customers) and project executor (for subsequent projects).

Yet, another way to consider PCR, is to define PCR as a record that shows the achievements of a project from inception to completion, as against the original intended outcomes or outputs. It is a way of appraising the impact, drawing out conclusion, and expressing the lessons learnt that may be useful to other similar projects in the future.

COMPONENTS OF PCR

From the above explanation of what PCR is, it could be said that PCR is a summary report on the specified and unspecified life of a project. Therefore, depending on the type of project, the following (though not exhaustive) will form parts of the PCR:

1) Project Title
2) Overview or Introduction
3) Aims or Objectives
4) Project Activities
5) Project Outcomes
6) Post Completion Activities

7) Issues and Risk Summary
8) Lessons learnt
9) Improvement received
10) Appendices (a) Copies of the Project Design
(b) Budget Summary

PROJECT TITLE

This aspect of the PCR shows the summary of the summarized information shown in the Project Sign Post. Specifically, it reports the following:

(a) Name of Project
(b) Sponsor of Project
(c) Version of the Project
(d) Date of Commencement
(e) Date of completion
(f) Project Manager/Consultant
(g) Project Supervisor
(h) Project File Number

This summary may be in the form of a header or footer for all the pages of the PCR. If the header and footer style of presentation is used, the Project Title information will also show the number of pages. The header or footer version can be as shown below.

<table>
<tr><td rowspan="3">Project Name/Title:

Project Sponsor:</td><td rowspan="3">Version:

Date:

Project Manager:</td><td colspan="2">File Number:</td></tr>
<tr><td rowspan="2">Project client:</td><td rowspan="2">Page No.
..of..</td></tr>
<tr></tr>
</table>

It must be noted that the Project Name or title must be the same with what appears in the Contract Offer Letter of Understanding. It is advisable to state this title together with its particular Reference Number.

In the case of the Sponsor of the Project, the summarized information should include the name of the project owner and/or its representative and the name and address (postal, email and telephone) of the contact person or representative. Similar details should be given concerning the Project Manager and Project Supervisor(s).

PROJECT OVERVIEW/INTRODUCTION

This describes the concept of the project as well as the description of the entire project. The overview could begin with the gap the establishment of the project would fill, the capacities and operational methods of existing comparable or similar projects. The overview could cover the product(s), bye-products, the support businesses, and the downstream(value chain) businesses. The overview could

also indicate the expected duration of project and the specification and/or design of the project. For instance, a report on the installation and distribution of a giant water project at Ozuoba Town can state the centrality of the Town among neighbouring communities in the Akpor Kingdom, the need to forestall any environmental hazard like earth tremor resulting from the indiscriminant sinking of boreholes, the supply of certified portable water for the manufacture of packaged water, and the generation of revenue from the delivery of water to the residents.

OBJECTIVE(S) OF THE PROJECT

In this section of the PCR, the aims and/or objectives of the project are listed out. These aims and/or objectives must be stated in the original form. This will be followed by the observed reasons for possible changes to the aims and objectives. Finally, the agreed changes to the objectives of the project will be clearly stated. For instance, if the original objective of the reconstruction of an expired road was to resurface and provide single drainage on one side of the road so that the water from the two sides of the road will be evacuated by the single drainage. If the members of the public protest the concept of the road and the government (project sponsors) agrees to construct a dual carriage with a central drainage so that the road will be widened but the occupants on the both sides of the road will not accuse either

party of preferential treatment in evacuating the water in front of their houses. In reporting the work done, the original objective and the amended objective(s) must be stated. The reason could be to justify the extension of scheduled time and increase in the cost of completing the project.

PROJECT ACTIVITIES

Here, PCR is expected to report on the activities or tasks undertaken from start to finish of the project. Particular of mention will be a brief on the Site Assessment (especially the choice and the composition of the physical aspects of the site), the community involvement and the consultations and level of negotiations, and the collective resolutions on the impacts and size of the physical site. Other activities can be stated according to the milestones the whole project was broken into, and possibly with the level of resources mobilized as well as the sponsor's/manager's supports.

PROJECT OUTCOMES

This section of the PCR informs the users of the report on the outcome, result or product of the project. Since most of the different types of projects are categorized under engineering and manufacturing, the outcomes of projects will be very obviously visible and tangible.

In this sense therefore, there may not be any need to restate

the obvious outcome but to state other aspects of the project outcomes such as:

(A) Milestones/deliverables
(b) Budget cost
(c) Final cost
(d) Schedule date of completion
(e) Final date of completion

These aspects can be tabulated as follows:

Project Outcomes

Milestones/Deliverables	Budgeted Cost	Final Cost	Schedule Date	Final Date
Total				

The essence of this section is to summarize the project costing and scheduling, which would be used to justify (or otherwise) the agreed changes to the objectives and other managerial analysis. This becomes very important to both the project sponsor/owner and the project manager/executor in the sense that the final total cost of the project is compared to the budgeted total cost which would have been comprehensively captured in the feasibility studies. By this comparison, the reasons for the variance are identified according to the milestones and deliverables.

Similarly, this section of the PCR explains the reason for the differences between estimated time or duration and the actual duration of the various tasks that constitute the project. This explanation is necessary because it shows the implication(s) of such variance on the project and the users of the outcome(s).

POST COMPLETION ACTIVITIES

The PCR should be able to report the activities that take place from the completion of the project. For instance, if the project is the construction of a bridge across a river. Upon completion, the project owner/sponsor should be able to independently assess the status of the bridge within a given period of time, and the commissioning and handing-over to the users. On the other hand, the project executor/contractor will undertake certain activities upon completion of the project. Such activities will include demobilization from site, abandonment of some machinery and equipment, the liquidation and sell-off of assets and the firm, final stock taking and accounting. The project implementers can also sample the opinion of users and sponsors of the project, while still carrying out a self-appraisal vis-à-vis the original and amended project plan and objective(s). The last thing is to send the project documentations to the archive. In summary, the post completion activities will involve:

1) Full assemblage/retrieval of the input documentations such as project plan/design, project management plan, contract documentation, project deliverables.
2) Full documentation of the techniques and tools used such as project management methodology, project management information system and expert judgement.
3) Full documentation of project archive such as the copies of delivered items, copies of user manuals, signed contract releases for completed work, pertinent project specifics and even the updated records of financial involvement.
4) Final claim and/or statement of expenditures made during the projects execution.
5) Full documentation on the transfer of assets, and inventory of disposal of assets.
6) Annual audited accounts of the projects executor, if not the project itself.

ISSUES AND RISK SUMMARY

This is where most of the observations made during the execution of the project are stated. For instance, the observations will generally cover two areas namely the risks and other vital issues noticed and handled during the project execution.

This report should indicate the risks identified in the implementation of the original plan and the periodic reports. It should state the risk that crystallized and how they were handled to reduce the impact on the project.

On the other hand, the vital issues will cover:

(a) The relevance of the outcome/product of the project within the project execution period with respect to the changes-agreed to the context and content of the project.
(b) Identified sources of funding, besides the main sponsors' funds, in order to augment or leverage the former.
(c) Identification of the sponsor whose responsibility it will be to continue the project, should the original outcome of the project become unachievable.
(d) Identification of the additional values (especially value for money) contributed by partners to the sponsor in the realization of the project objective(s).
(e) The identification of the extent to which spending decisions were influenced by the principle of value for money (VfM).
(f) The percentage of funds spent on overhead.
(g) The reasons for change(s) in the unit cost of items, if any. This is as good as variance

analysis and for responsibility accounting.

(h) Statement on whether the project was completed within the budgeted costs, if not what could be the cause of the variance.

(i) The positive and negative impacts of the project on the climate, and the environment as well as the climate and environment on the project or its outcome. This should be extended to the measures taken and the measures to be taken to address negative impact during execution and in the future, as well as the measures for the maximization of the positive impacts.

The above stated points can be grouped as follows:

(I) Issues on Risks [point (a)]

(II) Issues on Effectiveness [points (b)– (d)]

(III) Issues of Efficiency [points (e)– (f)]

(IV) Issues on Economy [points (g)– (h)

(V) Issues on Impact [point (i)]

LESSONS LEARNT

In this section, attempts are made to identify the high and low points of the project which might be very important to the planning and completion of future projects such as:

(a) Causes of variance and possible better ways to address the variance.

(b) Reasons for the measures taken to handle the variance and changes.

(c) Client's (project sponsor), potential users', and staff testimonies.

(d) Basis for the election of the tools, equipment, methodologies and strategies used.

All these and many others are expected to proffer answers to four sets of questions namely:

1) What were the phases/milestones covered?

2) What were the things that worked?

3) What were the things that did not work?

4) What are the suggested measures to improve the future?

These can be presented in a tabular form like below:

Lessons Learnt From The Ozuoba Water Project

Milestone/Phases	What Worked	What Did Not Work	Ways to Improve

A proper analysis of the issues under the four (4) questions will address several issues that pertain to the project and future projects generally. Specifically, lessons learnt can be discussed under the following four (4) headings:

(a) Equity
(b) Capacity building
(c) Approaches to advocacy/empowerment
(d) Monitoring and evaluation

a. *Lessons of Equity Learnt*

Most macro-projects in Nigeria are public sector projects. But, the bane of these projects have been non-inclusion of the communities and people the projects are to serve. This makes the people see the projects as externally owned by government(s). In recent times, however, and generally speaking, it is recommended that users and host communities of macro-projects should be made to be joint-owners of the projects. In the PCR, one of the lessons to be reported will be how the non-included or marginalized groups of users, communities and the general public were incorporated into the project, or how these disadvantaged persons would benefit from the project activities or outcomes.

The other aspect of equity will cover answers to what worked, what did not work, and how to improve on the immediate past experience.

b. *Capacity Building*

As a way to realizing the millennium development goals, capacity building should be one area projects are expected to generate lessons. In this regards, project execution and equity in project should be done in such a way that particular methods of capacity building that worked for the project should be identified. This cannot be in isolation from the cultural peculiarities of the partners and host communities. The essence of this is for the execution of projects in the future (whether similar or not) to be smooth. Another lesson in the area of capacity building would be the involvement of women and youths in the project (during and after execution). The PCR should be able to identify the approaches adopted for women capacity building and to appraise the rate of success for the methods. This will guide the planning and execution of future projects so that the benefits could be far-reaching in the attainment of one of the MDGs.

c. *Approaches to Advocacy/Empowerment*

Advocacy is very important, no matter the type, size, ownership and sponsorship of a project. There are many ways to advocate and many approaches to empower people through out a project. However, PCR should be able to identify the approaches used to engage the people on the reason for the project and their participation as well as their

empowerment. For instance, advocacy can be in the forms of representative meeting, town-hall meetings, seminars/workshops, radio and television programmes, and general campaigns. The emphasis in these advocacies will be the convincing of the community on why/how they should participate. Advocacy will also exposit the economic, social and political benefits of the project and peoples' participation. The PCR should be able to identify households' decisions and rating of the contributions of the project.

d. *Monitoring and Evaluation (M & E)*

This is a very important aspect of both the PCR and the project itself. The M & E section of the PCR is expected to summarize all the M & Es conducted during the project execution especially according to the milestones. Most public projects in Nigeria fail even when the projects are yet to be completed because of poor, compromised, inexperienced, and incompetent monitoring and evaluation. M & E should be able to show the methods, equipments, tools, materials, and personnel used from conception to mobilization and the to completion of a project. It shows also which methods, etc were most useful (effective and efficient) and practically applicable in measuring or demonstrating the evidence of results, vis-à-vis the objectives of the project. In this way, lessons could

be learnt on why those that were not useful were not useful.

IMPROVEMENTS RECEIVED

Improvements reported in the PCR will cover answers to four (4) main queries namely innovations, sustainability of funding sources, conditionalities of funding, and any other questions. For instance, PCR should report on the innovative aspects of the project, built out of the agreed changes to the aims/objectives, changes to designs, introduction of modern technologies, and the prospect of the project or product. It should be able to proffer answers to questions on sustainable funding, especially if the project exceeds completion time, or if there are chances that there could be changes in project sponsorship. The question could be if the project overshoots its target, how would funds be steadily supplied for execution and who will bear the responsibility? Or, what will be the conditionalities for the funding (whether under existing sources or additional sources) and how can the conditions be mitigated? Finally, other general questions could be addressed such as the maintenance of the completed project, the diversification of the project, the management of the completed project, the expansion/readjustment of the scope of the project, etc.

Chapter 8

POST-PROJECT APPRAISAL

Appraisal, evaluation and assessment mean the same thing. There are three basic points in the life of a project when appraisal should be conducted, i.e. before the project commences, during the execution of the project, and upon completion of the project. While assessment before the project commences (also known as Pre-Project Appraisal) assesses the likely strength, weakness, threats and opportunities of the intended project; evaluation during execution is an on-the-spot assessment; and appraisal upon completion (also known as Post-Project Appraisal or Post Audit) is a review of the work done. It follows therefore that a project can be evaluated on past, present and future bases. Infact, project evaluation mentioned in the early chapter of this book is a present assessment, that is assessment during the execution of the project. Not much emphasis is placed on pre-project evaluation. However, project management will not be complete and the Project Completion Report will be lopsided if a preview is not made. **Project appraisal or project preview** is usually done by business plans, feasibility studies or even project planning. These strategies have been discussed in the previous chapters. The overall goal of project preview

is to give an informed idea or basis for the project sponsor/owner to estimate his/her chances in the execution of the project, especially the cost, benefit and time implications vis-à-vis alternative investment opportunities.

Project evaluation is the phase-by-phase, and task-by-task appraisal of a project as its implementation is in progress. The aim is to ensure that the progression is in tandem with the project plan, by comparing the achievements against targets, and making necessary adjustments promptly (where need be) for the project to be on the right course. It is the most important of the three types of assessment if the project will avoid challenges or even failure, with respect to time, cost and quality of the outcome of the project. Notes taken during project evaluation form the bulk of information in the project hand-over and project completion reports. There are different ways of conducting project assessment or appraisal, such as:

(a) On-the-spot (unscheduled) evaluation and observation;

(b) Covered investigation (independent monitors' reports);

(c) Field staff reports

These various reports are usually supported by engineering drawings/details, charts and graphs.

From the above, it could be said that the general purpose of project appraisal will include:

1) To assess the actual cost incurred milestone by milestone with reference to the estimated/planned costs.
2) To device measures of correcting cost imbalances especially where over-expenditure occurs in order to mitigate its effect on the overall project.
3) To ascertain that the expected quality of the project and outcome(s) are in line with the project plan.
4) To evaluate the duration for each task and the time of completion to date in comparison with scheduled time so that lags are either curtailed or corrective measures taken.
5) To identify the problems encountered as well as their impacts on the project, and the various ways of solving the problems.
6) To inform project sponsor/owner/client about the extent of work done, the status of the project, the challenges and the lessons from the implementation of the project.

7) To create some sense of responsibility as a representative of project owner, and include sense of duty in the workforce as a way of mitigating laxity and nonchalance.
8) To compare targets against tasks accomplished.

In project evaluation, it is advisable to avoid a single team for the duration of the project. The membership of the supervisory and monitoring teams should be changed from time to time to avoid complacency and familiarities. It is also advised that the inspection, supervision and monitoring should be done at irregular intervals and without information to the project execution team. The effect of this strategy is enormous. For instance, it will make for the comparison of the reports of the various supervisory, monitoring and inspection teams to arrive at the actual status of work done. It will also keep the project execution team to avoid shady deals and shabby works since it will be difficult to agree on any form of compromise. However, the seriousness to deliver on expectation on the part of both the supervisory team and the workforce will ultimately depend on the critical use the project owner/sponsor/client puts the various reports into. This is one of the banes of projects' executions in Nigeria, where compromises are made, and eventually "completed"

projects fail even before completion and/or are commissioned without regards to the quality and other objectives of public projects. A very common example will be the incidence that led to the funny quotation: "Peter! Peter!! Peter!!! how many times did I call you and how many times would we commission this project?" Experience has shown that ever since the Central Bank of Nigeria and the Nigeria Deposit Insurance Corporation combined routine inspection/supervision with on-the-spot surprise checks on banks, some level of sanity in the personal and organizational behaviour and record-keeping of banks have been noticed. This can hardly be said of inspection/supervision (accreditation exercises) of most Nigerian Universities between 2002 and 2013, where window-dressings are done either to earn higher ratings to boost the achievements of the Vice Chancellors and the public image of the Universities, or to earn poor rating (and possible de-accreditation of some courses of study) so that the Proprietors/Visitors of the Universities will be forced to inject more funds. The same goes for most public infrastructural development projects supervised/ monitored/inspected by government ministries, departments and agencies like road, housing, electricity, water, security and governance projects.

POST-PROJECT APPRAISAL

This is the evaluation conducted upon the completion of a project. It is a retrospective appraisal of the tasks accomplished with respect to the planned timing, costing and quality of the project. Post-project appraisal is a comprehensive assessment of the actual time, cost and quality (level of performance) of a project, the analyses of the reasons for deviations of the "*actuals*" from the "*targets*", the evaluation of the actual social benefit-cost implication of a project, as well as the proportionate level of attainment of the desired objectives of project. It is also known as Post-Completion Evaluation (PCE) or Post-Completion Audit (simply called Post Project Audit).

Post Audit is a process of reassessing the performance of the project work-force (including the administrative, supervisory and managerial project teams), the outcomes of the projects, the problems/challenges, and impacts of decisions taken on the project. Given the elements of post completion audits, it could be said that this review is necessary because it is an avenue for building an archive of experiences against similar projects in the future. Post-Project Appraisal can be conducted by the project owner/sponsor/client, by the project executor/consultant/ contractor, by independent assessor, or by the project financier if different from project owner/sponsor. For

instance, the project owner will conduct a post project audit in order to document all the experiences gained or recorded during implementation, so as to provide an information bank against the planning of future projects with respect to the time-cost relationship, environmental impacts/implications, adjustments needed and the general costing and management of projects. For example, if a contractor is awarded the contract of constructing a residential house in a marshy area with bad link road, his experience could be that transporting of men and materials to site must have been a major challenge. This challenge would be the key reason why the project was not delivered in time and variation applied. His experience should inform him that he must inspect the topography of the proposed project site and do a thorough cost and time analyses before accepting the offer of a similar contract. The completion of this first job and the proper assessment of the execution process are simply referred to as EXPERIENCE DAIRY or Post Project Appraisal Report. The benefit is to know or plan to avoid all avoidable reasons for delay, variation in cost and difference in quality of outcome.

On the other hand, a project financier will conduct a post project completion appraisal because of the financial implications of change in proposed time and cost of completing the project on the financial agreement and the

financial status of the financier (e.g. lender). For example, the project could have been 80% financed by a medium-term loan with an estimated completion time of 18 months and grace-period before loan repayment of 6 months. Interest and loan repayment plan would be based on 24 months therefore. But if the project was executed in 12 months plus 6 months grace period, the interest and loan repayment plan will be affected. The financier will build up the dossier of the lessons learnt, the redrawing of amortization/loan repayment schedule based on the re-computation of the installment payments, the interest off-sets or interest payable to the project executor or owner that borrowed the funds, and the implication on future projects.

Finally, in post audit, there is usually the aspect of **RETENTION FEE**. This represents a provision made against eventual failure of the project after completion and possible hand-over of especially engineering projects. In most cases, a 10% of the contract sum is retained by the project owner for a period of time (say 6 months after hand-over). At the end of the retention period, if the outcome(s) have been normal (i.e. without error/defects/malfunctions that will necessitate corrections) the 10% is paid to the project executor/contractor. If the contrary occurs, the project executor/contractor will be expected to rectify the anomaly

at his own expense if the cost of correction is higher than the retention fee and the anomaly does not result from the fault of the operator of the handed-over project. This means that even after completion, the project executor must keep a close watch on the functioning of the product (completed project). Therefore, it can be stated that post completion audit may be conducted in two (2) time periods namely:

(a) Immediately after completion
(b) After the lapse of the retention period

Similarly, the purpose of post completion appraisal can be split into these two time zones as follows:

A1) To asses the reason for the variation in cost and time;
A2) To assess and highlight the tasks that accounted for the variations;
A3) To classify the reasons and tasks that account for the variation under diversifiable and non-diversifiable groups.
A4) To assess the impact of the non-diversifiable variances on the project and how they were and/or would have been better managed.
A5) To assess the impact of the diversifiable reasons and tasks, how they were handled, how they would have been better handled, and how they could be avoided.

B1) To answer the questions: were the objectives of the project achieved and to what extent with respect to time, cost and quality (or level of performance) of outcomes.
B2) To assess the scale of operation, given estimates.
B3) To assess the marketability and/or acceptability of the product or outcome.
B4) To assess the level of economy and profitability of the product or outcome.
B5) To assess the performance of the output, outcome or product as against anticipated level of the time of handing over.

FORMS OF POST COMPLETION APPRAISAL

Just as pre-project assessment has many parts, so is the post-completion appraisal. Generally there are five (5) forms of post audit namely technical, commercial, financial, economic and impact audits.

Technical Post Project Completion Appraisal

The basis of any form of post completion appraisal is the feasibility study report. Usually, apart from the introductory section of the feasibility study, the technical requirements together with their costs and capacities are detailed in the feasibility study. Consequently, technical post audit will assess the extent of compliance or

implementation of the planned technicalities and technical requirements of the project. This means that technical post audit evaluates the quality, cost of the machinery, equipment, furniture, fittings, motor vehicle, land and building, as well as the personnel required for both operation of these technical items and other aspects of the business operation. It also covers other revenue operational items/aspects of the project. In this form of appraisal, therefore, the outputs, products and/or outcomes are assessed on the basis of effectiveness and efficiency. Efficiency will ordinarily refer to the situation where comparison between the quality and quantity of outputs and the expected quantity of inputs is made. Effectiveness will be discussed under economic appraisal.

Technical post audit can be referred to as an appraisal of efficiency of a project, after the completion, hand-over and subsequent functioning of the product or outcome. In this type of post audit therefore the appraiser would want to find out the input mix in actual performance as against the prescribed mix at the point of handover.

Questions like: are the raw materials consumption higher, equal or lower than expected; are the raw materials and other direct and indirect requirements/overheads producing the expected quantity of output or not; is the process or utilization of the project easier or more

cumbersome than expected; is the process (e.g. manufacturing process) consuming more labour or not than expected; and if the expected/recommended quantities of materials, labour and overheads are exactly implemented, what will be the impact on the quality of output/products from the operation.

Commercial Post Audit

Commercial post-audit can also be known as marketability audit. In this kind of evaluation, the sales or turnover projection is compared with the actual sales recorded. The essence of this assessment is to know how widely, or richly accepted the outcome of operating the project have been by the customers or clientele. If the project is an improvement on an existing manufacture, for instance, the likely questions to be asked will include (but not restricted to) how many persons patronized the improved product, how many new buyers/users, does the product require extra marketing channels and strategies to reach the public, and what proportion of the market has been captured by the improved product and how can the trend be sustained.

Financially speaking, commercial post audit proves the basis for ascertaining the turnover from the sale of the product against which other costs will be weighed to arrive at the viability of the product vis-à-vis the estimated

viability at the point of handing over.

Financial Post Project Evaluation

Just as stated in pre-project appraisal where financial appraisal was discussed in feasibility study report, post project financial evaluation is the study and reporting of all aspects of a functioning or operating project that involves money and money's worth. It is actual evaluation of a going project, product or process after implementers or contractors have handed-over the project, etc. upon complete execution. Financial post project evaluation is therefore the amalgamation or summary of the monetary aspects of all other audit reports. It is the audit of the operations or functioning of a plant, project, or process, aimed at verifying the feasibility, viability, liquidity, solvency, profitability and sustainability of the project, etc., by showing the cost of assets, overheads, consumables, materials, utilities, as well as turnover, funding, and distribution of income. The information for the audit is sourced from the financial and accounting records of the plant, project or process as it is in operation.

Economic Post Audit

Ordinarily, economic post completion audit should form part of financial audit in the sense that it considers the cost and benefits implication of the operation of the handed-over project. It is therefore the intension of the author to

separate the two closely related audits by differentiating them by subjectivity and objectivity considerations. Generally, economic appraisal is subjective while financial appraisal is objective.

However, technically, economic appraisal refers to an assessment of the effectiveness of a given project, product or process. By this therefore, a product or process is considered effective if the monetary value of all inputs is less than the monetary value of outputs. This difference can be referred to as gain, margin, gross profit, net profit or net cash inflow depending on the evaluator's sense of valuation. This basis of economic post project appraisal is applicable mostly to manufacturing projects, or even to private sector projects or private goods and services. The implication is that efficiency basis of economic post audit becomes handicapped when applied to social goods and services or public sector projects. This is because social goods and services (or products or projects) are established principally with public benefits in mind, i.e. to benefit most persons with the principles of non-excludability and non-market mechanism. For instance, if a water project is sited in a community, it will be expected that the project should supply water to the people in that community, at most at a user charge (social rate). It is possible that the consumers of the supplied water may not

be monetarily buoyant enough to pay for the water, which means that taxes from the tax-paying public will off-set the cost of supplying the water. The assessment questions will include how many persons (households) have access to the water, what proportion of these households are tax paying adults, how many persons are employed by the project and the several other sources of employment in the value chain, how much has the water supply contributed positively to the health or hygiene and what is the cost of operating and maintaining the water plant.

From these and other related questions for appraisal, and as applicable to several other projects, it presupposes that there will be more non-quantifiable questions and answers pertaining social costs and social benefits. This is why economic post project evaluation would mean the analysis of the costs and benefits implication of the operation or functioning of a plant, project, process or product, socially or monetarily. Since it is mostly social costs and benefits, such analysis would be more subjective than objective, more pessimistic than optimistic. This explains why economic post project appraisal is very difficult to undertake since the valuation parameters will vary from person to person and depending on the circumstance.

In most technical cases involving public sector projects,

efficiency is determined at any point where the Marginal Social Benefit (MSB) equals the Marginal Social Cost (MSC) especially where the marginal social cost covers the Marginal Private Cost (MC) and the Marginal Damage (MD) resulting from the existence of negative externalities from the operation of the project or process.

Impact Post Completion Audit

In assessing the impact of a functioning project, excluding its commercial, technical, economic and financial assessment, would simply mean an assessment of that project or process on the environment (also known as Environmental Impact Assessment). This assessment becomes imperative especially where the designer and/or implementer of the project have been silent on its impact, in its functional state, on the environment.

Example 8.1

RVSG awarded the construction of a 50km road project linking Khana LGA to Opobo/Nkoro LGA through Nkoro Kingdom. The road is to pass through the mangroves, swamps and cross the creeks. The mangroves, swamps and creeks have been very useful to the people around the project route. If the construction entailed sand-filling three-quarter **(¾)** of the width of every existing creek and river for the erection of bridges, with only the feet of the bridges piled. Six months after the commissioning of the

road, the communities between Khana LGA and Opobo/Nkoro LGA by the banks of the creeks and rivers experienced flooding from high tide and the washing away of the shores while the rivers become narrower and shallower.

You have been engaged by indigenes of Job-Ama to advice on the road that went through their community as a way of assessing the impact of the bridges on the socio-economic life of the people. Please advice pointedly, and elucidate on the effect of the road on their environment generally.

Solution 8.1

APPRAISAL OF THE USEFULNESS OF THE KHANA LGA OPOBO/NKORO LINK ROAD BY INDIGENES OF JOB-AMA

1) **Technical Appraisal**: This will cover the quality of materials used for the road and bridge construction, the width of the road and bridges, the heights of the road/bridges, and the general durability of the roads and bridges.
2) **Commercial Appraisal**: This will cover the traffic on the road compared with the traffic without the road.
3) **Economic Appraisal**: This will cover the reduction in cost of transportation, the jobs that have been created, the possibility of robbery attacks, the ease

of escape for hoodlums (law-breakers), etc. It will also cover the loss of income from environmental impact.

4) **Environmental Impact Appraisal**: This will cover the flooding of the communities, the erosion of shorelines, the difficulty in fishing on the rivers/creeks, the washing off of the bridges and the danger of impending collapse of the road and bridges, and the drying up of the vegetation. One of the benefits can be the use of the road for the proper delineation of the geographic boundary with neigbouring communities, and the road's contribution to the development of the communities.

Where the independent negative environmental impacts together with other negative externalities of a project are high, and appear to be threatening the overall benefits and sustainability of projects, humanity and environment, the project can be considered failed. In this case, alternative measures will be taken such as to revamp the project, or even the establishment of a new project, the prosecution of the project implementer and the approval/inspection team.

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Table 1 Terminal value of 1

Periods	*1%*	*2%*	*3%*	*4%*	*5%*	*6%*	*7%*	*8%*	*9%*	*10%*
1	1.010	1.020	1.030	1.040	1.050	1.060	1.070	1.080	1.090	1.100
2	1.020	1.040	1.061	1.082	1.102	1.124	1.145	1.166	1.188	1.200
3	1.030	1.061	1.093	1.125	1.158	1.191	1.225	1.260	1.295	1.331
4	1.041	1.082	1.126	1.170	1.216	1.262	1.311	1.360	1.412	1.464
5	1.051	1.104	1.159	1.217	1.276	1.338	1.403	1.469	1.539	1.611
6	1.062	1.126	1.194	1.265	1.340	1.419	1.501	1.587	1.677	1.772
7	1.072	1.149	1.230	1.316	1.407	1.504	1.606	1.714	1.828	1.949
8	1.083	1.172	1.267	1.369	1.477	1.594	1.718	1.851	1.993	2.144
9	1.094	1.195	1.305	1.423	1.551	1.689	1.838	1.999	2.172	2.358
10	1.105	1.219	1.344	1.480	1.629	1.791	1.967	2.159	2.367	2.594
11	1.116	1.243	1.384	1.539	1.710	1.898	2.105	2.332	2.580	2.853
12	1.127	1.268	1.426	1.601	1.796	2.012	2.252	2.518	2.813	3.138
13	1.138	1.294	1.469	1.665	1.886	2.133	2.410	2.720	3.066	3.452
14	1.149	1.319	1.513	1.732	1.980	2.261	2.579	2.937	3.342	3.797
15	1.161	1.346	1.558	1.801	2.079	2.397	2.759	3.172	3.642	4.177
16	1.173	1.373	1.605	1.873	2.183	2.540	2.952	3.426	3.970	4.595
17	1.184	1.400	1.653	1.948	2.292	2.693	3.159	3.700	4.328	5.054
18	1.196	1.428	1.702	2.026	2.407	2.854	3.380	3.996	4.717	5.560
19	1.208	1.457	1.754	2.107	2.527	3.026	3.617	4.316	5.142	6.116
20	1.220	1.486	1.806	2.191	2.653	3.207	3.870	4.661	5.604	6.727
21	1.232	1.516	1.860	2.279	2.786	3.400	4.141	5.034	6.109	7.400
22	1.245	1.546	1.916	2.370	2.925	3.604	4.430	5.437	6.659	8.140
23	1.257	1.577	1.974	2.465	3.072	3.820	4.741	5.871	7.258	8.954
24	1.270	1.608	2.033	2.563	3.225	4.049	5.072	6.341	7.911	9.850
25	1.282	1.641	2.094	2.666	3.386	4.292	5.427	6.848	8.623	10.835

Table 1 *Cont'd*

Periods	*11%*	*12%*	*13%*	*14%*	*15%*	*16%*	*17%*	*18%*	*19%*	*20%*
1	1.110	1.120	1.130	1.140	1.150	1.160	1.170	1.180	1.190	1.200
2	1.232	1.254	1.277	1.300	1.322	1.346	1.369	1.392	1.416	1.490
3	1.368	1.405	1.443	1.482	1.521	1.561	1.602	1.643	1.685	1.728
4	1.518	1.574	1.630	1.689	1.749	1.811	1.874	1.939	2.005	2.074
5	1.685	1.762	1.842	1.925	2.011	2.100	2.192	2.228	2.386	2.488
6	1.870	1.974	2.082	2.195	2.313	2.436	2.565	2.700	2.840	2.986
7	2.076	2.211	2.353	2.502	2.660	2.826	3.001	3.185	3.379	3.583
8	2.305	2.476	2.658	2.853	3.059	3.278	3.511	3.759	4.021	4.300
9	2.558	2.773	3.004	3.252	3.518	3.803	4.108	4.435	4.785	5.160
10	2.839	3.106	3.395	3.707	4.046	4.411	4.807	5.234	5.695	6.192
11	3.152	3.479	3.836	4.226	4.652	5.117	5.624	6.176	6.777	7.430
12	3.498	3.896	4.335	4.818	5.350	5.936	6.580	7.288	8.064	8.916
13	3.883	4.363	4.898	5.492	6.153	6.886	7.699	8.599	9.596	10.699
14	4.310	4.887	5.535	6.261	7.076	7.988	9.007	10.147	11.420	12.839
15	4.785	5.474	6.254	7.138	8.137	9.266	10.539	11.974	13.590	15.407
16	5.311	6.130	7.067	8.137	9.358	10.748	12.330	14.129	16.172	18.488
17	5.895	6.866	7.986	9.276	10.761	12.468	14.426	16.672	19.244	22.186
18	6.544	7.690	9.024	10.575	12.375	14.463	16.879	19.673	22.901	26.623
19	7.263	8.613	10.197	12.056	14.232	16.777	19.748	23.214	27.252	31.948
20	8.062	9.646	11.523	13.743	16.367	19.461	23.106	27.393	32.429	38.338
21	8.949	10.804	13.021	15.668	18.822	22.574	27.034	32.324	38.591	46.005
22	9.934	12.100	14.714	17.861	21.645	26.186	31.629	38.142	45.923	55.206
23	11.026	13.552	16.627	20.362	24.891	30.376	37.006	45.008	54.649	66.247
24	12.239	15.179	18.788	23.212	28.625	35.236	43.297	53.109	65.032	79.497
25	13.585	17.000	21.231	26.462	32.919	40.874	50.658	62.669	77.388	95.396

Table 11 *Present Value of 1*

Periods	*1%*	*2%*	*3%*	*4%*	*5%*	*6%*	*7%*	*8%*	*9%*	*10%*
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909
2	0.980	0.961	0.943	0.925	0.907	0.890	0.873	0.857	0.842	0.826
3	0.971	0.942	0.915	0.889	0.864	0.840	0.816	0.794	0.772	0.751
4	0.961	0.924	0.888	0.855	0.823	0.792	0.763	0.735	0.708	0.683
5	0.951	0.906	0.863	0.822	0.784	0.747	0.713	0.681	0.650	0.621
6	0.942	0.888	0.837	0.790	0.746	0.705	0.666	0.630	0.596	0.564
7	0.933	0.871	0.813	0.760	0.711	0.665	0.623	0.583	0.547	0.513
8	0.923	0.853	0.789	0.731	0.677	0.627	0.582	0.540	0.502	0.467
9	0.914	0.837	0.766	0.703	0.645	0.592	0.544	0.500	0.460	0.424
10	0.905	0.820	0.744	0.676	0.614	0.558	0.508	0.463	0.422	0.386
11	0.896	0.804	0.722	0.650	0.585	0.527	0.475	0.429	0.388	0.350
12	0.887	0.788	0.701	0.625	0.557	0.497	0.444	0.397	0.356	0.319
13	0.879	0.773	0.681	0.601	0.530	0.469	0415	0.368	0.326	0.290
14	0.870	0.758	0.661	0.577	0.505	0.442	0.388	0.340	0299	0.263
15	0.861	0.743	0.642	0.555	0.481	0.417	0.362	0.315	0.275	0.239
16	0.853	0.728	0.623	0.534	0.458	0.394	0.339	0.292	0.252	0.218
17	0.844	0.714	0.605	0.513	0.436	0.371	0.317	0.270	0.231	0.198
18	0.836	0.700	0.587	0.494	0.416	0.350	0.296	0.250	0.212	0.180
19	0.828	0.686	0.570	0.475	0.396	0.331	0.277	0.232	0.194	0.164
20	0.820	0.673	0.554	0.456	0.377	0.312	0.258	0.215	0.178	0.149
21	0.811	0.660	0.538	0.439	0.359	0.294	0.242	0.199	0.164	0.135
22	0.803	0.647	0.522	0.422	0.342	0.278	0.226	0.184	0.150	0.123
23	0.795	0.634	0.507	0.406	0.326	0.262	0.211	0.170	0.138	0.112
24	0.788	0.622	0.492	0.390	0.310	0.247	0.197	0.158	0.126	0.102
25	0.780	0.610	0.478	0.375	0.295	0.233	0.184	0.146	0.116	0.092
26	0.772	0.598	0.464	0.361	0.281	0.220	0.172	0.135	0.106	0.084
27	0.764	0.586	0.450	0.347	0.268	0.207	0.161	0.125	0.098	0.076
28	0.757	0.574	0.437	0.333	0.255	0.196	0.150	0.116	0.090	0.069
29	0.749	0.563	0.424	0.321	0.243	0.185	0.141	0.107	0.082	0.063
30	0.742	0.552	0.412	0.308	0.231	0.174	0.131	0.099	0.075	0.057

Periods	*11%*	*12%*	*13%*	*14%*	*15%*	*16%*	*17%*	*18%*	*19%*	*20%*
1	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	0.812	0.797	0.783	0.769	0.756	0.743	0.731	0.718	0.706	0.694
3	0.731	0.712	0.693	0.675	0.658	0.641	0.624	0.609	0.593	0.579
4	0.659	0.636	0.613	0.592	0.572	0.552	0.534	0.516	0.499	0.482
5	0.593	0.567	0.543	0.519	0.497	0.476	0.456	0.437	0.419	0.402
6	0.535	0.507	0.480	0.456	0.432	0.410	0.390	0.370	0.352	0.335
7	0.482	0.452	0.425	0.400	0.376	0.354	0.333	0.314	0.296	0.279
8	0.434	0.404	0.376	0.351	0.327	0.305	0.285	0.266	0.249	0.233
9	0.391	0.361	0.333	0.308	0.284	0.263	0.243	0.225	0.209	0.194
10	0.352	0.322	0.295	0.270	0.247	0.227	0.208	0.191	0.176	0.162
11	O.317	0.287	0.261	0.237	0.215	0.195	0.178	0.162	0.148	0.135
12	0.286	0.257	0.231	0.208	0.187	0.168	0.152	0.137	0.124	0.112
13	0.258	0.229	0.204	0.182	0.163	0.145	0.130	0.116	0.104	0.093
14	0.232	0.205	0.181	0.160	0.141	0.125	0.111	0.099	0.088	0.078
15	0.209	0.183	0.160	0.140	0.123	0.108	0.095	0.084	0.074	0.065
16	0.188	0.163	0.141	0.123	0.107	0.093	0.081	0.071	0.062	0.054
17	0.170	0.146	0.125	0.108	0.093	0.080	0.069	0.060	0.052	0.045
18	0.153	0.130	0.111	0.095	0.081	0.069	0.059	0.051	0.044	0.038
19	0.138	0.116	0.098	0.083	0.070	0.060	0.051	0.043	0.037	0.031
20	0.124	0.104	0.087	0.073	0.061	0.051	0.043	0.037	0.031	0.026
21	0.112	0.093	0.077	0.064	0.053	0.044	0.037	0.031	0.026	0.022
22	0.101	0.083	0.068	0.056	0.046	0.038	0.032	0.026	0.022	0.018
23	0.091	0.074	0.060	0.049	0.040	0.033	0.027	0.022	0.018	0.015
24	0.082	0.066	0.053	0.043	0.035	0.028	0.023	0.019	0.015	0.013
25	0.074	0.059	0.047	0.038	0.030	0.024	0.020	0.016	0.013	0.010
26	0.066	0.053	0.042	0/.033	0.026	0.021	0.017	0.014	0.011	0.009
27	0.060	0.047	0.037	0.029	0.023	0.018	0.014	0.011	0.009	0.007
28	0.054	0.042	0.033	0.026	0.020	0.016	0.012	0.010	0.007	0.006
29	0.048	0.037	0.029	0.022	0.017	0.014	0.011	0.008	0.006	0.005
30	0.044	0.033	0.026	0.020	0.015	0.012	0.009	0.007	0.005	0.004

Table III *Terminal value of I per period (annuity)*

Periods	*2%*	*2½%*	*3%*	*4%*	*5%*	*6%*	*8%*	*10%*
1	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
2	2.020	2.025	2.030	2.040	2.050	2.060	2.080	2.100
3	3.060	3.076	3.091	3.122	3.153	3.184	3.246	3.310
4	4.122	4.153	4.184	4.247	4.310	4.375	4.506	4.641
5	5.204	5.256	5.309	5.416	5.526	5.637	5.867	6.105
6	6.308	6.388	6.468	6.633	6.802	6.975	7.336	7.716
7	7.434	7.547	7.663	7.898	8.142	8.394	8.923	9.487
8	8.583	8.736	8.892	9.214	9.549	9.898	10.637	11.436
9	9.755	9.955	10.159	10.583	11.027	11.491	12.488	12.580
10	10.950	11.203	11.464	12.006	12.578	13.181	14.487	15.937
11	12.169	12.484	12.808	13.486	14.207	14.972	16.646	18.531
12	13.412	13.796	14.192	15.026	15.917	16.870	18.977	21.385
13	14.680	15.140	15.618	16.627	17.713	18.882	21.495	24.523
14	15.974	16.519	17.086	18.295	19.599	21.015	24.215	27.976
15	17.293	17.932	18.599	20.024	21.579	23.276	27.152	31.773
16	18.639	19.380	20.157	21.825	23.658	25.673	30.324	35.950
17	20.012	20.865	21.762	23.698	25.840	28.213	33.750	40.546
18	21.412	22.386	23.414	25.645	28.132	30.906	37.450	45.600
19	22.841	23.946	25.117	27.071	30.539	33.760	41.446	51.160
20	24.297	25.545	26.870	29.778	35.066	36.786	45.762	57.276
21	27.299	28.863	30.537	34.248	38.505	43.392	55.457	71.404
22	30.422	32.349	34.427	39.083	44.502	50.816	66.765	88.499
23	33.671	36.012	38.553	44.312	51.114	59.156	79.954	109.184
24	37.051	39.860	42.931	49.968	58.403	68.528	95.339	134.212
25	40.568	43.903	47.575	56.085	66.439	79.058	113.283	164.496

Table IV *Present value of I per period (annuity)*

Periods	*1%*	*2%*	*3%*	*4%*	*5%*	*6%*	*7%*	*8%*	*9%*	*10%*
1	0.990	0.980	0.971	0.962	0.952	0.943	0.935	0.926	0.917	0.909
2	1.970	1.942	1.913	1.886	1.859	1.833	1.808	1.783	1.759	1.736
3	2.941	2.884	2.829	2.775	2.723	2.673	2.624	2.577	2.531	2.487
4	3.902	3.808	3.717	3.630	3.546	3.465	3.387	3.312	3.240	3.170
5	4.853	4.713	4.580	4.452	4.329	4.212	4.100	3.993	3.890	3.791
6	5.795	5.601	5.417	5.242	5.076	4.917	4.767	4.623	4.486	4.355
7	6.728	6.472	6.230	6.002	5.786	5.582	5.389	5.206	5.033	4.868
8	7.652	7.325	7.020	6.733	6.463	6.210	5.971	5.747	5.535	5.335
9	8.566	8.162	7.786	7.435	7.108	6.802	6.515	6.247	5.995	5.759
10	9.471	8.983	8.530	8.111	7.722	7.360	7.024	6.710	6.418	6.145
11	10.368	9.787	9.253	8.760	8.306	7.887	7.499	7.139	6.805	6.495
12	11.255	10.575	9.954	9.385	8.863	8.384	7.943	7.536	7.161	6.814
13	12.134	11.348	10.635	9.986	9.394	8.853	8.358	7.904	7.487	7.103
14	13.004	12.106	11.296	10.563	9.899	9.295	8.745	8.244	7.786	7.367
15	13.865	12.849	11.938	11.118	10.380	9.712	9.108	8.559	8.061	7.606
16	14.718	13.578	12.561	11.652	10.838	10.106	9.447	8.851	8.313	7.825
17	15.562	14.292	13.166	12.166	11.274	10.477	9.763	9.122	8.544	8.024
18	16.398	14.992	13.754	12.659	11.690	10.828	10.059	9.372	8.756	8.204
19	17.226	15.678	14.324	13.134	12.085	11.158	10.336	9.604	8.950	8.362
20	18.046	16.351	14.877	13.590	12.462	11.470	10.594	9.818	9.129	8.511
21	18.857	17.011	15.415	14.029	12.821	11.764	10.836	10.017	9.292	8.649
22	19.660	17.658	15.837	14.451	13.163	12.042	11.061	10.201	9.442	8.772
23	20.456	18.292	16.444	14.857	13.489	12.303	11.272	10.371	9.580	8.883
24	21.243	18.914	16.936	15.247	13.799	12.550	11.469	10.529	9.707	8.985
25	22.023	19.523	17.413	15.622	14.094	12.783	11.654	10.675	9.823	9.077
26	22.795	20.121	17.877	15.983	14.375	13.003	11.826	10.810	9.929	9.161
27	23.560	20.707	18.327	16.330	14.643	13.211	11.987	10.935	10.027	9.237
28	24.316	21.281	18.764	16.663	14.898	13.406	12.137	11.051	10.116	9.307
29	25.066	21.844	19.188	16.984	15.141	13.591	12.278	11.158	10.198	9.370
30	25.808	22.396	19.600	17.292	15.372	13.765	12.409	11.258	10.274	9.427

Table IV Contd

Periods	*11%*	*12%*	*13%*	*14%*	*15%*	*16%*	*17%*	*18%*	*19%*	*20%*
1	0.901	0.893	0.885	0.877	0.870	0.862	0.855	0.847	0.840	0.833
2	1.713	1.690	1.668	1.647	1.626	1.605	1.585	1.566	1.547	1.528
3	2.444	2.402	2.361	2.322	2.283	2.246	2.210	2.174	2.140	2.106
4	3.102	3.037	2.974	2.914	2.855	2.798	2.743	2.690	2.639	2.589
5	3.696	3.605	3.517	3.433	3.352	3.274	3.199	3.127	3.058	2.991
6	4.231	4.111	3.998	3.889	3.784	3.685	3.589	3.498	3.410	3.326
7	4.712	4.564	4.423	4.288	4.160	4.039	3.922	3.812	3.706	3.605
8	5.146	4.968	4.799	4.639	4.487	4.344	4.207	4.078	3.954	3.837
9	5.537	5.328	5.132	4.946	4.772	4.607	4.451	4.303	4.163	4.031
10	5.889	5.650	5.426	5.216	5.019	4.833	4.659	4.494	4.339	4.192
11	6.207	5.938	5.687	5.453	5.234	5.029	4.836	4.656	4.486	4.327
12	6.492	6.194	5.918	5.660	5.421	5.197	4.988	4.793	4.611	4.439
13	6.750	6.424	6.122	5.842	5.583	5.342	5.118	4.910	4.715	4.533
14	6.982	6.628	6.302	6.002	5.724	5.468	5.229	5.008	4.802	4.611
15	7.191	6.811	6.462	6.142	5.847	5.575	5.324	5.092	4.876	4.675
16	7.379	6.974	6.604	6.265	5.954	5.668	5.405	5.162	4.938	4.730
17	7.549	7.120	6.729	6.373	6.047	5.749	5.475	5.222	4.990	4.775
18	7.702	7.250	6.840	6.467	6.128	5.818	5.534	5.273	5.033	4.812
19	7.839	7.366	6.938	6.550	6.198	5.877	5.584	5.316	5.070	4.843
20	7.963	7.469	7.025	6.623	6.259	5.929	5.628	5.353	5.101	4.870
21	8.075	7.562	7.102	6.687	6.312	5.973	5.665	5.384	5.127	4.891
22	8.176	7.645	7.170	6.743	6.359	6.011	5.696	5.410	5.149	4.909
23	8.266	7.718	7.230	6.792	6.399	6.044	5.723	5.432	5.167	4.925
24	8.348	7.784	7.283	6.835	6.434	6.073	5.746	5.451	5.182	4.937
25	8.422	7.843	7.330	6.873	6.464	6.097	5.766	5.467	5.195	4.948
26	8.488	7.896	7.372	6.906	6.491	6.118	5.783	5.480	5.206	4.956
27	8.548	7.943	7.409	6.935	6.514	6.136	5.798	5.492	5.215	4.964
28	8.602	7.984	7.441	6.961	6.534	6.152	5.810	5.502	5.223	4.970
29	8.650	8.022	7.470	6.983	6.551	6.166	5.820	5.510	5.229	4.975
30	8.694	8.055	7.496	7.003	6.566	6.177	5.829	5.517	5.235	4.979

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