

Project Management: A Catalyst For Rapid Industrial Development For Emerging Economies

15th Inaugural Lecture
of the Federal University of Technology,
Owerri (FUTO), Imo State.

Delivered on
Wednesday, 25th November, 2009

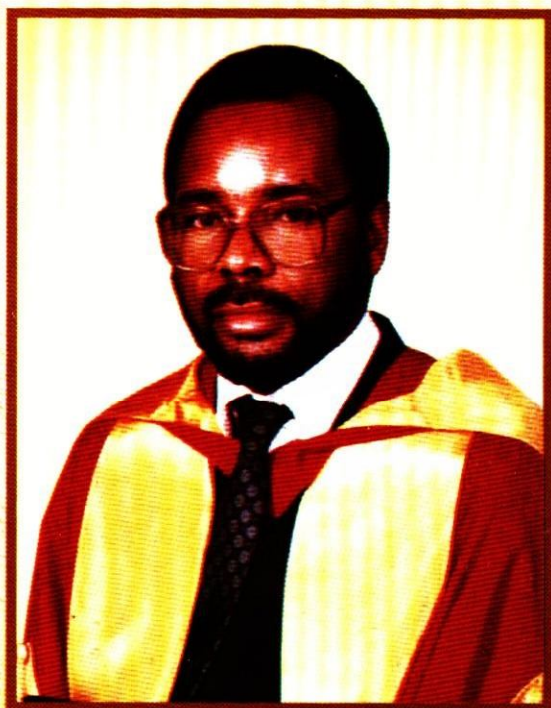
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Chairman and Members of the Governing Council of this
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My Lords Spiritual and Temporal,
Staff and Students of this University,
Representatives of the print and electronic media,
Distinguished Ladies and Gentlemen.

I am indeed indebted to all of you for accepting the invitation to be here and also very delighted to present this lecture, the first in the School of Management Technology. This should be expected from a pioneer staff of the School even though the lecture should have come much earlier. I am really very grateful to our amiable Vice-Chancellor, Professor C. O. E. Onwuliri for granting me the necessary logistics and his encouragement for this outing.

My choice of the topic, *Project Management: A catalyst for rapid industrial development for emerging economies* is very timely especially to our dear country, Nigeria as we are trying to catch up with the developing economies of the Asian Continent. Today we are still talking of generating 6000 megawatts of electricity to serve a population of over 140 million people when South Africa with a sixth of our population is generating more than eight times this figure. The best we can achieve are the various probes and counter-probes and while

this jamboree is going on, the economy continues to nosedive with industry closures and its adverse effect on employment. Here we are, saddled with the problems of building power stations and transmitting the power so generated at a cost comparable to what we have in other countries. While there are two sides to the argument, in this case the client/sponsor and the implementing agencies, it is the latter which is central to this inaugural lecture. This is not only on power sector alone but on the whole infrastructural development in which we seem to be at disarray poor quality work, escalating cost, late deliveries and even project abandonment. To avoid making the same mistake all over again, there is therefore a clarion call on the part of project managers to fully accept the concept of project management for rapid industrial development. It should not be the issue of project management by name but acquiring the necessary skills to belong. According to Ad (1994) "you can't manage what you don't understand". Before we take off, we need to understand some of the problems which are a recurring decimal in infrastructural development and secondly to understand the fundamental principles and a little bit of the history of the profession in order to appreciate some of the models I have developed over the years to address the problems for efficient project implementation.

1: Introduction

Project Management is as old as the universe itself when viewed in the context of timing and quality in the whole process of creation in which these two factors, the most essential elements in the field of project management were fully utilized. Everything which was envisaged came on time and within quality specification (as mentioned in the Bible with the use of the phrase "it was good") before the next stage of progression in this noble project (Genesis 1: 3-27) which finally culminated in the creation of man.



Man, in his quest and ingenuity to be more superior than the other animals and to rule over them as mandated by God started building cities (Genesis 4:17) and embarked on other projects for his comfort. In the course of time, man offended God and God in His own wisdom decided to raise a new generation by commissioning Noah to build an ark, the first gigantic project of the time for the purpose with all the design specifications as given to him by God. However, we are not told of the time frame for this project. Many similar projects later followed; the Tower of Babel, the Great Pyramids of Egypt and the Pharaohs, the Great Walls of China just to mention a few before the re-emergence of Project Management in the late 1950s in a more refined form embracing the essential elements of time, cost and quality specification.

As could be noticed in the above discussion, cost was however not mentioned in the whole building programme and this might have been due to the fact that resources were freely available with no desire to efficiently utilize them.

Cost and time overrun in infrastructural development is the norm rather than an exception the world over. Time and cost overrun generally result from factors such as increased project scope, adverse weather conditions, unexpected site locations and other project-related changes (Rowland, 1981; Jacoby, 2001; JLARC, 2001; Bordat *et al*, 2004).

Several studies have sought to determine the magnitude of cost overrun problems. For example, Korman and Daniel (1998) found that Washington State highway projects averaged 10% cost increase overrun and that the cost of larger projects tended to have a higher likelihood of running over than those of smaller ones. Wagner (1998) found that Delaware Department

of Transportation (DOT) experienced cost overruns averaging 13.9% between 1994 and 1996, due to changes in the work scope and incorrect estimates of work quantities in the original bid specifications. Virginia Joint Legislative Audit and Review Committee (JLARC) also found that underestimation of construction costs are common and typically led to some serious consequences such as postponement or cancellation of other projects (JLARC, 2001). In yet another study, Chang and Kumaraswamy (1997) categorized the reasons for time and cost overrun increases in engineering design projects as (i) those within the owner's control for which the owner is responsible (ii) those within the consultant's control for which the consultant is responsible, and (iii) those beyond the control of the owner or the consultant (such as increased scope of work, changes in legislation, or changes in standards, and archaeological discoveries). Finally, Frimpong *et al* (2003) studied the factors that cause time and cost overruns in groundwater and construction projects in Ghana. The result of their study indicated that time and cost overrun are related to payment difficulties from agencies, poor contractor management, material procurement, poor technical performance and material cost escalation.

1.1: Need for Projects and Project Management

Projects are implemented as a means to achieving organizations' strategic plans. Before any detailed work is done on the proposed project, normally presented in the form of tentative design, the technical and economic/social factors of the proposal must be examined for its feasibility and viability (pre-project). A project generally comes in the form of an idea and it is the responsibility of project management to turn this idea into a product in conformance with the requirements/specifications, on schedule and within budget. As earlier stated, this idea is

normally captured in the form of tentative design (based on one's thinking or client's brief and affordability) and if it is accepted, the detailed design is made. The design would further be broken down into manageable units or activities as they are sometimes called, and then costing them prior to implementation. The interrelationship of the different activities must be established for proper tracking of these activities during the design implementation to keep them on schedule and within budget. The whole exercise is what constitutes a project, the backbone of project management with its peculiar characteristics of uniqueness and one-time operation as distinct from what obtains in industrial production of goods which are of repetitive nature. Project Management has been found to have relevance in many fields of human endeavour but as a discipline, it is normally offered with options in construction technology/management, industrial technology (initially as industrial engineering but of recent split into two optional areas manufacturing systems engineering and industrial process technology) and information technology. It must be noted however that this profession has two main areas of concentration; that of provision of infrastructure or the expansion/upgrading of the existing ones, and the provision of customer-designed goods, mostly make-to-order (MTO) which are quite unique e.g. shipbuilding, software, etc.

2: The Rebirth of Project Management

Whilst Frederick W. Taylor(1856-1915) is credited as the father of scientific management for his pioneering work on work study followed later by time and motion study by Frank Gilbreth and the wife with additional inputs and practical application by Henry Ford with his assembly line methodology (Payne *et al* (1996)), Henry Gantt (1861-1919) is given the honour of being

the forerunner of modern project management when he came out with the chart named after him (Clough, 1972) which is a variant of the bar chart utilizing most of the work of the above named researchers. With its simplicity of displaying job elements on a time format, it is very much in use as different Bills of Quantities (BOQs) can be so displayed and quantitatively analyzed to provide a platform for the provision of the necessary inputs for the building programme. Despite this characteristic, the chart soon fell into disrepute due to its inability to easily display the relationship and nature of interdependencies between project activities. It was also difficult as at then to effectively identify and isolate the activities generally referred to as critical activities that uniquely control and influence project duration.

The need to find a more comprehensive format gained a greater momentum immediately after the Second World War not necessarily to help in the massive reconstruction effort but to fast-track the different defense systems developed as at then to checkmate one another, both friends and foes alike. Bernard Schriever (1910-2005), the architect of the US Air Force's ballistic and missile programme was credited with the coinage of the term "Project Management" in 1954 and may rightly be regarded as the "Father of Modern Project Management" (*source www.pmforum.org*). The major breakthrough came in 1958 with the birth of Program Evaluation and Review Technique (PERT) and Critical Path Method (CPM). These two models and their associates normally grouped under the broad name of network scheduling technique are coordinated work plan unlike the Gantt chart. PERT was pioneered by Booz, Allen & Hamilton Consultants in collaboration with the United States Navy in the design, planning and development of the Polaris missile project and it is reported (Clark *et al*, 1959) to

have saved two valuable years during the engineering and developmental stages. Another effort at the same time was going on at E. I. du Pont de Nemours Company of America codenamed CPM for the planning, maintenance and overhaul of their chemical plants. The aim basically was to reduce the required time for the maintenance and overhaul and it is reported by de la Mare (1982) that the planned downtime was reduced by 40% with savings of up to \$1 million during the first year of its inception.

PERT methodology was very much concerned with the time of completing a project and the proponents of it concentrated most of their efforts on time estimation based mainly on beta distribution. A lot of materials have appeared in the open literature for and against PERT approach but the beauty of it is that it has an inbuilt mechanism of determining the probability of meeting certain due dates either for the whole project or certain milestones. Other approaches, mostly CPM stress more on the cost aspect and with a lot of interest shown in many quarters about this emerging profession, a need to fashion out a set of courses in the form of book of knowledge (BoK) was envisaged.

3: The Body of Knowledge (BoK)

There have been divergent if not dissenting views of what constitutes project and project management to the extent that there are now two distinct regulating bodies, one in the United States of America the Project Management Institute (PMI) and the other, in the United Kingdom the Association of Project Managers (APM) which philosophy is very closely related to the global International Project Management Association (IPMA). The former stresses more of the management content while the latter lays some emphasis on



the technical dimension. The two bodies went on to draw up bodies of knowledge (BoKs) with PMI having seven specialized areas to include:

- (i) management
- (ii) integration scope management
- (iii) time management
- (iv) cost management
- (v) quality management
- (vi) human resource management
- (vii) risk management
- (viii) communication management
- (ix) procurement management

My view is that project management encompasses all of these BoKs as a whole and separating one from the other as specialized knowledge areas dangerously fractionalizes the discipline and limits the scope of project management. Time and cost vis-à-vis resources are like siamese twins and as such “time management” may not suffice on its own as a specialized option area. It might have been due to this criticism that led to the latest revised edition of PMBoK with the streamlining of the above into five process groups of initiating, planning, executing, monitoring and controlling and closing. APMBok on the other hand concentrates on four broad based areas of front-end, external issues, technical and commercial issues and further classified these into seven sections with 52 subtitles consisting of:

- (i) *Project in context* with basic concepts of project management, project context, project sponsorship, etc.
- (ii) *Planning the strategy* dealing with such topics as stakeholder management, value management, project management plan, project risk management, health, safety and environmental

- management, etc.
- (iii) *Executing the strategy* having such topics as scope management, scheduling, resource management, earned value management, etc.
 - (iv) *Techniques* dealing with topics as estimating, requirement management, development, value engineering, technology management, etc.
 - (v) *Business and commercial* dealing with project finance and funding, procurement, legal awareness, etc.
 - (vi) *Organization and governance* concentrates on project life cycle, concepts, definitions, implementation, handover and closeout, project review, etc.
 - (vii) *People and the profession* deals with communication, teamwork, leadership, negotiation, professionalism and ethics, etc.

It may be more appropriate if APM concentrates on the four basic areas originally fashioned out by putting a comprehensive package of related topic areas together with more enhanced technical courses to meet the cardinal imperatives of time, cost and quality specifications rather than the present fractionalization.

It may be interesting to note what PMI lists as projects which include among others:

- (1) Installation of new equipment or a modified process
- (2) Developing a new product design
- (3) Building a new house
- (4) Processing a new customer or a new customer's order
- (5) Getting dressed in the morning



- (6) Preparing and delivering a report, presentation or speech
- (7) Moving to a new building
- (8) A new marketing or advertising campaign
- (9) Preparing a meal for your family
- (10) Birth of a baby

(source - www.pqa.net/ProdServices/ccpmi).

Looking at the list, one may conclude that all activities under the sun are projects in one form or the other. For example, in the case of the birth of a baby, what are the time, cost and quality parameters and who can we call the project manager and the client in this particular "project" if we look at this in the context of a write-up in Project Management Network, Vol. VIII, No. II of February, 1994 about project management and project manager which states thus:

"if there is a single word that characterizes project management, it is "integration". It is the responsibility of the project manager to integrate the efforts of the varied human resources, the variety of equipment, supplies, and materials, and technologies to produce the product of the project..... in conformance with the requirements/specifications, on schedule, and within budget"

Yes, I may equally be wrong, wood as a material is not synonymous with material science/engineering so the birth of a baby or getting dressed in the morning considered above as projects are not synonymous with project management. These "projects" can however benefit from project management principles. The different BoKs are oriented towards sponsor/client that is, the profitability of the proposed project, the marketing strategy of the product of the project (post-

project aspect), etc rather than on project implementation, which is the fulcrum on which project management rests. There is basically no emphasis on the measuring yardstick in the two BoKs at the implementation stage since the emphasis is placed more on the outcome of the project which can only be appraised after implementation. However, the outcome is influenced by the operation strategies which are outside the scope of project management. A project may successfully be executed and delivered but suffers from management inefficiencies during its normal operations. So for it to be accepted as a profession, it must operate within defined boundaries and be distinctive enough to be so accepted as a discipline.

4: The Journey so far

Modern project management as a programme has mainly evolved on the basis of the foundation laid down by these two bodies in which time, cost and resources are treated in some fashion as different entities. These approaches have taken four different forms:

- (i) Time estimate in determining project duration and other indices such as earliest starting time, latest starting time, total float, etc.
- (ii) Time and resources dealing with such topics as resource loading, resource smoothing/levelling and constrained resource models using different mathematical models and priority rules
- (iii) Time and cost in the form of expenditure control loop and time/cost trade-off analysis
- (iv) Cost estimate in the form of bills of quantities (BOQ).

4.1: Time Dimension

The originators of PERT as earlier stated adopted beta distribution with its three time estimates of optimistic, the most likely and the pessimistic in determining the expected time of each activity. They further went on to use Normal distribution to determine the probability of meeting the due date at each node or the entire project duration. A lot of criticisms have trailed the PERT approach and Elmagraby (1977) in particular has catalogued series of improvements which ought to be made in reshaping the technique to place it on a more solid foundation. Many others (Nkasu, 1983) have even questioned the use of beta distribution in the first instance and went on to suggest other distribution models such as normal, gamma, exponential, Weibull, uniform, etc which they even argued has given a better estimate than the beta model. In a similar vein, Akpan (1987) deployed the above five as well as beta distribution models for both time and resources in a particular project and found out variations of 26% and 28% of cost of the transforming inputs and time respectively.

4.2: Time and resources

Time has no intrinsic value if it is not related to the number of resources (labour and other transforming inputs) and/or efficiency in which it is based on. Having determined the project duration, it is always normal to find out in total for each time period (e.g. hours, days, weeks, etc.), the number of resources needed to support the implementation programme. In the case of network scheduling technique with no resource constraint (unconstrained resource model), resource loading is carried out using either the earliest starting time or latest starting time whereas in the case of the Bar/Gantt chart, the exercise is mainly based on the earliest starting time. It must be realized that the Bar/Gantt chart is incapable of producing the latest

time schedule in its original form. There would therefore be peaks and valleys associated with these schedules and if the loading is based on the earliest starting time, attempts at having one schedule which is optimal may be contemplated. This is achieved by what is normally termed resource smoothing/levelling by moving activity (or activities) with floats from the high peak regions to be started at a later date and it is assumed that as this is done, the valleys will be filled to smooth the resource profile, subject of course, to project duration as determined by the critical path. If on the other hand, the resources are indeed limited, the objective would shift to finding the minimum project duration which may likely go beyond that of the critical path, that means finding a minimum path of a maximal problem. This is usually achieved by the use of mathematical models such as linear programming (Pritsker (1969)), branch and bound algorithms (Hastings (1972)) and priority rules (Davis (1974), Russel (1986) and Akpan (2000)). Over the years, several solutions employing mathematical techniques have appeared in the open literature to deal with this resource-duration minimization problem but a lot of attention has now shifted to the use of priority rules because of their simplicity and the ability to handle a more practical problem devoid of a lot of assumptions. With this reality comes idle capacity, a feature very much considered in job-shop sequencing problems when searching for optimum solution (Akpan, 1996) with its attendant cost which is inevitable in any system. This idle cost is always ignored during the bidding process but what seems to appear is an element of cost normally termed contingency allowance which may be the fallout of this but what can one say of its magnitude. This is generally calculated as a percentage of the contract sum depending on the riskiness of the project and its complexity. This method has long been criticised as arbitrary and unscientific and a number of

other methods have been suggested. These according to Bello *et al* (2008) include Monte Carlo simulation, Artificial neural network (ANN), PERT approach, Probabilistic itemised allocation (based on Pareto's law), standard deviation and Contingency tracking system (CTS)

4.3: Time and Cost

The optimization problems as enumerated above have everything in common with cost. While the constrained and unconstrained resource optimization models concentrate on the resources as prime causes of cost which have to be minimized by opting for the schedule which makes this possible, this section under consideration treat cost as a convenient homogeneous measure of resources which act or interact so as to cause the requisite activities to be completed. Generally cost is assigned to individual activities and thereafter loaded using either the earliest starting time or latest starting time. If the exercise is carried out in these two extremes then separately drawn on a cumulative basis, one would end up with expenditure control loop which would indicate possible expenditure pattern likely to be experienced during project execution. This technique could also serve as a control tool as expenditure outside the loop signals possible dangers of either cost or time overruns or both. The other aspect is the time/cost trade off analysis in which two components of time and cost the normal and crash are utilized to expedite the project to the desired completion time taking into consideration the direct and indirect costs (see Akpan, 2001).

4.4: Cost Dimension

Here cost is the dominant factor normally presented in the form of bills of quantities (BOQ). Costs are assigned to individual work packages without any attempt of stating when each work

package would be carried out during project execution. According to Akpan and Igwe (2001), in the event of delay the BOQ cannot provide the basis for the estimation of that delay and the cost associated with it. Analysis of cost deviation is always difficult to undertake since the different costs are usually lumped together.

4.5: Observation

From the foregoing, one could easily notice why a lot of uncertainties are associated with time and cost. While it is simple to estimate to some extent the material and overhead costs, it is difficult indeed to state precisely the project completion time and the cost of the transforming inputs. It is on the basis of this that one should be talking of a range of possible completion times and costs since the elements making up these two are probabilistic in nature. Appropriate contract type should therefore be adopted in contract award to take care of this and this phenomenon seems to favour a combination of the Fixed Cost Price and the Guaranteed Maximum Price, the former giving the baseline and the latter the highest. The journey so far has not been very encouraging as it was originally thought. Project Management from my own perspective has not met the yearnings of industrial practitioners based on the data of Tables 1 and 2, one from United States of America and the other from Nigeria.

Table 1: Typical problems and challenges of Projects in USA

Typical Challenges & Symptoms with Projects	National Average (1998)
Late	Only 44% of all projects finish on schedule or before. The rest tend to be very late. On average, projects are 222% longer than planned
Over budget	By 189%
Fall short of planned technical content	70% of projects
Cancelled before finished	30% of projects
Day-to-day chaos and frustrations	Epidemic
No reliable way to measure project status	Until it is too late

As reported in a national survey conducted by The Standish Group (*source – <http://www.pqa.net/ProdServices/ccpm>*)

Table 2: Executed Projects and their Critical Factors, Bayero University, Kano

S/N	Project	Initial Contract Sum	Final Contract Sum	Contract Variation	% Variation	Initial Date Of Completion	Final Date of Completion	Period Variation	% of Period Variation	Remarks State of Status
1	Construction and Furnishing of AKTH (1 st Phase)	9066550	10396753.30	1330203.52	14.67%	26 weeks	32 weeks	6 weeks	23.08%	100% completed
2	Construction of 2 nd Hostel Block	7691495.19	8053449.54	361954.32	4.70%	10 weeks	52 weeks	42 weeks	420.00%	100% completed
3	Construction of Hostel Blocks at AKTH	6584495.19	8080071.15	1495575.96	22.71%	10 weeks	52 weeks	42 weeks	420.00%	100% completed
4	Construction of 500 Capacity Lecture Hall	92334923.65	92334928.65	-	-	56 weeks	136 weeks	80 weeks	142.00%	95% completed
5	Construction of Computer Centre	88601292.10	103651380.15	15050088.37	16.99%	36 weeks	64 weeks	28 weeks	77.78%	100% completed
6	Construction of Students' Hostel Block	20947500.00	21929039.97	981539.97	4.69%	16 weeks	29 weeks	13 weeks	81.25%	100% completed
7	Construction of Information Centre	33429905.75	44275650.98	10845745.43	32.44%	16 weeks	52 weeks	36 weeks	225.00%	100% completed
8	Completion of Conference Centre	93383010.26	96306050.60	2917040.34	3.12%	12 weeks	20 weeks	8 weeks	66.67%	100% completed
9	Convocation Square	24932617.50	24932617.50	-	-	36 weeks	40 weeks	4 weeks	11.11%	97% completed
10	Office Block of AKTH	19442428.32	19442428.32	-	-	30 weeks	34 weeks	4 weeks	13.33%	97% completed
11	Construction of Sports Complex I	7541158.00	7541158.00	-	-	20 weeks	76 weeks	6 weeks	8.57%	98% completed
12	Aminu Durrada Business School	35876260.00	35876260.00	-	-	4 weeks	32 weeks	28 weeks	700.00%	95% completed

Source: Visitation Panel Report of 2004

Those found not to have contract (cost) variation were awarded on Fixed Price contract basis. One could also notice that a few of them are yet to be completed and might have even been abandoned despite the fact that the total contract sums have fully been paid.

The reasons for this abysmal performance are not far-fetched as:

- (i) There is generally, lack of knowledge of the use of project management tools especially in the core area of project implementation. Many still rely solely on Bar/Gantt chart which realistically cannot help in determining the project duration.
- (ii) The two bodies PMI and APM trying to fashion out BoKs for the profession concentrate all their efforts mostly on the periphery and as such have lost focus of putting in place a sound framework for successful project implementation.
- (iii) There is a lack of integration of the different project management tools e.g. Bar/Gantt chart, network scheduling technique, bill of quantities, etc to produce the product of the project in conformance with the requirement/specification, on schedule and within budget.

4.6: Other Developments - The Earned Value Analysis (EVA) Model

Probably not satisfied with the development as at then, Earned value analysis formally came into existence in 1967 when the US Department of Defense (DoD) established the Cost/Schedule Control Systems Criteria (C/SCSC) to standardize contractor requirements for reporting cost and schedule performance on major contracts. A basic tenet of C/SCSC is the concept of Earned Value Management. Earned Value Management is a methodology for determining cost and schedule performance of

a project by comparing the “planned” work with “accomplished” work in terms of monetary value assigned to the work. Earned value analysis then became the industry standard method of measuring a project's progress at any point in time, forecasting its completion date and final cost, and analyzing variances in the schedule and budget as the project proceeds. It compares the planned amount of work with what has actually been completed, to determine if the cost, schedule and work accomplished are progressing in accordance with the plan. In a nutshell, earned value analysis is a method of showing the progress of a project by comparing the actual result of each activity within the project against the plan (budget and schedule). Using this data, the earned value creates indicators that show whether or not the project/task is on schedule and whether or not it is meeting the cost plan. As the work is completed, it is considered “earned”. Earned value is therefore the missing link between cost reporting and cost control. This depends on the existence of a sound framework according to Lock (1996). This last stage is what seems to be lacking when one looks closely at the methods of approach where cost information is used to determine the schedule performance index (SPI) and schedule variance (SV) using a common graph at time, t. These according to Payne *et al* (1999) are given as:

$$\text{Schedule performance index (SPI)} = (\text{BCWP}/\text{BCWS}) \quad \text{-----(1)}$$

$$\text{Schedule variance (SV)} = ((\text{BCWP} - \text{BCWS})/\text{BCWS}) * 100\% \quad \text{-----(2)}$$

and

$$\text{Cost performance index (CPI)} = (\text{ACWP}/\text{BCWP}) \quad \text{-----(3)}$$

$$\text{Cost Variance (CV)} = ((\text{ACWP} - \text{BCWP})/\text{BCWP}) * 100\% \quad \text{-----(4)}$$

where

ACWP is the actual cost of work performed

BCWP is the budgeted cost of work performed

BCWS is the budgeted cost of work scheduled

and the above information according to this methodology could further be

used to forecast the eventual cost of the project and its duration thus:

$$C_f = C_s (1 - CV) \quad \text{-----(5)}$$

$$T_f = T_s (1 - SV) \quad \text{-----(6)}$$

where

C_s and C_f are scheduled and forecasted projected costs and

T_s and T_f are scheduled and forecasted project completion times respectively.

However, PMBoK Guide Exposure Draft (PMI Standard Committee, 1994) adopts the reverse for BCWP and ACWP in respect of Cost Performance Index (CPI) and Cost Variance (CV). These are:

$$CPI = BCWP/ACWP \text{ and } CV = (BCWP - ACWP)/BCWP$$

A negative schedule variance calculated at a given point in time means that the project is behind schedule while a negative cost variance means the project is over budget. The reverse is the case with those of Payne *et al* (1999).

It was in the light of this anomaly of using cost to determine the schedule variance and schedule performance index that prompted Ibbs and Kwaks (1998) to look at the problem once again and in the course of their research came out with two indices for the above, CI (Cost Index) and SI (Schedule Index) in evaluating project schedule performance. These are given as:

$$\text{Cost Index (CI)} = (\text{Actual Project Cost}) / \text{Original Budget} \quad \text{-----(7)}$$

$$\text{Schedule Index (SI)} = (\text{Actual Project Duration}) / \text{Original Project Duration} \quad \text{-----(8)}$$

Equations (7) and (8) however look at the global picture and one may have a problem evaluating the progress at certain intervals. To appreciate the problem of the Earned Value Analysis methodology, let us look at a small project designated as AB-947, a bungalow to be precise which was awarded by the one of Federal institutions in Owerri at a cost of N10,000,000.00 with a contract period of five months. At the end of the 3rd month, the different costs were as shown in Table 3.

Periodical costs are the sum of all the costs charged to the project within each period. These costs include purchased materials, labour, special charges, office expenses and allocated overhead costs. The different costs of EV analysis are:-

$$ACWP = \text{N } 4,000,000$$

$$BAC (\text{total budgeted project cost}) = \text{N } 10,000,000$$

$$BCWP = \text{N } 5,000,000$$

$$BCWS = \text{N } 6,000,000$$

From the above, the

CPI = 0.80 (or 1.25 using PMI model) which signifies a good result.

CV (Cost Variance) = -20% (or 20% according to PMI) indicating a good result too.

SPI = 0.8333 which is less than 1 indicating a bad result and the

SV (Schedule variance) of -20% indicating a bad schedule performance also.

From these results, one could conclude that the contractor was performing well in terms of cost but actually behind schedule by 20%. What a mixed result! In most project situations especially in this part of the world, the concern has always been focused on cost in the form of bills of quantities without necessarily stating how long each work package in the bill is going to be accomplished. This has given rise probably to rather unsatisfactory schedule performance as shown above. It must also be noted that the BCWP is just an estimate based on how far it is assumed the work has been accomplished so also the BCWS, in this case 60% of the project duration (3months out of 5).

EVA was widely publicized and accepted in the industry and led to the emergence of Primavera software package which is built on its methodology. How satisfactory the concept is could be attested to from the information on Table 3 but from those I have had the privilege of interacting with on the use of the concept and Primavera, there are doubts as its success. This is mainly due to the wrong concept of EVA.

Table 3: ACWP of Project AB-947

Performance Details	Periods in months					Totals
	1	2	3	4	5	
<i>Project Administration</i>						
Periodical Costs	400,000	300,000	200,000			
Cumulative Cost	400,000	700,000	900,000			900,000
<i>Design</i>						
Periodical Costs	1,100,000	1,200,000	200,000			
Cumulative Cost	1,100,000	2,300,000	2,500,000			2,500,000
<i>Drafting</i>						
Periodical Costs			300,000			
Cumulative Cost			300,000			300,000
<i>Structural Works</i>						
Periodical Costs			300,000			
Cumulative Cost			300,000			300,000
<i>Roofing/Cladding & Ceiling</i>						
Periodical Costs						
Cumulative Cost						
<i>Electrical & Mechanical</i>						
Periodical Costs						
Cumulative Cost						
<i>Painting & Decoration</i>						
Periodical Costs						
Cumulative Cost						
<i>Certificate & Delivery</i>						
Periodical Costs						
Cumulative Cost						
Total Periodical Cost	1,500,000	1,500,000	1,000,000			
Cumulative Cost	1,500,000	3,000,000	4,000,000			4,000,000

5: Quality

While measuring and assessing quality is minimal as compared to that of time and cost, it is important to know what is involved so as to be able to put appropriate tools in place for its analysis and evaluation. Quality has three components; the client specification, the technical as well as the environmental contents. These components must synchronize one another. What the client needs must be technically feasible and must conform to the basic environmental laws of the locality. For example, a client wishing to build a house in Owerri without making a provision for human waste disposal or making provision for a pit latrine would not be acceptable since this runs counter to the Municipality laws on environment even though this might have been his desire/requirement. Project design therefore has to include a sewage system which is very likely to increase the project cost to meet the overall specification. What is sometimes ignored is the quality of the design to meet certain peculiar needs e. g. channeling of the water from the rooftop. Sometimes there is over-design which adds more to cost rather than functionality; value analysis/engineering principles should therefore be employed in all facets of design. It is this quality element which forms the three essential factors in project performance assessment although of recent Kerzner (2003) has included the fourth element; the satisfaction of the project stakeholders. This is quite unnecessary since this aspect forms a part of the quality specification. Since there is no repeat performance, all project functions must be done right the first time. Adequate attention must individually be directed at every activity to maintain quality.

6: The way forward

The bane of project management is the lack of integration of the

5: Quality

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6: The way forward

The bane of project management is the lack of integration of the

different methodologies for a holistic system. Network scheduling technique has been recognized as providing a mechanism for project planning and control but there is always that tendency among its users of using it mainly as a guiding document (Akpan (2000)), not as an implementation tool. This lack of integration has occupied my mind over the years and efforts to develop models have yielded some positive results, one taking a qualitative approach in the form of interface matrix for efficient project performance and the other, a quantitative model which attempts at the integration of time, cost and resources.

6.1: Interface Matrix

Project performance requires an appropriate sponsor/owner's involvement for efficient project performance. The owner as the ultimate risk bearer must play an active role in project effort for the above objectives to be achieved. For this to be possible there must exist an appropriate organizational structure. The choice of the project organisational structure, however, is influenced by the choice of contract type and contact strategy.

An interface matrix which contains the recommended combinations of the different contract type, contract strategies and the sponsor/owner's organisational structure/surveillance techniques that makes for owner's involvement has since been developed. The need for the existence of a collaborative environment for the project effort and curtailing of the negative tendencies encouraged by the different contract types are factors influencing the balance on the choice of the appropriate contract type, contract strategy and sponsor/owner's organizational structure/surveillance type.

Several attempts in this direction have been made but such efforts have not been very comprehensive. Allen (1989) dwelt on contract strategy and owner's organizational structure while Anton de Wit (1986) used transaction-cost approach in choosing the organizational structure with respect to contract strategy. Richie (1982) and Vickland (1980) concentrated on the size of owner's project management team which according to them depends on the type of project structure and contract strategy.

Before building on the interface matrix, the underlining terminologies need to be discussed. A full and comprehensive treatment could be found in Akpan and Ukairo (1998). Contract types consist mainly of Fixed cost contract or Lump sum, Cost plus or Cost reimbursement contract and Guaranteed maximum price contract. Project contract strategy defines the contractual relationships between the owner and the contractor(s) on one hand and between the different contractors working on the same project on the other as passive participation of the client can be very costly indeed in terms of poor quality of work, cost/time overruns and even project abandonment. Those normally mentioned are Design-Build strategy, Project Management strategy, General Contractor strategy, Prime Specialty Contract strategy, In-House Construction.

The organizational structure ranges from the pure functional type at one extreme to the pure project type at the other extreme. In between these two, we have matrix organisation which is described as the policy, procedure and work relationship resulting when a project team headed by a project manager is superimposed on an existing hierarchical structure. There are three basic types; each type addressing the relative influence of the project manager and the functional manager on

the project. Type A normally called the Functional matrix is a case where an individual is formally appointed to oversee the project across different functional areas with functional managers retaining primary responsibility for the different work packages. Type B known as Balanced matrix is where a person is assigned to oversee the project and relate to functional managers on equal basis while Type C generally called Project matrix is where the project manager is charged with overall responsibility of completing the project while the role of functional managers is limited only to assigning personnel as and when needed and also providing advisory expertise.

Project surveillance provides professional advice and guidance throughout the project life cycle to the project sponsor/owner thus enabling him play an active role in the project effort. The activity is often concerned with organization/management, programme/progress, financial/cost and resource issues surrounding a project. There are two of them that can be utilized, Project Performance Audit (PPA) and Project Management Oversight (PMO). PPA is a technique whereby project monitoring is conducted intermittently throughout the life of the project. This can be done at different stages in the life of the project; pre-project, in-project and post-project while PMO does its monitoring continuously from project conception through operation to maintenance. It is very comprehensive and therefore very costly and takes into consideration internal and external environment of a project incorporating the form of services provided by PPA. It adopts a pre-emptive approach to problem solving, focusing on the people, the process and the tools employed in meeting the project objective.

A balance between the influences of these four elements ensures that the elements bear positively on the outcome of a

project. Those factors which influence the balance between the different elements are cost, required level of owner's control, in-house capability, level of management at which intra-organisational integration is carried out and need to control contractor's attitude.

Having considered the four elements and the factors which can influence the balance, it is possible to develop the interface matrix as shown in Fig. 1. The matrix ensures the availability of knowledge and experience for the project planning, implementation and control including the management of the environment. When a project owner conceives the need for a project, the proper step is to hire an appropriate surveillance contractor depending on his in-house capabilities. Having decided on this, he can choose the other three elements in sequence. For example, where the owner decides on PMO, guaranteed maximum price as the contract type, the owner can either choose the functional management, functional matrix or balanced matrix as his project organizational structure. The same procedure is followed where the owner chooses his project strategy and contract type. The shaded cell represents the "envelope of balance" most acceptable. Matrix left blank or with a minus (-) will not support a balance between the four elements while the cells with plus (+) sign provide an owner involvement costlier than what is necessary.

GUARANTEED MAXIMUM PRICE	COST PLUS	FIXED COST	STRUCTURE/ SURVEILLANCE	DESIGN BUILD	PROJECT MANAGEMENT	GENERAL CONTRACTOR	PRIME SPECIALTY	IN-HOUSE CONSTRUCTION
	—		FUNCTIONAL MANAGEMENT + PMO			—	—	
	—		FUNCTIONAL MATRIX + PMO					—
+			BALANCED MATRIX + PPA	+				
+		+	PROJECT MATRIX + PMO		+			
+		+	PROJECT MATRIX + PPA		+	+		
		+	PURE PROJECT + PPA					

Fig. 1. Interface Matrix for contract strategy, organizational structure, project surveillance and contract type.

This cross-reference matrix therefore can be applied by an inexperienced project owner as a rule of thumb to effect a more successful project management outcome.

6.2: Time, Cost and Resource Integration

There has been dearth of literature in this area but our recent effort has provided substantial information for the work which took the form of a network-based bill of quantities and with it, a new approach incorporating the traditional Gantt chart, network scheduling technique and bill of quantities was developed (see Akpan *et al* (2008)). As it is well known, the bills of quantities are made of raw materials (or work-in-progress as the case may be), the cost of labour and equipment (the transforming input) and overhead but the number of each transforming input making up this cost which could have enabled resource loading to be carried out were not available.

The data in question came from two borehole projects sponsored by United Nations Development Programme (UNDP) in Ikwuano Local Government area of Abia State, one (X) in Umuokigbo which took off in June, 2002 and the other (Y) at Inyila in September, 2002. As would later be observed, there were a lot of improvements in the second project after a lot of experience gained from the first and also the methodology used. The bills of quantities for the two projects were divided into four sections, A, B, C, and D comprising of drilling, construction of pump/generator house, pump installation and construction of overhead tank. The cost of each of the twenty-six activities that make up the network is shown in Table 4 with their durations. Those figures with negative values represent unfavourable variances (i.e. higher expenditure than budgeted for) while the positive ones represent favourable variances. The network diagram is presented in Fig. 2.

Table 4: United Nations Development Programme Assisted Borehole Projects in Abia State, Nigeria

S.N	Job Description	Activity			Start and Finish Times (Days)						Floats	Critical Path	Budgeted Cost (₦)		Actual Cost (₦)		Variation in Cost (₦)		Actual Duration
		Code	Path	Duration	EST	EFT	LST	LFT	TF	FF			X	Y	X	Y	X	Y	
1	Clearing of site	A1	1-2	3	0	3	0	3	0	0	0	•	1515	2190	1800	-675	285	3	
2	Geographical Survey	A2	2-3	3	3	6	25	28	22	0			10000	10000	10000	0	0	3	
3	Access Road & Structures	A3	2-4	7	3	10	21	28	18	0			12244	12244	12244	0	0	3	
4	Mud pits and channels	A4	2-5	3	3	6	12	15	9	0			4000	4000	4000	0	0	7	
5	Foundation for pump generator house	B13	2-6	3	3	6	11	14	8	0			10428	17800	17800	-7372	7372	5	
6	Foundation for O/h tank	D21	2-7	5	3	8	3	8	0	0	•		96471	150000	96471	-53529	53529	5	
7	Dummy	-	3-4	0	6	6	28	28	22	4			0	0	0	0	0	5	
8	Transportation of materials	A5	4-20	4	10	14	28	32	18	9			4000	8000	4000	-4000	4000	5	
9	Drilling	A6	5-8	10	6	16	15	25	9	0			44500	44500	44500	0	0	8	
10	Block work and lintel	B14	6-9	4	6	10	14	18	8	0			26800	26800	26800	0	0	13	
11	Erection of tank	D22	7-10	14	8	22	8	22	0	0	•		25960	495780	25960	-239820	239820	5	
12	Logging	A7	8-11	1	16	17	25	26	9	0			6500	6500	6500	0	0	14	
13	Roofing	B15	9-12	4	10	14	18	22	8	0			139500	139500	139500	0	0	1	
14	Ladders and Platforms	D23	10-13	10	22	32	22	32	0	0	•		22500	22500	22500	0	0	5	
15	Casing	A8	11-14	2	17	19	26	28	9	0			217000	217000	217000	0	0	10	
16	Windows and doors	B16	12-15	4	14	18	22	26	8	0			34600	34600	34600	0	0	2	
17	Water level indicators	D24	13-16	2	32	34	32	34	0	0	•		10000	10000	10000	0	0	2	
18	Gravel packing	A9	14-17	1	19	20	28	29	9	0			9600	9600	9600	0	0	2	
19	Plastering	B17	15-18	3	18	21	26	29	8	0			5000	10000	5000	-5000	5000	1	
20	Galvanization and bitumen	D25	16-23	2	34	36	34	36	0	0	•		160000	160000	160000	0	0	4	
21	Grouting	A10	17-19	1	20	21	29	30	9	0			3000	3000	3000	0	0	2	
22	Electrical & wiring installation	B18	18-21	5	21	26	29	34	8	0			21000	21000	21000	0	0	1	
23	Cleaning & well development	A11	19-20	2	21	23	30	32	9	0			20000	40000	20000	-20000	20000	4	
24	Pumping test	A12	20-21	2	23	25	32	34	9	1			30000	30000	30000	0	0	2	
25	Painting	B19	21-22	2	26	28	34	36	8	0			6000	6000	6000	0	0	3	
26	Supply & pump installation	C20	21-23	2	26	28	34	36	8	8			381100	381100	381000	-100	100	4	
27	Dummy	D22-23	0	28	28	36	36	36	8	8			0	0	0	0	0	2	
28	Pipe connection & leakage test	D26	23-24	4	36	40	36	40	0	0	•		56850	75390	56850	-18560	18560	4	
Total													1588545	1933904	1609665	-345356	324239	40	

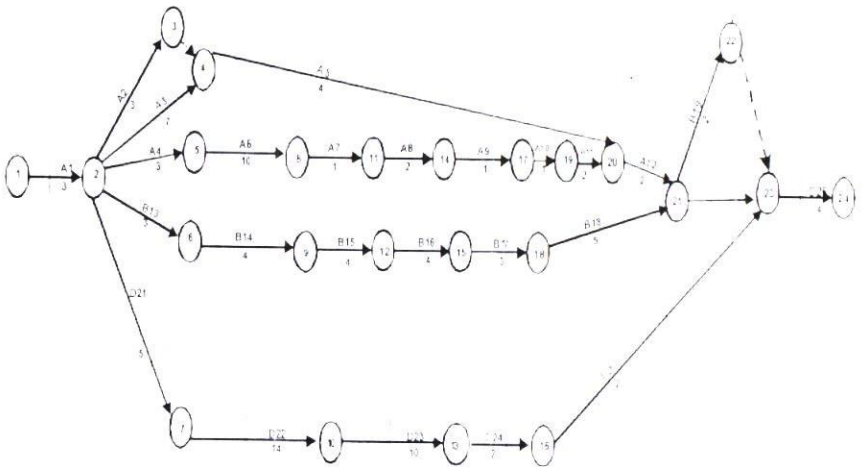


Fig. 1: Network Diagram for Projects X and Y (Planned Estimate)

The first project was implemented and monitored using EVA methodology, which has given an impressive result at T_{32} in terms of cost. The CPI and CV at this point are:-

$$\text{CPI} = 0.9557 \text{ or } 95.57\% \text{ (i.e. } 1301414/1361718) \text{ and}$$

$$\text{CV} = 0.04429 \text{ or } 4.43\% \text{ (i.e. } ((1361718 - 1301414)/1361718))$$

Although these results appear to be satisfactory but what these indices have not stated are the activities, which ought to have been carried out at this time according to the plan. This may pose some problems in future. At this point, activities B19 and C20 are yet to be carried out and this contributed to the cost being lower than the budgeted.

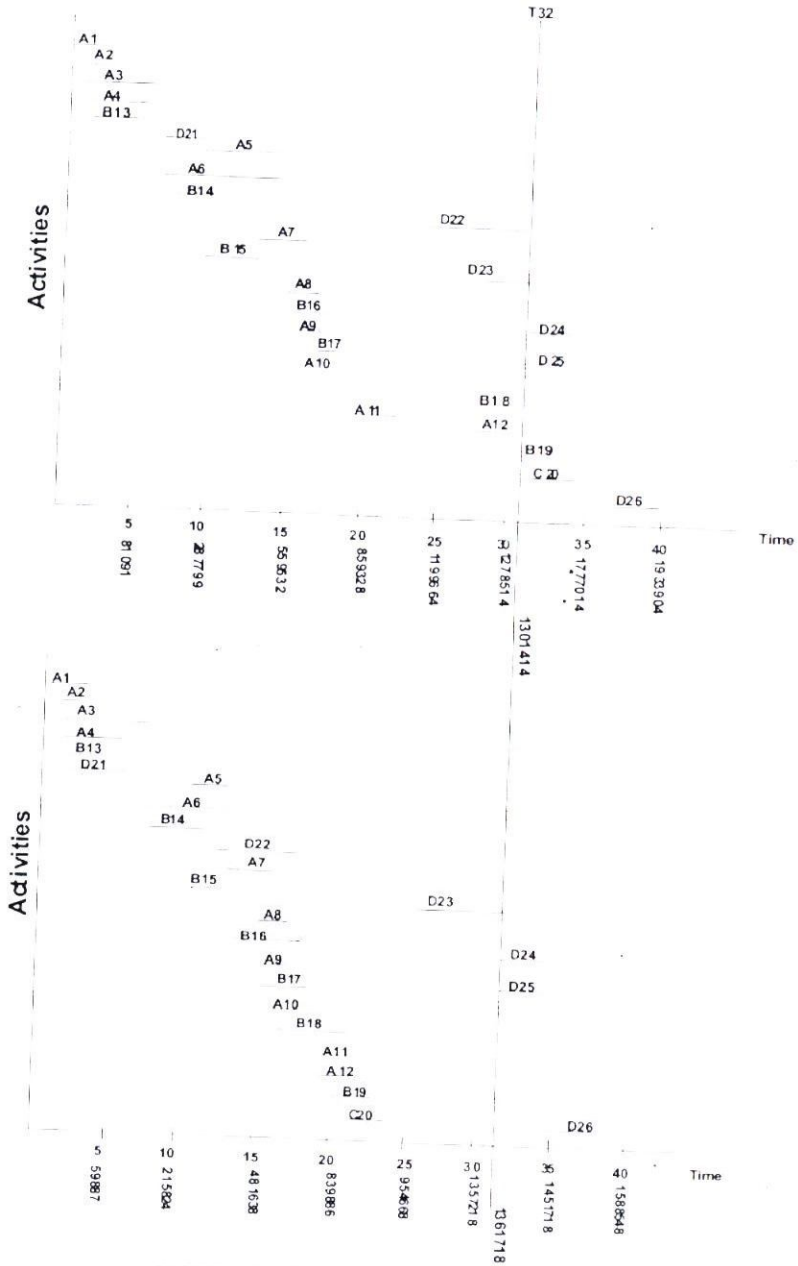


Fig. 2: Gantt chart for Actual Project Performance (Top) with the Planned Project Performance (Bottom) for Project X

The schedule variance and schedule performance index are unfavourable at this point in time. For proper analysis, this project was subjected to the concept outlined above. When the project was displayed in the form of network before transforming it into Bar/Gantt chart for the purpose of clarity during implementation, the project as a whole was not behind schedule. It is recommended that the monitoring of the project should be more frequent towards its termination point in order to keep cost down and also deliver the project within schedule.

At T_3 , the

$$\begin{aligned} \text{CPI} &= 1.2241 \text{ or } 122.41\% \text{ (i.e. } 1777014/1451718) \text{ and} \\ \text{CV} &= .1830576 \text{ or } 18.31\% \text{ ((1451718 - 1777014)/1777014)} \end{aligned}$$

These two indices are rather unsatisfactory three days after an impressive result. One should have expected the EVA model to predict this unfavourable result as this was what it was meant to accomplish but what a disappointment! From the records, certain justifications were given as to the unfavourable outcome, which include among others; that the price of labour and materials increased substantially during the period of implementation. This is difficult to believe when one looks at Project Y executed and monitored using the proposed model immediately after the completion of Project X in the same locality. Before carrying out this analysis, the five-day interval of actual expenditure for Project Y is summarized in Table 5. This is used alongside the budgeted cost to draw inferences at different milestones similar to what we have in Fig. 3.

Judging from the actual cost of N1364275 as against the planned cost of N1361718 at T_{32} , only a slight difference of N2557 (unfavourable variance) was noticed. This had to do with monitoring the budget hand in hand with the activities, which this approach has afforded. This is also applicable to another period, T_{35} where the actual cost is N1454215 as against the planned cost of N1451718, a difference of N2497 (unfavourable variance). The resource loading graph (see Akpan and Chizea (2005)) based on the budgeted resource information is placed below the actual and budgeted graphs on periodical basis to get the number of resources of each type (crane, carpenter, mason, etc designated as A, B, C, etc) to be deployed during project implementation. Resource usage table shown in Table 6 should have accompanied the bill of quantities for the above to be achieved. There is bound to be variations in resource usage over the entire project direction. In practical terms, it is not possible to hire and fire resources (labour (fixed and variable), equipment, etc) at will, a certain minimum has to be maintained throughout a reasonable period of time. This is where the idle capacity comes in with its attendant cost which has to be minimized as much as possible by adopting techniques such as resource smoothing/leveling (see Akpan (1999)) or lending these resources out when they are not immediately needed.

Table 5: Cost of Project Y at different time intervals

Interval	Cost (₦)	Cumulative Cost (nearest integer) (₦)
5	62120.02	62120
10	154660.70	216781
15	263864.30	480645
20	365231.00	845876
25	107249.10	953125
30	406650.00	1359775
35	94500.00	1454275
40	155390.00	1609665

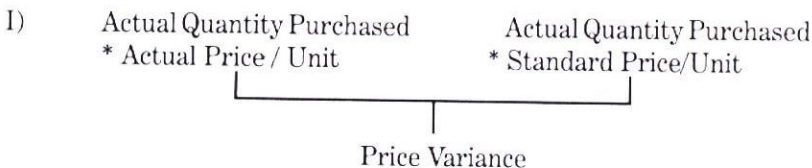
Table 6: Resource Usage Table

S/N	Activities	Resources											
		A	B	C	D	E	F	G	H	I	J	K	L
1	Clearing of site												
2	Geographical Survey												
3	Access Road & Structures												
4	Mud pits and channels												
5	Foundation for pump/generator house												
6	Foundation for O/h tank												
7	Transportation of materials												
8	Drilling												
9	Block work and lintel												
10	Erection of tank												
11	Logging												
12	Roofing												
13	Ladders and Platforms												
14	Casing												
15	Windows and doors												
16	Water level indicators												
17	Gravel packing												
18	Plastering												
19	Galvanization and bitumen												
20	Grouting												
21	Electrical & wiring installation												
22	Clearing & well development												
23	Pumping test												
24	Painting												
25	Supply & pump installation												
26	Pipe connection & leakage test												


The issue of schedule performance index and schedule variance seems to be built on the assumption that all activities must start at their expected times (i.e. earliest starting times). An activity having float could take advantage of it without experiencing any schedule variance with respect to the project duration. The analysis of variance on activity basis is simple to undertake with this approach rather than subjecting the project to the whole exercise with the likelihood of one losing sight of closely monitoring similar activities in future projects.

The concept outlined above is mainly concerned with the earned value which is quite different from expenditure incurred in the course of the project which may entail buying and paying for materials in bulk for future use. This equally applies to plants and equipment. The period of occurrence (i.e. payment) is very important which may occur at certain nodes of the network. This aspect of the exercise is very useful for project financial planning and control as improper funding could have disastrous consequences on the project. The same approach should be adopted but attention should be shifted to when the payment is made.


The analysis of cost variance was somehow difficult to carry out because of non-availability of data which was also the case with resource loading. We needed to have the cost of materials, the cost associated with the transforming input and the overhead for each activity. This analysis could be carried out using the summary below when one has these data in place.



(ii)

Actual Quantity Used	Standard Quantity Used
* Standard Price/Unit	* Standard Price/Unit
	
Usage Variance	

(iii)

Actual Hours Worked	Actual Hours Worked
* Actual Rate Paid/hour	* Standard Rate Paid/hour
	
Labour Variance	

7: Industrial Growth and Development

As project management is primarily concerned with the provision of infrastructure or the expansion/upgrading of the existing ones (building, machineries, power plant, car assembly lines, dockyards, machine tool design and manufacture, etc), the feasibility analysis for it would have given a favourable return on investment before the final decision to undertake the project is taken. With the cost of infrastructure known which represents the fixed cost, it would be possible to find the number of units to produce in order to breakeven and possible ranges of output for profit maximization. Marginal costing approach may be a useful tool for this important task.

Marginal costing is built on the whole concept of marginal cost which is defined as the amount at any given volume of output by which aggregate cost would change if the volume is increased or

decreased by one unit using a fixed capacity over a relevant period. Knowing the selling price and the variable cost (consisting of raw materials, labour and variable cost) of each unit of output, the above objective can easily be calculated. The difference between the two normally called contribution margin indicates how much sales have contributed towards recovering the fixed costs and hopefully to make some profit. Contribution margin can equally be read out from the graph. This is done by drawing the variable cost line from the origin, this line being parallel to the one emanating from the fixed cost line. The angle between the sales line and the variable cost line represents the contribution and the wider the angle, the more the returns and vice versa. The term can be expressed in unit called the "unit contribution margin" which is the difference between the unit selling price and the unit variable cost or in percentage terms called the "contribution margin ratio" or "contribution margin percentage" or simply as "profit volume ratio" and this last term is usually used when the solution is needed in monetary value especially in the case of multi-product organisation.

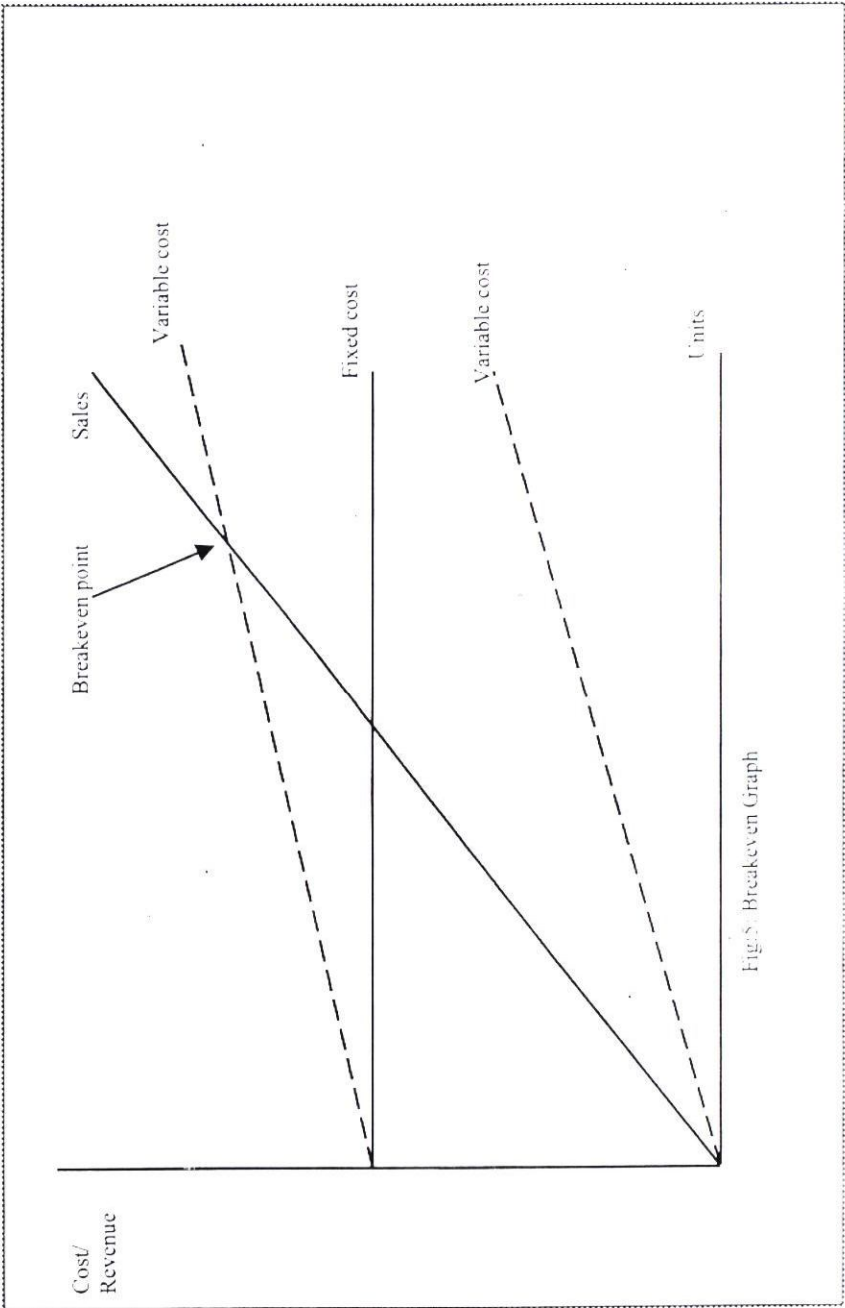


Fig.5. Breakeven Graph

There is a general equation for solving all marginal costing problems. For computational purposes, what is required can be derived from this equation which is expressed as:-

$$\text{Sales} = \text{Fixed costs} + \text{Variable cost} + \text{Desired net profit} \text{ ----- (9)}$$

and at breakeven point (no profit is made or loss incurred), this becomes:-

$$\text{Sales} = \text{Fixed costs} + \text{Variable Costs} \text{ ----- (10)}$$

In order to show how this can affect the project outcome, it is better to illustrate this with a small example. Let y represent the total number of units of a particular product with the selling price and variable cost per unit of N80.00 and N45.00 respectively and a fixed cost of N30,000.00. Utilising the above equation we have:

$$\text{Sales} = \text{Variable costs} + \text{Fixed costs}$$

$$N80y = N45y + N30000$$

$$y(N80 - N45) = N30000$$

$$y = N30000 / (N80 - N45) \text{ giving } y = 857 \text{ units approx.}$$

The organisation may wish to know this in monetary terms rather than in units for those at corporate management level and financial decision making. Either contribution margin ratio (CMR) or contribution margin percentage can be used. In the former, the contribution margin is expressed as a ratio to the selling price while in the latter, the percentage of the variable cost sometimes called variable cost ratio (VCR) is subtracted from the selling price, also expressed in percentage and always taken as 100% is utilised.

Using CMR, we have:-

$$\frac{\text{Contribution Margin}}{\text{Selling Price}}$$

$$\text{this gives, using our example above as:-}$$

$$\frac{(N30000 \times N80)}{(N80 - N45)}$$

$$\text{this gives, using our example above as:-}$$

Using the alternative method of VCR, we have:-

Fixed Cost	N30000
100% - (N45/N80)%	100% - 56.25%
	= N68571 approx.

These results could be checked using the units at breakeven point which should confirm the earlier result.

From this treatment, one could easily employ either the CMR or VCR to know the amount the organisation is gaining or losing for either an increase or a decrease in sales volume. CMR is the complement of VCR. If VCR is 70%, then the CMR is 30%. When CMR is known, a change in profit from a contemplated change in sales can easily be calculated. If on the other hand there is a 60% project cost overrun and assuming that all the other things remain constant the selling price, the variable cost and enough demand for increased production, there will also be a proportionate increase in breakeven point; jumping from 857 units to 1372 units.

Cost overrun may be the first symptom of “white elephant project” syndrome. If there is a substantial cost increase during the developmental stages of the project, this will impact negatively on capital recovery and the breakeven point. Effort therefore should be made to curtail the incidence of price variation during the period of project execution by adopting appropriate contract type and contract strategy together with appropriate project management tools.

Time overruns may also have the same disastrous consequences on capital recovery and subsequently the profit. To further advance the argument, let us consider a project with a budgeted cost of N10,000,000.00 spread over a three-year period and revenue profile of seven years with a capital cost of

15%. This project, however took five years to execute but stayed within the budget and revenue (including the scrap value) profile as shown in Table 7. The project is assumed to start at year 0 following the normal convention. If the project is executed according to plan, a 38.20% profit is possible but a reduced profit of 13.92% based on actual, a loss of 24.28% in real terms even though the actual expenditure is lower in real terms by 8.26%.

Table 7: A Cost and Revenue Profile of a particular project

Year	Expenditure			Revenue				
	Budgeted (₹)	Value at 15%	Actual (₹)	Value at 15%	Budgeted (₹)	Value at 15%	Actual (₹)	Value at 15%
0	2500000	2500000	2000000	2000000				
1	4000000	3478260	2200000	1913043				
2	3500000	2646502	3000000	2268431				
3			1500000	986274	2200000	1446536		
4			1300000	743279	3000000	1715260		
5					3500000	1740119	2200000	1093789
6					3600000	1556380	3000000	1296983
7					5600000	1879695	3500000	1315780
8					4000000	1307608	3600000	1176846
9					8000000	2274099	5000000	1421312
10							4000000	988739
11							8000000	1719546
Total	10000000	8624762	10000000	7911927	293000000	11919597	293000000	9012995

8. Challenges

Project management has been assisted immensely by the emergence of information technology. Managing the vast amount of information normally encountered in project management systems could be a herculean task. The days of engineering drawing in the drawing board is over and CAD/CAM and other software packages like Autodesk packages (Revit) have taken over which not only makes drawings easier to create and store, they are much more easier to revise since revisions are integral part of project/product design. One of the latest innovations is to automatically convert these drawings into Virtual Reality Modelling Language (VRML) files so that the designer can “flythrough” the product seeing how the different components fit together inside the model. Another is in terms of precision and for the fact that the design can be subjected to various tests to determine the functionality under certain loads and environmental conditions. Above all, some packages can carry out the costing in respect to each design when some basic inputs are given. This cannot be done manually with much precision and the resultant effect is a badly managed project with escalating cost, undue delay and even project abandonment. This therefore has a spiral effect on the economy making our goods rather expensive and sucking in imports especially from the Asian Tigers.

It is interesting to note that environmental issues are becoming dominant factors in project development. It is even mandatory to carry out baseline studies which involve collecting and interpreting information on the condition/trend of the existing environment before a full Environmental, Social, and Health Impact Assessment (ESHIA) is undertaken. This assessment provides key information for quality business decisions by helping to identify potential problems, gain effective input from

local and regulatory stakeholders in order to better assess cost related to compliance, mitigation or project delay. Specific objectives of ESHIA are to protect human health and the environment, minimise or eliminate potential liabilities from operations, provide greater understanding of community needs (social aspect) and promote consistency and efficiency within and between projects. ESHIA adopts in total the Strength, Weaknesses, Opportunities, and Threat (SWOT) analysis in its evaluation. One may therefore wish to question some of the controversies which raged during the power probe saga as to site, land matters with respect to communities, access road to site, etc. if at all baseline studies and ESHIA were actually undertaken by contractors and agencies of government.

Another challenge to the profession is the issue of the budget, the product of the design. It is not just a question of staying within the budget but how realistic that budget is; bloated or reasonable. This calls for a cost comparison of similar projects in other locations. The project must meet the overall objective of what was expected at reasonable cost; that is value for money. Considering a social project like provision of water or classroom block for increased enrolment; one may wish to ask at what cost the water is being delivered per litre. In the case of building of a classroom block, the increase in enrolment should justify that intervention. Another issue is the quality level the project is delivered even if the project is completed on schedule and within budget. We should look around the campus on the various projects so far delivered to draw our own conclusions.

9. SUMMARY AND CONCLUSION

It is an undeniable fact that project implementation is fraught with dangers of time and cost overruns and in extreme cases,

project abandonment. To further compound the problem, some of these projects are delivered below quality specification. Many factors have been associated with the problem of cost and time overruns which include among others; increase and changes in project work scope, adverse weather conditions, unexpected site locations, incorrect estimates of work quantities, changes in legislative/standards, payment difficulties from clients, poor contract management and poor technical performance leading at times to rectification which adds more to cost and time. Many efforts have also been made to tackle these problems, the most prominent being the birth of network scheduling technique and Earned Value Analysis (EVA) concept. It has been observed that some of these models are very inadequate as they seem to treat some aspects of these factors in isolation to one another.

Another effort towards evolving a new concept for the profession and to nip the above problem in the bud has vigorously been pursued by two leading bodies the Association of Project Managers (APM) of United Kingdom and the Project Management Institute (PMI) of the United States of America. While this is a welcome development, these two bodies have failed to fashion out a comprehensive package to address the problem area of project implementation which could have been utilized to checkmate the incidence of time and cost overruns. Basically there is no measuring yardstick in the two BoKs at the implementation stage, the lack of it being a recipe for confusion as to the success parameters

It could have been the frustrations of meeting these critical objectives of adhering to cost and time parameters that prompted the emergence of Earned Value Management and with it, the Primavera software package. Even though it is

widely publicized and claimed to be widely used, there is every doubt as to its success as cost is used to determine time and the rationale is difficult to understand. Project employing this methodology and even the one used in our discussion for this lecture still experience substantial cost and time overruns as compared to the methodology discussed here which looks at the same problem despite the fact that not all the available information was available for robust analysis. The problem of ignoring the idle cost arising from the difficulty of maintaining exact resources to be used has given rise to contingency allowance although this is not always acknowledged to be so which could have prompted more researches to help in estimating to a reasonable extend this mysterious allowance.

The two models presented in this lecture tended to offer some hope for successful project implementation as reported by some practitioners although a comparative analysis is yet to be carried out with the existing methodologies. Even the one on time/cost trade-off analysis which only got a slight mention here is reported to have assisted much in evaluating the cost with respect to penalty clause when such arises due to late delivery.

10. RECOMMENDATIONS

It is interesting to note that the bill of quantities normally tendered during the bidding process is not always followed with the work plan and even it is, it is just a sketch in the form of Gantt chart. It is highly recommended that a work plan in the form of network scheduling technique should always be presented during the bidding process which would clearly state in logical sequence when each activity (or work package) will start and end and the overall completion time in addition to some other critical indices.

The bill of quantities should be more elaborate. Lumping the different cost components associated with each activity material cost, cost of the transforming input (labour and equipment) and overhead is not helping matters in resolving cost overruns. The number of each resource input should also be stated for one to be able to work out the level of each resource to maintain in a particular period so as to help in combating the menace of the so called contingency allowance.

The problem of poor project management practice must be addressed seriously. Is it a profession for every Dick, Tom and Harry? This calls for a certain level of education on the part of the practitioners. One who cannot interpret the design has no business in the profession and interpreting the design calls for a lot of engineering stuff. It is this design that one would use in costing and at the end of the day developing it into a product or infrastructure as the case may be. I am therefore calling for the review of the curriculum content of project management and for us in the Federal University of Technology, Owerri to go back to the original document which stipulated at least 60% of engineering/science, 30% of management/economics and 10% of some courses mainly in the areas of General Studies. This essentially entails the strengthening of the technical content of the programme. I would also urge that the option areas be brought in to create room for specialization, feature very much identified with programmes in FUTO. The entry requirement for the undergraduate programme should be restricted to those with credits and above in five subjects including English Language, Mathematics, Physics, Chemistry and Economics/Biology. For the postgraduate programme, I do recommend those with Engineering/Science and other related discipline relevant to project management.

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First of all, I thank the Almighty God for this day, the day He has made for us to rejoice in Thee without whom I could long been forgotten. Where do I start and end in this acknowledgement; to my parents of blessed memory, I salute you for starting the journey even though you did not stay long to enjoy this bountiful harvest. To you, my late uncle, Edem Peter Akpan who took over the baton when my father died at the time I was about to take my WASC in 1971, I say, thank you and continue to rest in the bosom of the Lord. I cannot easily forget my two older siblings, my sister and brother of blessed memory who were my first teacher helping me to read and write before entering the primary school. That foundation you laid made me to be noticed among peers and though I was small, that gave me an edge to be given the mantle of leadership at that young age which really transformed my upbringing. To my early academic mentor, the late Etim U. Ekpenyong, the Headmaster who picked a special interest in me to the extent that I completed my primary school in six years of the normal eight years, I have every cause to be grateful and I know you are resting in perfect peace for your good works You were really a rare gem.

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To God be the glory. Thank you for listening and God bless you all.

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LIST OF INAUGURAL LECTURERS

S/N	NAME	DATE	TITLE
1.	Prof. E.O. I. Banigo	Saturday 18/01/1986	"Food Processing & Preservation Paths to Self Sufficiency"
2	Prof. C.O.G. Obah	Friday 12/12/1986	"Communication in the Service of the Nation"
3.	Prof. V.O. Nwoko	Wednesday 11/12/1990	"Where Rust Doth Corrupt"
4	Prof. S.C.O. Ughofue	Wednesday 11/12/1996	"In the Throes of Polymer & Textile"
5.	Prof. O.O. Onyemobi	Wednesday 17/07/2002	"Mineral Resources Exploitation, Processing and Utilization: A Sine Qua Non for Nigeria's Metallurgical Industrial Development"
6.	Prof. A.B.I. Udedibia	Thursday 18/09/2003	"In Search of Food: FUT0 & the Nutritional Challenge of <i>Caryaxala</i> Seeds"
7.	Prof. F.O. Okorafor	Wednesday 17/03/2004	"Expendable Polystyrene Pattern Casting Process: A Revolution in Metal Casting"
8.	Prof. P.B.U. Achi	Wednesday 02/06/2004	"Acquisition of Indigenous Machinery Design Manufacturing & Control Technology: The Engineering Education and Training Perspective"
9.	Prof. M.I. Nwifo	Wednesday 28/07/2004	"Securing the Harvest to Ensure Food for all: A Plant Pathologist's Perspective"
10.	Prof. M.U. Iloje	Wednesday 17/11/2004	"The Chicken or the Egg: Nature and Nurture, New Genetic Spreadsheets & Gene Pools in the Breeding & Evolution of a New Nigerian Man"
11.	Prof. J.O. Uzuegbu	Wednesday 29/10/2008	"Salvation our Food from Fungal Rot to Ensure Food Security"
12.	Prof. C.S. Nwadiaro	Thursday 07/05/2009	"Inland Water Data Base as a Sine Qua Non for Fisheries Development in Nigeria"
13.	Prof. M.C. Ofoh	Wednesday 27/03/2009	"Food Security & Mitigation of Climate Change through Ecosystem Based Agriculture"
14.	Prof. Babinton Onyemaechi Esonu	Wednesday 24/06/2009	"Unconventional Feed Resources for Livestock Development and Food Security Paradigms From Nigerian Livestock Industry"



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