

Application of Project Management Techniques to Environmental Impact Assessment (EIA) Methodologies: A Case Study of the Installation of Solar Panels in Afe-Babalola University Ado-Ekiti, Ekiti State

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ABSTRACT

An Environmental Impact Assessment (EIA) is an integral part of the consent process from regulatory bodies before embarking on major development projects. This study examines the application of project management tools and techniques to the implementation of the EIA processes. The method of research design adopted was ex-post facto technique with secondary data on activity duration of EIA obtained from the study background. Project Management tools and techniques; Gantt charts and Critical Path Method (CPM) were used for scheduling and displaying activity formation and network diagram, respectively.

The network analysis via CPM identified and isolated critical path and activities that determine the entire project duration. Close monitoring and control are therefore to be exerted on the critical activities in order to forestall project time overrun. The Gantt chart was also applied to the EIA method selected and used as basis for comparison for the EIA on the solar installation project. The results of the study and analysis indicates that the application of Project Management Technology on EIA methods has simplified the deployment of EIA methodologies and reduced the rigorous time frame on carrying out EIA of solar installation projects for organizations or schools. The study therefore recommends the application of CPM on EIA prior to project implementation in order to fast track the entire process.

(Keywords: Environmental Impact Assessment, EIA, methodologies, critical path method, Gantt chart, ex-post facto technique, project management tools and techniques).

INTRODUCTION

The use of project management tools and techniques in achieving organizational objectives is on the increase. One of such is applications in tackling the problems in environmental impact assessments (EIAs). The EIA is a planning tool used in assessing and evaluate the impact of a proposed project and its alternatives. EIA is a vital element of the rational process of planning and decision making before project implementation and execution. It is a rational model (objective and criteria) for evaluating alternative projects identified at the outset.

The multidisciplinary nature of projects brings about different perspectives in meaning and interpretation by different authors. A project, according to the Project Management Institute (PMI, 2008) is defined as a temporary endeavor undertaken purposely to create a unique output (product or service) within budget, time and standards. Also, a project is the art of science of planning, designing and managing work throughout all the phases of the project life cycle (Abbasi and Al-Mharmah, 2000). It is also regarded as a system or process of planning, designing, scheduling, managing and controlling interconnected project activities in order to achieve specific objectives or goal within a specific time, subject and standards (Lewis, 2007). Project management techniques include planning, organizing, directing and controlling activities in addition to motivating team members, which is usually the most expensive resources on the project, (Harvey, 2001).

EIA comes into project management because the positive impact of any project may also induce harmful effects on nearby communities and the natural environment. People and properties may be in the direct path of road works and affected in a major way. The natural environment may also

be affected by disturbances such as soil erosion, water pollution, change in streams and underground water, and other interferences with animal and plant life. New projects may induce development in previously undeveloped areas, sometimes significantly affecting sensitive environments and the lifestyles of indigenous people.

Projects are agents of change and can be responsible for both existing balance between people and environment (Tsunokawa and Hoban, 1997). The EIA is an integral part of the appraisal process for major development projects. Its various guidelines are broadly similar in their content and advice, and all emphasize the continuing and contributory nature of environmental impact assessment with other components of project appraisal as part of a comprehensive process of project preparation implementation and operation. This study presents an overview of the process of EIA and identifies various procedures, outputs and actions of the process while examining the application of project management techniques on Environmental Impact Assessment methodology.

Statement of the Problem

Many solar energy projects in Nigeria have suffered delay in scheduled commencement date and startup due to late completion of EIA and the submission of the accompanying reports. These have resulted to multiplier effects of time and cost overruns of the entire solar energy construction and installation projects and poor-quality project delivery as a result of rush to meet up with the original project schedule. The rugged geographical terrain and complex environmental characteristics make it difficult to predict the completion time of EIA and hence delay in the schedule commencement date of transportation and installation of solar energy projects in Nigeria. There is little literature yet to demonstrate causal application of project management techniques on the environmental impact assessment methodology though studies on causal relationship between the application of formal project management and project outcomes are numerous (e.g., Ibbs and Kwak (1997) and Crawford (2001)). Thus, this study sets out to investigate further the application of Project Management techniques on EIA methods.

Aim and Objectives of the Study

The aim of the study is to evaluate the application of project management techniques on environmental impact assessment to enhance the overall performance of road construction projects vis-à-vis timely completion and commencement of solar energy project. Its objectives include:

- To examine the relationship between project management and environmental impact assessment.
- To identify the critical EIA processes and activities that have the potential of time overrun if not properly addressed.
- To understand the applicability of project management techniques in the EIA processes.
- To identify the perceived benefits and obstacles of applying project management techniques to EIA.

Significance of the Study

The work finds great relevance in the public sector where there is usually tendency to embark on infrastructural development projects without recourse to its resultant effects on the environment. Proper planning of EIA can significantly help government save cost and time in implementing major projects. This study can also find significance in the private sector where project management techniques are used extensively in large Engineering, Procurement, and Commission projects.

Scope of the Study

The project will be limited to the application of Microsoft Project, Gantt Chart, and Network Analysis to EIA methodology. The case study will focus only on EIA for solar energy installation in Afe-Babalola University, Ado-Ekiti, Ekiti State, Nigeria and the solar panels would be laid on the car parks in the school.

LITERATURE REVIEW ON ENVIRONMENTAL IMPACT ASSESSMENT

Historical Background of EIA

Over the years, the quest for human development has brought about change in every area of the environment. Desertification, deforestation, ozone layer depletion, etc., are examples of the resultant effects of these developments. In some cases, lives (human, animal and plant) have been lost. Water, land, and air have been degraded to the point where they can no longer sustain existing levels of development and quality of life. Without adequate environmental planning, human activities have resulted in the creation of social and communal harmony, the results of which include transmission of communicable diseases, and the destruction of renewable resources. Consequently, efforts were now being made to determine the hazards associated with development and, hence the birth of Environmental Impact Assessment in the USA in the early sixties (Glasson, Therivel, and Chadwick, 2005).

Born in the wake of such elevated concern about environmental pollution, the U.S. Environmental Protection Agency opened its doors in Washington, D.C., on December 2, 1970. Even before this, the National Environmental Policy Act (NEPA, 1969) of the United States of America was constituted and for the first time, EIA requiring environmental consideration in large-scale projects was enforced as legislation. Since then, the EIA has been one of the successful environmental policy innovations of the 20th century. The phrase Environmental Impact Assessment comes from Sec. 102 (2) of the National Environmental Policy Act (NEPA) – 1969, USA. NEPA ushered in a new era of environmental awareness by requiring federal agencies to include environmental protection in all their plans and activities. And it created the environmental impact statement for assessing the likely effects of projects that agencies intend to build, finance or permit. NEPA also provided the interested and affected public with one of its most important tools – the right to bring a case to court.

Until NEPA was enacted, it was very difficult to persuade the courts to hear cases involving environmental issues such as land-use changes. Litigation during the 1960s and 1970s established that any adverse effect to even a noneconomic value (viz. aesthetic, conversational, recreational,

etc.) could be taken to court. Although the effectiveness of NEPA is often questioned, it is largely agreed that NEPA made a significant difference in environmental decision making at the highest level.

The influence of NEPA (1969), which had the concept of 'EIA system' as its bedrock, was extended beyond the US and provoked the introduction of EIA policy in many countries in Europe, Asia and elsewhere.

Environmental Impact Assessment is an integral part of appraisal process for major development projects with most international finance institution (IFIs) requiring applicants to submit as ES in support of applications for funds. Most IFIs have developed guidelines on what they expect of an EIA, and recipients are required to comply with these. The various guidelines are broadly similar in their content and advice, and all stress the continuing and contributory nature of environmental impact assessment with other components of project appraisal as part of a comprehensive process of project preparation implementation and operation. This study presents an overview of the process of EIA, and its place in the project cycle. Using the DFID guidelines (DFID, 1997) as a model, it identifies the various procedures, outputs and actions of the process.

Project Management

According to PMI (1994), project management involves applying knowledge, skills, tools, and techniques to project activities in order to meet or exceed stakeholder needs and expectations. It is the art of directing and coordinating human and material resources throughout the life of a project to achieve project objectives within specific constraints.

According to Wysocki (2009), project management entails planning, organizing, directing and controlling of activities. It is the closer link between project teams and downstream. It is a specialized branch of management which has evolved in order to coordinate and control some of the complex activities of modern industry. The changing business environment of the twenty first century increases the range of activities coming under the periphery of project management techniques and the way projects are managed.

According to Pinto, (2007) Project management is a central strategy in the changes that many organizations are undergoing as they adapt from a stable, machine like model to a more dynamic one in face of environmental turbulence and change. It involves planning, organizing, directing, and controlling of company resources for a relatively short-term objective that has been established to complete specific goals and objectives. It is also the application of knowledge, skills and techniques to execute projects effectively and efficiently. It is a strategic competency to organizations, enabling them to tie project results to business goals and compete better in their market. It has always been practiced informally but began to emerge as a distinct profession in the mid-20th century. Project management processes fall into five groups: Initiating, Planning, Executing, Monitoring and controlling, and Closing (PMBOK guide).

Project Management Phases

The five identified processes involved in project management, initiating, planning, executing monitoring and controlling, closing evolve in the project lifecycle. Project management phases otherwise known as project lifecycle refers to the stages in a project's development. Project lifecycle is important because it demonstrates the logic that governs a project. It also helps in developing plans for carrying out the project. (Pinto, 2007) identified four distinct project lifecycle phases which are Conceptualization, Planning, Execution and Termination. The diagram below shows the various phases in sequences and approximate effort involved in each phase of a project although in real life the phase may overlap.

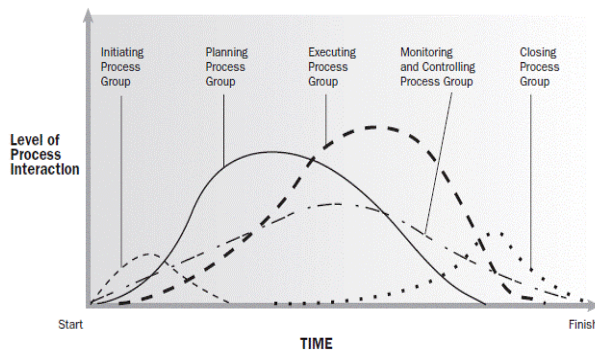


Figure 1: The Project Life Cycle (Source: Project Management Book Of Knowledge, 5th Edition).

Project Management Tools and Techniques

According to Wysocki (2009), tools and techniques for managing projects in order to obtain a desirable outcome include Work Breakdown Structure, Gantt Chart, Project Network Diagram (Critical Path Method and Program Evaluation and Review Method Techniques), Prince 2 methodology, Project Sensitivity Analysis, Cost Benefit Analysis, Graphical Evaluation and Review Technique (GERT), and Project Software, etc.

I. Work Breakdown Structure (WBS) deals with breaking down the project into manageable individual components in a hierarchal structure. A structure defines a task that can be completed independently of other tasks, facilitating resource allocation, assignment of responsibility, measurement and control of a project.

II. Gantt chart is a useful tool for planning and scheduling projects. It depicts a graphical representation of the duration of tasks against the progress time. It was developed by Henry Gantt in 1915 purposely for monitoring projects progression and tracking.

III. PRINCE 2 which connotes Projects in Controlled Environment 2 is a process-based method for effective project management. It is a de facto standard used extensively by UK government and is widely recognized in the private and public sector, both in division of projects into manageable and controlled stages, flexible in application at a level appropriate to the project management team.

IV. Project Sensitivity Analysis determines which variables has the most potential to affect the project. Variables include, task duration, success rate and costs, risks, lags between predecessors and successors, project duration, total project costs and so on. It is also useful in decision making under uncertainty and risk.

V. Cost Benefit Analysis (CBA) is one of the widely accepted and applied methods for project appraisal for large scale infrastructure in public and private sector. CBA is a prescriptive method that provides guidance on the criteria to take account in decision making, ensuring that the net aggregate benefits to the society outweighs net aggregate cost (Patel, 2008).

VI. Graphical Evaluation and Review Technique (GERT) is a network analysis technique used in project management that allows probabilistic treatment of both network logics and activities duration estimates.

VII. Critical Path Method is also a project network analysis technique used to determine which sequence of activities (path) has the least amount of scheduling flexibility and therefore will most likely determine when the project can be completed.

VIII. Program Evaluation and Review Technique (PERT) is an event-and-probability based network analysis system generally used in projects where activities and their durations are difficult to define. It assumes three estimates (usually from experts) of activity duration which are used to compute the expected completion time of the project. PERT is often used in large program where the project involves numerous organizations at widely different locations.

Identification of the Various Outputs, Procedures, and Actions of the Processes of EIA

Environmental Permitting Process: The environmental permitting process with the most general application and widest ranging scope is the Environmental Impact Assessment Authorization process. It is defined under the EIA Regulations, of which the last major revision was released in 2010 (Regulation R.543 to R.546 of 18 June 2010). The regulations are published under the auspices of section 24 of National Environmental Management Act, 1998, and specify which development activities require permits as well as the process required to assess environmental impacts for the purposes of permitting. All the activities listed in the three schedules of the Regulations must obtain EIA approvals before they may commence. Generally, an EIA must contain a scoping phase, an impact evaluation, and a form of management plan/program to mitigate the negative residual impacts of a development. The regulations also make provisions for compliance and enforcement actions and penalties.

Atmospheric Emission License: A list of activities with potential emissions impacts has been published under the auspices of Section 21

of the National Environmental Management: Air Quality Act, 2004. These activities require permits before they may exceed certain thresholds.

Conservation Ordinances: Various activities, like hunting practices and movement of specimens, still require permits under the Nature Conservation Ordinances as published for provincial jurisdictions.

The Environmental Impact and Assessment and Project Management Process

Most of the industrialized nations have established procedures in EIA, to which project developments must confirm. This framework is finding increasing applications in the developing world, as national governments, spurred on by Earth Summits and evolving local concerns, create fledgling Environmental Protection Agencies and introduce their own environmental standards. This process is being encouraged by all the major multi-lateral and bi-lateral lending agencies, who have prepared guidelines for EIA, and make compliance (at least for the larger projects) with these guidelines as conditionality for lending.

In many instances, recipient nations have adopted the guidelines on EIA and environmental standards used by the principal donors. The DFID model is used to describe the typical environmental assessment activities. It is broadly similar, in approach, to other donor guidelines, though screening is less prescriptive in the sense that projects are not referenced against pre-published categories (of size), but against a series of checklists which seek to determine the nature of the proposed development, the sensitivity/importance of the local environment, and likely environmental effects and their scale. Various activities are completed during the project cycle, which are identified in Table 1. The main activities are described in more detail below as contained in (DFID, 1997).

Empirical Review of EIA and Project Management

Several empirical studies have been carried out in developing and developed countries and all of them have arrived at various findings.

Stage of Project Cycle	Environmental Appraisal Activity	Output
Project Development		
Identification	Preliminary review of base documentation	
Preparation (project Concept Note).	Screening	Environmental Screening Summary Note (ESSN)
Design and appraisal	Environmental appraisal/EIA	Design Mitigation Measures
Approval	Environmental Annex of project Memorandum	Environmental Monitoring Plan (EMP)
Project Implementation		
Initiation/monitoring	Activate EMP	Monitoring Reports
Operation/monitoring	Environmental monitoring	Review Reports
Evaluation	Environmental Evaluation/Audi	Evaluation Reports

Table 1: Project Life Cycle.
(Source: DFID, 1997)

This section reviews some empirical studies, for example, Ibbs and Kwak (2000) demonstrated no statically significant correlation between project management maturity (PMM) and project success based on cost and schedule performance. This interprets that the inference of Jakovljevic (2003) guides project managers to allocate and monitor their teams effectively and regularly during the course of project life. To perform it, project over time. Monitoring is the most feasible and pragmatic mechanism of ensuring effective performance by HR or machine resources. A control system needs to be monitored to ensure that it continues to operate effectively as intended. Without continual and effective monitoring, a control process may fail into state of despair or not be executed altogether (Strub and Lucas, 2003).

This study perceives that monitoring the work of a project in a consistent and structured manner should bring value. Members of the teams working on projects must be aware that their efforts are being monitored consistently by their leader (Project Manager) not only for possible corrections at the nick of time when required, but also for recording performance that would be set as the basis for awarding the annual reward. Fairness in such monitoring shall certainly play as a cohesive force motivating team members towards the project's cause. A relevant web-based source of knowledge revealed that organization adopting a," formal project management methodology gives considerable

competitive advantage", over those which do not follow a formal project management approach (Standing et al. 2006).

This study found the same true for IT industry where it has been conducted. It shared the concept of project success in four dimensions that are: (1) Reduced time-to-market and time-to-profitably, both key factors for any organization, develop products through their projects, (2) Ensure predictable schedules for profit and product delivery, (3) Offer more effective ways to prioritize, allocate and monitor resources and (4) Demonstrate a commitment to excellence to your customers, your employees and other stakeholders.

This study finds the aforementioned guidelines for project management helpful for interpreting what the project success is. These guidelines indicate that project success could be a mix of the magnitude of the profitably and the times estimated for delivery of the products to the customers and return on investment. The study perceives that profitability may not be a primary concern for project managers who are not sponsoring the projects. However, meeting timelines should be a primary concern for project managers to cost overrun. This study identifies timing and profitability as two parameters for measuring the project success out of which timing happens to be a major responsibility of the project managers in most of the cases and

further a factor that could affect profitability. In project management literature.

Crawford et al. (2008) identifies top management support as one key theme that has emerged more recently. However, several empirical studies show contrary results of positive or negative influence of top management involvement. For instance, concerning the single project success, majority of literature shows a positive impact of top management support to project management techniques (Young and Jordan, 2008). Wheelwright and Clark (1992a) for example, demonstrate the importance of the senior management regarding new product development projects.

Pinto and Prescott (1990), alongside many others, give empirical evidence on strong positive influence (Fortune and White, 2006). Regarding the role definition of the project portfolio manager, it is further argued that role clarity on work demands is relatively unimportantly in the face low leadership support (Bliese and Castro, 2000).

METHODS OF ENVIRONMENTAL IMPACT ASSESSMENT

i) The Environmental Impact Assessment Process Within EIA there are several tasks that are fundamental to the successful delivery of an EIA. EIA can be considered as a data management process with three components (Patel, 2008). First, the appropriate information necessary for a particular decision must be identified and collated. Secondly, changes in environmental parameters resulting from the proposed project must be forecast and compared with the situation without the proposal. Finally, the actual change must be accessed and communicated to decision makers. Table 1 provides a schematic representation of this process.

ii) Screening and Scoping: The process of screening usually involves the review of the project proposal against a checklist of projects to determine whether an EIA is a mandatory requirement. Often there is some uncertainty and an environmental assessment specialist may be required to help advise on which of the following is applied:

- Environmental Appraisal – a 'low-level' investigation which focuses on individual issues and environmental inputs to design activities.

- Environmental Impact Assessment- a 'high-level' investigation which involves a multi-disciplinary, comprehensive and detailed study of proposed development, and the environment within which it is to be developed.

- Environmental Audit- is similar in scope to an EIA, but it is applied to existing projects rather than new developments.

iii) Impact Identification: The process of impact identification is based upon an appreciation of how the proposed project might interact with its receiving environment. As such, this requires an appreciation of what are considered to be valued environmental and community resources within the vicinity of the proposal. A projection is then required of the future state of these resources without the proposed project. From this series of environmental design objectives can be established to aid both the EIA and project design process.

iv) Impact Prediction: Once potential impacts are identified; the project design should be examined to attempt to minimize those which are adverse and maximize those that are beneficial. The process continues with the forecasting the effects in terms of magnitude, the affected feature/resource/population, action causing the effect, timescale and duration of the effect, level of uncertainty in the forecast, proposed mitigation and enhancement measures, and its significance. The effects must be recorded in terms of duration (short term, long term, and direct, indirect, synergistic, cumulative).

v) Mitigation and Enhancement: Environment mitigation can often result in reduced project costs and lower community costs when incorporated as a fundamental part of project design rather than as an add-on exercise. Often simple design changes such as the type of bridging strategy or time of year the major earth moving activities take place can have a dramatic effect upon improving environmental performance.

vi) Reporting: The purpose of the exercise is to improve the project design prior to its submission for consent and then to report the findings to the decision makers and the affected public in a manner that they can understand. An EIS is not a long academic thesis on effects of a proposal, but is to be focused upon the key issues that decision maker should appreciate.

vii) Environmental Management Plan (EMP): An EMP should be prepared, which sets out the actions for monitoring and evaluation of the project during implementation or construction and operation.

viii) Environmental Audit/Evaluation: When the project is in existence, then an environmental audit may be required in order to satisfy International Finance Institutions (IFIS) that is it operating to an appropriate environmental standard. The audit seeks to confirm the operational practices and to highlight any deviation from the accepted norm.

RESEARCH METHODOLOGY AND DESIGN

This work is based on the methodology of the application of project management tools and techniques in environmental impact assessment methodology with a view to studying how project management techniques can improve on the works involved. The current methods of environmental impact assessment in Nigeria were considered along with the methods of carrying out EIA in other countries.

This study is based on various methodologies carried out by past researchers, both locally and internationally. It can be inferred that past methodologies of EIA research have been through the use of models and frameworks. Previous researchers identify the factors that impact EIA and the bid to describe the relations between these factors, various frameworks were created. This study involves a critical study of some of EIA methods with comments on their suitability. One of the methods was selected and the suitable project management tools and technique was fitted.

Procedures for the Application of Project Management Tools to Environmental Impact Assessment

As with Gantt Charts, the essential concept behind Critical Path Analysis is that you cannot start some activities until others are finished. The concept is to determine the activities that are of priority and allocate resources and time to them. The first process is to analyze the project by determining all the individual activities and then show the planned sequence of this activities on a network. The second process is to estimate how

long it will take to perform each activity, perform computation to locate the critical path and then use the information to develop a more economical and efficient schedule. The final process is to use the plan and schedule to control and monitor the project progress.

EIA Methodologies

- 1. Mcharg Overlay Method:** This method is used to detect possibilities offered by the environment by preserving uses, identifying compatibilities and consequences and by creating a land use evaluation system. This method of EIA can be used for the assessment of energy. It is highly subjective were the degree of compatibility and the selection of values are concerned and requires several maps to be drawn and results in high cost. It is also not capable of absorbing impacts of social, economic and cultural nature and it cannot be applied to solar energy or its installation
- 2. The Battelle Method:** It is used to compare alternative projects through the systematic evaluation of their impacts by selecting, among others, those likely to cause less harm to the environment. It is frequently used in the assessment of projects for water resources, plans for the management of the quality of water, roads, nuclear plants and other projects. It requires data and sound knowledge on a wide range of subject. It is used for projects for water recourses and cannot be applied to solar energy construction projects;
- 3. The PDC Methods:** The objective of this study is to apply techniques for the evaluation of potential impact on physical environment resulting from industrial development projects. They encompass economic and social considerations in the areas where such programs are not compatible with the existing land use programs. It does not take the resilience of the site into account and cannot be applied or used in the assessment of solar energy construction projects.
- 4. The Welch and Lewis Methodology:** This methodology defines the relationship between different environmental aspects when there is a land use change. It

comprises a system for the identification of the subjects that have to be brought together in the evaluation process and lists the areas in which the degree of knowledge is insufficient. It applies directly and essentially to road network and land management. Besides from being cost effective, it offers a considerable flexibility in assessing different alternative projects with regard to different environmental

aspects. It applies to the assessment of solar energy and the installations processes.

Application of a Gantt Chart and Network Diagram on the Welch and Lewis EIA Method

A Gantt chart is a form of horizontal bar chart used in planning the time scale for a project and to estimate the amount of resources required.

S/N	ACTIVITIES	DURATION	PRECEDENCE
A	Identification	4weeks	-
B	Preliminary review of base documentation	4weeks	-
C	Environmental screening	8weeks	A,B
D	Environmental appraisal	3weeks	A
E	Design mitigation measures	5weeks	D
F	Approval/environmental annex of project memorandum	2weeks	A
G	Activating EMP	12weeks	A,B,C
H	Environmental monitoring	7weeks	C,D
I	Environmental evaluation/ audit	16weeks	A
J	Commissioning		A,B,C,D,E,F,G,H,I

Table 2: The Activities, Duration and Precedence for Welch and Lewis Method.

Activity number	Activity name	Immediate predecessor (list number/ names, separated by)	Normal time
1	A	-	1
2	B	-	1
3	C	A,B	2
4	D	A	3
5	E	D	5
6	F	A	2
7	G	A,B,C	3
8	H	C,D	7
9	I	A	4
10	J	A,B,C,D,E,F,G,H,I	

Table 3: The Activities that are Dependent of Each Other or can be Done Simultaneously for Welch and Lewis Method.

S/N	Activity name	On critical path	Activity time	Earliest start	Earliest finish	Latest start	Latest finish	Slack time (LS-ES)
1	A	Yes	1	0	1	0	1	0
2	B	No	1	0	1	1	2	1
3	C	No	2	1	3	2	4	1
4	D	Yes	3	1	4	1	4	0
5	E	No	5	4	9	6	11	2
6	F	No	2	1	3	9	11	8
7	G	No	3	3	6	8	11	5
8	H	Yes	7	4	11	4	11	0
9	I	No	4	1	5	7	11	6
10	J	Yes	0	11	11	11	11	0
Project Completion Time				11 Weeks				
Number of Critical Path(s)				3				

Table 4: The Slack Time, the Earliest Finish and Start and also the Latest Finish.

EIA Processes	Duration
Preliminary identification	5 weeks
Preliminary review of documentation	4 weeks
Screening (pre-feasibility)	3 weeks
Scoping (site selection)	9 weeks
Implementation of mitigation measures	5 weeks
Plan of study of EIA	2 weeks
Authority approval/ Board decision	2 weeks
Detailed design/ EMP activation	6 weeks
Environmental auditing	4 weeks
Monitoring and post auditing	36 weeks
Documentation of report	4 weeks
Commissioning/ closure of EIA	8 weeks

Table 5: The Activities and Duration of Each Task for EIA on Solar Panel Installation (case study).

THE STUDY AREA

The study area for the proposed project is within the perimeter of Ado Ekiti with the university Afe-Babalola University taken as the center of the project area. This is because the potential impacts of the project are likely to occur within this area

The processes used in the execution of the EIA are:

1. Preliminary identification
2. Preliminary review of documentation
3. Screening (pre-feasibility)
4. Scoping (site selection)
5. Implementation of mitigation measures
6. Plan of study of EIA
7. Authority approval/ Board decision
8. Detailed design/ EMP activation
9. Environmental auditing
10. Monitoring and post auditing
11. Documentation of report
12. Commissioning/closure of EIA

s/n	ACTIVITIES	DURATION	PRECEEDENCE
A	Preliminary identification	5 weeks	-
B	Preliminary review of documentation	4 weeks	-
C	Screening (pre-feasibility)	3 weeks	-
D	Scoping (site selection)	9 weeks	A,B,C
E	Implementation of mitigation measures	5 weeks	D
F	Plan of study of EIA	2 weeks	C,D
G	Authority approval/ Board decision	2 weeks	A,B
H	Detailed design/ EMP activation	6 weeks	A,B,C
I	Environmental auditing	4 weeks	A
J	Monitoring and post auditing	36 weeks	C,D
K	Documentation of report	4 weeks	G,H,I
L	Commissioning/ closure of EIA	8 weeks	A,B,C,D,E,F,G,H,I,J,K

Table 6: The Activities that are Dependent of Each Other or can be done Simultaneously EIA on Solar Installation (case study).

S/N	Activity Name	On critical Path	Activity Time	Earliest Start	Earliest Finish	Latest Start	Latest Finish	Slack (Ls-Es)
1	A	Yes	5	0	5	0	5	0
2	B	No	1	0	1	4	5	4
3	C	No	3	0	3	2	5	2
4	D	Yes	9	5	14	5	14	0
5	E	No	5	14	19	19	24	5
6	F	No	2	14	16	22	24	8
7	G	No	2	5	7	21	23	16
8	H	No	6	5	11	17	23	12
9	I	No	1	5	6	22	23	17
10	J	Yes	10	14	24	14	24	0
11	K	No	1	11	12	23	24	12
12	L	Yes	2	24	26	24	26	0
Project Completion Time					26	Months		
Number of Critical Path(s)					3			

Table 7: The Slack Time, the Earliest Finish and Start and also the Latest Finish and Start of Each Activity EIA on Solar Installation (case study).

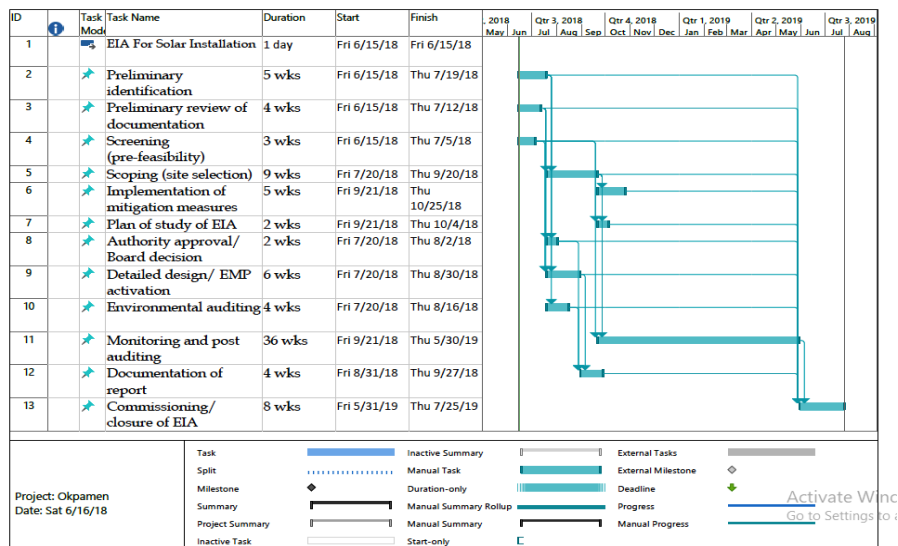


Figure 2: Gantt Chart for Afe-Babalola Solar Panel EIA Activity.

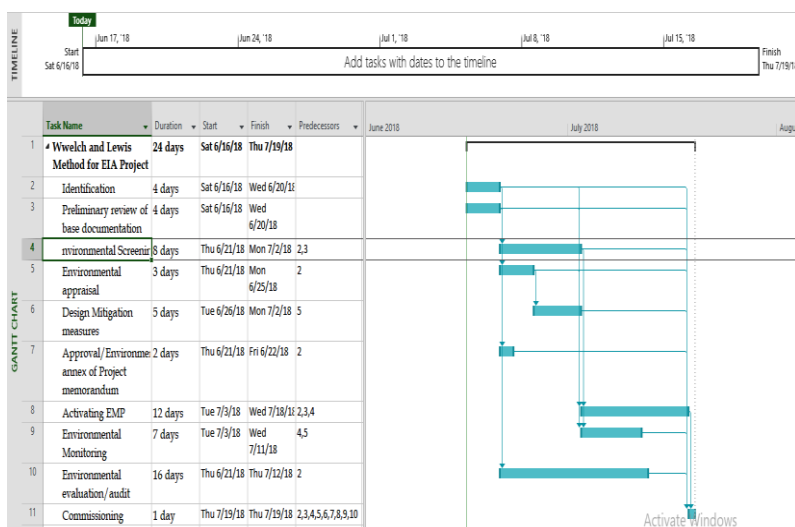


Figure 3: Gantt Chart of Welch and Lewis Methodology.

DATA PRESENTATION AND ANALYSIS

This chapter aims at analyzing the application of the framework of models presented in chapter three on the practical data obtained on the EIA assignment of on a solar energy installation project. The project is the EIA of a solar panel installation in Afe Babalola University Ado Ekiti. The welch and Lewis method was selected as the basis for comparison. The analysis centers on the research instrument, which is structured to reflect the purpose and objectives of this study. The data

collated has been used to develop a Gantt chart and critical path model that has been carefully stated and applied in chapter three of this research, which is used in displaying the sequence of activities and to help with planning and controlling large projects. The following points identified:

1. The starting date and finishing date of each activity or task
2. The duration of each task
3. The dependencies between tasks

WELCH AND LEWIS METHODOLOGY ACTIVITIES	DURATION OF ACTIVITIES	AFE-BABALOLA EIA METHODOLOGY ACTIVITIES	DURATION OF ACTIVITIES
Identification	4 weeks	Preliminary identification	5 weeks
Preliminary review of base documentation	4 weeks	Preliminary review of documentation	1 month
Environmental screening	8 weeks	Screening (pre-feasibility)	3 weeks
Environmental appraisal	3 weeks	Scoping (site selection)	9 weeks
Design mitigation measures	5 weeks	Implementation mitigation measures	5 weeks
Approval/ environmental annex of project memorandum	2 weeks	Plan of study of EIA	2 weeks
Activating EMP	12 weeks	Authority approval/ board decision	2 weeks
Environmental monitoring	7 weeks	Detailed design/ EMP activation	6 weeks
Environmental evaluation/ audit	16 weeks	Environmental auditing	1 month
Commissioning		Monitoring and post auditing	10 months
		Documentation of report	1 month
		Commissioning/ Closure of EIA	2 months

Table 8: Comparison Between the Welch Model and The Afe-Babalola Model.

COMPARISON OF BOTH GANTT CHARTS

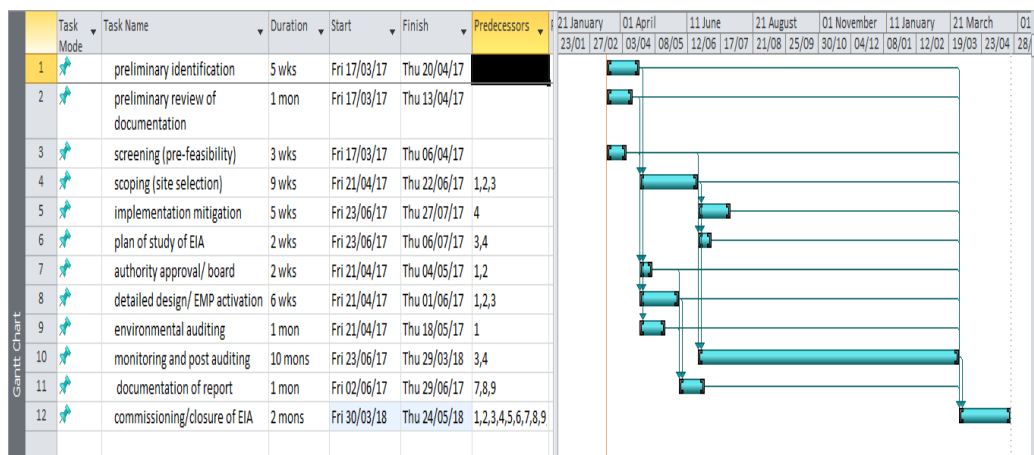


Figure 4: The Gantt Chart for Afe-Babalola University EIA Activities.

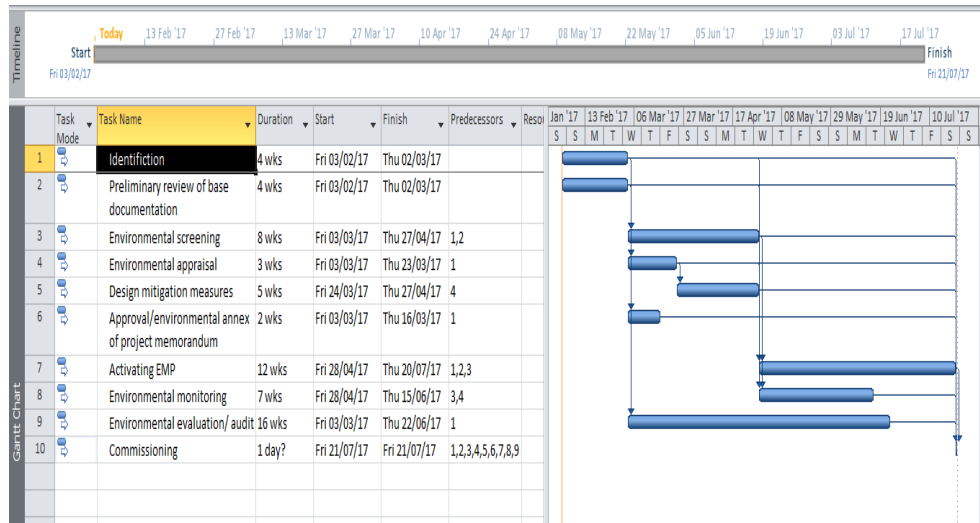


Figure 5: The Gantt Chart for Welch and Lewis Methodology.

DATA ANALYSIS AND INTERPRETATION

The study Area is the installation of Solar panels in Afe-Babalola University Ado Ekiti, Ekiti state, Nigeria. This EIA methodology was carried out for 64 weeks with prolonged activities that could have been reduced i.e. the time duration. All the activities in both models are mostly independent of the other so therefore can be carried out simultaneously. The Welch and Lewis methodology produced a data that showed that applying project management techniques on it produces a shorter time frame of carrying out the EIA. The Gantt chart for this methodology shows that various activities are cut shorter as to the original duration of the EIA.

RESULTS AND FINDINGS

The Welch and Lewis methodology shows that the total number of weeks designed for this project is 11 weeks and all the activities have to be carried out within this duration. The earliest time and earliest finish for the activities all fall within this month. The slack shows the duration at which activities can be played around with. This period gives room for modification, whatever modifications are made must fall within the 11 weeks.

The EIA methodology on the installation of solar panels in Afe-Babalola University in Ekiti state shows that total number of weeks designed for this project is 64 weeks, whereas with applying the same techniques on the Welch model it produced 11 weeks.

Therefore, one can concurrently say that applying the Welch and Lewis Methodology on any EIA project produces a shorter and more distinctive delivery of work at a shorter and stipulated time duration. This helps in the amount of time that would be put into the research. It also cuts down the cost because applying Welch and Lewis methodology with project management techniques results into a proper work break down structure that shows the activities that can be carried out in a shorter period of time instead of the prolonged time it usually takes in delivering EIA.

SUMMARY

The Environmental Impact

By using a renewable energy resource, emissions level is gradually reduced to zero while preventing unwanted payback to nature. Other effects of It might not stop climate change but it will help prevent it. It will also be a great help to stop typhoons which are mostly caused by the heat trapped on our atmosphere.

Application of Project Management

The application of project management techniques in environmental impact assessment methodology is about restructuring EIA through the process of analyzing the internal activities that could help in the commencement of the assessment. The technique used for this research is the critical path analysis and Gantt chart. These techniques tend to determine what tasks must be carried out, where parallel activities can be performed, the shortest time in which a project can be completed, resources needed to execute a project, the sequence of activities, scheduling and timings involved, task priorities.

The critical path analysis is a tool that helps to determine a project success or failure. The study employed the use of a particular method in comparison of the initial study model with the application of Project Management Techniques and showed how this method of EIA produces an efficient result in the research of EIA in a shorter time frame. One can properly deduce and state that Welch and Lewis methodology with the application of Project Management Techniques poses a positive and accurate impact on an EIA project

CONCLUSION

It has been deduced from this study that Environmental Impact Assessment methodology (Welch and Lewis) with the application of Project Management Techniques can be managed adequately and with the use of these techniques the steps taken to produce an efficient and accurate EIA process is met in necessary time and with the minimum costs.

In conclusion, Critical Path Analysis and Gantt chart formally identified tasks which must be completed on time for the whole project to be completed on time. It also identified which tasks can be delayed if resources need to be reallocated to catch up on missed or overrunning tasks. The critical path showed the activities that need extra attention in order for the project to meet the schedule and resources allocated to it because delay in these activities leads to increase in resources (cost) allocated to the activities.

RECOMMENDATION

It is well known that poor management is the basic cause of project failure and the introduction of project management has minimized the problem of poor management due to the fact that project management has a variety of tools and techniques that can be used to plan and schedule project activities for proper monitoring and implementation.

Gantt chart and Critical path analysis are one of the widely used project management tools used in managing projects these days according to a research carried out by Diana white, Joyce Fortune (Centre for Complexity and Change, The Open University, U.K.) amongst others. This is because Gantt chart and Critical path analysis breaks down complex projects into the simplest forms for easy monitoring within moderate time duration.

This research has shown how Critical Path analysis and Gantt chart can be used to break down all the activities into the fastest time to finish an activity and the activities that focus should be on making it easy to monitor the project and allocate resource.

For this reason, it is recommended that Welch and Lewis methodology with the application of Gantt chart and Critical path analysis be used in carrying out complex projects to guarantee the success of the project.

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