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Full Length Paper

Project Planning and Control Techniques, A Pipeline Rehabilitation Work

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Abstract

A successful project is one which accomplishes its objectives within a specified period of time and one whose activities are executed according to a laid-down plan. Quite a number of projects including Engineering projects suffer from improper planning and thus result in unaccomplished or failed projects. This however can be minimized by applying adequate planning and control techniques. This project aims at applying project planning and control techniques to a case study of a rehabilitation project in the Oil and Gas facility. The rehabilitation project is for the purpose of repairing and upgrading facilities of the oil and gas involved in the supply of gas from one station to another. Planning and Control Techniques have been applied in this research using techniques such as Work Breakdown Structure, Network Diagram and Critical Path Method, Time Scheduling, Resource Crashing. This was done to ensure proper planning before commencement of the project. The work activities, duration of activities, work schedule and cost were determined using the estimates of experienced workers, contractors and consultants.

Keywords: *Project planning and control, oil and gas facilities, rehabilitation process.*

09. INTRODUCTION

A project can be defined as an exclusive set of coordinated activities with definite starting and finishing points undertaken by an individual or an organization to meet specific objectives within a defined schedule, cost and performance parameters. Project planning is that part of project management which relates to the use of schedules to plan and subsequently report schedules within a project environment. In other words, project planning is a discipline for stating how to execute a project within a certain timeframe, usually with defined stages, and with designated resources. Project Control is that element of the project that keeps it on-track, on-time and within the given budget (Oakland, 2008). Planning usually involves setting targets as to how all work items required, finance and management inputs are going to be utilized (Ezekeil et al. 2013). The control aspect comes in when monitoring of the planned and on-going work is necessary thereby, comparing the process with the planned and then doing something to bring other process conditions to the planned state. Considering the stated definition, Project Planning and Control (PP&C) can be defined as the discipline which involves planning, organizing, securing and managing resources to achieve specific goals. (Mhada et al. 2011) PP&C begins early in the project life cycle with planning and ends late in the project life cycle with post-implementation reviews, having a thorough involvement of each step in the process. Each project should be thoroughly examined before implementing the appropriate level of control; as too much control would

be time consuming depending on the nature of the project while too little control is very risky (Zheng et al. 2002). Experience has shown that projects that begin without proper planning and control procedures are usually subjected to delayed completion, abandonment, waste of resources and other undesirable consequences. Adequate planning and control is therefore necessary in the life of any project to ensure effective and efficient implementation of the planned work as well as to enable one comprehend the inter-relationship between work items, services and materials in completing the work on schedule within the estimated cost (Davrajh and Bright, 2013). Paciarotti et al. (2014) emphasized the importance of quality control in PP&C.

The following are special project management techniques which form part of the project management integrative process: Work breakdown structure (WBS); Critical path method (CPM); Resource smoothing; Earned value and Configuration control. It is important for a project manager to be able to apply these techniques during the course of a project which he/she might be handling.

2. THE OIL AND GAS SECTOR

The oil and gas sector or industry is considered as one of the largest sectors in the globe. Oil is vital to the worldwide economic framework (Okwu et al. 2016). The oil & gas industry is broken down into three segments: upstream, midstream, and downstream (Thaddeus et al. 2016). The upstream sector is where exploration activities take place/ Reservoirs are available and drilling operation takes place at this sector. At the midstream level, companies are saddled with the responsibility of transporting products obtained from the wells to various refineries at diverse locations within the state. Downstream sector is where the refining operation takes place. At this sector, products can be sold to different retailers at diverse locations (okwu and Angella, 2018). Planning approach using pareto analysis is possible in manufacturing sector (Fadeyi et al. 2016).

Project planning and control is of great importance in addressing the issue of oil and gas projects. This aspect of production process cannot be ignored and cannot be overlooked, if PP&C is overlooked, there is tendency of performance in terms of output ((Mhada et al. 2011). This research is focused on the best possible ways of implementing project planning and control techniques in the oil and gas sector. As a result of the nature of rehabilitation projects going on in the oil and gas system, the structural aspect of the oil and gas sector will be considered. The main aim of this study is to plan and execute projects within a specified period of time by implementing the PP&C strategies To achieve the aim, PP&C techniques will be required, which include: Developing of work breakdown structure for the specified project; draw a network diagram to determine the critical path for the defined project; develop a scheduling template in graphical form; determine the cost of the project and finally optimize the duration of the project.

3. MATERIALS AND METHODS

In order to adopt the PP&C technique to the rehabilitation project of the oil and gas, understanding the working environment is very crucial, since large number of activities are usually involved in such rehabilitation project which involve different departments like Electrical, Mechanical and Civil/structural aspect. Due to a very large number of activities, this study is focused on the civil/structural activities involved in the oil and gas rehabilitation project in Delta State. The system under consideration was investigated with the aim of achieving the stated objectives using the methods/techniques: Investigating and implementing work breakdown structure; adopting Network Diagram and Critical Path techniques; Sketching a Gantt Chart; conducting a standard market survey and project crashing

3.1 Work Break-Down Structure (WBS)

This is used in this study to define and list the various tasks or jobs that would be executed. WBS in a simple definition is the torrent of deliverables, where the overall product or objective of the project is broken into sub-products, assemblages and components. This is necessary to sub-divide the scope of work into manageable work packages which can be estimated, planned and assigned to a responsible person or department for completion. The first step towards mastering the WBS technique is to fully understand the structured methodology for sub-dividing the scope of work. The main components of the WBS are: Structure, methods of sub-division, numbering or coding system and roll-up.

3.2 Critical Path Method (CPM)

In order to determine the rehabilitation project duration, the critical path method would be employed. For project managers to effectively plan and control a project, they need to be able to process large amounts of data quickly and accurately to enable them to create order in a complex situation. The critical path method (CPM) offers a structured approach to project planning which has been designed to meet this need. It is necessary to have a network diagram in the calculation of critical path which can be derived from the work breakdown structure. The network diagram may be defined as a graphical presentation of the project's activities showing the planned sequence of work. The

next process is to establish a logical relationship between the activities using the network diagram.

3.3 Gantt Chart

The Gantt chart would be utilized in this project for the purpose of planning the scheduled activities within their respective defined durations. A Gantt chart is a tool used for time scheduling of activities in a project and is constructed with a horizontal axis representing the total time span of the project, broken down into increments (such as days, weeks, or months) and a vertical axis representing the tasks that make up the project. Horizontal bars of varying lengths represent the sequences, timing, and time span for each task. A vertical line is used to represent the report date. Though Gantt charts give a clear illustration of project status, one problem with them is that they don't indicate task dependencies that is you cannot tell how one task falling behind schedule affects other tasks.

3.4 COST DETERMINATION

In determining the cost required for running the rehabilitation project, two major costs have to be taken into consideration. These are:

- **Material Cost:** The quantity of materials needed depends on the outcome of the engineering specification. From the specification, the cost of each quantity of material needed would be determined. However, the cost of material is determined through the quotation given by the contractor and through market survey as well.

The objective of a market survey is to collect information on various aspects of the project needs. This survey is a tool through which we can minimize risk and after the market survey, the results must be analyzed in order to finalize the project plan.

- **Labour Cost:** In determining the labour cost, an investigation would have to be carried out on the minimum daily wage ate for the average worker. This information would be gotten from an experienced contractor as the daily rate largely depends on the quantity of work to be performed by the worker. The number of workers needed would also depend on the quantity of work available and time required to delivery. With this in mind, the labour cost would be estimated.

3.5 Project Crashing

Project crashing is a method for shortening the project duration by reducing the time of one or more of the critical project activities to less than its normal activity time. The major objective of crashing is to reduce project duration while minimizing the cost of crashing.

In project crashing, it is necessary to reduce the scheduled completion time to reap the results of the project sooner. The following are the terms normally used: Crashing, crash time and crash cost

4. ANALYSIS

4.1. Work Breakdown Structure

To achieve the desired task in record time, it is Important to set up a timing for easy and quick completion of scheduled task**.** Breakdown of every activity to be carried out in each respective unit. Since similar maintenance activities are being carried out in various units. For ease of computation, the work breakdown structure can be simplified as shown in building structure in the oil and gas facility presented below.

- Clearing of Site
- Site Cleaning Operations
- Repairing of Eroded Concrete
- Replacement of the existing PVC tiling
- Replacement of damaged/ missing wire mesh
- Replacement of Pipes and Triangular AC stilling plates
- Repair of top support RC slab
- Replacement of damaged mansory block wall
- Water tightness Test
- Repair of Pump Room Floor
- Replacement of Steel Doors
- Replacement of reinforced concrete precast platform slabs of alum saturation building
- Overhauling of Steel Shutter Gates
- Painting works
- Testing and commissioning
- Final Site cleaning
- Handover

TABLE 1: Activity Precedence Relationships

ACTIVITY	DESCRIPTION	CODE	DURATION(DAYS)	PREDECESSOR
1-2	Clearing of Site	A	15	-
2-3	Site Cleaning Operations	B	10	A
3-4	Repairing eroded concrete surfaces	C	15	B
4-5	Replacement of Pipes and Triangular AC stilling plates	D	5	C
4-6	Replacement of the existing PVC tiling	E	7	C
4-7	Replacement of damaged/ missing wire mesh	F	2	C
5-6	Replacement of damaged mansory block wall	G	7	D
6-9	Repair of Pump Floor	H	7	E,G
7-8	Repair of Top Support RC Slab	I	5	F
8-9	Water Tightness Test	J	3	I
9-10	Replacement of Steel doors	K	1	J,H
10-11	Replacement of Reinforced Concrete slab	L	2	K
9-11	Overhauling of Steel Shutter Gates	M	5	J,H
11-12	Painting Works	N	15	M,L
12-13	Testing and Commissioning	O	7	N
13-14	Final Site Cleaning	P	4	O

4.2. The first three activities are common activities to most if not all of the Activity areas and must be carried out first as shown in the sequence to ensure the smooth flow of subsequent operations. The activities listed are such that some have to be completed before others can start while others can occur simultaneously due to both activities not being related in such a way that the work progress of one results into a disruption of the other . From the Activity precedence relationship shown in Table 1, one can derive the Network diagram for the rehabilitation project. The Network diagram is shown in Figure 1.

4.3 NETWORK DIAGRAM FOR REHABILITATION PROJECT

Based on the Activity precedence relationship the network diagram outlining the precedence relation of the activities is established to facilitate the process.

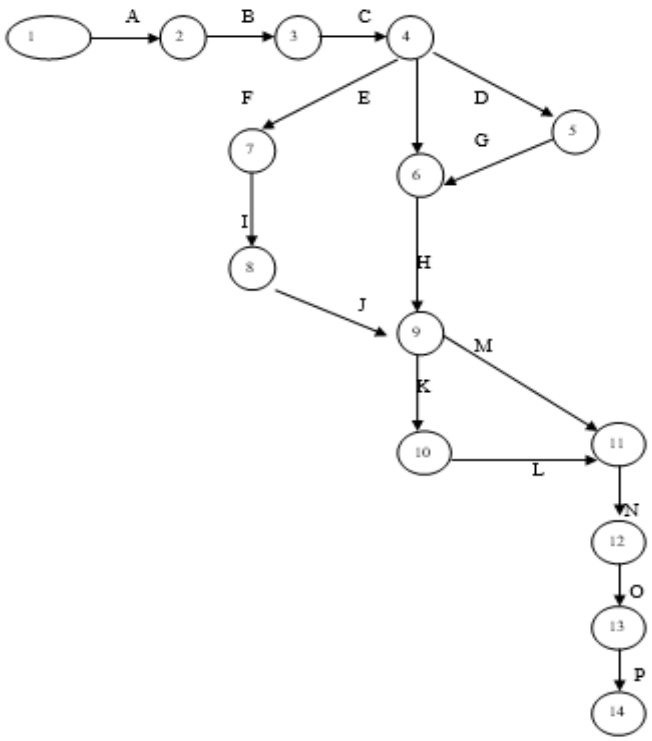

Figure 1: Network Diagram for Rehabilitation Project

The network diagram in Figure 1 shows the precedence or flow of activities but it is still necessary to determine early start and late start of the project in order to determine the total slack and thus the critical path. Early Start (ES), Late Start (LS), Early Finish (EF), Late Finish (LF), Duration (D), Total Slack (TS).

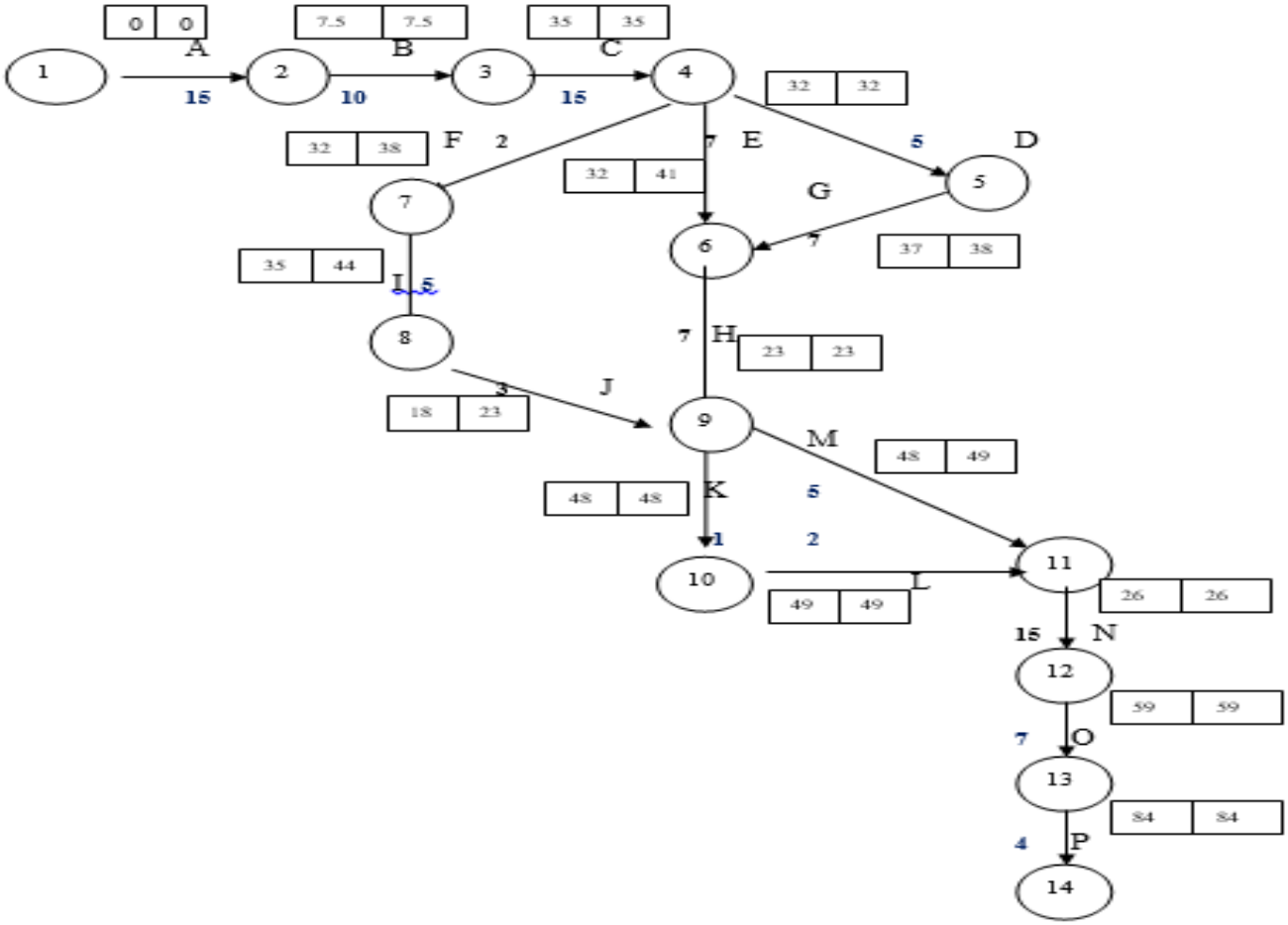

Figure 2: Critical Path Determined by Late Finish and Early Start of a Project

As shown in Figure 2, the Total Slack (TS) equals (LF - ES) – D; where LF is the Late Finish, ES represent Early Start, D represent Time and Critical Path is denoted by CP.

From the Table 1, the critical path has been determined which is obtained in summary as
CP = 1—2—3—4—5—6—9—10—11—12—13—14
CP = 15+10+15+5+7+7+1+2+15+7+4= **88 days**

Thus the completion date of the rehabilitation work in the oil and gas should be **88 days** after commencement under normal circumstances. Note that LF (late finish) = LS (Late Start) of next activity.

4.4 Time Scheduling With Gantt Chart

The Gantt chart has been used for the purpose of time scheduling the rehabilitation project such that it would show and illustrate the start and finish dates of elements and respective activities of the project. Table 2 has been used to develop a time scheduling table for the construction of the Gantt chart which is plotted as seen in Figure 2.

5. DISCUSSION OF RESULT

The following results obtained after analysis of the system using PP&C technique for proper planning and project implementation. This research has demonstrated the relevance of have project planning and control in the proper planning of a project. This is highly recommended for proper scheduling and timely completion of any kind of project.

Result obtained shows the breakdown of every

activity to be carried out in respective units. For the purpose of drawing a network diagram with ease the initial work break down structure must be simplified by merging similar activities. For instance, merging all clearing activities and others with similar relationship into one unit makes the work easy and the possibility of timely completion is certain.

The activity precedence relationship as presented in Table 1 was obtained from the simplified work breakdown structure and then arranged according to its precedence which was obtained from the consultant of the ongoing oil and gas project. The activity precedence table gives an Activity Code to each activity and shows the immediate predecessor activity before it. This has been used to obtain a suitable network diagram as shown in Fig 1.

The critical path was the derived using the total slack calculation. Thus the longest of the chain in terms of duration from the network diagram is the critical path which is the project duration. This case study is an indication that the project can be completed in record time of 88 days.

The Scheduling Gantt Chart is recommended in future work. The chart can help in proper monitoring of the activities and ensuring they are carried out within the right time frame.

CONCLUSION

The availability of techniques such as Work Breakdown Structure (WBS), network planning, (Critical Path Method) CPM etc. has made the project planning more accurate and easy to achieve. Project planning cannot be over emphasized as it is the main reason why most projects either succeed or fail. Failure to achieve the laid down plans within the given or specified time frame can be classified as a failed project and thus result in a bad reputation for the project manager. However a manager with the right skills and techniques at his fingertips can easily avoid this. It is also very vital and important that there exists a high degree of honesty and full commitment among the workers or parties involved as dishonesty would only bring about failure irrespective of whether the right project planning techniques are applied or not. The Project manager of the facility under investigation or any other manager should ensure the techniques are not just utilized but must also ensure they work according to the plan rather than using the rule of thumb. Quite a number of projects are delayed or abandoned due to application guess work or rule of thumb. These can however be managed or controlled through the application of Total Quality Management (TQM) guidelines. Adequate supervision is necessary for monitoring the various rehabilitation activities in the oil and gas and other sector to ensure they are carried out in the right manner within the specified time frame. The Project Crashing method should only be used if the deliverables expected within a given timeframe are not delivered with the resources at hand. This method would attract higher cost and doesn't have to be applied unless the time constraint is less than the projected completion time or there is a sudden change in duration plans.

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