

An Emperical Survey on Production Planning Practice of Nigeria's Small and Medium sized Construction Firms

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Abstract— Effective production planning is vital for overall productive gains in the construction endeavors as its various processes are interwoven requiring careful planning from conceptualization through production process to enable control and effective delivery. Nigerian construction industry constantly faces challenges in effective production planning in light of the dynamic nature of the industry and misconception of production planning as a task related to plan generation rather than a managerial process. This Paper examines the effectiveness of production planning by small and medium construction firms in Nigeria; identify the factors militating against good production planning practice and recommend possible ways to overcome such challenges. Data were collected from construction professionals in charge of production planning in the firms in, analyzed and subjected to t-test. The results showed that production planning exercises is mostly carried out by project managers who in most cases use the bar chart technique for planning whatever type of projects. Also, factors militating against good production planning practice include: inadequate duration allowed for preparation of the production plan; inadequate project information; fluctuations in labour and material cost; cash flow inadequacies. It is recommended that adequate time should be allowed for production planning; appropriate planning technique should be used for projects as appropriate; adequate project information should be provided to project planners prior to production planning exercise and a realistic cash flow programme should be prepared and closely monitored to ensure that production plans are not hindered due to cash flow delays.

Keywords—*construction; production planning; small and medium firms; nigeria.*

I. INTRODUCTION

The poor performance of the Nigerian construction industry can be related in some ways to the economy.

Nevertheless, the prevailing economic climate, the performance of the industry can be improved through the implementation of appropriate and relevant management practices by the industry operators. The need to develop competences and capabilities required for efficient project management is particularly important in this century. Increased competition due to a more global economy and improvement in information technology means that local operators within the construction industry in developing countries need to deliver projects as efficiently as possible. Project planning has been found to be one of the most significant factors for the efficient and effective delivery of projects [1]; [13]; [37] and [7]. Since the planning function of management is responsible for defining the work to be managed, planning can be said to provide the basic for the performance of other management functions, aid productivity improvement [27] and therefore, considered to be the most critical management function [1]; [13]; [17] and [7].

The need for production planning effectiveness in construction has been expressed in literatures as [35] and [30] stated that achieving project success is largely dependent effective coordination on the projects which requires an in-depth knowledge of core planning elements. Project planning involves the determination of the lines of carrying out a firm's operation. That is the identification of the company's policy objectives, the general program, the overall plans, the assessment of cost and the organizational requirements. If the production process is to run smoothly, scheduling of equipment, tools and materials required, the preparation of working instruction and techniques as well as the balancing of personnel required for the execution of the project must addressed properly [29]. "The lack of pre-construction planning is surely the greatest failure of contractors in the entire construction industry," and the greatest benefits of

planning is “the project control and organization that lead to increased productivity, fewer accidents, and increased profitability” [31] and [27]. Thus, this paper examines the state of construction production planning by construction firms in Nigeria, identify the factors militating against qualitative production planning by construction firms in Nigeria and proffer solutions to the identified problems. This section has introduced the need for adequate planning in the construction industry and subsequent sections will expatiate on construction planning, planning stages, chosen methodological approach of the study and analysis of the results to a logical conclusion.

II. CONSTRUCTION PLANNING

Production planning involves the process of working out plan of program for a contract as a whole and assembling. The necessary data aim of such a program promotes organization and flow of various contract operations during the course of construction. Time and sequences of all operations and requirements of labour, materials and equipment are planned in advance [8]. At project onset an important adequate period, before starting operations is made available for the proper planning of methods, sequence of operations, safety, information required for production, ordering of materials and preparation of balanced programme. Time necessary for production planning of construction projects vary in the size and nature of the projects and this essential preliminary can affect the whole course of the project [8]. In areas of time management, The Last Planner System (LPS) explicitly list work activities and included in a weekly work plan (WWP) to increase commitment by project members [11]; [5]; [3], [2]; [18]; [32]; [3] and [28]. Production planning in its broader perspective involves advancing as to what is to be done, what are the activities, how it is to be done, when it is to be done, where it is to be done, what is needed to do it, who is to do it and how to ensure that it is done: all of these channelize to generate and evaluate options for solving an action plan aimed at achieving the product and or specified goals [10].

Production planning is a process of deciding in advance what is to be done and how and how to get what done. It involves determination of overall missions, identifying key results and setting out goals as well as developing policies, programmes and procedures for achieving them. It provides also, a frame work for integration of complex systems of interrelated future decisions [6]. The scientific approach to production planning according to [6], begins with a complete analysis of the project, down to its smallest component part. In construction equipment motion planning and re-planning for instance, crane path and collision detection for construction safety are essential for smooth operations [22], [20]; [9]; [38]; [24]; [25] and [4]. The production of each is planned in terms of the optimum quality and quality of materials, considering the labour and plant resources available. The whole is then fitted into a closely integrated program of production, the ideal which is that; each component should be ready on time; in the component should be ready on time; at the right place; the flow of work should be logical and in a single direction; the distance travelled and the amount of lifting and handling during this flow should be minimum possible and Machinery and men should be

employed at the optimum balance, to capacity, without breaks or delay due to shortage or error in the programme.

A. Construction Planning Parties and Personnel

The knowledge of several parties involved in construction planning plays a key role in understanding how various aspects of planning operate in practice. [34] grouped parties involved in construction planning as: (i) concept and design: client (customers and users) project managers (the owner’s) project specialist (from various disciplines: cost, schedule, construction, procurement), and design engineers (for both process and facility) and (ii) production planning: project managers (the constructions), project engineers, home office (consisting of construction planning and control, procurement and controls, and operations and engineering), design engineers (same individuals as in design), client (represented by the owner’s project manager), and sub-contractors. Majority of those trusted with construction planning on site are designated as site Agents and Engineers. Many of them have spent less than 3 years in the industry and therefore, would not be expected to possess enough experience to cope adequately with the responsibilities of ensuring that large projects are executed properly. In smaller firms also, many site agents and engineers have very little formal education in construction planning. They are as a result not conversant with planning techniques that would aid successful execution of project. As a result; continuous professional development (CPD) should be organized to educate these categories of planners [30].

B. Construction Planning Attitude

In the Nigerian construction industry as it was expressed by [30], management attitude towards project execution have not been encouraging to site Agents and engineers as projects such as shortage of materials/plant and cash flow problems are part of general lack of interest in the smooth running of construction sites and do contribute greatly to delays on sites. A project is successfully managed and delivered when the entire project organization is involved from top management down through supervision [26]. To ensure success on all projects, management need demonstrate readiness to make construction resources available to project staff as all parties involved in construction project execution would benefit from adequate provision of construction resources on site. Since construction costs are borne by clients, the degree of interest shown by clients in the planning of projects is important for timely completion of projects.

C. Construction Planning Importance

[10] concluded that a well conceived project plan, developed before the commencement of project execution, can go a long way to preventing project collapse on account of management failures although, carefully project production plan, cannot make up for bad production management. The objective of planning construction project is therefore to pre determine how the project objectives will be effectively achieved. Planning precedes all managerial activities and the process combines systematic creative thinking with planning techniques to develop a project plan. The project plan comprises time plan, resources plan and project control plan highlighting:

- Project plan clearly defines the scope of work. It breaks down its objectives into clear, identifiable, qualified, attainable and verifiable goals which are assigned to individuals and responsibility centres for accomplishment.
- Project plan and the management in performing its function efficiently and effectively.
- It forms the basis of operation and directions and show how project is to be runs
- It identified critical activities, thus enabling the managing of project by exceptions.
- Project plan provide the yard-sticks for measuring progress and evaluating resources performance.
- Project plan provides the basis for coordinating the efforts of clients' consultants, designer, builders and all other team players.
- It maintains continuity of work, especially when project organization is temporary its staffing is transient in nature
- Project plan creates healthy environment. It promotes only of purpose among functional Diversities to make people, time and cost conscious. It commits individuals to task which makes them to achieve challenging targets.

D. Planning Improvement Perceptions

Comprehensive utilization of planning system and scheduling of materials, but its deliver, labour requirements and plant schedules. This would help in immunizing delays on construction sites. Comprehensive utilization of planning system will and agents and construction in soliciting management assistance towards project delivery. Such planning would facilitate speedy production by establishing: materials delivery dates; types, quantities and duration of equipment needs; the classification and numbers of workmen required and the time they are expected on site, and possibilities of reducing project duration. The introduction of better technology into the planning process in the Nigerian construction industry is highly essential as a result of need for regular up date of plans. This is required in all the sites of firm ranging from small to large firm. Aside the fact that computer aids production planning, other site functions such as preparation of accounts, estimating information, storage, should control could benefit from the use of computer. For the Nigeria construction industry to rise up to the challenges of a growing economy, there is need to continually update the knowledge of construction personnel either on site or at head office Project production planning in Nigerian is grossly deficient as project are poorly managed and some firms simply do not posses necessary technology for executing the projects they are handling. There are needs to setting up training schemes to educate contractors on different aspects of construction management. Efforts should be concentrated in the following areas as stated by [30]. These areas are: short and long term planning for the firm; realistic programming of individual jobs: site layout sub-contractors work; material purchasing handling and stock control; office management and financial control procedures information storage and retrieval, record-keeping, book-keeping, costing, and

accounting; proper control of work in progress using standard management technique.

E. Planning Stages

Production planning according to [14] could classified into three main stages, which includes: pre-tender planning, pre-contract planning and contract planning stages.

1) *Pre-Tender Planning*: This is the planning carried out estimate preparation in contribution to tender for a project. It is usually prepared by contractors and shows their consideration to aid tendering process. The pre-tender programme further helps the estimator to estimate the method related items and also time-related costs. The time period for currying out pre-tender planning activities may vary from one need to three months, depending upon the nature of the engineering [19]. The stages involves the preparation of an estimate are: the decision to tender; the pre-tender report; the site visit report; engineered to subcontractors and supplies; the statement of construction methods; the build-up of the estimate rates; the pre-tender program; the preliminaries build-up; the estimate adjudication and analysis of result. The above sequence of events takes place during the estimating process within the structure of the medium to large scale firm [14].

2) *Pre-Contract Planning*: This is the planning which takes place after the award of a contract, prior to the commencement of construction work on the project. A pretender plan is usually developed by the winner contractor based on traditional procurement system [19]. The time period for pre-contract planning activities varies widely. The date of possession of the site is normally stated in the contract document. Time period of up to six weeks are however of common practice. The stages involved during pre-contract planning are: the pre-contract report and meeting; pre-contract check List; placing of Subcontracts; site layout planning; schedules of requirements; preparation of master program; arrangements for commencing and the preparation of contract budgets [14].

3) *Contract Planning*: This is the planning that takes place during the building production process. Contract planning is prepared by the main contractor to maintain and ensure that the work is done on-time and within budget. "It is mainly the breakdown of the master programme into stage, short term and weekly programme" [19]. It is the

responsibility of the contractor to complete the contract within the specified time period contract planning activities established standards against which progresses be reviewed at regular intervals during construction. To complete the project within the contract period demands action to current for any short falls in such progress. The stages involved in contract planning during a project may be summarized as six-weekly and monthly planning review; weekly or short term planning; daily planning; monthly and Weekly report of progress and

updating of progress and comparison of budget with performance. The contract planning stages of a contract enable requirements and progress to be reviewed monthly and weekly. Site meetings of monthly intervals with actuates, consultant and subcontractors from an integrate part of the planning process [14].

III. RESEARCH METHODOLOGY

In order to adequately capture respondents perception on existing factors militating against proper planning within Nigerian construction industry, 40 structured questionnaire were randomly distributed to Architects, Builders, Engineers and Quantity Surveyors. The respondents were selected across small, medium and large scaled construction firms. Questionnaire response rate amounted to 62.5% adequate for

the sample size. The data derived was subjected to descriptive analysis and t-test.

IV. RESULTS AND DISCUSSION

The demographic outlook of respondents as in Table 1 below revealed that 68% of the respondents were drawn from building construction companies, 4% from the civil engineering and 28% from real estate development firm. It was also observed that 44.6% of respondents were drawn from small scale firms, 46.8% from medium sized firms (based of firms classification on labour turnover basis) while 8.6% of respondents left were drawn from large scale companies denoting that respondent were largely drawn from Small and medium sized firms. Categorizing the respondents based on this: Architects 2%, Builders 86%, Civil Engineers 8.0% and Quantity Surveyors 4.0%. Based on experience, the percentage of respondents with work experience of less than 5 years are 24.0%, those within the bracket of six to ten years are 36.0%, eight percent (8.0%) had between 11 and 15 years of work experience and 32 % have above 15 years of work experience. With respect to qualification of respondents, 4 % have OND, 28% with HND 32% are with B.Sc., 20% with PGD and 16% have masters degree. None of the respondents have a doctorate degree.

TABLE I. DEMOGRAPHIC DISTRIBUTION OF RESPONDENTS

Nature of Company (%)		Company Size (%)		Profession (%)		Experience (%)		Qualification (%)	
Building Construction	68.0	Small	44.6	Architects	2.0	0-5	24.0	OND	4.0
Civil Engineering	4.0	Medium	46.8	Builders	86.0	6-10	36.0	HND	28.0
Real Estate Development	28.0	Large	8.6	Civil Engineers	8.0	11-15	8.0	B.Sc.	32.0
				Q.Surveyors	4.0	>15	32.0	PGD	20.0
								M.Sc.	16.0
								PhD	0.0

The result centered around production planning issues in table II below, shows that 52% of the professionals that does production planning for construction are project managers, 28% being head office planning department, 8% are general managers and site engineers and consultants planners 4%. Also 56.5% of these planners have between 6-10 years of construction experience, 30.4% with over 15 years, 8.7 % with below 5 years and 4.8% indicates that theses planners have between 11-15 years construction experience. It can also be deduced from the survey made that about 79% of production planning function is located at the head office of the firm and about 20% is located at the site office with none available with consultants' planners. 58.3% of firms visited start the planning of projects before tendering, 41.7% starts planning after bidding, and none of the companies visited starts planning for projects during its construction phase. Based on the results on the survey made as shown on figure 4.4 about 71% of respondents indicated that designers involved in planning of projects while about 29% indicated that designers do not involve in the project production planning.

Planning Personnel (%)		Experience (%)		Location of Planning Function (%)		Planning Stages (%)		Designer Involvement in Planning (%)	
Site Engineer	68.0	0-5	8.7	Head office	2.0	Before Tender	58.3	Yes	70.8
Project Manager	4.0	6-10	56.5	Site office	86.0	After Tender	41.7	No	29.2
General Manager	28.0	11-15	4.3	Consultant	8.0	During Construction	0.0		
Planning Dept (H/O)	28	>15	30.4						
Consultant	4								

TABLE II. PRODUCTION PLANNING DISTRIBUTION ISSUES

From the survey, Table III shows that about 44% of those that production planning for project hold B.Sc, 24% with far HND, 20% respondents identified that some of the planners obtained HND, 20% related that some of those that does production planning for construction project have masters degree and 4% for doctorate. With respond to attendance of Continuous Professional Development (CPD), the analysis revealed that 52% of respondent claim that their production planners attend CPD annually, 21.1% say their planners attend twice a year 13% agreed that those that does production planning for their company don't attend CPD with this it shows that since 52% of respondent claim their planner attend CPD it means majority of those that plan are equipped with relevant skills required form effective planning of construction projects. With respect to planning stages, it was shown from analysis that most sites visited (58.3%) do plan for project production before tendering. Most of respondents see pre-tender planning as being very important in the effectiveness of the project even though the tender is not guaranteed to be successful, aside the fact that it

could be required by contract. This planning make the planner know what expected and the time or duration in which the project should finish. 41.7% plan for production after tender as such company/firm see it as a time wastage since such tender are not guaranteed to be successful . The implication of failing to prepare a pre-tender plan is that production deadline is negotiated without any realistic plan. None of the firms starts production planning during construction stage as shown by survey result. Also it can be induced that most about 71% of respondent stated that designer pops in where there seem to be problems in the design which may be realized in the course of production. For most of the site or firms visited 81.8% undergo site investigation before planning for production, this assist in knowing the approach and method of production to be followed, 18.8% of the firms do not undergo site investigation before planning for production. This means that details of the site is received such project is not known and this may result into a whole lot of problems that may be realized during the production phase of the project.

TABLE III. QUALIFICATION, ATTENDANCE OF CONTINUOUS PROFESSIONAL DEVELOPMENT AND PLANNING INVOLVEMENT

Qualification (%)		Attendance of CPD (%)		Planning Stages (%)		Designers involvement in planning (%)		Site investigation before planning (%)	
OND	0.0	Quarterly	13.0	Before Tender	53.8	Yes	70.8	Yes	81.8
HND	24.0	Bi-annually	21.7	After Tender	41.2	No	29.2	No	18.2
B Sc.	44.0	Annually	52.2	During Construction	0.0				
PGD	8.0	Don't attend	13.0						
M.Sc.	20.0								
PhD	4.0								

Table IV below shows the prices of the project handled of which 42.1% of firms of respondents handled worth between 10 to 50 million, 28.7% handled between 50 to hundred million Naira projects, 15.8 handled less than N10 million worth project while a few percentage of 5.2 Percent greater than N500 million worth. Most of these firms (about 67%) handled both private and public while 12.5% and 20.8%

handled private and public projects respectively. On number of operatives involved in project handled, about 20% of respondents agreed that the operative involved in the project handled was between 1-10 and 10-30 respectively while 58.3% agreed they had operatives more than 30 on project handled. It can be seen from analysis made on repetitive projects that 47.6% constituting almost half of the

respondents uses the simple bar chart technique for planning projects, 33.3% use the critical path method (CPM), about 14 percent use the line of balance technique (LOB) while 4.8 percent used PERT. It is surprising to know that a large chunk of firms uses the bar chart technique for repetitive projects. This ought not to be so as the line of balance (LOB) delivers perfectly and on time repetitive projects compared to

the bar chart technique. On complex projects, about 48% employ the critical path method being the most versatile tool used for planning complex projects while 33.3% still employ the simple bar chart technique and 9.5% each uses both LOB and PERT respectively.

TABLE IV. CONTRACT TYPES OF PROJECT CONTRACTS AND PLANNING TECHNIQUE

Contract Prices (%)		Type of Project (%)		No of Operatives (%)		Repetitive Projects (%)		Complex Projects (%)	
<10M	15.8	Public	20.8	1-10	20.8	Bar Chart	47.6	Bar Chart	33.3
10-50	42.1	Private	12.5	10-30	20.8	CPM	33.3	CPM	47.6
50-100	28.7	Both	66.7	>30	58.4	LOB	14.3	LOB	9.5
100-500	13.2					PERT	4.8	PERT	9.5
>500	5.2								

The most frequent reason for choosing these planning techniques in Table V were giving as 56.5% of respondents agrees that it is easy to understand by workmen, 17.4% indicated that it is easily understood by top management, 13% percent indicated that is best to control, about 9% indicated is as being good for cost control and 4.3% agreed that it is used as a result of client request. This is in agreement with [30] assertion on project planning in Nigeria construction industry. Also, it was shown that most respondents rate cost and cash flow with mean 3.81 as being most important planning area, followed by material allocation with the mean of 3.62, project structure with mean 3.55, manpower allocation was indicated also as being important in production planning as it has a mean of 3.50, followed by work methods, site logistics with both of mean 3.45 and 3.30 respectively. The least

important in planning area as rated by respondents are major equipment and work schedule respectively with both of mean 3.20 each rating both as the least. Responses were made by respondent regarding the factors that militate against qualitative production planning in Nigeria from which the following frequent factors were listed in the following order of precedence: inadequate information i.e. specifications, detailing, site information and drawings; lack of technical know-how/professional skills; government instabilities and policies; inadequate funding (cash-flow); environmental and climatic factors; procurement methods; fluctuations in cost of labour and materials; wrong use of planning techniques and change of production personnel.

TABLE V. CHOICE OF TECHNIQUE AND PLANNING PRIORITY

Contract Prices (%)		Planning Area		Rating
Client request	4.3	Cost and cash flow	3.81	1
Easily understood By workmen	56.5	Material allocation	3.62	2
Easy for top management To understand	17.4	Project structure	3.55	3
Best to control	13.0	Man power allocation	3.50	4
Good for cost control	8.7	Work methods	3.45	5
		Site layout and logistics	3.30	6
		Major equipment's	3.20	7
		Schedule	3.20	7

From the responses made in terms of projects handled by respondents, where the project value at award of contract, project value at final account, planned duration of projects and final duration of such projects were given and subjected to t-test, shown in Table VI reveals that: There is no significant difference between project value at award and at final account and there is/are significant difference between planned duration of project and final duration of project.

TABLE VI. STUDENTS' T – TEST FOR DURATION OF PROJECT AND PROJECT VALUE

Project Number	Final Duration of Project (f)	Planned Duration of Project (i)	Difference (Di) Di = f - i	Project Number	Awarded Project Value (i)	Difference (Di) Di = f - i	Final Value of Project (f)
	(weeks)				(N Millions)		
1	24	16	8	1	72	50	22
2	72	48	24	2	400	350	150
3	72	48	24	3	300	225	75
4	96	64	32	4	1,200	800	400
5	72	48	24	5	420	300	120
6	64	16	48	6	26	28	-2
7	40	24	16	7	23	22	1
8	17	16	1	8	9.8	10	0.2
9	22	22	0	9	16	16	0
10	32	24	8	10	6.5	5	1.5
11	144	48	96	11	37	32	5
12	28	20	8	12	3.5	3.2	0.3
13	72	48	24	13	11	10	1
14	20	16	4	14	14.5	15	-0.5
15	28	24	4	15	48	56	-8
16	24	28	-4	16	53	60	-7
17	44	48	-4	17	110	125	-15
			$\sum Di = 209$ $SD = 174.84$ $t = 1.03$				$\sum Di = 743.1$ $SD = 49.18$ $t = 4.24$

V. CONCLUSION AND RECOMMENDATIONS

The paper set out to examine the state of construction production planning by construction firms in Nigeria which was successfully actualized. The results points to a large majority of project production planners were project managers with a majority having construction experience not less than six years. The majority of these planners have their location in the companies head office with a few of the planning function located in the site office. Findings also shows that a good number of construction firms start project production planning before tendering or bidding for the project with the anticipation that such bid would be won in line with [28]. Before this planning is stated, a large chunk of these firms undergo site investigation before the commencement of planning. Furthermore, the investigation revealed that designers are involved in the production planning process. It also reveals that most of the planners hold a Bachelors' degree and that they only attend CPD annually though some of them do not attend CPD at all. On planning techniques, it was revealed that majority of the firm use the bar chart technique for planning repetitive projects considering the fact that it is easily understood by workmen. For complex projects, even as the Bar chart is put into use by some firms, majority of firm use the CPM though the Bar

chart is used in simplifying it on site so for workmen to easily understand it. The fact that the bar chart is easily understood by all does not warrant that such should be used for planning all kinds of projects but planning techniques should be used as they are appropriate or suitable for project to be planned.

Thus, the factors militating against qualitative production planning practice by small and medium size construction firms in Nigeria include: duration allowed for preparation and submissions for contract bids. Procurement procedure or method; inadequate information on project i.e. drawings and specification, site information and project delivery; government instabilities and policies; fluctuations' in the cost of labour and materials; inadequate cash flow wrong application of planning techniques; lack of technical know – how/ professional skills, change in production personnel and environmental or climatic factors. Though the research is limited to small and medium construction firms, the authors recommend the following for overall improvement in construction production planning:

- Production planners should possess adequate knowledge and acquire competencies in order to cope with the responsibilities of planning and management of projects. Professional bodies like the NIOB, NSE e.t.c, should improve more on the

organization of CPDs' to educate planners on production planning practice.

- Educational establishments training construction professionals should improve on their curricular to give students' as much adequate knowledge on planning as possible and judiciously monitor them in the course of training.
- Adequate duration should be given to contractors bidding for project by client in order to allow them have sufficient time to critically examine the project and so come up with suitable duration of project.
- Location of planning function should be made closer to point of project execution in order to monitor project execution. Such, the planning function should be located more at the project location and not at the Head office.
- Comprehensive utilization of planning systems should be ensured as it will aid constructor in soliciting management assistance towards prompt project delivery. Such planning would facilitate speedy project execution by establishing: Material delivery dates, types, quantities and duration of equipment needs, classification and number of labour required and times they are expected to work and possibilities of reducing project duration.
- Besides using adequate planning tool for planning projects, work breakdown structure of projects should include more activities as this would also enable project duration to be better estimated and make it easier to determine resource requirements and allocation.
- There should be prompt provision of funds and also cash flow to aid the processes of project execution so that such does not distort planned programs to ensure on – time delivery of projects.

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