

Construction Project Planning Techniques: Awareness, Usage and Suitability

Opeoluwa Akinradewo¹, Clinton Aigbavboa¹,
Babatunde Ogunbayo¹, Didibhuku Thwala², Ornella Tanga¹,
and Olushola Akinradewo³

¹cidb Centre of Excellence, Faculty of Engineering and the Built Environment,
University of Johannesburg, South Africa

²Department of Civil Engineering, College of Engineering, Science and Technology,
University of South Africa, South Africa

³Department of Quantity Surveying, School of Environmental Technology, Federal
University of Technology, Akure, 340271, Nigeria

ABSTRACT

Every project is unique on its own with predetermined commencement and delivery dates. The constraints imposed on the project make it necessary to plan its execution to keep it within those constraints. The checks and balances put in place in the construction industry to facilitate the completion of projects within the contractor's schedule and to the client's desired time, quality and cost as planning techniques are applied in varying degrees depending on the stage at which it is carried out. The main purpose of this study is to evaluate the various construction project planning techniques employed in the Nigerian construction industry and the suitability of these techniques. To achieve the objectives of the study, a quantitative research method was utilised and a well-structured questionnaire was contrived using variables obtained from reviewed literature. The respondents chosen are Quantity Surveyors, Builders, Engineers, and Architects. Analysis of retrieved data was done using Percentile, Frequency, Mean Item Score (MIS). Findings of the study revealed that Bar/Gantt chart is the widely used planning technique as it is efficient while the Critical Path Method is more accurate in ensuring a project is delivered to the scheduled time and predetermined cost. From the result of this study, it is concluded that awareness level and recognition of planning techniques in the Nigerian construction industry is low and proper project planning is seldomly practised which requires urgent professional attention. This will help in ensuring that construction project time and cost overrun are addressed from the commencement of the project.

Keywords: Network analysis, Project planning, Work breakdown structure

INTRODUCTION

Planning is one of the most important five managerial functions that need to be exercised to achieve the set objectives of any company. Planning is not only the most basic of all the managerial functions, but it determines how the four other functions will be implemented. As a result, planning plays a

pivotal role in which managerial decision-making process seats (Fayol, 2016). Planning in construction involves establishing the most effective sequence of events necessary to accomplish a project as well as the allocation of resources in a way that could guaranty effectiveness of the construction firm. There is need to put proper checks and balances in place in the construction firm to make sure that projects are completed on time, within the budgeted cost and to the requirements of the client, desired and satisfactory quality. To achieve this, planning techniques come in which can be applied in varying degrees depending on the state at which it has been carried out (Ibrahim, Daniel and Ahmad, 2014). Project planning technique serves as a basis of determining project success and its reality. Most building or construction project experiences delay in various ways leading to either an extension in the time of project delivery due to the negligence of the management of the resource-oriented factors, i.e. the components such as material, labour and plant as they have a negative effect on the cost of the project if not properly looked into (Andawei, Enenimiet and Openebo, 2007). The impression is that planning techniques are very complex, time-consuming and involve difficult procedures. This article reviewed the project planning in the construction industry as well as the different planning techniques used.

PROJECT PLANNING TECHNIQUES

Project planning can be carried out using various techniques based on how complex the construction project is, the available information, and the stage of construction. These techniques all have a major objective to be achieved which is to give a sequence of the activities needed to be carried out in order to achieve the construction project. Harris and McCaffer (2013) submitted that these techniques include Bar Charts/Linked Bars; Work Breakdown Structure (WBS); Network Analysis; and Line of Balance (LOB).

Bar Charts/Linked Bars is the most used and the easiest to understand planning technique used for construction projects. Bar Charts also referred to as Gantt Chart was the product of Henry Gantt's development in 1990 which was adapted from management in industrial production to construction. The chart gives a pictorial view of the project activity schedule against the project time schedule on two co-ordinate axes. With the introduction of the Linked Bars, there is a connectivity between the different activities that make up the complete project such that the completion of a particular activity is linked to the start of another. Due to its simplicity, charts are also used for the presentation of the results of other sophisticated techniques as it makes it easier to monitor the progress of work on site (Harris and McCaffer, 2013; Seeley, 2015). Work Breakdown Structure is the process of taking a construction project into smaller components by carrying out deliverable-oriented decomposition. This is done by disintegration in incremental and hierarchical order, the different activities that lead to the achievement of the construction project into work packages, deliverables, and phases. This disintegration shows the required labour, materials and time for a particular subdivision of the construction project (Kerzner, 2001).

Network Analysis was developed to indicate the inter-relationship of project activities which other techniques have not been able to establish. Network analysis technique comes in two different forms which are Project Evaluation and Review Technique (PERT) and Critical Path Method (CPM). PERT is known to be a control and planning tool serving as the road map for the project. In PERT, all the project major activities must be completely identified alongside the inter-relationship that exists between them. (Motawa and Almarshad, 2015). Critical Path Method (CPM) on the other hand, employs a deterministic approach to project planning such that accurate estimates are used for each project activity thereby arriving at a more accurate project end date once the starting date can be established. The network diagram in CPM establishes the actual time required for each activity while showing the inter-relationship of each activity along their paths (Ibrahim, Daniel and Ahmad, 2014; Subramani, Sarkunam and Jayalakshmi, 2014).

RESEARCH METHODOLOGY

The main purpose of this study is to evaluate the construction project planning in the Nigerian construction industry (NCI) with a look at the various techniques employed and the suitability of these techniques. To achieve this, quantitative research method was utilised which according to Babbie (2010) places great emphasis on the analysis of unbiased mathematical, statistical, or numerical data which may be collected through the use of well-structured questionnaires, voting polls, survey studies or through the use of computational techniques to alter or validate existing statistical data. To this end, a well-structured questionnaire was designed based on variables obtained from reviewed literature for respondents to rank according to their perception of the set variables. The study was carried out within Ondo State in South-Western Nigeria. The respondents chosen for this research work includes construction industry professionals mainly Quantity Surveyors, Builders, Engineers, and Architects. A purposive sampling technique was used in carrying out this research, this is because this sampling technique satisfies the principle of statistical regularity such that all the categories of respondents were well represented (Kothari, 2004). A total of 86 questionnaire was distributed while 71 copies were returned and found suitable for analysis forming 83% response rate. According to Richardson (2005), a response rate of 50% is considered to be adequate for social research. To analyse the retrieved data, descriptive statistics (percentile and frequencies) were used to analyse the background information of the respondents while the evaluation of the project planning techniques usage and suitability were analysed using Mean Item Score (MIS). Test of validity was carried out on the data collection instrument to determine whether the responses measure what they had initially intended to measure. This was achieved by using Cronbach's Alpha test which gave the following results: Project Planning in the NCI = 0.765, Evaluation of Project Planning Techniques = 0.889 and Suitability of the various Project Planning Techniques = 0.794. This shows that the concepts in each category of questions are similar, and all the items are inter-related. It can also be concluded that the responses are not biased.

RESULTS AND DISCUSSION

Background Information of Respondents

The professional qualification and affiliation of the respondents was evaluated based on the categories of professionals adopted for the research study which includes Architects (NIA), Quantity Surveyors (NIQS), Builders (NIOB) and Engineers (NSE) while their academic qualification was assessed using HND, PGD, BSc/BTech, MSc/MTech, and Ph.D. classifications. The years of experience of respondents was measured using the categories 1-5 years, 6-10years, 11-15years, 16-20years and above 20years. Majority of the respondents are Quantity Surveyors followed by Architects while Engineers are the least among the respondents. This shows that they possess reasonable professional qualification coupled with years of experience and enough projects handled practically to be able to give answers to the questions of this research study.

Project Planning Awareness, Usage and Suitability in the NCI

The opinion of the respondents was sought on the level of awareness of planning in the NCI and the adequacy of the project planning for construction projects. Three major factors that affect the choice of planning technique used for construction projects were identified from literature which are expertise required; project complexity; and location of the project. These factors were assessed based on the role they play in determining which planning technique is used for construction projects within the study area while the stage of work in which planning is best carried out was also determined as shown in Table 1.

From Table 1, the majority of the respondents are of the opinion that awareness and recognition of planning techniques in the study area is not enough while only a few said the awareness is enough. Most of the respondents also claimed that project planning in NCI is inadequate while very few of them are opined that it is just satisfactory and adequate each. Table 1 also shows that only a minute number of respondents consider the location of the project when choosing the planning technique to be used for a particular construction project. Most of the respondents consider all the identified three factors in choosing the planning technique to employ for construction projects. Concerning the stage at which planning is best carried for construction projects, Table 1 revealed that the respondents agree with pre-contract planning stage, pre-tender planning stage and contract planning stage in descending order respectively.

From the information above, it is crystal clear that professionals' level of awareness in the study area about project planning techniques is low while planning techniques usage is inadequate which is not supposed to be so compared to other developing countries. With the low level of awareness of project planning techniques by professionals, there will be poor planning for construction projects which has led to cost and time overrun, project delay and subsequent abandonment. According to Dansoh (2005), 87% of construction organisations in Ghana carry out planning for construction projects. This is also supported by the findings of Amoatey et al. (2015) who opined

Table 1. Evaluation of project planning in the NCI.

	Variables	Frequency	Percent
Is there enough awareness and recognition of planning?	Yes	9	12.70
	No	62	87.30
	Total	71	100.00
Assessment of project planning in NCI	Inadequate	65	91.50
	Just Satisfactory	3	4.20
	Adequate	3	4.20
	Total	71	100.00
Factors that affect the choice of planning techniques	Management expertise required	15	21.10
	Complexity of Project	21	29.60
	Location of Project	3	4.20
	All of the above	32	45.10
	Total	71	100.00
	What stage of work is planning techniques best applicable?	Pre-tender planning stage	30
Pre-contract planning stage		26	42.30
Contract planning stage		15	21.10
Total		71	100.00

that planning is a major part of construction projects in developing countries. This calls for the adoption of planning techniques by professionals in the NCI to help in achieving construction projects in scheduled time and within the specified cost. Lines et al. (2015) submitted also that project planning is best carried out at the pre-contract planning stage of the construction project. This supports the findings of this study as pointed out by the respondents.

The identified project planning techniques from reviewed literature were evaluated by the respondents to ascertain the level of usage and degree of accuracy. The result was presented in Table 2 which revealed that CPM is the most accurate project planning techniques followed by Bar/Gantt Chart, PERT and WBS while Line of balance ranked below the average mean item score value of 3.00. This shows that line of balance technique cannot be relied upon when selecting a planning technique for construction project. Respondents are of the opinion that Bar/Gantt chart is the most used planning technique for construction projects even though it is not the most accurate of all the planning techniques while line of balance is the least used based on its perceived level of accuracy. This can be attributed to its ease of understanding by professionals, unlike CPM. According to Seeley (2015), Bar Charts/Linked Bars is the most used and the easiest to understand planning technique used for construction projects. The submission of Ahuja, Dozzi, and AbouRizk (1994) and Naem et al. (2018) also corroborated the findings

Table 2. Evaluation of project planning techniques.

Project planning techniques	Degree of Accuracy		Level of Usage	
	Mean	Rank	Mean	Rank
Critical Path Method	3.89	1	3.51	2
Bar/Gantt Chart	3.55	2	3.85	1
Project Evaluation Review Technique	3.06	3	2.86	3
Work Breakdown Structure	3.01	4	2.72	4
Line of Balance	2.37	5	2.25	5

with the opinion that CPM is dependable for planning construction projects and it is widely used by professionals in the construction industry. Respondents gave their opinion on the suitability of the planning techniques based on their acceptability, time efficiency, appropriateness for short term projects, material resource planning, plant resource planning, labour resource planning, money conservation, and general efficiency.

From Table 3, CPM is more suitable for material, plant and labour resource planning due to its dependability while Bar/Gantt chart can only be used for material resource planning and plant resource planning but not suitable for labour resource planning. PERT is also reported to be completely unsuitable for material and plant resource planning. WBS can be used adequately for labour resource planning as it has the second highest frequency according to respondents' opinion. To conserve money utilised in project planning, respondents are of the opinion that WBS comes first followed by PERT and LOB. However, more money is spent on utilising CPM and Bar/Gantt chart. This, therefore, translates to the efficiency of CPM in project planning followed by Bar/Gantt chart as indicated in Table 3.

The adequacy of CPM in planning construction project is revealed by the responses of the respondents. Its suitability based on the different questions asked took about 38% of the total responses on average. This can be supported by the submission of Subramani, Sarkunam, and Jayalakshmi (2014) that CPM employs a deterministic approach to project planning such that accurate estimates are used for each project activity thereby arriving at a more accurate project end date once the starting date can be established. Bar/Gantt chart also accrued about 28% on average to attest to the submission of (Harris and McCaffer, 2013) who asserted that due to its simplicity, charts are used for presentation of the results of other sophisticated techniques as it makes it easier to monitor progress of work on site thereby making professionals adopt it. Technically, WBS is the basis for all other planning techniques as it gives the breakdown of all the activities to be carried out in achieving the construction project but it doesn't provide the additional information needed for efficient project planning.

CONCLUSION AND RECOMMENDATIONS

The study set out to appraise the project planning techniques adopted for construction projects in the NCI which was achieved through thorough literature

Table 3. Suitability of the various project planning techniques.

Variables	WBS		Bar/Gantt Chart		Line of Balance		CPM		PERT		Total	
	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.	Freq.	Perc.
Which of the planning techniques is widely accepted for construction projects	3	4.20	42	59.20	3	4.20	14	19.70	9	12.70	71	100.00
Which of the techniques saves more time?	14	19.70	9	12.70	3	4.20	39	54.90	6	8.50	71	100.00
In short term planning, which is most appropriate?	9	12.70	39	54.90	17	23.90	0	0.00	6	8.50	71	100.00
Which of the planning techniques do you use for your material resources on site?	3	4.20	12	16.90	12	16.90	44	62.00	0	0.00	71	100.00
Which of the planning techniques do you use for your plant resources on site?	6	8.50	20	28.20	6	8.50	39	54.90	0	0.00	71	100.00
Which of the planning techniques do you use for your labour resources?	23	32.40	3	4.20	9	12.70	33	46.50	3	4.20	71	100.00
Which of the techniques conserve money best?	23	32.40	12	16.90	13	18.30	7	9.90	16	22.50	71	100.00
Which of the techniques ensure maximum efficiency?	3	4.20	28	39.40	0	0.00	36	50.80	4	5.60	71	100.00

review and questionnaire survey. From the result of this study, it could be concluded that awareness level and recognition of planning techniques in the NCI is very low, project planning is also inadequate and needs to be worked on by the professionals so as to ensure that the problems of construction project time and cost overrun can be ameliorated. Out of all the five (5) project planning techniques identified in this study, Line of Balance is the least accurate of all and it is also the least used in the NCI because it has proven to be inefficient unlike the other techniques identified in this study. On the other hand, Bar/Gantt chart is the widely used planning technique as it is efficient while Critical Path Method is more accurate in ensuring a project is delivered to scheduled time and predetermined cost with all other project factors remaining constant. This study, therefore, recommends that proper awareness be carried out to sensitize professionals in the construction industry about the different project planning techniques available and their suitability for each construction project. The study was limited to one state among the 36 states in Nigeria, therefore, further study should be carried out to cover the 36 states in Nigeria.

REFERENCES

- Ahuja, H. N., Dozzi, S. P. and AbouRizk, S. M. (1994) Project management: Techniques in planning and controlling construction projects, Construction management and engineering.,.
- Amoatey, C. T. et al. (2015) 'Analysing delay causes and effects in Ghanaian state housing construction projects', *International Journal of Managing Projects in Business*. doi: 10.1108/IJMPB-04-2014-0035.
- Andawei, M. M., Enenimiet, A. K. A. and Openebo, O. B. (2007) 'Project planning in the construction industry: A study of some selected project in river state of Nigeria', *The Quantity Surveyor*, 55(3), pp. 9–16.
- Dansoh, A. (2005) 'Strategic planning practice of construction firms in Ghana', *Construction Management and Economics*, 23(2), pp. 163–168. doi: 10.1080/0144619042000241435.
- Fayol, H. (2016) *General and industrial management*. Ravenio Books.
- Harris, F. and McCaffer, R. (2013) *Modern construction management*. John Wiley & Sons. doi: 10.1139/190-056.
- Ibrahim, I. I., Daniel, S. and Ahmad, A. (2014) 'Investigating Nigerian Indigenous Contractors Project Planning In Construction Procurement: An Explanatory Approach', *International Journal of Civil & Environmental Engineering IJCEE-IJENS*, 14(4), pp. 16–25.
- Kerzner, H. (2001) *Strategic planning for project management using a maturity model*. Wiley.
- Kothari, C. C. R. (2004) *Research Methodology: Methods and Techniques*. 2nd Editio. New Delhi: New Age International (P) Ltd., Publishers.
- Lines, B. C. et al. (2015) 'Planning in Construction: Longitudinal Study of Pre-Contract Planning Model Demonstrates Reduction in Project Cost and Schedule Growth', *International Journal of Construction Education and Research*, 11(1), pp. 21–39. doi: 10.1080/15578771.2013.872733.
- Motawa, I. and Almarshad, A. (2015) 'Case-based reasoning and bim systems for asset management', *Built Environment Project and Asset Management*, 5(3), pp. 233–247. doi: 10.1108/BEPAM-02-2014-0006.
- Naeem, S. et al. (2018) 'Impact of Project Planning on Project Success with Mediating Role of Risk Management and Moderating Role of Organizational Culture', *International Journal of Business and Social Science*, 9(1), pp. 88–98.
- Richardson, J. T. E. (2005) 'Instruments for obtaining student feedback: A review of the literature', *Assessment and Evaluation in Higher Education*, pp. 387–415. doi: 10.1080/02602930500099193.
- Seeley, I. H. (2015) *Quantity Surveying Practice*, Quantity Surveying Practice. Macmillan International Higher Education. doi: 10.1007/978-1-349-14402-0.
- Subramani, T., Sarkunam, A. and Jayalakshmi, J. (2014) 'Planning and Scheduling of High Rise Building Using Primavera', *International Journal of Engineering Research and Applications*, 4(6), pp. 134–144.