Effects of Project Management Techniques on Project Success in Julius Berger Nigeria Plc

By

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Abstract

Implementations of construction projects require huge capital investment and can lead to huge financial loss if not well managed. The use of project techniques by Julius Berger Plc in Nigeria's construction industry cannot be ascertained. This study therefore examines the effect of project management techniques on project success in Julius Berger Nigeria Plc. The study adopted survey research design to obtain information from randomly selected Engineers and Supervisors of Julius Berger Nigeria Plc who are currently working on the Badagry Express Way Road Construction. The respondents were selected based on the routing and specification of their jobs. The data collected were analysed using descriptive statistics. The study revealed that the project management techniques used by Julius Berger Nigeria Plc are based on the ideology of Programme Evaluation and review Technique (PERT) and Critical Path Method (CPM). The study also found out that projects with proper scheduled activities produce better quality work, are cost saving and have faster construction periods. It further revealed that the organization's Engineers and Supervisors adhere to the schedule of projects so that it does not breach the obligation and responsibility of completing construction projects according to the stipulated time. Based on these findings, the study therefore recommended that project management techniques should be applied and implemented in construction projects and adequate knowledge of project scheduling should be a major requirement for Engineers and Supervisors involved in construction projects.

Key words: *Project, Project Management Techniques, Project Schedule, Construction Projects.*

Introduction

The pace of the economic growth of any nation can be measured by the development of physical infrastructures, such as buildings, roads and bridges. Construction project development involves numerous parties, various processes, different phases and stages of work and a great deal of input from both the public and private sectors, with the major aim being to bring the project to a successful conclusion. The level of success in carrying out construction project development activities depend heavily on the quality of the managerial, financial, technical and organisational performance of the respective parties, while taking into consideration the associated risk management, the business environment, and economic and political stability.

The common assessment of the success of construction projects is that they are

delivered on time, to budget, to technical specification and meet client satisfaction (Baker et al., 1983; Slevin and Pinto, 1988; Morris and Hough, 1987; Turner, 1993).

This can be achieved through the application of Project Management Techniques. These techniques involve planning, organizing, directing and controlling activities by using the ideology of project management (Olateju 2011). There are two basic planning and control techniques utilized in project management Programmed Evaluation Review Techniques (PERT) and Critical Path Method (CPM) (Olateju 2011). One may be quick in suggesting that project management techniques are applied in Julius Berger Nigeria ltd. The validity of this statement cannot be ascertained based on Julius Berger's role in the development of Nigeria. In 1965, Julius Berger was awarded a contract to engineer, build and construct a major infrastructure project in Nigeria - the Eko bridge in Lagos, this was the foundation of Julius Berger's commitment to Nigeria.

Following this initial project, the company began to diversity its portfolio and its growth started to run in parallel to the development of Nigeria. Today, Julius Berger maintains its role as an integral partner in Nigeria's construction industry.

According to Kasimu and Usman (2013) majority of the construction projects in Nigeria experience time and cost overrun which in turn lead to the abandonment of projects. Many construction projects suffer from delay.

Suspension means stoppage of work directed to the contractor by a form from the clients, while delay is a slowing down of work without stopping it entirely (Bartholomew, 1998). Delay gives rise to disruption of work and loss of productivity, late completion of project increased time related costs, and third party claims and abandonment or termination of contract. It is important that general management keep track of project progress to reduce the possibility of delay occurrence or identify it at early stages (Martin, 1976). Construction planning has to be much more decentralized activity to cope with the inherently uncertain nature of task duration. Till date little study on this subject has been conducted in Nigeria in documenting the success or failure of construction projects to meet time and cost targets. Implementations of construction projects require huge capital investment and poor management of the process lead to huge financial loss to the owner. To be able to respond to the use of project management techniques in Julius Berger it was instructive to investigate and understand the effects of project management techniques on the success of construction projects in Nigeria, using Julius Berger Plc
The main purpose of this study is to evaluate the effects of project management techniques on project success while the specific objective is;

* *To examine the effect of project scheduling on project completion time*

LITERATURE REVIEW

THEORETICAL FRAMEWORK

Project Management Theory

A project is a temporary endeavour undertaken to create a unique product or service (PMI 2000). The theory of project is conceptualized as a transformation of inputs to outputs, flows and value generation which considers time, variability and customers on an operation (Koskela 2000). There are a number of principles by which a project is managed, these principles suggests the decomposing the total transformation hierarchically into smaller transformations,

tasks and minimizing the cost of each task independently, this is known as work

In the early years of the development of modern project management practices it was common to see each phase of a project being planned, scheduled, and managed as a separate project, from start to finish of each phase.

Mogbo (2004) stated that, construction is being used to control the economies of nations; it is always strongly related to politics, economics, sociology and the legal framework. Political contribution in construction planning is obligatory in the current world democracies. Construction cannot grow in a weak and docile economy.

Construction cannot feature where there is social distress and social instability, (Mogbo, 1998). However, as defined in developed countries (Hillebrandt, 1985), construction is considered unique in that it can stimulate the growth of other industrial sectors. Improving construction efficiency by means of cost effectiveness and timeliness would certainly contribute to cost saving for the country as a whole .Effort directed to cost and time effectiveness were associated with managing time and cost, which this study aimed at via investigating causes of delay at construction projects in Nigeria. Like other developing countries, such as Saudi Arabia (Assaf et al., 1995), Libya (Saleh, 2009) and Malaysia (Yong, 1988), Nigerian construction industry has suffered many setbacks in terms of completion of projects at stipulated period within the predetermined sum.

CONCEPTUAL FRAMEWORK

Project

A project could be viewed as a system, which is dynamic and ever changing from on stage to another in a life cycle (Atkinson, 1997). Considering a generic project, its status changes from that of an idea or a concept through to feasibility studies, execution and finally completion. (Peter, 2001). Also projects are nowadays far more complicated than ever before. They involve large capital investments and embrace several disciplines, widely dispersed project participants, tighter schedules, stringent quality standard and so on.

The creative concept of project management is universal and generic. This cut across all cultural, natural and logistic barriers, Some corporate cultures are much more supportive of project techniques than others. Top managers who plan to introduce the project management discipline, or who wish to improve existing project performance, needs to take cognisance of cultural, structural, practical and personal elements.

Different school of thought viewed project from different dimensions. According to (Nokes, 2007), a project is a temporary activity with a starting date, specific goals and conditions, defined responsibilities, a budget, a planning, a fixed end date and multiple parties involved. (Lewis, 2006), viewed project as an undertaking requiring concentrated efforts. "A project is a temporary endeavor undertaken to create a unique product, service, or result." (PMBOK 2010). According to International Project Management Association (2008), a project is a time and cost constrained operation to realize a set of defined deliverables (the scope to fulfill the project's objectives) up to quality standards and requirements. A project refers also to a value creation undertaking based on a specific, which is completed in a given or agreed timeframe and under constraints, including resources and external circumstances (Project Management Association of Japan, 2010). A project as defined by Australian Institute of Project Management (2012) is a

temporary endeavor undertaken to create a unique product, service or result in order to achieve an outcome. Akarakiri (2007) defines project as any scheme, or part of a scheme for investing recourse which can reasonably be analyzed and evaluated as independent unit.

Project Attributes

* A project has a unique purpose. A project is temporary.
* A project is developed using progressive elaboration or in an iterative fashion.
* A project requires resources, often from various areas.
* A project should have a primary customer or sponsor.
* A project involves uncertainty.
* Project creates something new or improves something that already exists.
* Projects are planned, controlled and executed.

A project is considered constrained by three functions:

1. Delivery - The time schedule for the project.

2. **Cost -** The money, budget, and resources for a project.

3. **Quality -** The customer requirements for the project.

These three constraints are closely related in that typically one cannot be changed without impacting at least one of the others. For example, if you want to shorten a schedule, you can hire more resources (which would increase cost), or reduce customer requirements (which would affect quality).

Project Management

Project management is the closer link between project teams and downstream. Harvey (1977), in his own view sees project management as planning, organizing, directing and controlling of activities. Generally from different schools of thought, it is believed that Project management is the discipline of planning, organizing and managing resources to bring about the successful completion of specific project goals and objectives. It sometimes combines with programs, group of related projects or interdependent projects.

The purpose of project management is to achieve successful project completion with the resources available. A successful project is one which:

* has been finished on time
* is within its cost budget
* performs to a technical/performance standard which satisfies the end user.

Generally, project management is distinguished from the general management of corporations by the mission-oriented nature of a project. A project organization will generally be terminated when the mission is accomplished.

Project Management Techniques

A major decision at the outset of any project is to decide upon the organization and composition of the project team. In so doing, it is worth remembering that many members will have dual responsibilities of involvement in the project in addition to a commitment to other projects or management of a functional area on a day-to-day basis. It is at this stage that a project manager should be appointed and responsibilities made explicit for all members of the team. According to Harvey (2002), while project management skills are obviously important for project managers, interestingly the methods and tools that managers use can be helpful for everyone.

The selection of the team will be dependent upon the skill requirements of the project, and upon the matching of those skills to those possessed by individual members of the team. There may be a conflict here with hierarchical status.

The project management team will, therefore, begin its task in advance of project proper so that a plan can be developed. An important first step is to set the objectives and then define the project, breaking it down into a set of activities and related costs. It is probably too early to determine exact resource implications at this stage, but expected requirements for people, supplies and equipment should at least be estimated during the planning stage.

Project scheduling is primarily concerned with attaching a timescale and sequence to the activities to be conducted within the project. Materials and people needed at each stage of the project are determined and the time each is to take will be set. A popular and easy to use technique for scheduling is the use of Gantt charts and network analysis.

Gantt Charts

Gantt charts, named after Henry L. Gantt, one of the pioneers of scientific management, are a useful means of representing a schedule of activities comprising a project and enable the operations manager to know exactly what activities should be performed at a given time. It is used to monitor daily progress of a project so that corrective action may be taken when necessary. Gantt charts also provide a summary of the project as a whole and can be used as a rough and ready means of assessing progress at the project control phase. At any date, the project manager can draw a dateline through the Gantt chart and see which activities are on-time, which are behind schedule and generally record project status against plan.

A Gantt chart is a simple technique that can be used to attach a time scale and sequence to a project. A Gantt Chart is a form of horizontal bar chart and horizontal bars are drawn against a time scale for each project activity, the length of which represents the time taken to complete. To construct a Gantt Chart the following steps are necessary:

1) Use the horizontal axis to represent time
2) Use the vertical axis to represent activities
3) Represent each activity by a horizontal bar of appropriate length

4) Take activity procedures into account by starting each activity bar to an appropriate

point along the time axis after its preceding activities. Normally the start point for an activity is the earliest time that it could start after its preceding activities had finished.
It is possible to enhance the Gantt chart in several ways. For instance the number of staff required to do a task can be entered into the bar on the diagram.

Gantt charts, also commonly known as milestone plans, are a low cost means of assisting the project manager at the initial stages of scheduling. They ensure that:

1. all activities are planned for,
2. the sequence of activities is accounted for,
3. the activity time estimates are recorded; and
4. the overall project time is recorded.

They are therefore a simple, rough and ready means of planning a project and assessing progress and are sufficient for most simple projects. However, where projects become complex, it becomes difficult to see relationships between activities by using a Gantt Chart. For more complex projects Network Analysis techniques are used.

NETWORK ANALYSIS

The two most common and widely used project management techniques that can be classified under the title of Network Analysis are Programme Evaluation and review Technique (PERT) and Critical Path Method (CPM). Both were developed in the 1950's to help managers schedule, monitor and control large and complex projects. CPM was first used in 1957 to assist in the development and building of chemical plants within the DuPont corporation. Independently developed, PERT was introduced in 1958 following research within the Special Projects Office of the US Navy. It was initially used to plan and control the Polaris missile programme which involved the coordination of thousands of contractors. The use of PERT in this case was reported to have cut eighteen months off the overall time to completion.

PERT and CPM differ slightly in their terminology and in network construction. However their objectives are the same and, furthermore, their project analysis techniques are very similar.

Differences Between Pert and Cpm

The major difference is that PERT employs three time estimates for each activity. Probabilities are attached to each of these times which in turn is used for computing expected values and potential variations for activity times. CPM, on the other hand, assumes activity times are known and fixed, so only one time estimate is given and used for each activity. Given the similarities between PERT and CPM, their methods will be discussed together. The student will then be able to use either, deciding whether to employ variable (PERT) or fixed (CPM) time estimates within the network.

The PERT/CPM Procedure

There are six stages common to both PERT and CPM:

1. Define the project and specify all activities or tasks.
2. Develop the relationships amongst activities. Decide upon precedences.
3. Draw network to connect all activities.
4. Assign time and/or costs to each activity.
5. Calculate the longest time path through the network: this is the "critical path".
6. Use network to plan, monitor and control the project.

Finding the critical path (step 5) is a major in controlling a project. Activities on the critical path represent tasks which, if performed behind schedule, will delay the whole project. Managers can derive flexibility by identifying the non-critical activities and replanning, rescheduling and reallocating resources such as manpower and finances within identified boundaries.

PERT and CPM can help to answer the following questions for projects with thousands of activities and events, both at the beginning of the project and once it is underway:

* When will the project be completed?
* What are the critical activities (i.e.: the tasks which, if delayed, will effect time for overall completion)?
* Which activities are non-critical and can run late without delaying project completion time?
* What is the probability of the project being completed by a specific date?
* At any particular time, is the project on schedule?
* At any particular time, is the money spent equal to, less than or greater than the budgeted amount?
* Are there enough resources left to complete the project on time?
* If the project is to be completed in a shorter time, what is the least cost means to accomplish this and what are the cost consequences?

CRITICAL PATH ANALYSIS

The objective of critical path analysis is to determine times for the following:

* **ES = Earliest Start Time.** This is the earliest time an activity can be started, allowing for the fact that all preceding activities have been completed.
* **LS = Latest Start Time.** This is the latest time an activity can be started without delaying the start of following activities which would put the entire project behind schedule.

* **EF = Earliest Finish Time.** The earliest time an activity can be finished.

* **LF = Latest Finish Time.** The latest time that an activity can finish for the project to remain on schedule.

* **S = Activity Slack Time.** The amount of slippage in activity start or duration time which can be tolerated without delaying the project as a whole.

If ES and LS for any activity is known, then one can calculate values for the other three times as follows:

EF = ES + t

LF = LS + t

S = LS - ES or S = LF - EF

Analysis of a project normally involves:

1. Determining the Critical Path. The critical path is the group of activities in the project that have a slack time of zero. This path of activities is critical because a delay in any activity along it would delay the project as a whole.

2. Calculating the total project completion time, T. This is done by adding the activity times of those activities on the critical path.

The steps in critical path analysis are as follows:

a) Determine ES and EF values for all activities in the project: the Forward Pass through the network.

b) Calculate LS and LF values for all activities by conducting a backward pass through the network.

c) Identify the critical path which will be those activities with zero slack (i.e.: ES=LS and EF=LF).

d) Calculate total project completion time.

PROGRAMME EVALUATION AND REVIEW TECHNIQUE (PERT) AND ACTIVITY TIME ESTIMATION

The major distinguishing difference between PERT and CPM is the use of three time estimates for each activity in the PERT technique, with CPM using only one time for each activity using CPM.

The three time estimates specified for each activity in PERT are:

i) the optimistic time;

ii) the most probable time; and

iii) the pessimistic time.

The optimistic, most likely and pessimistic time estimates are used to calculate an expected activity completion time which, because of the skewed nature of the beta distribution, is marginally greater than the most likely time estimate. In addition, the three time estimates can be used to calculate the variance for each activity. The formulae used are as follows:
Where:

o, m, p - optimistic, most likely, and pessimistic times

t - expected completion time for task

v - variance of task completion time

$$t = \frac{o+4m+p}{6} \qquad v = \left(\frac{p-o}{6}\right)^2$$

Knowing the details of a project, its network and values for its activity times (t) and their variances (v) a complete PERT analysis can be carried out. This includes the determination of the ES, EF, LS, LF and S for each activity as well as identifying the critical path, the project completion time (T) and the variance (V) for the entire project.

Normally when using PERT, the expected times (t) are calculated first from the three values of activity time estimates, and it is these values of t that are then used exactly as before in CPM. The variance values are calculated for the various activity times and the variance of the total project completion time (i.e. the sum of the activity expected times of those activities on the critical path) is the sum of the variances of the activities lying on that critical path.

Project success

According to Cleland et al (1975), a project is termed successful if it passes four success test criteria i.e. the time criterion completed on time; the cost or money criterion completed within budget; the effectiveness criterion completed in accordance with the original set performance and quality standards; and client's satisfaction criterion - accepted by the intended users or clients whether the client is internal or from outside the organization. The above success criteria call for successful project implementation by the utilization of proven management techniques of planning, organizing, directing and control. The issues on life cycle management, time management, conflict resolution and management, networking, contracts management, project choice and project quality are the key factors that contribute to project success. Effective project choice, for example, which results in a good project selection, greatly improves the probability of project success especially when the project is executed in accordance with project management implementation guidelines. The Critical Path Method (CPM) and Programme Evaluation andReview Techniques (PERT), for example, contribute a lot to project success as they foster a great discipline through definition of project scope, time scale/schedule and cost. Empirical evidence, however, suggests that the importance of networking is far overweighed by the contribution of other project tools, which include work breakdown structure, life cycle planning, systems engineering, configuration management and status reports.

Networking contributes to better cost and schedule performance but not necessarily to better technical performance and better client acceptance. Perceived success is more adequately defined as meeting the project's technical specification.

* **THE PROJECT LIFE CYCLE**

PROJECT LIFE CYCLE IN CONSTRUCTION ACTIVITY

There are six stages of project life cycle management in the construction industry. These are

a) ***Pre-Project Phase.***
Here the project objective or need is identified; this can be a business problem or opportunity.

b) ***Planning and Design Phase.***
The project solution is further developed considering minute details and necessary steps are planned to meet the project's objective.

c) ***Contractor Selection Phase.***
In anticipation of selecting a contractor, the owner decides whether an open invitation will be issued to all possible vendors or whether only certain contractors will be invited to submit offers and whether any sort of prequalification process will be invoked to limit the number of tenders.

Project Mobilization Phase.
After the contractor is selected, a number of activities must be completed before installation work can begin at the project site that includes securing of various bonds, licenses and insurances.

d) ***Project Close-out and termination phase.***
Finally, as the project nears completion, a number of special activities take place before the contractor's responsibilities are considered complete. There are the various testing and startup tasks, the final cleanup, various inspections and remedial work that may result from them and the process of closing the construction office and terminating the staff's employment. In addition, a myriad of special paperwork is required, including approvals and certifications that allow the contractor to receive final payment, a set of as-built drawings that include all changes made to the original design, operating manuals, warranties and a final report.

RESEARCH METHODS

This study adopted survey research design to obtain information from engineers and supervisors of Julius Berger Nigeria Plc who are currently working on an on-going project. The engineers and supervisors were randomly selected based on the routing jobs and specification of their jobs. The project chosen was the on-going Badagry express way road construction. The project was also chosen because the company's subsidiary prime-tech Design and Engineering Nigeria

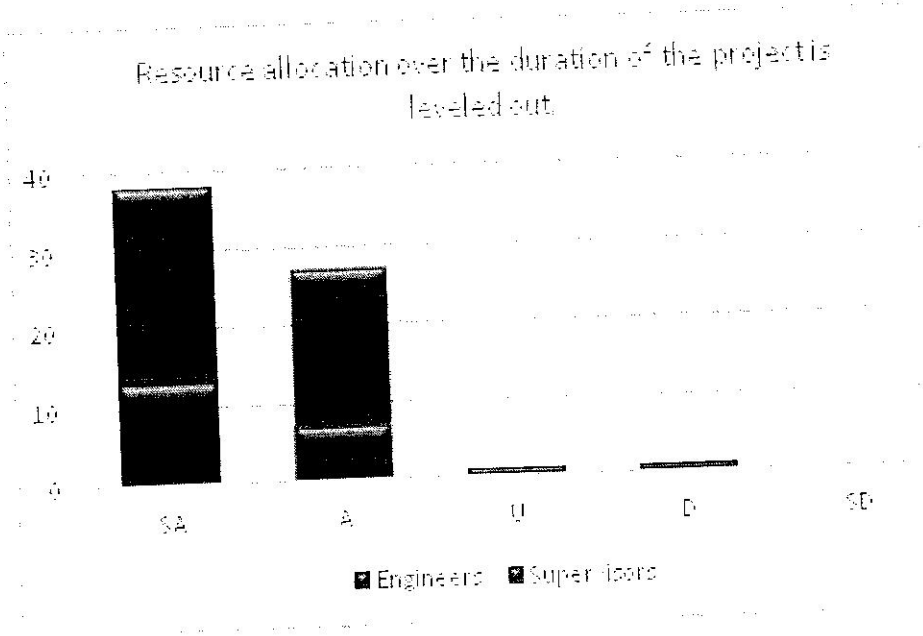
limited is involved in the project, the various departmental structure of Julius Berger Nigeria Plc are also on-ground at the different work stations. They include electrical workshop, plumbing, repair centres, aluminium-building material, furniture and steel, carpentry, foam work, precast fabrication, scaffolding, welding, concrete mixing and material testing.

DESCRIPTIVE STATISTICS OF DATA COLLECTED.

Table 1: Responses on PROJECT RESOURCES

PROJECT RESOURCES		SA	A	U	D	SD
Resource allocation over the duration of the project is leveled out.	Engineers	13	7	0	1	0
	Supervisors	25	20	1	0	0
Activity completion time is related to the amount of resources committed to it.	Engineers	16	3	1	0	0
	Supervisors	34	10	0	2	0

Source: Field Survey (2015).



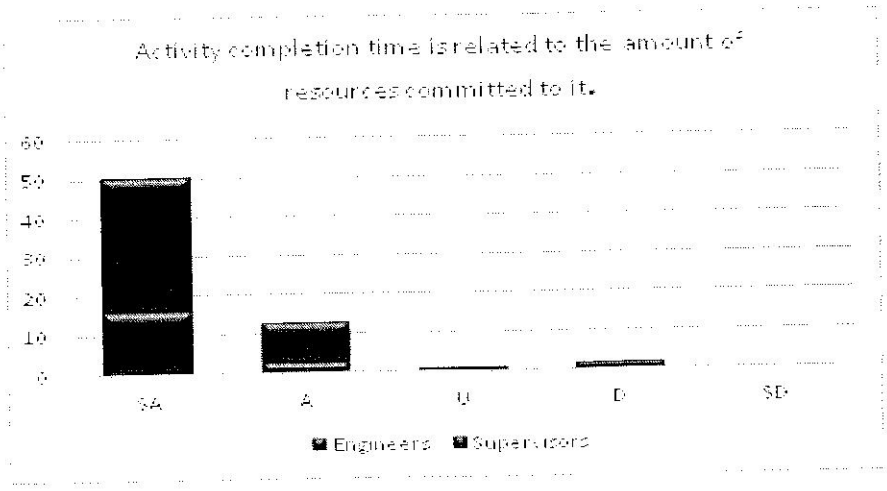
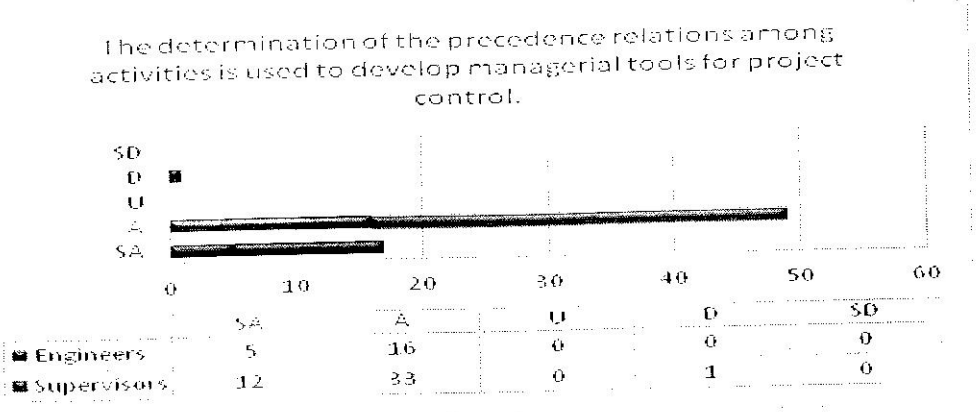
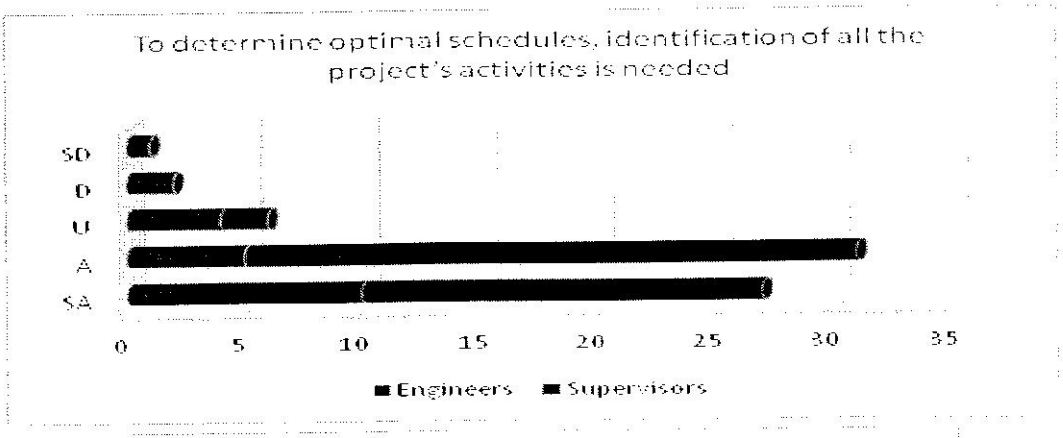


Table 2: Responses to Activities Involved in Project Schedule

ACTIVITIES INVOLVED IN PROJECT SCHEDULE		SA	A	U	D	SD
The determination of the precedence relations among activities is used to develop managerial tools for project control.	Engineers	5	16	0	0	0
	Supervisors	12	33	0	1	0
To determine optimal schedules, identification of all the project's activities is needed	Engineers	10	5	4	2	0
	Supervisors	17	26	2	0	1
Activities with rigid schedule and activities have slack in their schedules	Engineers	8	13	0	0	0
	Supervisors	42	4	0	0	1





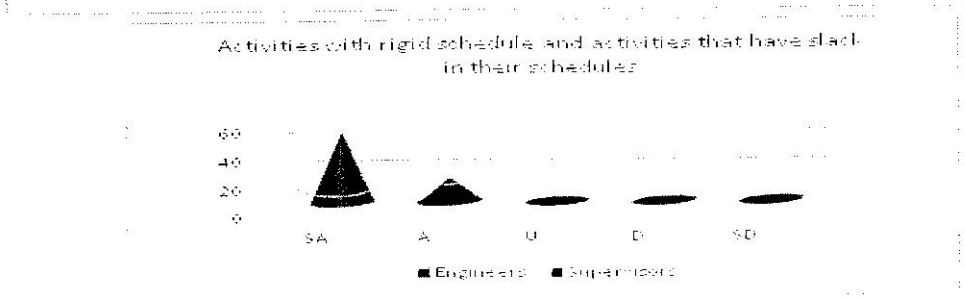
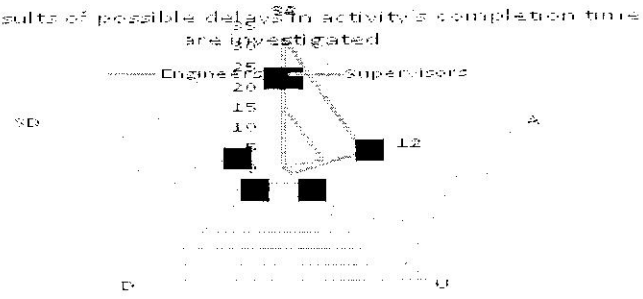
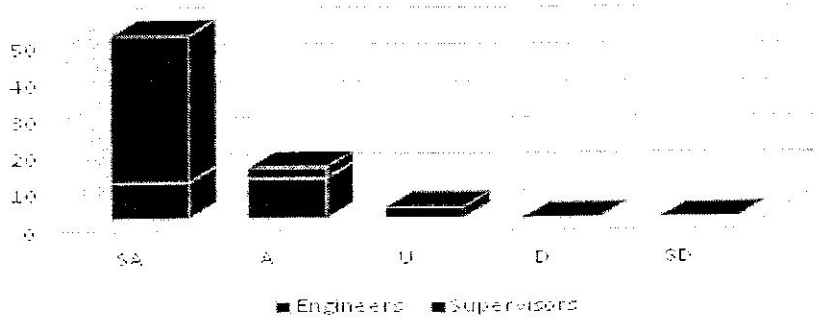


Table 3: Responses to Delay in Completion Time

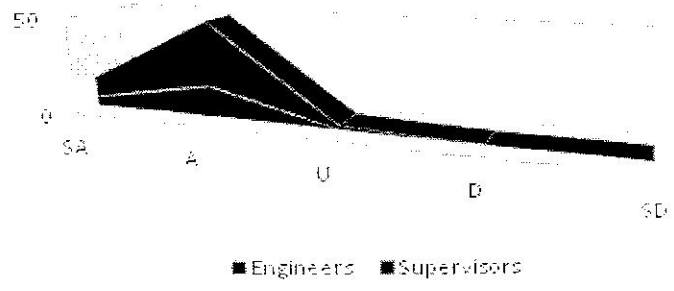
DELAY IN COMPLETION TIME		SA	A	U	D	SD
The results of possible delays in activity's completion time are investigated	Engineers	15	6	0	0	0
	Supervisors	32	12	2	0	0
The likelihood that a project will be completed within a certain time period is calculated.	Engineers	10	11	0	0	0
	Supervisors	40	3	3	0	0
The earliest and latest start times for each activity which will alter the earliest completion time of the project	Engineers	5	16	0	0	0
	Supervisors	11	33	2	0	0
Projects are completed as early as possible by determining the earliest start and finish of each activity.	Engineers	14	7	0	0	0
	Supervisors	39	7	0	0	0
The degree of activity details depends on the application and the level of specificity of data.	Engineers	8	10	2	0	0
	Supervisors	23	17	1	5	0

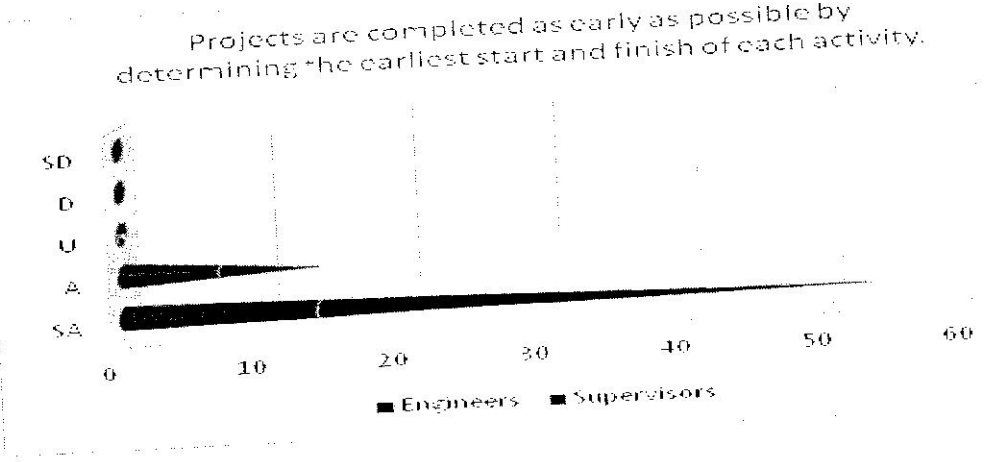


The likelihood that a project will be completed within a certain time period is calculated.



The earliest and latest start times for each activity which will alter the earliest completion time of the project





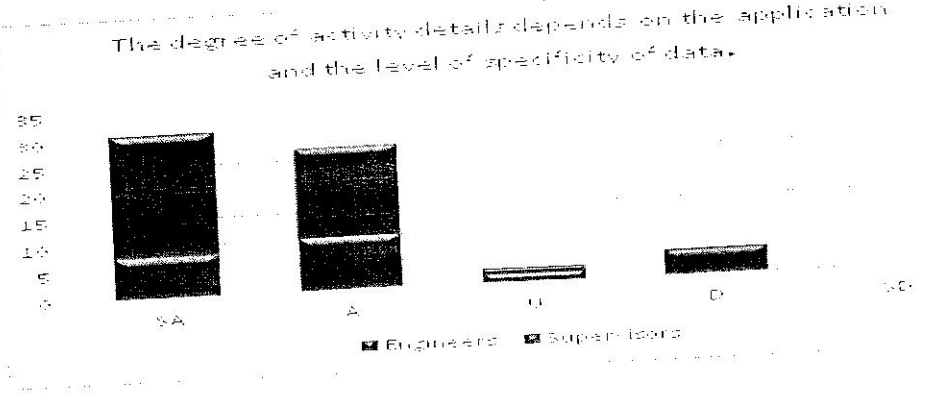
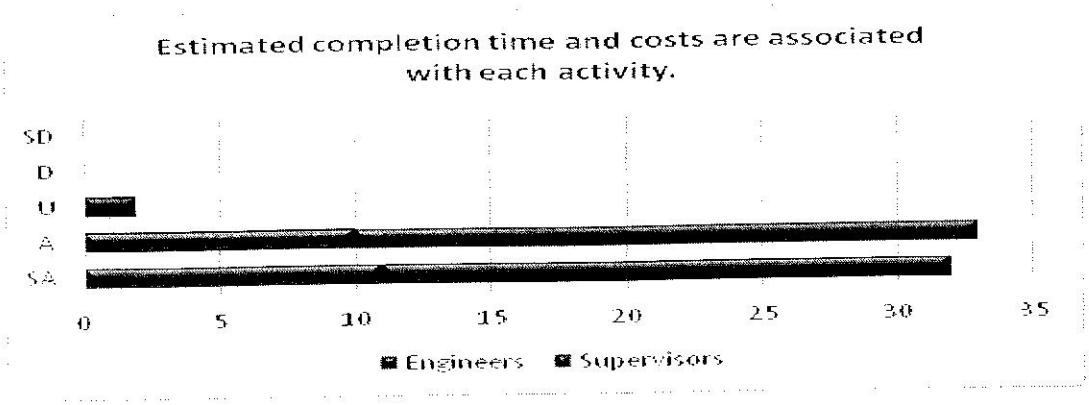


Table 4: Responses to Cost Associated with Schedule

COST ASSOCIATED WITH SCHEDULE		SA	A	U	D	SD
The minimum cost schedule needed to complete the project by a certain date is always calculated.	Engineers	5	14	0	2	0
	Supervisors	17	23	6	0	0
Estimated completion time and costs are associated with each activity.	Engineers	11	10	0	0	0
	Supervisors	21	23	2	0	0



DATA ANALYSIS AND FINDINGS ON DISCUSSIONS

* Data Analysis and Finding on Project resources

Table 1 revealed that most of the respondents (97%) agree that resource allocation over the duration of the project is leveled out; 94% agree that activity completion time is related to the amount of resources committed to it.

* Data Analysis and Finding on Activities Involved in Project Schedule

Table 2 shows that 99% of the respondents agree that the determination of the precedence relations among activities is used to develop managerial tools for project control; 87% agree that to determine optimal schedules, identification of all the project's activities is needed; while all the respondents (100%) agree that activities with rigid schedule and activities have slack in their schedules

* Data Analysis and Finding on Delay in Completion Time

Table 3 shows that 97% of the respondents agree that the results of possible delays in activity's completion time are investigated; 96% agree that the likelihood that a project will be completed within a certain time period is calculated; 97% agree that the earliest and latest start times for each activity which will alter the earliest completion time of the project; 100% agree that projects are completed as early as possible by determining the earliest start and finish of each activity; while 87% agree that the degree of activity details depends on the application and the level of specificity of data.

* Data Analysis and Finding on Cost Associated with Schedule

Table 4 shows that 88% of the respondents agree that the minimum cost schedule needed to complete the project by a certain date is always calculated; while 97% agree that estimated completion time and costs are associated with each activity.

Discussion and Conclusion

Projects with proper scheduled activities can produce better quality work, cost saving and

faster construction periods (Keizer & Render, 2008). Project scheduling is vital to project execution success and in accomplishing the objectives and goals of a project (Graham, 2006). This position is upheld by the outcome of this study. The study revealed that the organization's engineers and supervisors adhere to the schedule of projects so that it does not breach the obligation and responsibility of completing construction projects according to the stipulated time. The findings of the study is also in line with the work of Badron (2005) and Alan (2007) who are of the opinion that the failure to employ proper project scheduling might result in high risk of project being delayed, interruption in project completion and project financial lost.

The study also found out that all the respondents interviewed agreed that project scheduling is a major factor that contributes to the success of construction projects. This means that Julius Berger use project planning, scheduling and monitoring in every aspects of management in construction projects.

Recommendations

The application and implementation project scheduling on project success were proven by previous studies. Based on previous literatures and current research findings, the study recommends that

1. Project management method is suitable to be applied and implemented in construction projects.

2. Project management techniques should be used so that the performance of construction companies can be improved and increase the productivity of projects.

3. Adequate knowledge of project scheduling should be a major requirement for engineers and supervisors involved in construction projects.

4. A project can only be successful when quality targets, budget and schedule are adhered to strictly by all the parties involved in the project.

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