Effectiveness of Project Planning and Scheduling Techniques in Construction Project Performance [1]

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ABSTRACT

This study focused on effectiveness of project planning and scheduling techniques in construction project techniques. The objectives are to: determine the extent of effect that the benefits existing in the various construction scheduling techniques have on construction project performance; ascertain whether the challenges confronting the use of software scheduling techniques have any significance effect on construction project performance; determine the level correlation between Gantt/Bar chart scheduling technique and construction project performance; ascertain whether there is any significant correlation between Critical Path Method scheduling technique and construction project performance. Seventy-three (73) respondents were selected purposively. Data were collected via questionnaire. The data collected were analyzed using t-test and correlation analytical techniques. The result of the t-test show that benefits of project scheduling and network techniques are critical to construction project performance. The correlation analysis result indicates that Gantt/bar charts and critical path method have correlation with construction project performance. The study conclude that project operators should be properly trained and retrained on the application of various project planning and scheduling techniques available for improved project performance. Proper application and utilization of Gantt/Bar chart methodology. Lastly, improved knowledge and expertise of project planners and operators on the effective use of Critical Path Method in planning and scheduling construction projects through workshops, conferences, seminars, etc.

Key words: *construction projects, planning and scheduling techniques, critical path method, Gantt/bar charts, project performance.*

1.0 Introduction

In recent times, construction projects are congested as a result of the penetration of new players into the industry. This has led to business competition, increase in costs of resources caused by increase in demand and competition to maintain the lead. It can be observed from this perspective that mediocrity can no longer be entertained, having technical skills and experience are vital to maintain the lead.

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Construction planning and scheduling, therefore involve the determination of appropriate construction sequence and methodology with the right allocation of resources over a specified time frame (Chizea, 2022). The data presented when all these factors are analyzed and put together is called the Construction Project Plan. Utilizing this data will involve both monitoring and possible rescheduling of activities throughout the construction process until completion.

The time required for completion of a project depends on the number of activities required, the durations of individual activities and the dependencies between activities. There is also the determination of the critical path of the project. The critical path is defined as the list of linked activities within the project schedule to which any change in their timelines or resources or both will have great impact on the entire project (Akpan & Chizea, 2023). Any delay on an activity within the critical path will delay the project and vice versa. The quality of the data also is dependent on the right allocation of resources with respect to cost, quantity and specification. As posited by Chizea (2022), clarity, proper layout and presentation of all activities describe the quality of the data.

In general, the adequacy and quality of construction planning and scheduling data is determined by the provision of a good roadmap that everyone in the construction team can follow a realistic project time line, well detailed resource requirement, valid cost estimate and advanced identification of activity slippage.

Software planning and scheduling techniques have been challenging to contractors and other project stakeholders in the management and control of construction projects in Nigeria. Poor scheduling or non-existence of scheduling has resulted in considerable waste, as labourers and equipment become idle due to delay in completion of preceding tasks, limited availability of needed resources, or other space and time constraints (Akpan, Echeme & Ubani, 2017). Recent planning and scheduling practices in the construction sector are inefficient, which has resulted into budget and time overrun (Castro & Dawood, 2019: Chizea, 2022). In Nigeria, depending on which class of construction one belongs to and the nature of contract procurement, construction planning and scheduling (work plan) data would be prepared at the inception of a project, usually as a contract requirement. Financial institutions also request for the construction planning and scheduling data from construction firms as a prerequisite for loan approval or project financing (Akpan et al, 2017). The data presented in all cases varies in diverse degrees of adequacies.

A casual observation of construction projects has shown that most construction firms are unable to integrate the various components of a construction planning and scheduling data and this has resulted in firms exceeding construction timelines and resource usage. Consequently, overall construction costs are exceeded and usually are unknown at the end of projects. Construction to a large extent is a capital-intensive venture, therefore, to achieve targeted profit, it is important to ensure that a proper construction scheduling data is generated and monitored all through to completion.

Additionally, project leaders have depended largely on previous experiences and personal feelings in construction projects planning and scheduling, notably roads and others alike (Dawood & Castro, 2019). Also, the use of software planning and scheduling techniques in construction of building/road works has not penetrated much in the construction industry (Kamat & Martinez,

2021; Hajar & AbouRizk, 2020). Majority of construction projects are mostly carried out without the deployment of planning and scheduling techniques, a practice which has resulted in dire consequences for both clients and contractors in terms of value for money. Environmental factors and other constraints are not considered in construction projects planning and scheduling as it has the potential of delaying the project (Mohd, 2016). This phenomenon has affected the profitability of the contractor thereby shrinking their chances of survival in construction business.

This study has the potential of igniting the penetration of planning and scheduling techniques deployment in construction project sectors of Nigeria. This study is relevant to the development of Nigeria in terms of construction improvement and resource overrun mitigation in the sector. The situation where professionals deliberately delay projects to benefit through corrupt practices can also be checked by the massive adoption of the findings of this study. The fact that this project is geared towards construction project software planning and scheduling, means that its contribution to the reduction of construction disputes relating to projects duration, is significant.

Hence, the main objective of this study is to analyze the effectiveness of project software planning and scheduling techniques in the performance of construction projects. The specific objectives are:

i. To determine the extent of effect that the benefits existing in the various construction scheduling techniques have on construction project performance.
ii. To ascertain whether the challenges confronting the use of software scheduling techniques have any significance effect on construction project performance.
iii. To determine the level correlation between Gantt/Bar chart scheduling technique and construction project performance.
iv. To ascertain whether there is any significant correlation between Critical Path Method scheduling technique and construction project performance.

To achieve the objectives, the following research hypothesis have been formulated:

H_{01}: Benefits existing in the various construction planning and scheduling techniques have no significance effect on construction project performance.

H_{02}: Challenges confronting the use of software planning and scheduling techniques have no significance effect on construction project performance.

H_{03}: Gantt/Bar chart scheduling technique has no significance correlation with construction project performance.

H_{04}: There is no significant correlation between Critical Path Method scheduling technique and construction project performance.

2.0 Conceptual Review

One of the primary features that distinguish project management from general management is the attention to “scheduling” (Lewis, 2014). Project success ultimately is the key to successful profit making in any construction organisation (Hillier & Lieberman, 2021; Hancher, 2013). In view of this, efforts have been made over the years, to plan, direct, and control the numerous construction

activities to achieve optimum project performance. However, the incessant abandonment and the proliferation of delays and cost overruns on construction projects (Ahiaga-Dagbui et al., 2014) only suggest lack of integration of advanced construction planning and scheduling in the construction industry. This might be the reason for Allen and Smallwood (2008) assertion that clients and other stakeholders alike are not satisfied with the results of the industry. Accurate cost estimation and control are the essential elements to ensuring project success (Hillier & Lieberman, 2021; Elbeltagi et al., 2014). Essentially, the controlling cost and the accurate estimating of projects are intertwined with planning and scheduling. This places a demand on project planners and in some instances, project managers to integrate planning and scheduling in the Construction Industry. More so, the unprecedented growth and the general shortages of skills (Allen & Smallwood, 2008) in the industry further underscore the need for a more rethinking of construction planning and scheduling in the Construction Industry, since the existing practices are failing to produce the desired results (Allen & Smallwood, 2008).

Owing to the fragmented and unorganized nature of the industry, the roles of construction planners in the realm of construction are not appreciated (Allen & Smallwood, 2008). Indeed, in the Construction Industry in Nigeria such a title is virtually non-existing. The role of construction planners is mostly assumed by the project managers. This confirms the assertion by Allen and Smallwood (2008) that the Industry is limited in terms of the number of competent construction planners and in consequence less qualified personnel is being entrusted with the responsibility of construction planning. Throughout the history of construction industry, clients have consistently and progressively demanded for higher standards, and as a result, construction planners are at the forefront of these developments (Proverbs et al., 2016). Unfortunately, it appears the industry has not planned adequately to meet the competing demand of the clients. Hence the clients are dissatisfied with the outputs of the industry, and the productivity of the industry is low (Allen & Smallwood, 2008; Proverbs et al., 2016).

The unpredictability of the construction delivery time, budgets, inter alia are the manifestations of the gaps that exists in the current practice of planning and scheduling in the industry. Accordingly, making the industry attractive to both investors and potential recruits requires the stringent application or integration of technology to improve working efficiency and existing practices (Allen & Smallwood, 2008). The thrust of this achievement is the construction planning process. And this has been the focus of this section. The succeeding subsections

highlight the theoretical developments of construction planning and scheduling techniques.

2.1 Construction scheduling techniques

The era of traditional planning techniques dates back to the time of Henry Gantt ‘s Work, Wages and Profits in 1916. The Gantt chart otherwise known as the bar chart is useful for the illustration of work items and their estimated times (Hancher, 2013). It was named after Henry Gantt, hence the name Gantt chart. However, it was originally developed by Karol Adamiecki in 1896 (Bokor et al., 2011). He named it the harmonogram. Bokor et al. (2011) argued that the contradictory may come from the fact that the harmonogram was only popular in Poland, and until 1936, Karol Adamiecki had not published his work.

Basically, the Gantt chart is a bar graph with time on the horizontal axis and resources on the vertical axis. The chart has the advantages of easy to prepare, easy to interpret and understand. Compared to most planning tools, the Gantt chart is a very good communicative tool, especially in the industry where most of the artisans are not highly educated. In view of this it is the most widespread way of displaying project plans (Bokor et al., 2011). In spite of these advantages the Gantt chart has some limitations. First, relationships or logic between activities cannot be shown on the chart. Also, the effect on the schedule is difficult to determine.

2.1.1 Network Planning Techniques

The increasingly complicated projects saw an increased demand for a more sophisticated technique of depicting the project plans. To this the network planning techniques were created the procedures were advanced with contemporary project management in 1959 (Bokor et al., 2011). One of the roles of the Network Planning Techniques is that the duration of activities is indicated as a matter of a certainty. a.) Critical Path Method (CPM) Using the Gantt chart, it was impossible to show relationships between activities, they were only suggested (Hancher, 2013). Hancher also commented that natures of such a project are so complex to the extent the relationship cannot even be displayed. Because of that the development of the Critical Path Method (CPM) allowed a more formal and systematic approach to project management (Hancher, 2013). Moreover, one may also identify the critical activities with the Critical Path Method (CPM). The Critical Path is the maximum length path through the project and that is what determines the project. duration.

Events in a CPM network will be represented by circles and the activities represented by arrows (Bokor et al., 2011). They may also be called Activity- on-arrow diagrams. Events symbolize the end and starting times of activities into and out of them. The red line also gives the critical path of the project. Discussing the advantages of the CPM, Bokor et al. (2011) suggests that the tool can preserve the logic that has been developed and, therefore, it is easy to make changes to the initial plan. The CPM has successfully been applied on a number of projects. According to Rancher (2013), this success was not only unique to the construction sector, but to other professions so far as project management was concerned. To conclude, Rancher (2013) opined that a construction manager who chooses to ignore critical path methods nowadays will be turning his/her back on a good and practical management tool. However, to their surprise, Bokor et al. (2011) thought otherwise of the CPM. They observed that it lacked the capacity to deal with multiple relationships.

b.) Program Evaluation and Review Technique (PERT)

PERT functions the same as CPM, and it emerged around the same period i.e. in the late 1950. Nevertheless, the task durations, in contrast to, the CPM are stochastic (Bokor et al, 2011). Even nowadays, PERT has been the main concern of project managers and planners as it was in the past (Ika, 2009). Scholars aver that uncertainties are rife on projects and that is the greatest advantage of the PERT, and the distinction between the PERT and the CPM- information on PERT is not known with certainty.

Precedence Diagramming Method

It was created as an alternative to shortcomings in the Critical Path Method. Precedence Diagramming Method (PDM) provides the flexibility of having many dependencies concerning activities to the users (Bokor et al., 2011).

2.1.2 Common features of Network scheduling techniques

Critical Path Method (CPM), and Program Evaluation and Review Techniques (PERT) are the two most used methods in project scheduling. The purpose of PPM was to apply it to projects that may be able to access information on data of comparable predecessors to be used to estimate duration of new activities in the project. PERT was designed with research and a development project in mind, whose duration could not be easily estimated. Although CPM and PERT are dissimilar in some respects, they are also identical in certain aspects, which led them to be perceived as one technique called the PERT/CPM (Hillier & Lieberman, 2021). The similarities in the characteristics of the CPM and the PERT techniques are that the project takes the networked flow of activities that form the critical path of the project.

Project network is the graphic deplanement of the project and illustrates the precedence relation among the activities in the project. It identifies the list of tasks that bridge the gap between the start and the end of project. The CPM method and the PERT method take the time of the critical path to be assumed as the expected project time. Critical path The critical path is the longest path in the project network. It is important to note that a single project may be found to have several critical paths. Hillier and Lieberman (2021) presented the Critical path method (CPM) and PERT concepts to identify the critical path. The idea is comprised of the following:

i.) Determine the earliest start time (EST) and earliest finish time (EFT) of each and every activity. This is carried out along the start to the end of the activities within the project network. This is referred to as the forward pass To all activities, the EFT = the EST + the duration of activity (D), or EFT = ET (Event time) of the tail event +D. EST=Tail event.

ii.) Decide Latest Start Time (LST) and Latest Finish Time (LFT) of the activity. This is undertaken starting with the finish activity of the network through all the activities till the start activity of the project. duration (D), that is, LST=LFT - D. The Latest time (LT) of head event is equal to Latest Finish Time (LFT) of an activity, that is LFT = LT of head event.

Determine SLACK TIME of every activity. Slack time is the time that an activity can be postponed without causing the late finish of the project. In all activities, the slack = LFT-EFT. Those activities which do not have any slack time form the critical path. In CPM, to calculate the critical path, the time involved in each of the activities is considered, whereas in PERT, only an estimate of the expected time is used. This is because PERT addresses uncertainty by taking into consideration the three point estimates of the time duration of the activity (most likely [m], optimistic [o], and pessimistic [p] and assumes that the distribution of activity follows beta distribution (Hillier & Lieberman, 2021).

Paper Ahuja (2014) posited that in PERT analysis, only the estimates of the expected duration are taken into consideration as the calculation of critical path thereby disregarding the variances of

the network of activities. In case of any form of uncertainty in the project activity duration, the probability of project completion time must be examined first.

2.1.3 The advantages of the construction planning and scheduling methods

Based on this research study, it has been established that planning and scheduling is a very important aspect of project success and consequently the profitability of construction companies. Due to this, the interest in construction planning and scheduling techniques has significantly increased over time with both scholars and practitioners accessing the same (Hillier & Lieberman, 2021; Akpan et al., 2017). The growing interest in the field was further identified by the large number of construction planning and techniques tools developed over the years - both traditional and contemporary tools. A consistent trend towards the improvement of the tools/techniques at hand implies numerous inherent and explicit advantages. These advantages are as follows but not limited.

a.) Makes it possible to see information

The construction planning and scheduling strategies, especially the 4D models, enables the information to be queried visually before the construction starts (Allen & Smallwood, 2008). Such advantage is not only unique to construction industry but also to other industries. Other areas of application have supported this claim where planning and scheduling has offered the same advantage in sales and operations (Ivert & Jonsson, 2020). Because semi-literates are relatively numerous on construction sites it is necessary that the information be presented in a way which can be understood by all, and this is what the planning and scheduling techniques provide. The use of visualization has been cited by one site engineer as being vital in construction: location of equipment, carnage analysis etc. (Chau et al, 2005).

b.) Information available easily

In some ways, mental model has some benefits in comparison with computer or graphical model due to the flexibility and the ability to process the wide scopes of information shown in any form (Sterman, 2022). However, mental models have very immense drawbacks especially the interpretation of the mind. This is where the graphical presentation of construction plans is critical especially where constructions are complex. Using construction planning and scheduling tools such as Gantt chart, CPM, etc. is a method that puts the construction thought into formats that are readily understood by the teams (Barati et al., 2013). Without any member of the team, the information about the project can be accessed and as a result secure workflow.

c.) Allows finding unforeseen future consequences

The customary methods used in constructing planning and scheduling proved to be painstaking in establishing the issues arising at early phases, thus the variations are ubiquitous in constructing projects (Koo & Fisher, 1998). Nevertheless, with the current developments of planning and scheduling, there is the possibility of defining the inherent problems of the initiatives at the beginning of the projects (Heesom & Mahdjoubi, 2004). As an example, inconsistencies and concerns that might theoretically have been obscure to the professionals may have been exposed using the visualization technologies, like the 4D CAD.

d.) It enables one to analyse unforeseen future consequences

This advantage is inseparably connected to the one that is stated above. Before the analysis of the outcome, the unexpected outcomes of the future outcomes are identified. Comparing it to the traditional planning tools, which were significantly inclined towards the power of imagination and feeling, the modern planning and scheduling tools allow the user to engage with interactive controls, which provide a simple goal of analyzing the unforeseen future that can possibly come to pass (Chau et al., 2005).

e.) Outcome in an acceptable delivery schedule

The effectiveness of any project is pegged on the realistic of the project plan (Heesom and Mahdjoubi, 2004). To reinforce this, Hendrickson (2000) stated that planning is an important assignment in a project. In other words, there is a probability that trustworthy delivery strategy would translate into an effective project. There is no secret that competent and experienced personnel are required to develop effective plans (Heesom & Mahdjoubi, 2004). The experienced managers have the capacity to visualize the process in their minds. They further contended that there is an invariable gap between imparting the visualised information to other individuals, the second parties as involved in planning and other artisans. Here is where the planning and scheduling tools come into play. The exposure and the conceptualization of such information is done through planning and scheduling tools.

2.1.4 Difficulties in the application of the planning and scheduling of construction

The construction planning and the scheduling methods have appealing prospects (Azhar et al., 2008). Surprisingly, the construction industry in Nigeria is trailing behind in constructions as well as planning methods. As an example, 4D CAD hardly has any practitioners or scholars in the building sector. There are numerous reasons that explain the low pace of uptake in construction and planning methods. That is the aim of this section. Subsequently, the following sub sections explore the problems that hinder effective integration of construction planning and scheduling methods.

i.) Complexity of the tools

The complexity of the planning and scheduling tools has been used as an obstacle to successful integration of planning and scheduling tools. This problem has been largely investigated by numerous authors, and indeed the problem is common in any problem identified challenges studies globally. An example is where Woo (2006) noted that students, particularly the beginners, found it tough when using similar construction planning tools. Such a barrier is not unique to the case itself, but stretches through to sites. Complexity of tools also has effects like the difficulty in entering data and time taken in processing the data (Chau et al., 2005).

ii.) Not being able to take into consideration spatial planning

The current project planning and scheduling applications fail to consider spatial requirements of the construction sites (Winch, 2012). Consequently, according to Heesom and Mahdjoubi (2004), such planning and scheduling tools have been regarded as one dimensional. The practices of scheduling and planning that are related to a location have been largely ignored in research (Retik

& Shapira, 2009). It is more than ten years, and in this direction, development still is in an initial phase. This evolution resulted in the intensive use of intuition and personal experience of the professionals.

iii.) Technological challenges

It is impossible to derive maximum benefit out of planning and scheduling of construction planning and scheduling tools unless there is interoperability between them (Thurairajah & Goucher, 2023). Interoperability is when there is a smooth exchange of information transverse across all disciplines. Nonetheless, the construction is highly fragmented and solitude in character.

The existing compatibility issues between the BIM environment and the rest of the industry (Arayici et al., 2022) hinder this integration and consequently such mismatch further exacerbates the implementation of the latest construction planning and scheduling technologies such as the 4D CAD (Olatunji, 2021).

iv.) Entry level manpower skills

Skill is applicable in the proper and realistic formulation of construction plans and schedules with the help of visualization tools (Chau et al., 2005). Current construction planning and scheduling methods are much information-demanding in using the tools. In Construction Industry the majority of professionals lack the knowledge on modern construction tools due to absence of integration of the computer into the course in full extent. More so, there are few reference materials on the discipline.

v.) The split up nature of Nigerian Construction Industry

Construction projects today face significant conflicts which, in most incidences, cause projects to be buried in delays and cost over runs. The fragmented nature of the construction industry is one contributing factor which was explained by Khosrowshahi and Arayici (2012). This feature of the industry spans all countries; however, integration in construction industry of the developed economies has been made successful. This has triggered the application of numerous advanced planning and scheduling methods. Interestingly, the issues of collaboration and fragmentation in developing countries are still being grappled in the industry. Khosrowshahi and Arayici (2012) asserted that a change in the prevailing issue in the industry cannot be brought about by technology alone. It is impossible to use these techniques without collaboration.

vi.) Traditional tools enforces minds visualizations

A more problematic aspect of the conventional planning and schedule tools is the excess in the use of the mind modeling (Chau et al., 2005). Human is limited in cognitive, reflective and analytical capabilities as a result of situations like multi-interrelated factors and complexity in the co-ordination of construction sites (Chauei al., 2005). Uncontrolled cost and time overruns, the -90% syndrome and more are some of the highlights of the drawbacks of mental visualization (Sterman, 2022)). In order to get out of this construction planning and scheduling tools came into existence. The solution however has not been the people who work at the Construction Industry in Nigeria since they are part of the problem. This is because the industry is practiced using the

orthodox visualization tools like the Gantt chart, which is one dimensional (Heesom & Mahdjoubi, 2004) and thus compels the brain to visualize.

vii.) Price of the current planning and scheduling tools

A major obstacle to planning and scheduling approaches is software and hardware upgrades especially to the SMEs. Thurairrajah and Goucher (2023) noted that vast resources are dedicated to the execution of these techniques in the form of robust training requirement that in some cases become time-consuming.

WRS 3.5 Scheduling Software Tools

Project scheduling software tools come in many varieties, and, at first glance, they may also all appear to be very similar. Nonetheless, there exist specific differences distinguishing one project scheduling tool to the other and more applicable to a specific project.

a.) Microsoft project

Microsoft project is a project direction program, manufactured and marketed by Microsoft. It can be used in order to help a project manager and create a plan, allocate resources to activities, monitor project progress, and a budget, as well as examine workloads.

Parts of the Microsoft Project 2000 window

The window available in Microsoft project 2000 is very rich in terms of the number of things that an individual can use to get information about what he /she is working on.

By making a project plan we list the tasks and subtasks in Gantt chart view. It is the tool that is used most often to input task related information. Microsoft project has inbuilt functionality which aids in the creating of work breakdown structure. Having come up with the identification of the tasks as well as the relationships between. Afterwards we develop task dependences. It automatically attempts to start and end access-related tasks depending on each other.

The Network Diagram view reports a project as a drawing and represents how tasks are positioned to allow analyzing the relationships amongst tasks (Hillier and Lieberman, 2021). The calendar view is employed to show up project data in sequential order. The effort can be also estimated in days of the calendar.

Resource information is keyed in resource sheet. The total cost of each of the resources is automatically calculated by Microsoft project by use of values entered. The resource usage view can use estimates of resource vitalization since resource vitalization was defined relative to the numbers represented by resource use view objects. It also enables one to determine resource allocation of work or cost of resources within a definite period of time. Variance is the disparity between the actual and the planned charges. Variance table is an instrument to monitor the variance cost. Microsoft project can import and export data in other applications like the Microsoft excel. Project control is applied in the dissemination of information regarding project-to-project personnel. Having planned the basic duties to complete your project, you may start working with project 2000. The easiest way to initiate project 2000 is to hit the start button after which you select programs and then Microsoft project. Opening the project 2000, a new project file labeled

as concept, project appears on the Microsoft project help window. The screen presents five kinds of learning supports. You can search through project 2000 tutorials, preview, what is new in project 2000, use the office Assistant and references or navigate using the predesigned map to begin using project 2000.

b.) Runn

Best project plans and schedules in IT services Runn will enable a user to draft project schedules and reschedule them to view their effect on the overall budget, time, resources and capacity. It is formatted with a handy resource calendar where the people resources can be noticed, and the managers can see the degree of load that bang using to any important member of staff on a specified moment.

According to Runn (Sterman, 2022), Runn has a full functionality of resource management in the areas of capacity management, planning forecasting, and reporting. It also enables project managers to monitor the progress concerning the budget and time schedules, (Nicole, 2021) as well as to get a better financial analysis of the prospects so that better decisions can be made.

c.) Wrike

Project planning tool to coordinate distant workforce, wrike is a web-based project scheduling software to coordinate remote workforce.

This opportunely has an integrated project scheduling system which indicates that users can work remotely and do not require to be in the office in order to plan and track the progress of a project. Similar to most of these scheduling software tools, the interface used in Wrike enables users to work on multiple projects simultaneously.

It enables project managers to bring Gantt Charts, Kanban boards and other scheduling charts to life in one fell swoop, which is a tremendous asset to multiple individuals having multiple complex projects in process at the same time.

d.) Clickup

Most suitable project scheduling tool which can work a large team. Clickup includes everything

The project scheduling capabilities you require to plan your projects by scheduling project tasks, assigning resources and monitoring the project progress are powerful. All the searches, filtering and viewing of tasks are possible and comfortable.

Clickups free forever plan also has no restrictions in membership that a given account can enroll, and only some features of a given program are available in free accounts.

e.) Hive

Ultimate project scheduling program to an agency. Another web- -based project is Hive

It is a time scheduling tool based on Gantt charts and kanban boards that are used to simplify project management. It enables its user to track projects and tasks at the different stages including allocation associated resources, delegation, and oversight of the deadlines.

Specifically Hives offers improved team collaboration through the ability to host documents and share documents so users are to the same level of information should they require it.

f.) Asana

Application to schedule the project of complex tasks. Asana is an

The common or general project management programme commonly applied in all sections and operations of an organization. It is made a common room so that the users can be able to see, organize and set due dates and priorities.

Asana is provided with views, rules and forms that are customizable, allowing work planning of a specific project to become easier. There are over 50 scheduling templates available to use and the project scheduling tool has high ratings as a remote on the go scheduling tool.

g.) Gantt PRO

optimal project scheduling software to draw Gantt Charts. Gantt charts have gained popularity as one of the effective project schedule tools and are essentially found in project management software. Gantt PRO lets users make the most of Gantt charts by its intuitive interface and the variety of strong features it virtually offers. Gantt PRO: Extensive Project Scheduling Projects can be divided into tasks, and subtasks, dependencies and milestones and it can add status, estimates, deadlines and allocations.

h.) Adobe Workfront

excellent project scheduling program to purchase by project managers. Workforce is an all-inclusive project management scheduling program with the alternative of utilising it as a capacity planning and resource management program or a scheduling and planning program. This qualifies it as a perfect project scheduling tool when it comes to either detailed project plans or project managers who have ambitions of going higher than the entry level capabilities.

2.1.6 The advantages of scheduling software tools in projects

The aims of general application of the project scheduling software are two-folded. To make the best possibility of doing the project within time and budget. These are two pieces of critical success in project management success and project managers can more readily achieve them through automated project scheduling.

There are ways in which scheduling software can be used to accomplish these intentions in several ways

a.) Eliminating mistakes: Project scheduling software automates the processes and there is no scope of human errors. When handling numerous tasks, deadlines or even entire projects, mistakes begin to slip through the cracks and take longer to correct when working with a manual spreadsheet Errors can have secondary effects that may result in embarrassment.

b.) Better resource management: with project time scheduling software the centralized solution, the resource management should also have a home there. The availability of resources is

automated, so it is far easier to allocate resources, even when these are shared and different teams and projects. Resource management features are also useful in helping to anticipate the existence of bottlenecks beforehand and designing around them to avoid or reduce the impact they make.

c.) Assumed updating: when jobs get delayed longer than calculated or cost cuts above the allocated budget; this may destroy future workflow planning. Adjustments in resources or timelines and budget may become complex and when it is carried out at last minute using project scheduling software, it will be easier to change future scheduled work to reduce the effects of unexpected occurrences.

d.) Enhanced cooperation and decision support: Project timing systems eliminate much of the noise to enable project managers and stakeholders to have access to the most important information to make decisions. Reports can simply be shared, which facilitates conclusion far easier when it comes to collaboration and updating the status of the project.

e.) Improved inductions: When new personnel are inducted into projects, this can be metaphoric especially in lay job roles or during a crucial period. The project planning software will reduce the impact of team member changes and issues such as unavailability and enable new team members to familiarize with the project easily give them the context or the required information.

Empirical Review

The study conducted by Khadija et al., (2020) examines the impact that the project planning processes may have on the success of projects in terms of their efficiency and effectiveness and also determine the most important project planning activities that have a significant bearing on the success of the construction projects in Nigeria. A theoretical framework which was comprised of a set questionnaire using the Likert scale was formulated in this study and administered on a sample population of 60 people. There were a total of three organizations surveyed in Federal Capital Territory. Project success in construction will be used as independent variable and project planning processes will be used as a dependent one. The research method is quantitative and it uses applied survey instrument in collecting data. To analyze the data SPSS is used to do a descriptive statistic. The findings have revealed that most significant planning processes applicable to the selected firms are Creation of Work Breakdown Structure (WBS), Program Evaluation Review Technique (PERT) or Gantt chart or Project Schedule Network; determine Budget and Quality Management Plan and are the most familiar and used. Also, there is correlation between total level of planning and project success rho p(60) = -.493, p=.032, and the efficiency part of project success rho(60) = -.618, p=.005. The results indicated that the three variables were statistically significant because p was <.05 (two tailed), whereas the correlation between the level of planning in total and the effectiveness component in project success was not statistically significant. A general issue was discovered of rising awareness of the project planning processes and that has contributed to the success of construction projects. The results of the study thus indicate that construction projects need to rely on the active application of some other project planning procedures such as risk management plan, activity resource requirements in order to achieve superior performance. Trainings on project management should also be held on continuous basis on all professionals concerning management in the sector both in the private and government organizations.

GebrehanaDerbe, (2020), conducted a systematic review of studies that have been conducted on scheduling techniques on project construction. In the current research a total of 332 articles were initially recovered on Scopus database utilizing title, abstract and keywords regarding the scope of Construction Project Schedule (CPS) and narrowed by a factor of document type, language type and abstract content. Science mapping approach was specifically used to map the analysis of the selected journal articles. These articles were analyzed following three sequential stages, viz. bibliometric search, scientometric analysis and in-depth qualitative discussion. It might show the most prominent journals, researchers, published articles, and working countries/regions on this field. Besides, key knowledge areas related to the area of construction project schedule were identified and commented as the construction project schedule constructability, use of wide range of different construction project schedule techniques, construction project schedule optimization models and algorithms, schedule risks and uncertainties and their identification and quantification, construction project schedule performance management, as well as implementation of new emerging construction project schedule technologies and techniques.

As discussed by Alabi and Oppenheim (2018), Project scheduling was among the successful delivery of a construction project, yet despite the key role of such a tool, there are still numerous issues regarding its effective application. The schedule of some projects is set at inception of the project and never assessed on feasibility until issues start to arise. In addition, other contractors do not possess the expertise needed to draw practical project schedule. The paper will thus, analyze the issues that influence project scheduling methods and also determine the degree of these influences. Existing literatures reviews indicated factors influencing project scheduling approaches and they were framed to the form of questionnaire to obtain empirical data of the professionals. The empirical information was analyzed using statistical tools. The type, complexity and the materials requirement of the work were found out to be the biggest contributors to the project scheduling; The critical activity determination in the hands of combination of the poor managerial decision, an absence of expertise in the scheduling and the accuracy of the estimation of the human resources requirements emerge as the biggest project schedule performance hindrance. This paper has advised that only qualified and certified individuals be used in project schedule administration, as well as using a scientific approach as opposed to rule of thumb in establishing the labour and materials requirement in that doing so will improve the performance of project scheduling in the Nigerian construction industry and give rise to the optimum use of resources in project delivery.

Inuwa et al., (2014) examined how the construction industry is applying project planning techniques in the process of construction projects procurement in Nigeria. In the study, descriptive survey methodology and collective case study were applied. Data is collected by means of questionnaire. The contractors chosen in the case study using purposive sampling technique and stratified random sampling technique. The case study was utilised to elicit the questionnaire answers. The statistics were done on the reliability and significance of the data found on the questionnaires and the descriptive statistics. The case study was analyzed using the frame offered by the Bloom science hierarchy of taxonomy. The findings are, some of the Nigeria construction industries plan their project operations using their central administration, rather than employing project planning technique, underutilization of the technique of project planning, improper use of technique of project planning by most of the construction industries of Nigeria, and non-usage of

information and communication technology on projects planning in Nigeria. Some of the recommendations made by the study are as follows; contractors must employ project management methods, employ competent officials, employ continuous training, utilize ICT in its operations, invest in knowledge management; the type of form of contract in use in Nigeria needs to be revised to inculcate a clause to ensure that the contractors employ the necessary planning methods. Proper utilization of projects planning and scheduling methods will enhance/aid project management practice within the Nigerian construction sector.

Table 1: Content Analysis

Associated Author(s)	Software Planning & Scheduling related factors
Alabi & Oppenheim, (2018)	Poor evaluation of project, lack of expertise required for project scheduling, poor supervision.
Inuwa (2014)	Poor planning of project, lack of expertise to plan project operation, non-application of project planning techniques, communication barrier.
Khadija (2020)	Non-Implementation of project planning processes, Non-training and retraining of project management professionals, lack of expertise on software planning.
GebrehanaDerbe (2020)	Project schedule risk and uncertainties, project schedule optimization models and algorithms, Project schedule performance management, Stakeholder attitude towards scheduling.
Ghraizi & Al-Azzah (2003)	Lack of adequate planning, poor skilled workers, low knowledge base, insincerity.

3.0 Methodology

The research was designed to be descriptive and exploratory. This is because, it describes the assessment of construction project scheduling techniques as well as assess construction projects scheduling techniques in Nigeria construction industry. The study used both the primary and secondary sources of data. Primary data were collected by means of questionnaire administered to the selected sample, and through discussions with some stakeholders including mangers of construction projects; Architects, Builders, Quantity Surveyors and Engineers.

The study population of seventy-three (73) staff of Terdiff construction company Enugu, Enugu state. Based on the size of the population, the study adopted a census technique where all the population were sampled. This was done purposively, because the researcher targeted only those with requisite knowledge of planning and scheduling of construction projects.

The adopted both primary and secondary data sources. The primary source involves the use of questionnaires, and observation of behavior. On the other hands, the secondary source includes: review of relevant journals, reports and book of the organization under study and other previous relevant works.

A questionnaire was designed using Likert's 3-point scale (Agree = 3; Neutral = 2; Disagree = 1). This was done to enable respondents to express their opinion regarding the issues discussed. The

multiple structured questionnaires comprise of statements which enable respondents to indicate their level of agreement or disagreement regarding the content.

The data collected for this study were analyzed using descriptive statistics involving tables, percentages, frequencies, mean, etc. These include the use of chi-square analysis to test the hypothesis. One sample t-test was adopted in testing hypotheses one and two. Pearson's Correlation analysis was adopted in testing hypotheses three and four with the help of statistical Package for Social Sciences, version 21**.**

4.0. Results and Discussions

A total of 73 copies of questionnaires were administered to the selected respondents. All the distributed questionnaires were retrieved, representing 100% response rate and form the basis for the statistical analysis made in this study.

H_{01}: Benefits existing in the various construction planning and scheduling techniques have no significance effect on construction project performance.

Table 2: One-Sample test of effect of the benefits of construction scheduling techniques on construction performance

	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Benefits	20.7	72	.000	4.21739	3.8073	4.627

The one sample t-test show a t-value of 20.712 which is significant at 0.000 given an asymptotic value of 0.05 level of significance. Hence, we reject H_{01} and conclude that the benefits which exist in the various construction planning and scheduling techniques have significance effect on construction project performance.

H_{02}: Challenges confronting the use of software planning and scheduling techniques have no significance effect on construction project performance.

Table 3 One-Sample test challenges of software scheduling techniques on construction project performance

	Test Value = 0					
	t	df	Sig (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Challenges of the use of software scheduling technique	12.470	72	.000	1.71831	1.4435	1.9931

Table 3 indicates a t-values of 12.470 which is significant at 0.000, implying that at 0.05 level of significant, the challenges facing the use of software scheduling technique is significant to construction project delivery. Therefore, we reject the null hypothesis and conclude that the challenges confronting the use of construction planning and scheduling techniques have significance effect on construction project performance.

H_{03}: Gantt/Bar chart scheduling technique has no significance correlation with construction project performance.

Table 4 Pearson's Correlations of Gantt/bar chart scheduling technique on construction project performance

		Bar chart scheduling technique	construction projects performance
Gantt/Bar chart scheduling Correlation	Pearson	1	0.987
	Sig. (2-tailed)		0.029
	N	73	73
Construction performance Correlation	Pearson	0.987	1
	Sig. (2-tailed)	0.029	
	N	73	73

Table 4 show an R-value of 0.987 at a significant level of 0.029 implying that at 0.05 level of significance, the null hypothesis (H_{03}) is rejected. Hence, the study conclude that Gantt/Bar chart scheduling technique has significance correlation with construction project performance.

H_{04}: There is no significant correlation between Critical Path Method scheduling technique and construction project performance.

Table 5 Correlations of Critical path method scheduling technique on construction Performance

		Critical Path method scheduling techniqu	Construction project performance
Critical Path Technique	Pearson	1	0.877
	Sig. (2-		0.033
	N	73	73
Construction project Correlation	Pearson	0.877	1
	Sig. (2-	0.033	
	N	73	73

Table 5 show an R-value of 0.883 at a significant level of 0.033 implying that at 0.05 level of significance, the null hypothesis (H_{04}) is not significant and therefore, rejected. Hence, the study

concludes that there is significant correlation between Critical Path Method scheduling technique and construction project performance.

Result Discussion

Based on the study findings, the following can be deduced;

That the benefits which exist in the various construction scheduling techniques have significance effect on construction project performance (see table 2). This result depicts reality because project scheduling techniques have been proven to be crucial, if construction project objectives must be realized. The findings of Shannon, (2022) and Alabi and Oppenheim, (2018) corroborates with this finding as they complained that despite the huge benefits of project scheduling techniques, its poor application has been a great challenge for its effectiveness in assisting successful execution of projects. Hence, project managers should equip themselves with the various techniques of project planning and scheduling in order to achieve project success.

The challenges confronting the use of construction planning and scheduling techniques have significance effect on construction project performance (see table 3). Shannon (2022), claim that low expertise of most project planners negatively affect project success. Sterman (2022), assert that poor managerial decisions affect the use of proper scheduling techniques in planning construction projects. Inuwa et al., (2014), argue that the complexities associated with most network techniques deter planners from adopting the technique in the construction project scheduling.

Gantt/Bar chart scheduling technique has significance correlation with construction project performance (see table 4). Hancher, (2013) agree with this finding. Hancher (2013) posits that most construction project managers and their close attachment to the use of Gantt chart have contributed immensely in the successful achievement of project intentions. So, Gantt/Bar charts, despite their outdated nature, are still relevant technique for planning and scheduling projects. However, Inuwa et al., (2014) argued that the shortcomings associated with the use of Gantt/Bar charts have made it unsuitable for scheduling complex projects.

There is significant correlation between Critical Path Method scheduling technique and construction project performance (see table 5). This is a truism. The submission of Sterman (2022) and Shannon (2022) in their various articles corroborates with this finding as they complained the poor knowledge base of most project managers in handling the critical path methodology is the major reason for its poor application. However, critical path method is a veritable technique for planning and scheduling successful projects.

5.0 Conclusion

Successful completion of construction project in terms of time frame, budget and quality, largely depends on effective use and application of project scheduling at the planning stage, its implementation and control throughout the phase of the project. Hence, the study concludes that:

The various benefits of scheduling techniques should be explored by properly adopting the right technique in the planning and implementation of construction projects. Project operators should be properly trained and retrained on the application of various project planning and scheduling

techniques available for improved project performance. This will go a long way in minimizing the effect of the challenges confronting it application in construction projects management and enhance project delivery and economic development.

Gantt/Bar chart methodology should be properly applied and utilized for proper planning and scheduling of construction projects for improved delivery of construction projects. Yes, Gantt charts appear to be outdated, but its wide usage in planning construction projects in most developing countries cannot be overlooked.

Improving knowledge and expertise of project planners and operators on the effective use of Critical Path Method in planning and scheduling construction projects is critical. This can be achieved through workshops, conferences, seminars, etc. Professional project organizations and institutes can be of great importance in this direction. Intensive training and retraining has become very critical in order to achieve improved success in project delivery and national development.

Contribution to knowledge

The literature revealed that current research focus has been concentrated on the factors that influences the effectiveness of project software planning and scheduling in construction projects. As noted earlier, previous research has not addressed the link between planning and scheduling theory and current practices on the part of project stakeholders and organizations. Without having knowledge about such links between theory and practice of planning and scheduling, project managers and practitioners faces great challenges when implementing these theories and concepts in practice. Challenges should be assessed at both theoretical and practical levels on the part of organizations and practitioners.

Thus, this study tries to partially fill this knowledge by assessing project stakeholders and practitioner familiarity and knowledge in this area in order to align such knowledge with the development of project management concepts for more effective planning and scheduling systems.

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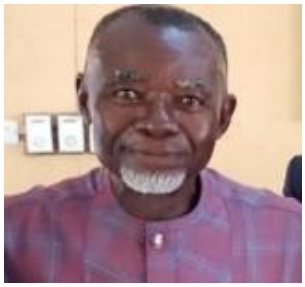

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