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Building production management practice in the construction industry in Nigeria

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ABSTRACT
Growing demands for building projects result from economic development. The building industry is dynamic and multifaceted. Efficient and effective practice of building production management (BPM) is required to successfully execute projects and achieve project goals upon completion as well as functionality aims for the lifespan of a building. This research aims to determine factors that influence the BPM practice in the Nigerian construction industry, particularly; during the project execution phase. A cross-sectional survey used; a questionnaire to identify 73 factors, which were grouped into 12 categories and assessed. A purposive sampling technique was used to identify 20 construction organisations specialising in building production management in Lagos, Nigeria. 114 questionnaires were distributed to the pool of stakeholders, which included 31 clients, 34 consultants and 49 contractors of current and past building production projects carried out by the selected firms in Lagos. The research used a selection of statistical tools for SPSS v.23, including the chi-square test, the Kruskal-Wallis test and Kendall's coefficient of concordance. The obtained result revealed the factors that mostly influence the BPM practice namely, architectural drawings, the construction programme document, the work breakdown structure, the adequacy of communication and coordination between the parties, the adequacy of raw materials and equipment, the availability of the competent team, the implementation of the safety management system, regular maintenance of project equipment, clear and timely inspections, the availability of funds as planned throughout the project duration, the availability of skilled personnel, and the aesthetics of the completed work. The research resulted in the development of the BPM implementation framework and recommendations for the improvement of the BPM practice in Nigeria.

KEY WORDS
building production management, practice, Nigerian construction industry, theory, critical success factors

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Introduction

Increasing client expectations, high demands related to construction time and cost, and the growing complexity of construction methods have made the building industry dynamic and multifaceted. As stated by Olanipekun, Aje and Adedokun (2014), the construction industry is diverse because construction professionals come together from different backgrounds, with varied training and experience to deliver common project goals. According to Odusami, Oyediran and Oseni (2007), construction companies must develop plans to survive in the competitive envi-

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ronment filled with client demands, and be competent in identifying those client requirements for contractors that aim for higher quality services. The Nigerian construction industry plays a vital role in economic development (Ugwu & Attah, 2016), which in turn increases the demand for building projects. According to Nwachukwu and Emoh (2011), the building development sector has proven to be the backbone of national economic growth; therefore, it is imperative that building projects are managed efficiently and effectively. This indicates the need for effective and efficient practice of building production management (BPM) in the building sector.

According to Henrich and Koskela (2006), production management methods can be responsible for many construction project failures. In most construction firms, a high rate of business failure results from the lack of skills and knowledge (Kanyago, Shukla & Kibachia, 2017) as well as the insufficient understanding among stakeholders of duties and responsibilities ascribed to industry professionals or experts managing building projects in Nigeria (Anyanwu, 2013). These issues and general negligence may cause; project delays and budget overruns, economically unviable design and solutions, inadequate specifications, poor workmanship, and rework.

Ineffective building production management (BPM) can negatively impact on the national economy. According to Osuizugbo (2020), ineffective BPM has negative implications on construction companies as well as the economy, and can only result in rework, budget overruns, project delays, premature project termination, poor workmanship and building failure/collapse. Aliyu, Adamu, Abdu and Singhry (2015) pointed out that ineffective work was the leading cause of poor project performance in the construction sector. Furthermore, the impact of the construction industry on the economy is directly associated with project performance. Ineffective BPM practice may also damage the reputation of the project team. According to Odediran et al. (2012), ineffective project management affects the company's competitive position in the market. Osuizugbo (2020) defined ineffective BPM as used inefficient operating methods, competence deficiencies among management and construction workers; or poor design and specifications, which lead to extra work. Most Nigerian cases of BPM are executed by unqualified people, such as artisans, craftsmen and technicians, who have no knowledge of technological or construction processes including the construction phase (Anyanwu, 2013). Ineffective BPM obstructs innovation, creativity, and the sector's growth (Osuizugbo, 2020). According to Anyanwu (2013), ineffective BPM wastes time, money, material and human resources, and generates an immense loss to the economy. Consequently, there is a pressing need to call for a solution because, construction failures, abandoned and collapsing building impede the development, economy and investment (Nwachukwu & Emoh, 2011).

This study emerged from the problems faced by building production management. The research aims to assess the local practice of building production management (BPM) with the view to improve the state of play of the Nigerian construction industry. To achieve this aim, the study identified and evaluated factors that affect the practice of building production management in Nigeria. Although this study applies specifically to the Nigerian construction industry, the same method could be used to in other countries that face issues of ineffective building production management.

1. Literature review

1.1. Nigerian construction industry

Historically, the construction industry has always been related to the process of industrialisation and development (Lopes, Oliveira & Abreu, 2011). The productivity of the construction industry in Nigeria, according to Aniekwu, Igboanugo and Onifade (2015), is very low compared with other industries, which is the result of a continuously used traditional project delivery method, which fails to effectively encourage the integration between design and construction, as well as the coordination and communication between participants of the construction industry. The Infrastructure Client Group (2015) states that; traditional methods are burdened with significant shortcomings that affect ways for the preparation and handling of construction projects. The industry consists of both the public and private sectors, but it is mostly private, while activities includes the procurement of goods and services, and the execution of various projects, such as building, civil engineering, power and energy, etc. (Okoye, 2016). The construction industry is the means, through which nations realises their potential goals for urban and rural development (Kanyago et al., 2017), while its activities and products are an essential part of the national economy and industrial development in developing countries, one of which is Nigeria (Okoye, 2016).

Globally, the construction industry accounts for 6-9% of the Gross Domestic Product (GDP) of many

countries (Kanyago et al., 2017). In Nigeria, the industry accounts for a substantial percentage of the Gross National Product (GNP) and constitutes almost half of the total public spending (Aniekwu et al., 2015). The relationship between the construction sector and the actual GDP was found to be significantly and strongly positive (Okoye, 2016). The Nigerian construction industry mainly consists of small and medium construction firms, with very few large multinationals. Most construction firms have less than ten employees, while several multinationals have hundreds (Jimoh, 2012). According to Okoye (2016), construction workers in Nigeria are hardly literate and poorly paid, having to work long hours under poor workplace conditions, which is often dangerous manual work.

The Nigerian construction industry plays an essential role in the national economy. Up to now, it has been battling with serious issues and challenges, such as cost overruns, project delays, economically unviable design, poor workmanship, rework, inadequate specifications, impracticable and uncontrolled schedules, deficient detailing, misunderstandings among project team members, and abandoned and uncompleted public and private building projects. These days, it is extremely common to see a collapsing building. Such frequent incidents have shaped a negative public opinion about the industry. Consequently, there is a pressing need to improve the BPM practice in the country.

1.2. Building Production Management (BPM)

BPM has been defined as the management of building production information, equipment, materials, labour and other resources that are used in the physical realisation of a building project, at the same time adhering to building codes and contractual conditions (Osuizugbo, 2020). It follows that BPM is the overall management of building production on site. According to the Nigerian Institute of Building (NIOB) (2002), in Nigeria, BPM is perceived as the main role/scope of professional service rendered by builders to clients in any building project. The scope of services under BPM includes the analysis of building production information, construction planning and the management of the production process on site.

Building production information includes architectural drawings, electrical and mechanical drawings, specification documents and structural drawings (Osuizugbo, 2018, 2019). Various documents are required during the phase of construction planning and the process of site production management. These BPM documents include the project health and safety plan, the construction programme and the project quality management plan (Okoye & Ngwu, 2015). Studies conducted by Okoye and Ngwu (2015) reported a low level of awareness and extremely low use of these documents, which indicates that the documents are not considered important in building production management. Other BPM documents, which are crucial for project performance improvement include the construction methodology, the early warning system chart and the information requirement schedule (NIOB, 2002).

During the phase of construction planning and site production management, project management tools or techniques are also important to BPM practice. Studies described several project management tools or techniques, including Projects in Controlled Environments (PRINCE/PRINCE2), in-house project management methods, cost-benefit analysis (CBA), decision analysis (DA), the buildability and maintainability analysis, in-house decision-making techniques, the programme evaluation & review technique, the project sensitivity analysis, the graphical evaluation & review technique, Line of Balance, the critical path method (CPM), work breakdown structure (WBS), life-cycle cost analysis (LCCA), the probability analysis (PA), in-house risk assessment tools and Gantt bar chart, etc. (Haron et al., 2017; Ugwu & Attah, 2016; Osuizugbo, 2018). Most of these project management tools and techniques are rarely used in the construction sector. For example, Haron et al. (2017) found that CBA, Gantt bar chart, and CPM are the most widely applied project management tools and techniques in the construction sector. The studies of Ugwu and Attah (2016) also found that the critical path method (CPM) was the most important project management technique that influences the management of construction projects.

Virtually all business activities are housed in a structure, which is generally referred to as a building. Its production attracts professionals and non-professionals and is considered to be complete when the project is handed over to the client (Nwachukwu & Emoh, 2011). As one of the most valuable assets of humankind, it needs to be properly structured (Osuizugbo, 2018). According to Ugwu and Attah (2016), construction projects in Nigeria are expensive; thus, it is of utmost importance to focus on construction practice and the best methods. Most times, project managers prepare a work programme without the input of actual workers, often starting tasks that cannot be completed (Infrastructure Client Group, 2015). The Infrastructure Client Group (2015) stated that, about

50% of works started on construction sites could not be finished as planned, which resulted in up to 50% of construction man-hours to be unproductive.

The solution to building failure, abandonment, building collapse, and project success; depends on efficient and effective BPM practice. The BPM process begins with the analysis of design information. The application of BPM practice is a well-organised approach to building production, which helps improve the capabilities of the building industry, thereby delivering and achieving success at the end of the project. When BPM is practised efficiently and effectively, it certainly results in massive tangible benefits received during the three main phases of the building process, which include the design, planning and production processes, which are the key focus of BPM. Professionalism plays a crucial role in the BPM practice as it determines the management of resources invested in the project for the benefits of clients.

1.3. Theoretical framework for BPM

The description of the production theory based on the economic principle mainly focused on the relationship between input and output. Osuizugbo (2020) outlined a new theoretical foundation of construction production, which rested on pillars of transformation, flow, and value generation. As stated by de Valence (2012), these three theories should be managed concurrently. Views regarding the BPM transformation and flow focused on different aspects of building production management. According to Koskela (1999), the transformation concept is based on the value-adding tasks with the main focus of transformation view placed on defining the task to be done; and achieving it professionally, whereas the flow concept is based on non-value adding activities, with the focus on the elimination of waste from flow processes.

Transformation theory

In the construction system, production takes inputs in the form of labour, materials, finance, information, plants and equipment, and converts them into the expected services and products, otherwise known as outputs. The principles of a classical transformation include (i) the division of production into smaller controllable sub-processes and further into tasks, then making available all the inputs required for a particular work section and then allocating these tasks to workers; (ii) the reduction of the project cost by minimising each cost of the sub process; and (iii) linking of the input value of a process with the output value (Gao, 2013). In practice, the value of a finished building can be increased using skilled labour, better materials and effective task management (Gao, 2013). This theory is particularly relevant to BPM because it explains the need to define works required to deliver a construction project, which helps to avoid unnecessary efforts.

Flow theory

According to Koskela (1999), flow processes include inspection, waiting, and moving, which represent waste (non-transformation activities) in production. As outlined by Gao (2013), the principles behind flow processes include (i) the reduction of activities that add no value; (ii) the reduction of lead time and variability; and (iii) simplicity, increased flexibility and transparency. The flow theory seeks to manage and continuously improve production, by making sure that unnecessary works are reduced to the barest minimum (Koskela, 1999). The sources of activities that add no value (waste) are (i) the production system structure; (ii) the production control style; and (iii) the characteristic nature of various phases in production, such as design, control and advancement of production (Gao, 2013).

Value generation

Value creation is the utmost concern in production management. It is a process whereby value for the client is formed by way of satisfaction of needs and eliminating value loss (i.e. with the help of value management) (Gao, 2013).

1.4. Conceptual framework

This study presented stages of the construction process, where the BPM practice can be implemented as presented in Table 1. The BPM framework aimed at improving the three main phases of the construction process. With the help of this framework, construction companies or developers and prospective clients are expected to achieve project objectives, increase efficiency and quality, and reduce time, costs and delays. Table 1 shows the summary of a typical BPM implementation framework with each phase in the construction process finalised by a decision (NIOB, 2002).

1.5. BPM experts

In the building industry, it is especially important to identify stakeholders and understand the roles they play in a project delivery. Failure to identify fraudulent stakeholders in the execution of a particular service can negatively influence the entire project. "It is not about knowing how to read an architectural or struc-

Tab. 1. BPM implementation framework

Phase	Work section	Tasks to be completed	Directly involved people	Work result	Decision to be reached
Design process	Buildability and maintainability analysis	1. Production information analysis (such as drawings, specifications, schedules, etc.); 2. Note-taking on problems such as omissions, inconsistencies and access for maintenance that could severely affect the future maintenance, efficient and economical building production; 3. Report documentation and advice on an efficient, economical and effective solution for building production; 4. Presentation of the buildability and maintainability analysis report to the project manager or client	design team, builder, contractor, project manager and client	design that facilitates the ease of construction and maintenance; or simply design a building that is production-friendly	solutions regarding the production information
Planning process	Construction planning	1. Preparation of the sequence of site operations; 2. Preparation and/or examination and review of the construction methodology document; 3. Preparation and/or examination and review of the construction programme document; 4. Preparation and/or examination and review of the project quality management plan document; 5. Preparation and/or examination and review of the project health and safety plan document; 6. Preparation and/or examination and review of the early warning system chart document; 7. Preparation and/or examination and review of the information requirement schedule document; 8. Preparation, examination and review of the project site organisational structure noting the conforming competence or otherwise; 9. Preparation of the construction planning report; 10. Presentation of the construction planning report to the project coordinator/manager or client; 11. Arrangement of workforce and tools, preparation of the access road to the site, hoarding installation, erection of temporary shops and huts, and tidying up the site	contractor, builder, project manager, and client	site prepared and ready for actual construction activities	readiness for the execution of the building project
Production process	Managing site production process	1. Delivery of materials to the site; 2. Setting out the building; 3. Site meetings, accounts, and financial control; 4. Engagement of resident builder(s) in the day-to-day management of the site production process; 5. Enforcement (appraising where necessary) of the use of all production management documents (PMDs) on and off the site; 6. Evaluation of workmanship services provided by artisans; 7. Suggestion of solutions to site difficulties and technical problems; 8. Preparation of BPM reports to be included in the periodic project reports	contractor, builder, project manager, and client	completed building	alternatives in the case the production or operations cannot proceed as planned
	Completion	1. Technical inspection upon completion; 2. Correction of errors, defects, and shortcomings; 3. Final technical inspection	design team, contractor, builder, project manager, and client	completed building, which, in the case of acceptance, is handed over to the client	acceptance of the quality of the building works carried out by the project team

tural drawing or having money to go into real estate and property development that makes one a builder or an engineer, it is all about having the required skill and academic discipline to marry the profession" (Osuizugbo, 2018). According to Osuizugbo (2018), evidence has shown that in the Nigerian construction industry, people perceive building and construction works as a quick means of making money; thus any lawyer, microbiologist, political scientist or even a trader can enter construction and engineering professions undisturbed. People without appropriate training can dabble in the field of engineering and construction uncontrolled due to the lack of regulation regarding the practice in the Nigerian construction sector. Construction management requires suitable skills and techniques, including sound and adequate management skills (Ugwu & Attah, 2016).

The scope of services/roles of professionals in the building industry has been the interest of many researchers. According to the study by Jimoh (2012), an architect is the one that determines the concept, the size and the layout of the building, while a builder is practitioner who is in charge of the production management right from site acquisition to handover, displaying good site management practice, which is vital for efficiency, cost effectiveness and control of the project.

According to Anyanwu (2013), architects and engineers prepare the designs of a building, while the execution is the role of professional builders, project managers and technical support workers. Anyanwu (2013) went further by stating that professional builders were the professionals of the physical construction works, and the role of a builder in project delivery was to produce a building by undertaking on-site activities, translating designs, drawings, schedules and specifications into a physical structure. Furthermore, builder uses production management skills, and essential resources, such as funds, labour, materials, and machines, to execute the project; a builder's skill in building production management is the core professional contribution to construction projects. According to Olanipekun et al. (2014), the following are unique functions of professional builders: preparing the buildability and maintainability analysis report, making the project quality management plan, devising the project health and safety plan, drafting the construction programme of works, managing the construction process and specifying materials and workmanship.

According to Osuizugbo (2018), in the building construction industry, engineers undertake calculations and analyses to produce a design solution; in other words, just like architects, engineers produce the design solution of a building project. Osuizugbo (2018) went further to described builders as professionals that have an analytical mind, by virtue of their training to organise and coordinate the activities of the tradesmen, subcontractors, and suppliers as well as to manage the entire building production process from the beginning to handover, with a view of ensuring that the project is completed on time, within the cost, and to specify the quality standard by utilising the most optimal construction methodology, also including other unique roles attributed to builders in the building project delivery. According to Bamisile (2004), building production management is the main role of professional builders; and in addition, builders have other major consultancy services. These consultancy services are shown in Fig. 1.

The role of a project manager necessitates for a technical expert to take charge of the construction site and control activities of the project execution process (Nwachukwu & Emoh, 2011), which are obviously some of the attributes of a professional builder. Hence, based on the literature findings, this study concluded that professional builders are BPM experts. In other words, professional builders (technical experts) are the project managers that are well experienced to act as BPM experts.

1.6. Critical success factors

A criterion is referred to as a benchmark or standard, by which something is judged or decided (Frefer et al., 2018). Project success criteria, according to Susil, Warnakulasuriya and Arachchige (2016), mean the measure, by which failure or success of a project is determined. According to Frefer et al. (2018), project success is classified into two groups, namely, macro and micro project success; the macro project success reflects the initial project concept, and when achieved, the project is considered successful, whereas micro project success considers project achievement in smaller unit levels. Contractors and clients view project success from the micro viewpoint, whereas stakeholders and users view project success from the macro viewpoint (Homthong & Moungnoi, 2016). The construction project success is achieved when investors meet their requirements individually and collectively (Takim & Akintoye, 2002); and the best criterion for project success is when the user, project manager and other stakeholders met all their prospects (Frefer et al., 2018). To improve the chances of building project success and reduce the possible failures, the performance

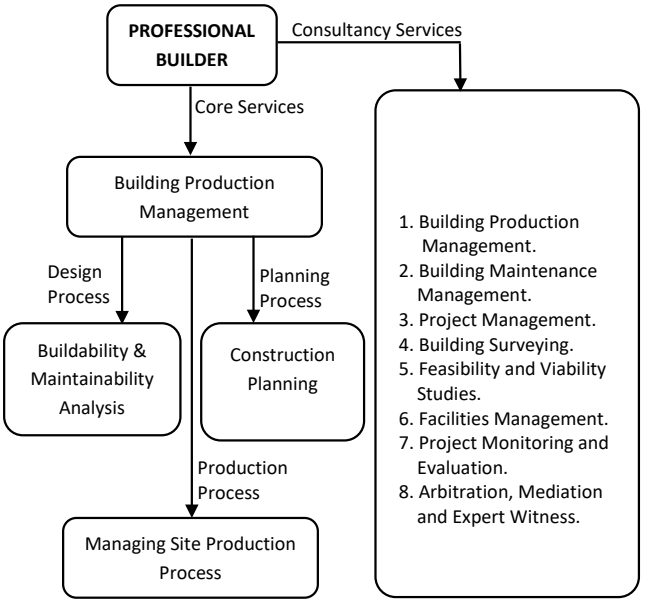

Fig. 1. Summary of professional builder functions in building project delivery
Source: (NIOB, 2020).

criteria for BPM practices should be properly and carefully identified, measured, and checked.

It has been observed that time, cost, quality, health and safety, environment, productivity, risk management, human resource and client satisfaction, among others, are dominant critical success factors reported by construction projects (Omer, 2017; Bryde & Robinson, 2005; Ramlee et al., 2016; Takim & Akintoye, 2002; Bahia & de Farias Filho, 2010; Al-Tmeemy, Abdul-Rahman & Harun, 2010; Koelmans, 2004; Gunathilaka, Tuuli & Dainty, 2013; Frefer et al., 2018; Homthong & Moungnoi, 2016; Gomesa & Romao, 2016; Toor & Ogunlana, 2010; Enshassi, Mohamed & Abushaban, 2009; Mukhtar & Amirudin, 2016). Studies by Homthong and Moungnoi (2016) revealed the most critical success factors influencing project success to include the competence of project participants, the durability of the completed work, the relationship between project participants, positive attitude of employees, effective quality assurance system in the organisation, quality of works to match standards, the relationship between an employee and a supervisor, competent supervisors and regular maintenance of equipment for the project. Haron et al. (2017) identified top five critical success factors that influence the project success to include competency of the project team, customer satisfaction, realistic cost and time estimation, effective planning and controlling and financial attributes.

According to Frefer et al. (2018), project success has two major components, which include issues related to the project and issues related to the client. Traditionally, time, cost, and quality, which are often referred to as the iron-triangle in the literature, are used as project success criteria. According to Homthong and Moungnoi (2016), this so-called iron-triangle has proved to be inadequate for measuring project performance, and the performance indicators are related to many dimensions, such as health, safety, environment, human resource development, client satisfaction, productivity, risk, contract and administration, profitability, and business efficiency. Also, according to Frefer et al. (2018), the traditional project success criteria, which include cost, time and quality, are no longer adequate to measure the success of the project since project success is more complex, and means different things to different stakeholders. According to Aniekwu et al. (2015), consistently low levels of performance are the result of the fragmented nature of the construction process and the distinct separation of industry professions, as well as the lack of concurrency, poor communication, institutional barriers, the lack of trust, ad-hoc problem-solving approach and team work between the client, design or construction team as well as other factors.

The major criteria used in this study to evaluate the BPM performance are time, cost, quality, health and safety, environment, productivity, risk management, human resources, and client satisfaction, as shown in Table 2. Fig. 2 explains the two major components of project success, as described earlier.

Tab. 2. Major project performance criteria summarised from following the reviewed literature

Research (author)	Critical success factors								
	Time	Cost	Quality	Health and Safety	Environment	Productivity	Risk Management	Human Resource	Client Satisfaction
Ramlee et al. (2016)	√	√	√	√	√				√
Takim and Akintoye (2002)	√	√				√			
Koelmans (2004)	√	√	√	√	√		√		√
Gunathilaka et al. (2013)	√	√	√			√			√
Frefer et al. (2018)	√	√	√	√	√	√			√
Homthong and Moungnoi (2016)	√	√	√	√	√	√	√	√	√
Enshassi et al. (2009)	√	√	√	√	√	√		√	√

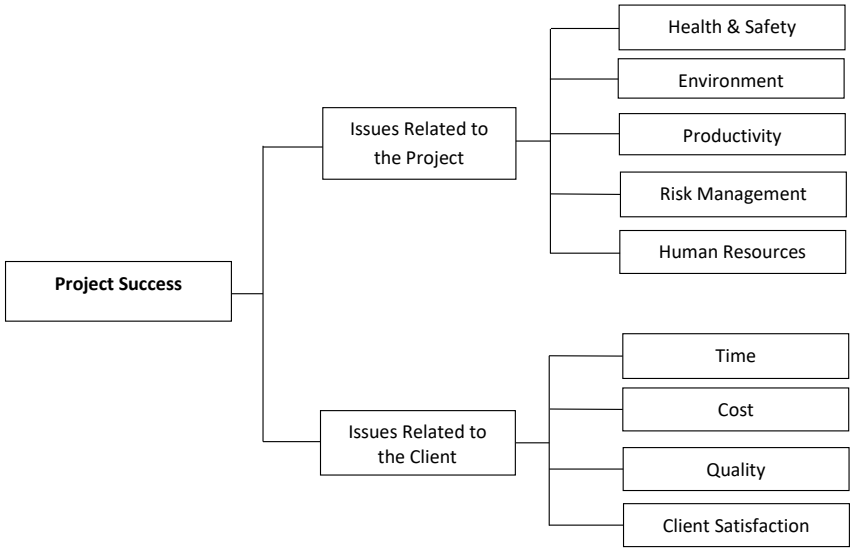

Fig. 2. Components of project success

2. Research method

This research used a field survey method to reveal the BPM practice in the Nigerian construction industry. The list of building production information (e.g. architectural drawings), building production management documents (e.g. the construction programme document), project management techniques/tools (e.g. the critical path method) and critical success factors (e.g. time and cost), which were identified in the literature, were used to design a questionnaire that served as the research instrument to achieve the aim of the study. The questionnaire survey was used to discern the attitude of industry stakeholders. Three groups of stakeholders of the Nigerian construction industry were invited to participate in this study, including clients, consultants, and contractors. A pilot study was conducted to show the accuracy and comprehensiveness of the instrument before distributing it to the participants. The reliability of multiple Likert scale questions was measured using the Cronbach's alpha. Using SPSS version 23, the value of the Cronbach's alpha (α) was 0.959, which indicated a high level of internal consistency for the scale and was considered reliable.

2.1. Study area

The research was carried out in the Lagos state, which is economically significant in Nigeria. The Lagos state has a high volume of building construction activities as well as a large concentration of building

contractors of various categories and sizes. The state was also chosen because of frequently collapsing of buildings.

2.2. Data collection

The purposive sampling technique was used in the study to identify the representative sample for the distribution of the questionnaire. The sampling technique is a non-probability method, which is based on the characteristics of the study population. Using a 5-point Likert scale, where No extent = 1, Moderate extent = 2, Medium extent = 3, Large extent = 4 and Very large extent = 5, the participants were asked to indicate the extent of use of each variables, namely, building production information, production management documents, and project management techniques/tools. To determine the level of importance attached to critical success factors, respondents were also presented with a 5-point Likert scale, where Least important = 1, Slightly important = 2, Moderate important = 3, Very important = 4 and Utmost important = 5. Table 3 shows the breakdown of survey responses.

Tab. 3. Questionnaire responses

S/NO	Respondent Groups	Distributed questionnaire	Returned questionnaire	Response rate (%)
1	Clients	31	23	74.2
2	Consultants	34	27	79.4
3	Contractors	49	37	75.5
4	Total	114	87	76.3

2.3. Method of the analysis

The study adopted the following for analyses: Frequency, Percentage, Mean, the Kruskal-Wallis Test and Kendall's Coefficient of Concordance. The analysis used the Statistical Package of Social Sciences (SPSS) v. 23. The frequency analytical tool was used to indicate the proportion of the respondent's characteristics while the percentage tool helped to simplify the proportion of the respondents in the study for better interpretation. The statistical mean was used to show the ranking given by respondents to different variables used in determining the extent of use of building production information, production management documents and project management techniques/tools practices. The Kruskal-Wallis inferential tool was used to determine if there was a significant difference among the clients, contractors and consultants on their ranking of the factors that independently measured the extent of use of building production information, production management documents and project management techniques/tools practices. Also, Kendall's statistical tool was used to test the agreement on the rankings given by BPM stakeholders to factors that influence the Building Production Management.

3. Analysis and results

This section presented the results and analysis of factors that influence the building production management (BPM) practice in Nigeria. The section also presents the demographic information on survey participants.

Tab. 4. Analysis of respondent demographics

Background information	Frequency	Percentage (%)
Professional Background of a Respondent		
Architect	18	20.7
Quantity Surveyor	16	18.4
Builder	27	31.0
Civil Engineer	22	25.3
Mechanical Engineer	1	1.1
Electrical Engineer	1	1.1
Others	2	2.3
Total	87	100.0
Highest Academic Qualification Attained		
HND	40	46.0
B.Sc./B.Tech.	28	32.2
PGD	1	1.1
M.SC	18	20.7
Total	87	100.0
Years of Working Experience in Construction		
Less than 5 years	16	18.4
5 – 10 years	36	41.4
11 – 15 years	20	23.0
16 – 20 years	10	11.5
21 – 25 years	3	3.4
26 – 30 years	1	1.1
31 years and above	1	1.1
Total	87	100.0
Type of Building		
Commercial	33	37.9
Residential	39	44.8
Religion	4	4.6
Office	9	10.3
Others	2	2.3
Total	87	100.0

The respondent background information is summarised and presented in Table 4. As shown in Table 4, 20.7% of the respondents were architects, 25.3% - civil engineers, and builders were the largest group of respondents with 31.0%. In addition, almost half or 46.0% of the respondents were HND holders and 32.2% had B.Sc./B.Tech. Furthermore, 81.6% of participants had from five to more than 31 years of experience in the field of construction, demonstrating adequate competency among respondents to participate in the study. According to Table 4, the majority of participants (44.8%) were involved in the construction of residential buildings.

To measure the extent of use of variables for building production information, production management documents and project management techniques/tools that are generally used in a construction project, respondents were asked to indicate the extent of use of twenty-eight research variables retrieved from the literature and grouped into three categories, namely, building production information, production management documents and project management techniques/tools. Table 5 shows the mean and chi-square values for 28 research variables, which had the mean between 3.01 to 3.80, with about 19 variables averaging between 2.11 to 2.90 and a 1.40. These results indicate that the mean responses to these questions were moderately important, slightly important, and least important, respectively. The Kruskal-Wallis test was run using SPSS v. 23 to determine the association between the variables. The result given in Table 5 showed a weak association and most of the variables were not statistically significant ($p>0.05$). The result in Table 5 also revealed a statistically significant difference in the mean score of the Programme Evaluation & Review Technique and the Decision Analysis across three groups of respondents. This means that the use of most of the variables depends on the nature of projects. The results also indicate that most of the variables for building production information, production management documents and project management techniques/tools are not used in project execution.

Using a comprehensive literature review, a total of forty-five critical success factors for construction project execution were identified and grouped into nine categories. The survey participants were asked to indicate the level of importance (Table 6) for each critical success factor. The Kruskal-Wallis test was also run using SPSS v. 23 to determine the association between various critical success factors. The results given in Table 6 revealed a weak association between the factors, which were statistically insignificant ($p>0.05$). It also showed a statistically significant difference in the mean score of some of the factors. This means that the participants did not focus on project performance criteria that could actually contribute to project success. Table 6 also shows the mean and chi-square values for each project performance factor. Forty-five project performance factors had a mean average between 4.00 to 4.13, which means that the mean responses to these questions were very important, excluding 37 factors, which had the mean values of 3.38 to 3.99, indicating moderate importance.

3.1. Significant testing for the hypothesis

The study used Kendall's statistical tool to test an agreement on the rankings given by BPM stakeholders to factors that influence building production management. Thus, Kendall's coefficient of concordance, which is a non-parametric test, was used to determine the degree of agreement or disagreement of target group responses concerning the factors that influence the BPM practice in Nigeria. SPSS v. 23 was used to run the test; the obtained result showed high significance (Table 7). Hence, the study concluded that, there was a statistically significant degree of agreement between different groups of respondents.

Tab. 5. Kruskal-Wallis test for building production information, production management documents and project management techniques/tools

Variables	Mean	Respondents groups	Mean rank	Chi-square	DF	Asymp. Sig
Factors for Building Production Information						
Architectural drawing	3.80	Clients Consultants Contractors	44.80 41.85 45.07	0.314	2	0.855
Structural drawing	3.71	Clients Consultants Contractors	45.50 39.87 46.08	1.138	2	0.566
Mechanical drawing	3.22	Clients Consultants Contractors	45.52 43.80 43.20	0.130	2	0.937

Electrical drawing	3.32	Clients Consultants Contractors	47.48 40.11 44.68	1.169	2	0.558
Other special drawing	2.90	Clients Consultants Contractors	50.48 39.57 43.20	2.529	2	0.282
Specification document	3.59	Clients Consultants Contractors	47.52 37.81 46.32	2.534	2	0.282
Factors for Production Management Documents						
Construction programme document	3.57	Clients Consultants Contractors	42.46 42.80 45.84	0.378	2	0.828
Construction methodology document	3.16	Clients Consultants Contractors	39.61 46.06 45.23	1.043	2	0.594
Project health and safety plan document	2.84	Clients Consultants Contractors	47.85 43.28 42.18	0.810	2	0.667
Project quality management plan document	2.90	Clients Consultants Contractors	44.61 49.98 39.26	3.028	2	0.220
Early warning system chart document	2.21	Clients Consultants Contractors	35.63 51.59 43.66	5.381	2	0.059
Information requirement schedule document	2.21	Clients Consultants Contractors	35.67 51.78 43.50	5.673	2	0.059
Factors for Project Management Techniques/Tools						
Project in controlled environments (PRINCE/ PRINCE2)	1.40	Clients Consultants Contractors	39.41 48.81 49.51	4.254	2	0.119
In-house project management methods	2.41	Clients Consultants Contractors	36.85 42.54 49.51	3.986	2	0.136
Cost-benefit analysis (CBA)	2.11	Clients Consultants Contractors	38.57 47.33 44.95	1.737	2	0.420
Decision analysis (DA)	2.24	Clients Consultants Contractors	30.48 42.19 53.73	13.342	2	0.001
Buildability and maintainability analysis	2.55	Clients Consultants Contractors	34.48 43.50 50.28	5.951	2	0.051
In-house decision-making techniques	2.72	Clients Consultants Contractors	35.63 43.48 49.58	4.692	2	0.096
Programme evaluation & review technique	2.82	Clients Consultants Contractors	37.28 39.52 51.45	6.226	2	0.044
Project sensitivity analysis	2.68	Clients Consultants Contractors	38.85 40.91 49.46	3.330	2	0.189
Graphical evaluation & review technique	2.52	Clients Consultants Contractors	42.24 42.26 46.36	0.612	2	0.736
Line of balance	2.54	Clients Consultants Contractors	46.85 40.81 44.55	0.793	2	0.673

Critical path method (CPM)	2.85	Clients Consultants Contractors	50.41 41.65 41.73	2.174	2	0.337
Work breakdown structure (WBS)	3.01	Clients Consultants Contractors	49.20 35.20 47.19	5.173	2	0.075
Life-cycle cost analysis (LCCA)	2.79	Clients Consultants Contractors	48.50 37.70 45.80	2.768	2	0.251
Probability analysis (PA)	2.56	Clients Consultants Contractors	48.98 40.09 43.76	1.650	2	0.438
In-house risk assessment tools	2.60	Clients Consultants Contractors	43.96 46.39 42.28	0.445	2	0.800
Gantt bar chart	2.20	Clients Consultants Contractors	47.46 38.78 45.66	1.898	2	0.387

DF = degrees of freedom, ASYMP. SIG = significance level

Tab. 6. Kruskal-Wallis test for critical success factors

Critical success factors	Mean	Respondents groups	Mean rank	Chi-square	DF	Asymp. Sig
Time Factors						
Adequate experience of project participants	3.86	Clients Consultants Contractors	48.11 35.93 47.34	4.451	2	0.108
Effective site management and supervision	4.02	Clients Consultants Contractors	46.67 36.61 47.73	3.842	2	0.146
Realistic obligation/clear objectiveS	3.69	Clients Consultants Contractors	51.30 34.48 46.41	6.709	2	0.035
Adequacy of communication and coordination among parties	4.06	Clients Consultants Contractors	49.96 40.93 42.54	3.196	2	0.202
Rapid decision making	3.91	Clients Consultants Contractors	59.80 30.11 44.31	5.123	2	0.077
Cost Factors						
Frequent progress meetings	3.67	Clients Consultants Contractors	49.65 45.37 39.49	2.688	2	0.261
Availability of resources	3.94	Clients Consultants Contractors	47.02 37.80 46.65	2.612	2	0.271
Adequacy of raw materials and equipment	4.02	Clients Consultants Contractors	47.17 36.50 47.50	3.880	2	0.144
Eliminating waste	3.97	Clients Consultants Contractors	50.30 35.59 46.22	5.559	2	0.062
Effective contract administration and management	3.76	Clients Consultants Contractors	55.17 32.63 45.35	11.470	2	0.003
Quality Factors						
Effective quality assurance system in an organisation	3.84	Clients Consultants Contractors	56.83 35.76 42.04	9.920	2	0.007

Effective monitoring and feedback by project participants	3.82	Clients Consultants Contractors	45.63 35.04 49.53	5.984	2	0.050
Availability of a competent team	3.99	Clients Consultants Contractors	47.78 35.11 48.14	5.668	2	0.059
Quality of equipment and raw materials	3.91	Clients Consultants Contractors	47.35 41.98 43.39	0.698	2	0.705
Effective corporation among project parties	3.78	Clients Consultants Contractors	48.09 35.41 47.73	5.133	2	0.077
Health and Safety Factors						
Implementation of the safety management system	3.60	Clients Consultants Contractors	49.80 37.78 44.93	3.167	2	0.205
Provision and delivery of appropriate safety training	3.54	Clients Consultants Contractors	48.63 35.65 47.22	4.864	2	0.088
Adequate number of site safety representatives	3.38	Clients Consultants Contractors	51.13 41.76 41.20	2.702	2	0.259
Involvement in the safety awareness of project participants	3.46	Clients Consultants Contractors	56.96 33.69 43.47	11.739	2	0.003
Conducting regular safety meeting or toolbox talks on site	3.44	Clients Consultants Contractors	47.24 35.83 47.95	4.462	2	0.107
Environment Factors						
Regular maintenance of equipment for the project	3.84	Clients Consultants Contractors	50.48 37.26 44.89	3.953	2	0.139
Sufficient provision of environmental management training	3.45	Clients Consultants Contractors	55.61 36.87 41.99	8.115	2	0.017
The use of up-to-date technology	3.63	Clients Consultants Contractors	59.20 37.15 39.55	12.658	2	0.002
Use of environmentally friendly equipment	3.76	Clients Consultants Contractors	49.30 30.59 50.49	12.193	2	0.002
Proper environmental site planning	3.75	Clients Consultants Contractors	50.85 41.28 41.73	2.610	2	0.271
Productivity Factors						
Availability of skilled workers	3.94	Clients Consultants Contractors	56.04 41.06 38.66	8.806	2	0.012
Clear and timely inspection	4.07	Clients Consultants Contractors	52.15 41.70 40.61	4.161	2	0.125
Effective change order management	3.79	Clients Consultants Contractors	52.35 36.44 44.32	5.859	2	0.053
The efficiency of tools and equipment	3.94	Clients Consultants Contractors	45.87 32.09 51.53	10.439	2	0.053
Availability of financial motivation system	3.80	Clients Consultants Contractors	46.26 37.41 47.41	3.077	2	0.215

Risk Management Factors						
Effective control of third-party delays	3.62	Clients Consultants Contractors	51.48 32.00 48.11	10.083	2	0.006
Absence of defective materials	3.79	Clients Consultants Contractors	51.02 31.11 49.04	11.170	2	0.004
Availability of funds as planned throughout the project duration	3.95	Clients Consultants Contractors	52.59 30.33 48.64	13.070	2	0.001
Implementation of an effective site safety management programme	3.86	Clients Consultants Contractors	45.52 37.37 47.89	3.184	2	0.204
Adequacy of risk management techniques	3.60	Clients Consultants Contractors	45.07 40.93 45.58	0.664	2	0.718
Human Resource Factors						
Availability of skilled personnel	3.90	Clients Consultants Contractors	43.67 42.57 45.24	0.203	2	0.904
Adequacy of skill training and development for all employees	3.71	Clients Consultants Contractors	53.20 39.15 41.82	4.785	2	0.091
Effective monitoring and feedback	3.84	Clients Consultants Contractors	48.33 37.28 46.22	3.323	2	0.190
Spirit of cooperation among project team members	3.75	Clients Consultants Contractors	42.63 39.02 48.49	2.518	2	0.284
Availability of internal promotion	3.69	Clients Consultants Contractors	54.76 38.52 41.31	6.458	2	0.040
Client Satisfaction Factors						
The durability of the completed work	4.10	Clients Consultants Contractors	47.96 33.37 49.30	8.037	2	0.018
Aesthetic of the completed work	4.13	Clients Consultants Contractors	46.17 35.37 48.95	5.416	2	0.067
Timeliness of service	4.00	Clients Consultants Contractors	41.50 35.30 51.91	8.122	2	0.017
Efficient functionality of product/service	3.91	Clients Consultants Contractors	52.61 34.37 45.68	7.451	2	0.024
The professionalism of project team services	4.10	Clients Consultants Contractors	52.89 34.11 45.69	8.113	2	0.017

DF = degrees of freedom, ASYMP. SIG = significance level

Tab. 7. Test statistics for Kendall's coefficient of concordance

Number (N)	87
Kendall's (W^a)	0.277
Chi-Square	1733.397
Degrees of Freedom (DF)	72
Significance Level (Asymp. Sig.)	0.000

4. Discussion of the results

Ineffective building production management (BPM) is one of the causes of poor project performance. In Nigeria, the BPM practice and its effect on

project performance still face disagreement/misunderstanding. The current study uses Nigeria as a representative case to provide some in-depth insights into the BPM practice used by construction stakeholders. The study identified several items that were very important for the BPM practice to be effective and grouped them into three categories, namely, building production information, building production management documents and project management techniques/tools. The study found that "architectural drawings" and "structural drawings" were most important pieces of building production information while "the construction programme document" and "the construction methodology document" were the most important building production management documents. Also, in terms of project management techniques/tools, "the work breakdown structure (WBS)" and "the critical path method (CPM)" were found to be the most important.

In the study, architectural and structural drawings were identified as the top two pieces of production information from among the six named, and possibly these drawings are required by a construction contractor before anything else. An architectural drawing is important as it shows client demands for a construction project. In the same vein, a structural drawing is considered important for the stability of the building project. Building production management documents are documents used in construction planning and site production management. This study found that the construction programme document and the construction methodology document were the most important for a construction project. The studies by Okoye and Ngwu (2015) found a low level of awareness and extremely low use of documents, such as the project health and safety plan, construction programme and project quality management plan. Put together, the importance of these documents for building production management is yet to be recognised. The reason behind the failure to use the documents could stem from negligence or the lack of effective control and regulation in the building system of Nigeria. In addition, the study participants considered the work breakdown structure (WBS) and the critical path method (CPM) as the most important project management techniques/tools. This situation could be the result of their simplicity and user-friendly nature or limited knowledge of the project management techniques/tools. The findings are consistent with those reported by the earlier studies. For example, Haron et al. (2017) found that CPM, CBA, and the Gantt bar chart were the most widely applied project management tools and techniques in the construction sector. Ugwu and Attah (2016) also found that the critical path method (CPM) was the most important project management technique that influenced the management of construction projects.

The effective use of building production information, production management documents and project management techniques/tools in the construction industry would provide stakeholders with headway to attaining project goals. The study into the use of drawings, construction documents, management techniques and tools that are widely applied in the industry, will help contractors and other stakeholders to create strategies for the built environment aimed at the efficient and effective application of the BPM practice. When these drawings, construction documents and management techniques are properly implemented, the BPM practice certainly results in adequate benefits at every part of project execution.

Furthermore, among the nine groups of critical success factors, the study identified the top nine, which have the most influence on project success, including "adequacy of communication and coordination among parties (the time factor)", "adequacy of raw materials and equipment (the cost factor)", "availability of competent team (the quality factor)", "implementation of a safety management system (the health and safety factor)", "regular maintenance of equipment for the project (the environment factor)", "clear and timely inspection (the productivity factor)", "availability of funds as planned throughout the project duration (the risk management factor)", "availability of skilled personnel (the human resource factor)", and "aesthetic of the completed work (the client satisfaction factor)". The findings are consistent with results reported in earlier research. For instance, studies by Homthong and Moungnoi (2016) revealed the most critical factors that determine project success, including the competence of project participants, the durability of completed work, the relationship between project participants, the positive attitude of employees, an effective quality assurance system in an organisation, the quality of works to match standards, the interrelation between an employee and a supervisor, competent supervisors and regular maintenance of project equipment. Haron et al. (2017) identified top five critical factors that influence the project success, including the competency of the project team, customer satisfaction, realistic cost and time estimation, effective planning and controlling, and financial attributes. The idea behind critical success factors rests on the identification of aspects that can lead to project success. The characteristics of the construction industry could be the underlying reason for the observed consistency.

The findings of this study provide insight into the BPM practice and factors influencing project success in the construction sector. As the study particularly focused on a developing country like Nigeria, its findings may not be generalisable, therefore must be applied with caution.

Conclusion

The study highlighted factors that influence the BPM practice in Nigeria construction industry, such as architectural drawings, the construction programme document, the work breakdown structure, the adequacy of communication and coordination between parties, the adequacy of raw materials and equipment, the availability of a competent team, the implementation of a safety management system, regular maintenance of project equipment, a clear and timely inspection, the availability of funds as planned throughout the project duration, the availability of skilled personnel, and aesthetics of the completed work. Based on the research findings, the building production information is considered of moderate importance in the management of building projects in Nigeria. The result of the analysis revealed that architectural drawings, structural drawings and the specification document were important factors relative to building production information. For the category of production management documents, two factors were moderately important, namely, the construction programme document and the construction methodology document, while others were slightly important. Project management techniques/tools are essential in construction management. The findings from the data analysis showed that the work breakdown structure was moderately important, and the remaining 15 factors that were relative to project management techniques/tools were either slightly or least important. This is as a result of the lack of adequate knowledge of these management techniques/tools, which is not helpful for building construction management. The concept of project performance criteria presents a meaningful way to identify factors that can lead to project success. The analysis revealed that for project success, adequacy of communication and coordination among parties is especially important in terms of time factors, adequacy of raw materials and equipment – cost factors; clear and timely inspection – productivity factors; and durability and aesthetics of the completed work as well as the timeliness of service and professionalism of the project team – client satisfaction factors.

The study recommends for the government of Nigeria to enact and enforce the law on the practice and implementation of BPM by qualified professionals only. This act will fish-out quacks in the building in would prevent unqualified individuals from accessing the building industry, which should reduce or even completely eliminate cases of building failures. All the building production information, including the production management documents, should be made compulsory by the government for the execution of every building project in Nigeria and such documents should be signed and stamped by relevant stakeholders. Proper monitoring and controlling of execution of building projects on site by relevant agencies should be effective and efficient so as to ensure good practice in the system. In addition, academia should contribute to adequate training and retraining on project management techniques/tools for project managers and encourage their use in the implementation of BPM.

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