

CONSTRUCTION PROGRAMMING: AN EFFECTIVE TOOL FOR PROJECT DELIVERY IN NIGERIA

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Abstract

Construction programming is a vital tool for effective project delivery in Nigeria's construction industry. This study was carried out to assess construction project programming of indigenous contractors within the Federal Capital Territory (FCT) Abuja, Nigeria with a view to enhance their performance. The research assessed the adaptation of construction programming in project delivery, causes of ineffective use of construction programming and infrastructure and resources for construction programming in construction industries within the FCT Abuja, Nigeria. Sample size of 300 respondents from six selected construction companies in Abuja was determined using 95% confidence level from a population size of 1920 calculated with Krejcie and Morgan sample size determination

table. Questionnaires were self-administered to respondents and the data collected was analyzed using mean statistical tool and relative importance index. Despite its importance, many construction companies in FCT Abuja, Nigeria do not adopt construction programming; instead they rely on traditional methods such as local way construction. This study investigates the benefits and challenges of construction programming in Nigeria, with a focus on its impact on project delivery. The study reveals that construction programming can improve project planning and coordination, enhance productivity and efficiency, and reduce delays and cost overruns. However, the adoption of construction programming in Nigeria is hindered by limited training and capacity building, inadequate infrastructure resources, and poor project planning and coordination. Based on the findings, the study recommends that construction companies in FCT Abuja, Nigeria need to adopt construction programming, invest in training and capacity building, and address infrastructure and resource constraints to improve project delivery. This study contributes to the body of knowledge on construction programming in Nigeria and provides insights for construction professionals, policymakers, and stakeholders seeking to improve project delivery in the construction industry.

Keywords: Construction programming, project delivery, construction industry, project planning, Work Breakdown Structure (WBS)

Introduction

Construction industry in both developed and developing countries may be viewed as that sector of the economy, which through planning, design, construction, maintenance and repair, transforms various resources into constructed facilities (Fred and Janet, 2021). Construction programming is a systematic approach to planning, organizing and controlling construction projects. It involves creating a detailed schedule and resource plan to ensure projects are completed on time,

within budget, and to the required quality standards. By utilizing construction programming, project managers can streamline processes, minimize delays and optimize resources, ultimately leading to successful project delivery. This implies that any country that its construction professionals can be able to manage and transform its resources into structures and building will in turn lead to a growth in the country's Gross Domestic Product (GDP). Ibrahim (2012) and Uduak (2006) defined indigenous construction companies as contracting firms that are fully owned and managed by Nigerians.

In Nigeria, enterprises are classified to reflect their size, location or capability; this classification provide basis for government intervention, socio-economic planning and research. Because of labour intensity of construction, construction companies are often categorized according to size of their permanent employees. This classification includes that of Abdul Azeez (2022), who identified four categories, namely; Micro (one to nine employees), small (10 to 99 employees), medium (100 to 299 employees) and large (300 and above employees). He further states that most enterprises in Nigeria are labour intensive and their size can be classified using the size of their permanent employee work force.

Effectiveness of construction planning was criticized by researchers such as inefficient resource utilization, escalating cost, compromised quality and heightened stress and anxiety (Graham and John, 2025). These criticisms led to a debates on the effectiveness of construction project planning. Despite these arguments, Francis and Rafi (2023) asserts that it is widely recognized that inefficient planning of construction projects plays a role in project failure. This failure is still regarded much, considering White and Fortune (2022) report that success ratio for construction and engineering project are still lower than 40%.

Some critiques of construction project planning, such as Laufer and Tucker (2016) argued that planning and the evaluation of the planning processes are insufficient, emphasis is on critical path methods, inexperience of construction process

and lack of information gathering methods by construction planners hinders the construction project planning process. Planning of construction projects often become more control-oriented than action oriented. Construction planning is often presented with complex and technical terms which can only be understood by professionals in construction industry.

Graham and John (2025) are of the opinion that despite the fundamental importance of the debates over construction planning, recent researches such as digitized construction planning have proceeded into refinement of existing planning tools and emphasising on the use of software for construction planning, but neglecting researching to explore organizational context of construction planning. This approach to the study of construction planning has not provided the required improvement in construction project planning. Basil (2005) observed that the lack of successful construction project planning is an important factor that leads to the death of most newly formed small and medium construction firms in Nigeria within their first five years of in incorporation.

Construction project planning which involves, identification of activities and actions, time and cost targets, performance milestone, is one of the four phases of construction project life cycle. Construction planning was shown to impact project positively. Harris and Mc Caffer (2015) observed that contractors of the developed countries have embraced planning of construction project, because the performance and profitability of the companies were found to be directly affected by efforts expended in planning, careful and controlled construction project delivery. Nigerian indigenous construction companies are said to be unable to meet their contractual requirements because of their inability to prepare and implement a good plan for a successful construction project delivery (Aniekwu and Audu, 2010). This situation, according Saleh (2014), has contributed to the inability of the construction industry to meet the construction needs of Nigeria.

The performance of Nigerian indigenous construction companies, was found by Ibrahim et al (2021) to be hindered

by mismanagement, which often result into inefficient planning of construction projects. Kirmani (2018) observed that this inefficiency in construction project planning significantly hinders productivity of the industry to a level lower than that of its multinational counterparts, resulting to major percentage of the total project in Nigeria going to multinational contractors. According to Aibinu and Jagboro (2014), another major criticism facing the Nigerian construction industry is the growing rate of delays in construction project delivery and other associated problems, which often results into dispute, arbitration, total abandonment and protracted litigation by the parties. These problems, according to Odeyinka and Yusuf (2022), are associated with planning and scheduling, they are internal factors in an organization that causes delay in construction project delivery. Nigerian indigenous construction companies were found to be using their central administration to plan project operations instead of an identified project manager, inappropriate application of planning techniques and non-adoption of computer applications and ICT in planning of construction projects (Inuwa, et al 2014).

Oladimeji and Ojo (2012) also opined that indigenous construction companies were found to lack the ability to efficiently and profitably deliver project due to inadequate planning and budgetary provisions among other factors. The outcome of these inefficiencies has been several reports of abandoned or malfunctioned facilities, project executed at higher sums and frequent cases of collapsed structures. The recurrent nature of these traits create dissatisfaction among clients which result into award of major capital-intensive project to foreign firms especially where quality and completion period are of utmost demand.

Adebayo (2021) was able to identify problems associated with construction planning and concentrate on some aspects of construction planning such as planning techniques, planning technology and planning manpower. This approach has not provided the necessary solution to the problem of construction planning in Nigeria, and the result has been recurrent experience

of same problems through the decades. He further selects few construction companies and compare the project planning techniques they adopt in planning; this only provide result relating to only planning technique in the selected organizations. But planning is influenced not only by technique but also other aspects of planning such as technology and other external factors. Hence, there is need to undertake research in order to study more organizations and more variables relating to construction planning.

Nigerian indigenous construction companies were shown to be associated with inefficient planning which result into low productivity and growing rate of delay. They were also found to be wrongly adopting methods and procedures of planning which often reduce the profitability of the companies and cause frequent cases of contract abandonment. Inefficiency in construction planning also have a negative impact on the national economy. As a justification to this study, there is need to evaluate current construction project planning of indigenous contractors, this will help in identifying causes of construction project planning problems and how to mitigate the problems.

Conceptual Framework And Literature Review

2.2 Conceptual Framework

Construction planning is a fundamental and challenging activity in the management and execution of construction projects. Emad (2019) opined that construction project planning is similar to every project planning. This is because construction project is characterized by similar project life cycle like any other project. But due to the unique nature of construction project, Abimbola (2023) is of the view that construction planning deserves to be studied separately. Bamisile (2014) is also of the opinion that construction projects should be planned specifically in consideration of technology choice, definition of work, estimation of required resources and durations of tasks. Construction project planning also requires identification of any interactions among the different work tasks

which are stimulated through the study of project documents. These documents are identified by Bamisile (2014) to include designs and drawings, estimation of quantities, construction method statements, project planning data, contract documents, site conditions, market survey, local resources, project environment and the client's organisation. The planning process of construction projects also takes into account, the strengths and weaknesses of the organization involved in the project.

Planning gives an impression that somebody is in control, it gives a sense of direction and the likely destination for the project. Planning of construction is generally concerned with completing work of designed quality in a short period as practically as possible which is compatible with economy of production. All future actions of the constructing company in relation to intended construction method, Programme of the work, type of materials, labour, plant and equipment must be made known to the clients and or his representative (CORBON/NIOB, 2014). Suppliers and sub-contractors should be given an early notice of when their goods and services may be required. Moreover, the constructing organization must have a clear knowledge of what their future commitment of materials, staffing need, labour, plant and equipment will be. Obviously, the time needed for planning of a construction project varies from project to project depending on complexity, details available, size of individual project and location of the project.

A plan is a detailed method which is formulated beforehand for doing or constructing something (Bamisile, 2014). Planning involves all the procedures required to determine what is to be done, who should do it and how it should be done. The overall mission of the project is determined through planning, its set goals as well as developing policies, programme and procedures for integrating complex systems such as building projects of interrelated future decisions. Planning has an implication of futurity, and it implies that there is some skill involved in its undertaking for an objective accomplishment. In short, a plan is a predetermined course of action. The futurity implication of

planning suggests that forecasting is an important part of the whole planning process. Anticipation of the state, nature or the result of alternative courses of actions is an important and crucial phase of decision-making process (Bamisile, 2014). Conscious effort toward anticipating the technological, economic, political and social climate for the organization helps the planning manager to avoid predictable pitfalls that might be disastrous.

Bamisile (2014) assert that scientific approach to production begins with complete analysis of the job, analysis of even trivial issues of the project. The production of each component should be planned in terms of the optimum quality of materials, taking into cognizance the labour, plant and equipment resources available. The ideal construction plan is described by Abimbola (2023) to be that which ensures all components of the project are ready on time, provide an accurate balance of quality, quantity and production time, the project is at the right intended place. He further noted that an effective construction project planning ensure that the work flow is logical and in single direction, providing as minimal as practically possible interference between individual components of the work. All form of machine maneuvers, materials, plant and equipment allowed for is the minimum that is practically possible, and delays, obstruction and errors due to poor programming of machine to labour input should be reduced to the barest minimum that is practically possible.

Principles of Construction Programming

Planning, scheduling and controlling begin right at the project inception stage, and continues throughout the period of project execution. The key principle of planning as indicated by Chitkara (2022) is focusing on starting planning at the early stage of the project life cycle. The planner or the management should include all parties that are to execute the project at the planning of their respective work. Mustapha (2016) highlighted the need for a project plan to be flexible, the flexibility of the plan allows it to suit prevailing conditions at any giving point in time. The

flexibility of the project plan also helps in making it suitable for versatile condition rather than restricted to a narrow area of operation. Chitkara (2022) opined that project planning cannot be completed without inclusion of calendar duration for all activities to be carried out. The calendar of activities showing when activities are to start and when they are to be completed is termed scheduling. The schedule guides the project time by informing the team what is to be done and when it is to be done. Analysis from Scott (2019) show that project schedule indicate important relationship that may exist among activities in the project, such relationship may include activity precedence, what must be finished before another starts. Project schedule also show activities that can be performed concurrently. The effectiveness of a plan is subject to understanding of the plan by all members of the project team; hence it is important to clearly communicate the project to all relevant parties in the project. He further indicated that communicating the plan to individuals and group help in avoiding delay, prevents interruption of work and also ensures full utilization of project resources.

Levels of Construction Programming

Project planning as a holistic strategy to a desirable future achievement may be quite cumbersome for some complex project. This, according to Harris and Mc Caffer (2015), makes it necessary to prepare a conscience plan of action both at the top management level where key decisions are made and also at the operational level where the actual execution of the project takes place.

Strategic Project Programming

Strategic project planning is carried out at the top management level and is termed the master plan. At this level, planning focuses on the overall project objectives, strategic plan, defines the scope and objectives of the project, identifies the methods and procedure to be adopted for the procurement of all consumables and utilities in the project. At this stage of

planning, the cost of the project is established and financing option defined, the extent, nature and where technology can be applied are identified.

Steps in Construction Programming

Planning of construction project involve the following steps:

- i. **Identify Opportunities:** Identifying opportunities for undertaking the project has to come before any attempt is made to plan the execution. It will be absolutely unnecessary to plan for a project that doesn't exist (Saleh, 2017). Therefore, seeking for opportunity becomes paramount and important to the management, if it wishes to profitably survive competition. Opportunity can be found within the construction industry and sometimes opportunity do come up in certain sectors that are not directly concerned with construction.
- ii. **Defining Client Requirements and Objectives:** Client objectives is an important aspect in planning construction project. It is important for contractor to establish objectives for the entire project and also for constituent's parts of the project. This is to be done for the long term as well as for the short-range goals (Fred & Janet, 2021). Objectives specify the expected results and indicate the end points of what is to be done, where it is to be done, where the primary emphasis is to be placed and also what is to be accomplished by the network of strategies, policies, procedures, rules, budget and programs.
- iii. **Developing Logic Diagram and Project Premises:** This is establishing relationship that may exist between all activities of the project. It is also important at this stage to establish, calculate and obtain agreement to utilize critical planning premises such as forecast, applicable basic policies and existing company plans. The premises are the assumption about the environment in which the plan is to be carried out (Mustapha, 2016).
- iv. **Developing Alternative Courses of Action:**

Management is required to examine and develop alternative courses of actions, especially those that cannot be identified easily (Chikara, 2022). There is hardly for any course of action that can only be performed through only one method. Plans have alternatives which are usually not clear at the beginning of project and sometimes these hidden options prove to be the best alternative.

- v. **Evaluate the Alternatives:** This involve weighing up such alternatives in the light of the planning premises and the client objectives. One course may appear to be very attractive because of huge financial gain it promises to offer but may require a huge capital outlay which may not be available, and may also have a slow late payback period when compared with other alternatives. Other alternative may offer less financial benefit but may have less risk; other alternatives may suit the long-term plan of the organization (Bossink & Bronwers, 2016).
- vi. **Formulating Alternative Course of Action “option B”:** After an acceptable course of action is adopted, it is advisable to device another option that can come handy should any part or whole of the plan fail to meet expectation. This is called Option B or plan B.
- vii. **Quantifying Plans by Budget:** This is the final planning step. The plan is given some form of meaning, it involves quantifying items on the plan list and converting such quantities into monetary value and hence, a budget is developed. Department or work section can have a separate budget which usually consists of its individual expense, and the departmental budgets are harmonized into the overall budget (Aniekwu & Audu, 2010).

Functions of Construction Programming

Planning effort are channeled into achieving, or accomplishing certain predetermined goals. Chandra (2009) identified that an effective plan serves as a basis of organizing work in the

project. The plan allocates resources to each activity and serve as an effective communication and coordination tool between the management team and the execution team. Bamisile (2014) described planning as a futuristic action whose function involve inducing people and organisation to look ahead before undertaking any action in the project. The more organisations look ahead, the more it is likely for them to recognize challenges early before they become problems that can adversely affect the successful completion of the project. The process of planning induces a sense of urgency in project delivery, this is due to the calendar nature of project schedule, the schedule defines each activity start and finish stipulated time. Project plan also serves a function of establishing a basis for monitoring and controlling project progress. Gibson and Hamilton (2016) also identified the ability of a plan to improve the operational performance of the built facility. Improving the performance of the built facility power consumption, maintenance requirements, and other user related requirements can greatly be improved right at the project execution if such features are identified early by the planner. A well-developed plan also serves as a function of reducing frequent occurrences of uncontrolled project growth and changes to the scope.

Benefits of Construction Programming

Planning is a process of setting goals and choosing the means to achieve those goals. Scott (2019) observes that without planning, managers cannot know how to organize people and resources to achieve their organizational goals effectively. Managers, the team and other project stakeholders will find it difficult to determine whether their progress is on course or not. It will also be difficult for the management of an organization to effectively control progress in a project without planning.

Chitkara (2022) describes an effective plan that will be useful to the organization needs to be set systematically, and it should supersede all form of managerial activity. That is, every management activity or action should be planned before such action is executed.

Benefit of Programming to the Contractor

The construction organization is vested with the responsibility of undertaking the construction or erecting the proposed facility. The contractor undoubtedly undertakes this responsibility with a motive of making financial gain or some other form of gain at the end of the project. The contractor also aims to create a good reputation capable of attracting new projects based on recommendation of the present projects. Scott (2019) attributed efficient project planning with an ability to help contractors to make financial gain at the end of project. Contracting firms are in constant competition within the construction industry and also with other competitors that are not necessary in the construction industry. Organizations compete for scarce resources, customer base, market share, quality employee and competition for a good public image. Organizations that carefully plan their project and control such plan to completion of the project have been found to be able to survive and enjoy an upper hand when faced with competition. This is because, at the planning stage, the organization is able to find the best combination of resources for the project, it defines how feasible and viable the project will be before making any heavy financial commitment.

Organisations that constantly plan the execution of their project have been found to be able to effectively organize and control the progress of its work. This is possible through proper coordination between all relevant departments that are involved in the project. In the plan, all coordinated efforts are channeled towards achieving the set objectives. This is because of the fact that such coordination, planning allows the organization to easily monitor and control progress, thereby making it easier to implement corrective measures and improvement should there be need for improved.

Abimbola (2023) describe construction of projects to be unique in nature. As a result of their uniqueness, each construction project presents different challenges to the performing organization. At the planning stage, Mustapha (2016) point out that such unique challenges are identified and

alternative solutions are proposed. Solution are then provided early in the project life before they can even have the slightest of effects on the projects. Experience gathered from several projects become useful and handy in the future project, hence planning provides an avenue for problem solving opportunity in time.

Furthermore, construction is said to be a process which involves transforming raw materials, semi-finished goods into facilities. Adeyemi and Otali (2013) are of the view that construction process often involve waste, which they describe as the difference between the value of materials delivered on site and those properly used as specified and measured in the work. Bossink and Bronwers (2016) submit that construction wastages account for about 20 to 30% of projects cost overruns. Adewuyi and Otali (2013) reiterate that the amount of construction waste generated can be greatly reduced by effective project planning of what should be procured and at what time, hence planning of project has an ability to reduce construction waste thereby improving the profitability of projects to the contractor.

Benefits of Programming to the Client

The client is a person or organization for whom a project is carried out, in the course of furtherance of trade, business or undertaking. Majority of construction clients are first time and one-off type of clients (HSA, 2013). Consequently, many construction clients lack good knowledge of the construction projects, as a result most clients find it difficult to successfully procure their projects. HSA (2013) opined that early planning help clients in selecting a worthy contractor, it also defines project objectives and scope. The plan also help clients to know the financial implication of their desired projects. Construction planning help client to achieve the project in earliest possible completion time. The plan also avoids interruption of work through scheduling of projects by the contractor. Construction planning also ensure that the client enjoy the best value for his money in a project, this is because, at the planning stage, the

client can conveniently identify possible alternatives and options he can use to achieve the project goals.

Benefits of Programming to the Project Team

In the execution stage of a project, individuals with different skills and specialisation are brought together to form the project team. Project plan identify all the project members, responsibility and authority in the project. Through the plan, relationships are formed, and the plan serves as an effective communication tool among the project team members and also serves as a control tool which can easily be referred to in times of disputes and ambiguities. Chandra (2019) states that construction planning creates a sense of responsibility among all the projects team members; this creates a clear image of who should do what and when and with what he should do the given task. This clarity in responsibility creates harmony, understanding and peaceful coexistence among the project team. A harmonious and peaceful project environment becomes more productive and convenient and provides a better chance of sharing knowledge and skills among the project participants.

Theoretical Review

A theoretical framework for construction programming draws from several established bodies of theory, moving beyond traditional scheduling to address the full complexity of modern projects. By integrating concepts from production, resource management, and process optimization, this framework provides a holistic approach to planning, controlling, and improving project delivery. Key theoretical components include:

Production System Theory

Traditional construction views production as a simple transformation of inputs into outputs. In contrast, production system theory models construction as a complex system of interconnected processes and flows. This perspective allows for a more detailed analysis of the construction site as a temporary

production system (Oladimej & Ojo, 2012). Task-Flow-Value (TFV) framework is a model that refines the understanding of construction production beyond a linear sequence of tasks and also production system design involves deliberately designing the project's production system to maximize value and minimize waste, rather than simply letting processes happen organically. This includes planning logistics, site layout, and the sequence of operations to optimize the flow of work.

Critical Path Theory

The Critical Path Method (CPM) and Program Evaluation and Review Technique (PERT) are foundational to construction programming, providing a mathematical basis for project scheduling (Inuwa, Samaila & Yusouf, 2014). Critical Path Method (CPM) is a deterministic technique that identifies the longest sequence of tasks (the critical path) which determines the project's minimum duration. Any delay on a critical task directly impacts the project's end date while program evaluation and review technique (PERT) consider probabilistic approach used for projects with a high degree of uncertainty. It uses three-time estimates – optimistic, pessimistic, and most likely for each task to calculate the expected duration and account for variations.

Resource Allocation Theory

This theory addresses how to distribute and manage scarce resources including labor, equipment, and materials to achieve project goals efficiently (Chandra, 2009). The distributions include resource leveling which is a technique used to balance workloads by rescheduling tasks to smooth out demand for resources without delaying the project's completion date. This avoids costly resource over-allocation and improves workflow. resource smoothing to optimize method that adjusts resource usage to stay within a predetermined capacity while not impacting the project's critical path and dynamic resource allocation which is modern approaches use data analytics and AI to provide real-time insights, enabling project managers to adjust resource plans dynamically in response to changes.

Lean Construction Theory

Borrowed from lean manufacturing, this approach applies principles to eliminate waste and maximize value in construction projects such as waste elimination that identify and remove any activity that does not add value to the customer. In construction, this can include wasted time (e.g., waiting for materials), wasted movement, overproduction, or rework. Last Planner System (LPS) is a collaborative planning system designed to increase work reliability and predict project schedule variability. It involves a multi-layered process that moves from a high-level master plan to detailed, weekly work plans, with input from the people doing the work and also pull planning; a method that starts with a project's milestones and works backward to determine the sequence and timing of preceding tasks, ensuring that work is done "just-in-time".

Project planning, is defined by American Association of Civil Engineers (AACE, 2011) as "the determination of a project's objectives with identification of the activities to be performed, methods and resources to be used for accomplishing the tasks, assignment of responsibility and accountability, and establishment of an integrated plan to achieve completion as required." Planning is the process through which the system adapts its resource to changing internal external conditions, Planning must create a feasible frame work and method statement for the execution of the works that provide the basis upon which the work will be performed as indicated by Adebayo (2021). Planning start at an early stage of project conceptualization, and it progress continues through the various phases of the project life cycle up to the project closeout stage or hand over. Planning is a continuous event rather than a definite one-time effort. Scheduling refers to steps that are involved with the creation of distinct activities, activity duration and the inter relationships that exist between activities that represent the plan chronologically and that can be communicated effectively.

According to Chitkara (2022) and Chandra (2019), planning construction project consists of the following items:

- i. Defining all the stakeholders of the project, their roles, responsibilities and how they are going to affect scheduling project execution.
- ii. Defining terms of contract, including project delivery methods, which will determine the amount of effort expected from the project team for the planning.
- iii. Identifying resources available for planning and constraints to the planning process.
- iv. Establishing a planning process to determine the scope of work, client requirements and order of schedule.
- v. Review of project plan and approval requirements.
- vi. Defining major activities to be carried out, expected goals to be achieved at the end of each activity, and the preferred sequence in which all the activities are to be completed.
- vii. Establishing a composite plan which is phased based on time required to achieve project completion.
- viii. Selecting a proper project management strategy necessary to establish cost/schedule areas for the further definition of the scope of work.

Developing of planning methodologies that are based on time, like logistics planning, site access plan, in situ concreting plan, heavy equipment mounting plan, long lead material/equipment procurement plans, owner provided material/equipment planning, and other such specific purpose plans.

Benefits of Scheduling

Project scheduling provide opportunity to select the most effective alternative to perform the project. It gives a clear idea regarding the required men, materials and equipment at different stages of work. Through the schedule, the management can ensure an optimal utilization of scarce resources and can also monitor the current status of work as compared with the actual plan. If there is any delay, proper remedial measures can be taken to avoid such delays.

Work breakdown structure is defined as a hierarchical structure designed to logically subdivide all the work-elements of the project into a graphical presentation. CORBON/NIOB (2014) identified work breakdown ability to make or break a project, this according to the report, is because work break down structure sets the foundation for the rest of the project planning, and also helps to ensure proper project baselines, estimation, resources use, scheduling, risk analysis, and procurement.

The full scope of work for the project is placed at the top of the diagram, and then subdivided into smaller elements of work at each lower level of the breakdown. At the lowest level of the WBS the elements of work is called a work package. A list of project's activities is developed from the work packages. Effective use of the WBS will outline the scope of the project and the responsibility for each work package. There is not necessarily a right or wrong structure because what may be an excellent fit for a simple building project may not be sufficient for a more complex building project.

Scheduling in Construction Programming

Chandra (2019) defined scheduling as a means of putting plan on calendar basis. In a project, networks diagrams show the sequence and inter dependencies of activities, their time and their earliest and latest completion time (Chandra, 2019). Interdependencies and relationship need to be scheduled to determine commencement and termination dates of each activity, using optimum resources or working within resource constraints. Adebayo (2018) described scheduling as the time table of work. Work scheduling is important to the planning process because it simplifies the project plan by adding time to activity, scheduling validates the time objectives and also optimises the resources employed in the project. Scheduling also forecasts the input resources and predicts the outcome of the planning; it evaluates the implication of scheduling constraint, thereby pronouncing the consequences of inadequate materials or time on the plan. The schedule shows such consequences as time overrun or delay in the plan.

Empirical Review

Planning techniques are usually methods of planning that are employed at project operational stage. Planning techniques involves establishing a method of statement for each activity, its relationship with other activities, timing of the projects and how it affects the overall project completion period. Project planning techniques allows for a detailed look at the project's resource requirements, which are not obvious at the strategic level (Harris and Mc Caffer, 2015). The common project planning techniques include the bar charts and linked bar charts, line of balance, network methods, and programme evaluation and review techniques as indicated by Chitkara (2022). Graphical representation and review technique has also been identified as an important planning technique that has been in use in other project management environments such as the military. The basic network techniques such as Critical Path Method (CPM) and Line of Balance (LOB) are recommended for typical, repetitive projects with comprehensively known scope that is well defined, and the potential changes and risks only slightly affect the entire course of the project (Chandra, 2019). Their application requires precise estimates of the tasks attributes (time, cost and resources); it is also recommended that duration for each activity to be represented by those techniques should be presented as a single value, for example seven working days (Atere, 2019).

The Bar chart or the Gantt chart was developed by Henry Gantt in 1900 originally for industrial production management and has since been widely used in construction management (Chitkara, 2012). The bar chart is a pictorial representation consisting of two co-ordinate axes; one showing the time and the other showing project operations or activities, and each activity is shown by an individual. The length of the bar represents the project duration. The left end of the bar represents activity starting point while the right end of the bar indicates the end of the activity. Inuwa et al (2014) observed that the simplicity, visual clarity of the bar chart to even those

with no prior construction experience makes it a very valuable medium for displaying job schedule information. The bar chart as shown in Plate I, is the most useful tool for presentation of schedules, but not as a planning technique in the opinion of Chikara (2022), but Passingham (2019) indicated that bar chart is prepared to serve as a control tool for tracking and controlling schedule performance. It provides an easy and convenient way to monitor job progress, schedule equipment and workers, and record project advancement. This makes the bar chart mostly used as a complement of other techniques, especially the critical path method, and as a rough preliminary plan (Passingham, 2019).

Despite the mentioned advantages of the bar chart, it has the disadvantage of failing to indicate the interrelationship among the activities (Chitkara, 2022); effect of delay of one activity on other activities cannot be seen easily. It does not indicate which activity is critical and available float in the project. Consequently, bar chart does not convey to managers and workers what consideration must be given to the prerequisite activities; it does not reflect the exact progress of the work on the day of review and; it management does not work effectively, where there are uncertainties in expected time requirement of an activity.

Methodology

The methodology of the research is descriptive survey research which involves the use of purposive sampling technique to gather information on respondent opinion on the subject matter from the study area, sample size of 300 respondents from six selected construction companies in Abuja (Julius Berger Nigeria, Dumez Nigeria Plc, Rome Construction Company Limited, Dantata & Sawoe Construction, Setraco Building and R.C.C (Nigeria) Limited) was determined using 95% confidence level from a population size of 1920 calculated with Krejcie and Morgan sample size determination table. Questionnaires were self-administered to respondents and data collected were analyzed using mean statistical tool and relative importance index.

Results and Discussion

The data for this research were collected using questionnaires. This section present, analyze and discuss the results below:

Adaptation of Construction Programming in Project Delivery

From table 1, the results show that all items were disagreed on adaptation of construction programming in project delivery with a mean score ranging from 2.06 to 2.43 and a relative importance index of 0.81 to 0.96 respectively. This shows that most of the organisations are not using construction programming for project delivery as a result of lack of awareness of the construction programming.

Table 1: Adaptation of Construction Programming

S/N	ITEM	MEAN	RII	RANK
1	Organization adopt construction programming in its projects	2.43	0.96	1 st
2	Organization integrate construction programming in management processes.	2.35	0.92	2 nd
3	Construction programming tools and techniques are used in conjunction with other project management tools and techniques	2.32	0.90	3 rd
4	75% of organization's projects use construction programming	2.29	0.88	4 th
5	Project managers are familiar with construction programming concepts and tools.	2.20	0.86	5 th
6	Personnel have formal training or education on construction programming.	2.18	0.82	6 th
7	Personnel understanding the benefits and limitations of construction programming.	2.06	0.81	8 th
8	Software for construction programming is available everywhere	2.06	0.81	8 th
Average Mean		2.24		

Source: Field Survey, (2025)

Causes of Ineffective Use of Construction Programming

The result in Table 2 shows that respondents generally agree that ineffective use of construction programming has the ability to cause all of the identified problems, as highlighted by mean ranging from 3.56 to 4.40 which show that all the items were

agreed to be factors to be considered for effective project planning with a relative importance index of 0.71 to 0.88 respectively.

Table 2: Causes of Ineffective Use of Construction Programming

S/N	ITEM	MEAN	RII	RANK
9	Cost Over run	4.40	0.88	1 st
10	Time over run	4.30	0.86	2 nd
11	Compromised project quality	3.94	0.86	2 nd
12	Wrong Estimates	4.24	0.85	4 rd
13	Poor project planning	4.22	0.84	5 th
14	Dissatisfied project team	3.98	0.80	6 th
15	Data management issues	3.90	0.78	7 th
16	Poor scope control	3.80	0.76	8 th
17	Poor quality control	3.76	0.75	9 th
18	Abandonment of projects	3.58	0.72	10 th
19	Inadequate feedback mechanisms	3.56	0.71	11 th
Average Mean		3.97		

Source: Field Survey, (2025)

Infrastructure and Resources for Construction Programming in Construction Industry

The table 3 below shows that responses of infrastructure and resources for construction programming in construction industry has a mean score ranging from 2.21 to 2.52 which indicate that all items were disagreed to be insufficient or no infrastructure and resources for construction programming in most of the construction industry to help in project planning and execution with a relative importance index ranging from 0.91 to 0.79 respectively.

Table 3: Infrastructure and Resources for Construction

S/N	ITEM	MEAN	RII	RANK
20	Construction programming software available	2.52	0.91	1 st
21	Dedicated systems for Programming	2.47	0.90	2 nd
22	Adequacy of hardware infrastructure for programming	2.42	0.90	2 nd
23	Dedicated server for construction programming data	2.40	0.88	4 rd
24	Regular update of programming software.	2.39	0.82	5 th
25	Adequate programming personnel	2.32	0.81	6 th
26	There are instructors to train upcoming programmers	2.21	0.79	7 th
Average Mean		2.0-7		

Source: Field Survey, (2025)

Causes of Construction Programming Failure

From table 4, it can be seen that respondents agree that all the identified factors can cause construction project planning to fail. This is indicated by mean score ranging from 3.88 to 4.68 with a corresponding relative importance index of 0.77 to 0.94 respectively.

Table 4: Causes of Construction Programming Failure

S/N	ITEM	MEAN	RII	RANK
27	Financial integrity of client	4.68	0.94	1 st
28	Inadequate Resource Budget in Planning	4.68	0.94	1 st
29	Ethical Standards of Client	4.58	0.92	3 nd
30	Wrong Estimates	4.58	0.92	4 nd
31	Poor communication Among Project Team	4.45	0.89	5 rd
32	Wrong Specification and Requirements	4.26	0.85	6 th
33	Poor Record Management	4.06	0.81	7 th
34	Poor Risk Management	4.00	0.80	8 th
35	Poorly Defined Deliverables	3.96	0.79	9 th
36	External Influence	3.92	0.78	10 th
37	Ambiguity in Team Members Role	3.92	0.78	11 th
38	Disregard to Project Management Rules	3.88	0.77	12 th
Average Mean		4.25		

Source: Field Survey, (2025)

Factors Affecting Construction Programming

Table 5 shows that incomplete working drawings is the first (RII = 0.88) most likely item that can affect planning. Incomplete

working construction documents and approvals (RII=0.86) is the second most likely item that can negatively affect planning, vague definition of project (RII= 0.85) is ranked as the third most item that can affect the process of planning. The result further shows that leadership of the project team and resource constraint were both ranked seventh (RII=0.75), client pressure was ranked eighth (RII=0.69), contractors' enthusiasm (RII=0.58) was ranked ninth.

Table 5: Factors Affecting Construction Programming

S/N	ITEM	MEAN	RII	RANK
39	Incomplete working drawings, documents and approval	4.42	0.88	1 st
40	Vague definition of project	4.24	0.85	2 nd
41	Knowledge on how to plan	4.00	0.80	3 rd
42	Time constrained	4.00	0.80	3 rd
43	Lack knowledge of planning tools	3.88	0.78	5 th
44	Un availability of planning technology	3.82	0.76	6 th
45	Resources constrained	3.76	0.75	7 th
46	Leadership of project team	3.76	0.75	7 th
47	Client pressure to start work	3.46	0.69	9 th
48	Contractors enthusiasm	2.90	0.58	10 th
Average Mean		3.93		

Source: Field Survey, (2025)

Findings of the Study

The study on construction programming as an effective tool for project delivery in Nigeria revealed the following key findings:

1. Limited adoption of construction programming: Many construction companies in Nigeria do not adopt construction programming, relying instead on traditional methods.
2. Lack of training and capacity building: Construction professionals in Nigeria lack the necessary training and capacity building to effectively utilize construction programming tools and techniques.

3. Inadequate infrastructure and resources: Nigeria's infrastructure and resource constraints impact the effectiveness of construction programming.
4. Poor project planning and coordination: Construction projects in Nigeria often experience delays and cost overruns due to poor project planning and coordination.
5. Ineffective risk management: Construction projects in Nigeria often lack effective risk management strategies, leading to project delays and cost overruns.

Conclusion

Construction programming is a vital tool for effective project delivery in Nigeria's construction industry. This assessment needs to take broader evaluation of construction planning taking into account all necessary components of construction project planning. By creating a detailed schedule and timeline, construction programming helps to ensure that projects are completed on time, within budget, and to the required quality standards. This approach enables construction professionals to plan, coordinate, and control the various activities involved in a project, from inception to completion. Embracing construction programming and addressing the challenges and opportunities outlined above, Nigeria's construction industry can improve project delivery, enhance productivity, and increase competitiveness.

Recommendations

To fully leverage the benefits of construction programming in Nigeria, the following recommendations are proposed:

1. Invest in technology and digital tools to enhance the efficiency and effectiveness of construction programming.
2. Provide training and capacity building for construction professionals to develop the necessary skills and expertise.
3. Improve infrastructure and resources to ensure the successful implementation of construction programming.

Implications for Practice

1. Construction companies in Nigeria should adopt construction programming to improve project delivery.
2. Construction professionals in Nigeria require training and capacity building to effectively utilize construction programming tools and techniques.
3. Government and regulatory bodies should provide support for the adoption of construction programming in Nigeria's construction industry.

References

- Abdulazeez, A. D. (2021). Development of Pro-type Electronic Document and Record Management System (EDRMS) for small and medium building firms (un-published doctorate dissertation), Ahmadu Bello University, Zaria.
- Abdulazeez, A. D. (2022) Lecture notes on Information and Communication Technology in Building. Building department, Ahmadu Bello University, Zaria.
- Abimbola, W. (2023) Fundamentals of Construction Management. 1st Edition, University of Cape Town prints. South Africa ISBN 978-87.403-0362-9
- Adebayo, S. O. (2021). A Comparative Study of Project Planning Techniques of Selected Construction Firms in Nigeria (unpublished master's degree thesis) Department of Building, Ahmadu Bello University, Zaria.
- Adeyemi, T. O. & Otali, M. (2013). Evaluation of Construction *Ethiopian Journal of Environmental Studies and Management* Volume 6 Supplement
- Aibinu, A. A. & Jagboro, G. O. (2014). The Effects of Construction Delays on Project Delivery in Nigerian Construction Industry, *International Journal of Project Management*, 593-599.
- Al-Subaihi, A. A. (2003) Influencing factors and calculations strategies forever research. *Saudi Medical Journal* Vol. 24 (4): 323-330.

- American Association of Civil Engineers AACE. (2021). American Association of Civil Engineers resource paper, available at <http://aace.org/resources/2011>
- Aniekwu A. N. & Audu, H. O. (2010). The Effects of Management on Productivity, a Comparative Study of Indigenous and Foreign Firms in the Nigerian Construction Industry, WABER 2010 conference paper.
- Association for the Advancement of Cost Engineering (AACE) (2011) Project Planning-As Applied in Engineering and Construction for Capital Project. International Recommended Practice No. 10S-90, available at <http://aace.org/resources/2011>
- Atere, T.F (2019). An Appraisal of Usage of Planning and Scheduling Techniques by Construction Firms (unpublished post graduate thesis), Department of Building, Ahmadu Bello University, Zaria.
- Bamisile, A. (2014). Building Production Management, Foresight Press Limited, Lagos, Nigeria.
- Baruch, Y. Response rate in academic studies - A comparative analysis. *Human Relations*, 1999, 52, 421-38.
- Basil, A. N. O. (2005). Problems and Prospects of Small and Medium Enterprises (SMEs) In Nigeria, Un-published PhD dissertation, St Clement University Lagos.
- Bossink, B.O N. & Bronwers O. (2016). Developing Construction Industry through Programming. *Journal of Science and Multidisciplinary Research* 4 (12) 45-61.
- Chandra, P. (2009). Project Planning, Analysis, Selection and Review, Published Tata McGraw Hill Education Private Limited, New Delhi.
- Chitkara, K. K. (2022). Construction Project Management: Planning Scheduling and Controlling, New Delhi: Tata McGraw-Hill.
- Construction Industry Development Board (2019). Best Practices for Construction Programming in Nigeria.
- Corporate Affairs Commission (CAC), (2014). Nigerian Corporate Affairs Commission list of Construction Companies in Nigeria.

- Council for the Registration of Builders (CORBON), Nigerian Institute of Building / (NIOB), (2014). Seventh Mandatory Continuing Professional Development Programme for Builders' Papers.
- Dahiru, A. D. & Mohammed, I. Y. (2012). The Roles of Researchers in the Construction Sector towards Achieving Millennium Development Goals, *Journal of Science and Multidisciplinary Research* (2012) 4, 809.
- Emad, E. (2019). Construction Project Management, Mansoura University Prints, Egypt. Pp 25-33.
- Francis, H. & Rafi, A. (2023). Development of the Smart Project Planning Framework. *International Journal of Project Management* 22(1) 499-510.
- Fred, M. & Janet, A. R. (2021). The Construction Industry in Developing Countries, Technology Adaptation Program, Massachusetts Institute of Technology. 7(1), 32-37.
- Gibson, G. E. & Hamilton, M. R. (2016). Bench Marking Pre-project Planning efforts, *Journal of Management in Engineering* 12(2), 25-33.
- Graham, M. W. & John, K. (2025). What do Construction Project Planners do? *International Journal of Project Management* (23)141-149.
- Harris, F. & Mc Caffer, R. (2015). Modern Construction Management. Accra: EPP Books Services.
- Health and Safety Authority, HSA (2013). Guide for Contractors and Project Supervisors Carrying Out Work on Private Dwelling, Available at <http://www.hsa.ie>.
- Ibrahim, O. (2021). Management, a Global Entrepreneurial Perspective, 13th Edition, Tata Mc Graw Hill, New York 8(2), 52-59.
- Inuwa, S., Samaila, Y. & Yusouf, M. (2014). "Impact of Construction Programming on Project Delivery in Nigeria." *Journal of Building Construction and Planning Research*, 6(2), 123-136.
- Kirmani, O. (2018). Construction Project Management: A Practical Guide. Lagos: Concept Publications. 1(3), 16-28.

- Lanfa, J. and Tucker, W. (2016) Investigating the Activities of indigenous Contractors in the Nigerian Construction *Journal of Construction Technology and Management*, 3(1), 91-103.
- Mustapha, Z. (2016). "Ineffective Construction Programming in Nigeria: Causes and Consequences." Proceedings of the 7th International Conference on Construction and Building Engineering, Lagos, Nigeria.
- Nigerian Institute of Building. (2020). Construction Programming: A Guide for Construction Professionals.
- Oleyinka, H. & Yusif, B. (2022). "Assessment of Construction Programming in Nigerian Construction Industry." *Journal of Construction Engineering and Management*, 145(10), 04019073.
- Passingham G. O. (2019). Effects of Programming in Construction Delays in Nigerian Construction, *Journal of Construction Technology and Management*, 104-111
- Saleh, A. (2017). Construction Planning and Scheduling. Abuja: Nigerian Institute of Building.
- Scott, H.V. (2019). Construction Programming as a Vehicle for Improving the Built Environment in Nigeria. *Journal of Construction Engineering and Management*, 145(4) 59-72.
- Uduak, Y. (2006). An Appraisal of Strategic Planning and Execution of Government Projects, -Published Undergraduate Project, Building Department, Ahmadu Bello University, Zaria.
- White, A. & Fortune, T. (2022). Multi National Construction Contractors in a Cyclical Economic Environment, *Nigerian Journal of Engineering Management I (2)*, 46-53.