*JCBM (2017) 1(1). 29 - 38*

**University of Cape Town**

Journal of Construction Business and Management

http://journals.uct.ac.za/index.php/jcbm

# Assessment of Building Maintenance Projects Success Factors in Developing Countries

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Received 30 October 2016; received in revised form 23 January 2017; accepted 02 March 2017

**Abstract**

Building maintenance projects have been characterized by poor quality delivery, which leads to client dissatisfaction. The maintenance contractor's personnel evolve around the uncertainties that surround maintenance decisions, which make the success of a maintenance project dicey. Hence, this study seeks to identify critical success factors that determine the performance outcome of building maintenance projects in Lagos State, Nigeria. A quantitative research approach was adopted for the study using a questionnaire survey for data collection. Descriptive and inferential statistics were employed for the analysis of the data collected. The findings of the study indicate that the eighteen identified factors can be grouped under six critical success factors named team integration and knowledge transfer, project learning and maintenance methodology, stakeholders' early project assessment, planning and control, information and communication management within project stakeholders, and quality and risk control. The effective management of these factors will improve building maintenance project's outcomes in Nigeria and adaptable for other similar developing countries.

**Keywords:** Building maintenance; Developing countries; Maintenance contractors; Project success factors.

## 1. Introduction

The importance of the buildings and its auxiliary facilities to human existence and their activities cannot be overemphasized. Though a building structure should be built to last, its longevity still depends on the level of care channelled into it. Effective maintenance is required to sustain the original purpose and intent of the building in terms of functions, aesthetics, health and safety, and so on. As the economy of a nation grows the need for maintenance functions increases (Tan, Shen, and Langston, 2012). Therefore, every growing economy must strengthen its maintenance output in the construction industry to meet the changing business environment. Factors that affect the maintenance market, according to Tan, Shen, and Langston (2012), are increasing number of ageing buildings, obsolescence and adaptive reuse, legislation, sustainability, and social responsibility. Maintenance is defined as "a combination of any actions carried out to retain an item in, or restore it to an acceptable condition" (BSI 1984, 3811). However, maintenance, according to Olanrewaju (2010 : 201) is "the processes and services to preserve, repair, protect and care for a building fabric and engineering services after completion, repair, refurbishment or replacement to current standards to enable it to serve its intended function throughout its entire lifespan without drastically upsetting its basic features and use". From the definitions, it can be seen that maintenance is a vital component of an organisation's existence in relation to its asset management.

In the study of Edmond, Lam Albert, and Chan Daniel (2010), they affirm that maintenance of existing building assets has been considered a top priority in most client

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organisations in their project planning. Most organisations have realized the efficacy of maintenance functions in their day-to-day activities and in the continuity of their production line to avoid a shutdown. These maintenance functions, whether services, repair, replacement, or cleaning, is a project to an organisation. The characteristic of the maintenance project depends greatly on the nature of the work to be executed. This also determines the mode of execution of the project, whether through in-house or outsourced contracting. No matter the mode of execution of the project, a successful completion of the project is paramount. Project success is seen as meeting goals and objectives as prescribed in the project plan, while a successful project means that the project has accomplished its technical performance, maintained its schedule, and remained within budgetary costs (Frimpong, Oluwoye, and Crawford 2003). Therefore, a project is considered successful if it meets the time criterion, monetary criterion, effectiveness criterion, and client satisfaction criterion set for it.

Unfortunately, building maintenance projects have been characterised by poor quality and delivery, which has led many times to client dissatisfaction. Also, the maintenance contractor and personnel evolve around the uncertainty that surrounds maintenance decision-making platform, which makes the success of the maintenance projects dicey. According to Mukelasi, Zawawii, Kamaruzzaman, Ithnin, and Zulkaranain (2012), the administration of maintenance management is not effective and efficient resulting in defective facilities and poor services. Obviously, maintenance approach altitude has been more reactive rather than proactive in nature without the interest of customer satisfaction (Mukelasi et al. 2012). This has resulted in the appalling conditions of buildings and auxiliary facilities, for example in Nigeria (Zubairu 2000; Adebayo 1991; Adenuga 2008; Adenuga, Olufowobi, and Raheem 2010; Okolie 2011). Therefore, to improve and retain the state of conditions of infrastructural facilities, it is paramount to improve maintenance management administration. Meaning that, the factors that can contribute to the success of building maintenance projects need to be identified. The identification of the constraints and the critical success factors (CSFs) in business can enhance management strategy and performance (Mukelasi et al. 2012). This will reduce the probability of failure during the execution of the project when all risks are well managed (Mukelasi et al. 2012). Therefore, maintenance project execution must be viewed and approach in an appropriate procedure to achieve success. The successful completion of maintenance projects will increase client satisfaction and organisational image of maintenance firms and the betterment of the built environment.

Buildings must be retained in a functional state to meet the needs of the occupants through an effective and efficient maintenance practice and execution. For this to be achievable in reality the critical success factors that can influence the improving of the maintenance workforce needs to be identified. Therefore, this study seeks to identify the critical success factors (CSFs) that determine the performance outcome of building maintenance projects in developing countries using Lagos, Nigeria as a case.

The study is divided into five sections, the first section is the introductory part that highlights the purpose of the study; the second section is the review of literature where previous related studies to the subject were presented; follow by the research method section that show the approach of data collection and analysis; while the fourth section deals with the discussion of the findings in relation to the literature review and the final part is the conclusion section.

## 2. Critical Success Factors (CSFs) Conceptual Review

Identifying critical success factors at the early stage of a project is paramount to the successful completion of a construction project. This couples with the consideration that there are some factors that influence project performance within the project environments. Critical success factors (CSF) are employed to measure organizational excellence (Mukelasi et al. 2012). According to Mukelasi et al. (2012), CSF is vital for building maintenance project because it can identify causes of project failure and also improve performance. Hence, these certain major factors must be well planned to achieve a successful project delivery.

Project success factors has been a major research area among the academia in the field of project management. Various contributors have established different factors that determine project success, such as Belassi and Tukel (1996); Divalcar and Subramanian (2009); Edmond, Lam Albert, and Chan Daniel (2010); and Straub (2011) (see Table 1). In 1996, Belassi and Tukel proposed a framework for determining critical success/failure factors in a project. Their findings reveal that critical factors have diverse ways of influencing the project outcome in different project environments. That means that the success factors for different projects may be diverse and unique in accordance to the projects' characteristics. The results of the study of Belassi and Tukel (1996) show that the project managers' managerial skills, team members' commitment and technical background, project attributes, and environmental factors are as viable and can be as critical as the organisational factors' in information technology and in manufacturing projects, managerial skills are the critical factors while environmental factors (economic and weather) mostly affect construction projects.

Edmond, Lam Albert, and Chan Daniel (2010) conducted an empirical study among maintenance contractors in the Hong Kong construction industry. They considered the time, cost, quality, functionality, safety, and environmental friendliness as the key performance indicators (KPIs) for building maintenance projects. But Belassi and Tukel (1996) attest that when time is considered as a KPI, the project manager's skills and communication between the team members becomes critical. This is reiterated by Straub (2011); communication and empathy skills toward the client are necessary for all consultancy activities. Basically, there exists a complex interaction between project variables which necessitate the need for further investigation of critical factors that determine project success in different project environments.

Straub considers maintenance contractors as service innovators; the study looks at certain attributes that determines the success of a maintenance project in relation to the personality of the contractor. Straub (2011) views that maintenance contractors must acquire more knowledge to ascertain the rate or level of deterioration of components and be able to give maintenance advice and cost implications. In addition, for a successful maintenance project, the ability to design, plan, and calculate maintenance scenarios, and performance measurement plans are vital (Straub 2011). Integrity, honesty, and coordination skills are also identified as necessary attributes (Straub 2011).

A study carried out by Divalcar and Subramanian (2009) identified nineteen project success factors that were reduced to three critical categories: role of project participants, planning; monitoring and feedback; and decision making, approval, and implementation. Further, seventy-seven factors were identified and classified under seven groups as project management-related factors, procurement-related factors, client-related factors, and business-related factors in the work of Saqib, Faruoqui, and Lodi (2008). The findings of their study show that the ten CSF of a project were decision-making effectiveness, project manager's experience, contractor's cash flow, contractor experience, timely decision by an owner/owner's representative, site management, supervision, planning effort, prior project management experience, and the client's ability to make decisions out of the seventy-seven identified factors. Also, Saqib, Faruoqui, and Lodi (2008) added that the top five CFS groups that influence project success were contractor-related factors, project manager-related factors, procurement-related factors, design team-related factors, and project management-related factors.

Bamber, Sharp, and Hides (1999) developed a conceptual framework for a successful implementation of Total Productive Maintenance (TPM) with nine factors namely, the existing organisation, measures of performance, alignment to company mission, the involvement of people, an implementation plan, knowledge and beliefs, time allocation for implementation, management commitment, motivation of management and workforce. From another point of view, Al-Hammad and Assaf (1996) considered the performance of maintenance contractors in Saudi Arabia from the perception of building owners and the maintenance contractors. According to the study, the building owners believed that factors that determine the successful performance of the maintenance contractors were proper planning and scheduling, safety precautions, technical competence, and workmanship while the contractors attested that proper planning and scheduling, safety precaution, subcontracting control, efficient administration, availability of equipment and facilities, and technical competence were the CSF needed to achieve a successful project delivery. Wahid and Corner (2009) stated that the composition of top management and employees, the reward system, teamwork, continuous improvement, understanding of International Standards Organisation (ISO), measurement of performance and communication are all critical success factors for ISO 9000 maintenance in the studied organisation.

Also, in the study of Mukelasi, Zawawii, Kamaruzzaman, Ithnin, and Zulkaranain (2012), the CSFs for building maintenance management of local authority in Malaysia were identified as leadership, culture, structure, roles and responsibilities, system infrastructure, and measurement. In their work, leadership relates to human capital, resources and relations which must consist of commitment, identification with the organisation, mutual trust, cooperation and future optimism. They further term culture as the nature of the maintenance work which entails the organizational practices, climate and norms, internal competence and integration, history and tools, conception and work demand. The organisational cultural elements culminate to organisation performance (Mukelasi et al. 2012). Also, the organisational structure is the division of responsibilities within the system as in top management and operational functions and physical inspection. According to Mukelasi et al. (2012) work policy will enhance a successful maintenance work system. Maintenance organisations must also utilize their system infrastructure which comprises resources, technology, management control, procedures and strategy to their advantage to achieve a positive project outcome (Mukelasi et al. 2012). In addition, project outcome needs to be measured whether it meets users' expectations in terms of quality, speed, reliability, safety, function and comfort (Mukelasi et al. 2012).

Ghanaee and Pourezzat, (2013) examined the critical success factors for urban residential renovation projects from the perspective of experts and urban managers. The findings of the study show four CSFs cluster of twelve factors as enabling factors prerequisites, requirements and facilitating factors.

In 2014, Tan, Shen, Langston, Lu and Yam studied the critical success factors for building maintenance business in Hong Kong. A total of eight CSFs was identified, such as maintenance service, organisation management, certification, people, relationship, technology, marketing, innovation and sustainability, while the two most relative principal CSFs are maintenance service and organisation, and project management (Tan et al., 2014). Their study also indicates client's satisfaction, certification of company, reliability of service, quality of service, and company reputation as elemental factors that determine building maintenance business success. Furthermore, Tucker, Turley, and Holgate, (2014) investigate the critical success factors of an effective repairs and maintenance service for social housing in the UK. The five top ranking CSFs found are stakeholder opinion, value for money, service standards, performance and continuous improvement. In support of these findings, Njuangang, Liyanage, and Akintoye, (2015) identified eight critical success factors to key performance measures to control maintenance-associated hospital-acquired infections (HAIs) as maintenance resource availability, maintenance strategies, infection control practices, risk assessment, liaison and communication with ICT, service level agreement, staff education, and customer satisfaction. Njuangang, Liyanage, and Akintoye, (2015) in their study stated that close collaboration and communication between the team are vital CSFs, and that customer satisfaction is an underdeveloped CSF.

Table 1: Summary of CSFs conceptual review

| Author(s) | Study Focus | Critical Project Success Factors |
|---|---|---|
| Al-Hammad and Assaf (1996) | Maintenance Contractors | Providing proper planning and scheduling, providing safety precaution, subcontracting control, providing efficient administration, making required equipment and facilities available, ensuring technical competence, delivering material, and providing suggestions on cost cutting |
| Bamber, Sharp and Hides (1999) | Total Productive Maintenance | The existing organization, measure of performance, alignment of company mission, the involvement of people, an implementation plan, knowledge and beliefs, time allocation for implementation, management commitment, motivation management, and workforce |
| Al-Zahrani (2001) | Maintenance Auditing | Organisation and human resources, material management, work planning and scheduling, work accomplishment, information technology and appraisal, workload identification, and performance measures |
| Hua, Sher and Pheng (2005) | Communication between Client/Maintenance Contractors | Checking information with users, use of appropriate visualization techniques, sufficient human resources, timing of information, clients' feedback, working experience, clients' attitudes, straightforward work requests, and contractor's suggestion matching interests of clients |
| Ali et al. (2006) | Reactive Maintenance | Knowledge sharing, quality of information |
| Saqib, Faruoqi and Lodi (2008) | Construction projects | Decision-making effectiveness, project manager's experience, contractor's cash flow, contractor experience, timely decision by an owner/owner's representative, site management, supervision, planning effort, prior project management experience, and client's ability to make decision |
| Divalcar and Subramanian (2009) | Construction Project (time monitoring) | Role of project participants, planning, monitoring and feedback, decision making, approval, and implementation |
| Edmond, Lam Albert and Chan Daniel (2010) | Key Performance Indicator in Maintenance Project | Time, cost, quality, functionality, safety, and environmental friendliness |
| Straub (2011) | Innovation in Maintenance Contracting | Knowledge and competencies in calculations of costs, design of maintenance scenarios and performance measurement plans, integrity and honesty, coordination skills, communication, and empathy skills |

Though the findings of some of the reviewed literatures were similar, contrary opinions are expressed in this subject area due to the uniqueness of the project environment. This change in the success factors are the rapid changes currently experienced in the business environment, according to Belassi and Tukel (1996). This makes the need to investigate the issues of CSFs in maintenance projects paramount in different domains (see Table 1). Therefore, a different project environment in a developing nation is considered in this study. The factors that determine the maintenance project's success in Lagos, Nigeria, from the perception of the clients, maintenance contractors, and the consultants were viewed to contribute to the existing literature.

## 3. Research Method

To achieve the purpose of the study, a review of literature on critical project success factors was conducted. This involved the identification of various factors that can contribute to a successful completion of a project. About eighty factors were identified from the literature in general. The identified factors were then reduced by an expert panel in the field of maintenance contracting, which included maintenance manager/officers, maintenance contractors, and academics with a research focus on maintenance activities, through a questionnaire Survey. The panelists were mandated to identify those factors that are most critical to a maintenance project considering its unique nature. The factors were reduced to eighteen, which was considered appropriate for the study. A structured questionnaire was developed to facilitate data collection and to ensure consistency in the elements examined. The questions were designed as statements seeking a participant's level of agreement to identify factors that determine the successful delivery of a maintenance project; the responses were based on a five-point Likert scale where 1.00-1.50 is not critical; 1.51-2.50 is less critical; 2.51-3.50 is critical; 3.51-4.50 is very critical and 4.51-5.00 is extremely critical (see Adewunmi, Omirin and Famuyiwa, 2011; Olanrewaju, Khamidi and Idrus, 2010). A systematic stratified sampling method was employed to select contracting firms from a list of registered contractors and consultants in professional recognized bodies. The client organizations were selected using a purposive sampling technique. A questionnaire survey was conducted among representatives from seventy-five major contracting/consulting firms and client organizations involved directly in maintenance projects in

Lagos, Nigeria. Sixty-three of the questionnaires were found valid for the study. The data collected was analysed using SPSS version 22.0.

The descriptive statistic of the responses was studied. A ranking of the factors based on the mean score of the responses through descriptive statistic was done. A test of one way Analysis of Variance (ANOVA) was done to study the difference in the perception of the criticality of these factors by the three groups of respondents, namely the clients, maintenance contractors, and the consultants. Factors with a less than 0.05 significance are said to have a different perception among the respondents. To identify which group of respondents had a different opinion, a Post Hoc (Tukey's B) test was conducted for the factors with a significance value less than 0.05. The test compares the means of the group of respondents. In addition, Cronbach's alpha was used in this study to test the internal consistency among the critical success factors of maintenance projects. Factor Analysis by Principal Component Analysis Method was done to extract the critical underlying factors (see Divakar and Subramanian, 2009, Ghanaee and Pourezzat, 2013, Tan et al., 2014).

## 4. Results

The demographic of the respondents (see Table 2) show that 47.6 percent of the respondents were forty years old and above while 74.8 percent had more than five years of practicing experience in the construction industry. Also, 25.4 percent, 44.4 percent, and 30.2 percent represent the participation of the client, contractor, and consultant organizations respectively.

The descriptive statistics identified fourteen factors overall with a mean score more than 2.50, depicts that the factors were critical to maintenance project success. In addition, the contractors identified sixteen critical factors while the clients and the consultants identified eleven and fourteen critical factors, respectively, as shown in Table 3. From the overall mean score of the factors, simplicity of programs, effective maintenance cost allocation budgeting, ease of techniques used, risk management in maintenance work and communication and information flow are the five most critical success factors (CSFs) for a maintenance project.

Table 2: Characteristics of respondents

| Demographics of the respondents | Frequency | Percentage |
|---|---|---|
| **Age of respondents** | | |
| 30-39 | 33 | 52.40 |
| 40–59 | 28 | 44.40 |
| 60 and above | 2 | 3.20 |
| **Professional qualification** | | |
| Council of Registered Builders of Nigeria (CORBON) | 29 | 46.00 |
| Architects Registration Council of Nigeria (ARCON) | 7 | 11.10 |
| Council of Registered Engineers of Nigeria (COREN) | 11 | 17.50 |
| Others | 16 | 25.40 |
| **Gender** | | |
| Male | 53 | 84.10 |
| Female | 10 | 15.90 |
| **Years of experience** | | |
| 0–5 | 16 | 25.40 |
| 5–10 | 31 | 49.40 |
| 11–15 | 8 | 12.70 |
| 15 years and above | 8 | 12.70 |
| **Educational qualification** | | |
| Bsc/B.Tech | 20 | 31.70 |
| MSc | 12 | 19.00 |
| HND | 18 | 28.60 |
| PGD | 8 | 12.70 |
| PhD | 5 | 7.90 |
| **Business type** | | |
| Client organization | 16 | 25.40 |
| Contractor organization | 28 | 44.40 |
| Consultant organization | 19 | 30.20 |

The level of significance (Sig.) of each factors was extracted from a one way ANOVA test as shown in Table 4, it indicated that four factors were significant as viewed by the respondents with a significance level $p < 0.05$. These factors were partnering (p=. 000), risk management in maintenance work (p=. 007), training of employees in maintenance-related works (p=. 015) and project program and scheduling (p=. 001). This means that the respondents had different perceptions of the factors as they affect their maintenance project's activities.

To study which group of the respondents perceived the factors differently, a Post Hoc (Tukey's B) test was conducted for the factors whose significance value was less than 0.05. As shown in Table 5, the maintenance contractors perceived partnering differently. The reason for this may be due to the challenges faced during business partnerships experienced in the study area. The problems of partnerships, such as trust and integrity between the partners, are major issues with which to contend, and these issues affect successful project deliveries. Further, the clients perceived risk management in maintenance work differently. This may be due to the fact that the clients are not directly involved in the execution stage of the maintenance project, whose nature is characterized by many uncertainties and risks.

Table 5 also indicates that the training of employees in maintenance-related work was perceived differently by the clients and maintenance contractors with an overlapping effect. The issue of training staff to achieve technical competence cannot be overemphasized, but the training of personnel is solely the responsibility of the company owners, which most contractors ignore due to the cost implication and the fact that long time benefits can't be predicted. However, the clients and the consultants may believe that trained and competent maintenance personnel will deliver a successful project. In relation to a project, program, and scheduling, the clients may perceive differently due to the fact that is not their responsibility to plan for the project; this is certainly the sole duty of the contractor.

Table 3: Ranks of factors that determine maintenance project success

| | Variables | Contractors | | Consultants | | Clients | | Overall | |
|---|---|---|---|---|---|---|---|---|---|
| | | Mean | Rank | Mean | Rank | Mean | Rank | Mean | Rank |
| V1 | Training of employees in maintenance-related work | 2.87 | 9 | 2.88 | 8 | 2.65 | 7 | 2.80 | 8 |
| V2 | Ease of techniques used | 3.15 | 3 | 2.40 | 17 | 3.30 | 1 | 2.95 | 3 |
| V3 | Simplicity of program | 3.63 | 1 | 2.96 | 5 | 2.89 | 3 | 3.16 | 1 |
| V4 | Information and communication technology (ICT) | 2.73 | 12 | 2.92 | 6 | 2.39 | 13 | 2.68 | 10 |
| V5 | Process coordination | 2.07 | 17 | 2.92 | 6 | 2.83 | 4 | 2.61 | 13 |
| V6 | Early involvement of project team | 2.93 | 7 | 2.76 | 10 | 2.30 | 15 | 2.66 | 11 |
| V7 | Experience and competent workforce | 2.60 | 15 | 2.48 | 16 | 2.30 | 15 | 2.46 | 15 |
| V8 | Maintenance project planning and control | 2.87 | 9 | 2.16 | 18 | 2.22 | 18 | 2.42 | 18 |
| V9 | Project program and scheduling | 2.73 | 12 | 3.36 | 1 | 2.52 | 10 | 2.87 | 6 |
| V10 | Partnering | 2.67 | 14 | 2.60 | 13 | 2.30 | 15 | 2.52 | 14 |
| V11 | Effective maintenance cost allocation budgeting | 3.27 | 2 | 3.04 | 3 | 3.00 | 2 | 3.10 | 2 |
| V12 | Understanding the stakeholder's attitude | 3.07 | 5 | 2.68 | 12 | 2.65 | 7 | 2.80 | 8 |
| V13 | Lean and just in time approaches | 2.07 | 17 | 2.88 | 8 | 2.43 | 12 | 2.46 | 15 |
| V14 | Continued improvement | 2.93 | 7 | 3.08 | 2 | 2.57 | 9 | 2.86 | 7 |
| V15 | Standardization | 2.87 | 9 | 2.56 | 15 | 2.52 | 10 | 2.65 | 12 |
| V16 | Communication and information flow | 3.13 | 4 | 2.72 | 11 | 2.83 | 4 | 2.89 | 5 |
| V17 | Risk management in maintenance work | 3.00 | 6 | 3.04 | 3 | 2.78 | 6 | 2.94 | 4 |
| V18 | Working collaboration | 2.53 | 16 | 2.40 | 17 | 2.35 | 14 | 2.43 | 17 |

*Note: 1-1.50 (not critical) and 4.51-5.00 (extremely critical)*

Table 4: Level of significance for maintenance project success factors

| Factor No | Factor Name | Sig |
|---|---|---|
| V1 | Training of employees in maintenance-related work | .007 |
| V2 | Ease of techniques used | .792 |
| V3 | Simplicity of program | .356 |
| V4 | Information and communication technology (ICT) | .738 |
| V5 | Process coordination | .128 |
| V6 | Early involvement of project team | .683 |
| V7 | Experience and competent workforce | .421 |
| V8 | Maintenance project planning and control | .203 |
| V9 | Project program and scheduling | .015 |
| V10 | Partnering | .000 |
| V11 | Effective maintenance cost allocation budgeting | .525 |
| V12 | Understanding the stakeholder's attitude | .334 |
| V13 | Lean and just in time approaches | .087 |
| V14 | Continued improvement | .902 |
| V15 | Standardization | .656 |
| V16 | Communication and information flow | .463 |
| V17 | Risk management in maintenance work | .001 |
| V18 | Working collaboration | .204 |

Table 5: Results of the Post Hoc (Tukey's B) test

| Groups and Variables | Frequency | Output | |
|---|---|---|---|
| Factor Name | N | Subset for alpha=0. 05 | |
| | | 1 | 2 |
| **Partnering** | | | |
| Consultant | 23 | 2.26 | |
| Client | 15 | 2.80 | |
| Maintenance Contractor | 25 | | 3.76 |
| **Risk management in maintenance work** | | | |
| Consultant | 23 | 1.70 | |
| Maintenance Contractor | 25 | 2.36 | |
| Client | 15 | | 3.13 |
| **Training of employees in maintenance-related work** | | | |
| Consultant | 23 | 2.26 | |
| Client | 15 | 3.00 | 3.00 |
| Maintenance Contractor | 25 | | 3.44 |
| **Project program and scheduling** | | | |
| Consultant | 23 | 2.13 | |
| Maintenance Contractor | 25 | 2.44 | |
| Client | 15 | | 3.27 |

### *4.1 Reduction of number of variables*

According to Field (2005) and Ho (2006), factor analysis is used to reduce variables and identify clusters of interrelated variables. To reduce the factors that determine the maintenance success in this study, a Varimax with Kaiser Normalization was employed to generate the final values. To categorize factors into one component, 0.50 values were used as a benchmark. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy test value is 0.622, which indicates that the sample size was adequate for factor analysis. The coefficient alpha in this test is 0.801, showing an acceptable internal consistency for these factors. All eighteen success factors identified were subjected to factor analysis with Varimax Rotation with Kaiser Normalization Criterion (see Table 6).

Table 6: Variables loading

| | Component | | | | | |
|---|---|---|---|---|---|---|
| **Variables (Initial factors)** | **1** | **2** | **3** | **4** | **5** | **6** |
| Training of employees in maintenance-related work (V1) | .084 | .624 | .287 | -.005 | -.245 | -.097 |
| Ease of techniques used (V2) | .161 | .534 | .213 | .497 | -.347 | .047 |
| Simplicity of program (V3) | .050 | .760 | .082 | .110 | -.011 | .078 |
| Information and communication technology (ICT) (V4) | .787 | .117 | -.016 | .009 | -.157 | -.010 |
| Process coordination (V5) | -.022 | .019 | .073 | .111 | -.098 | .868 |
| Early involvement of project team (V6) | .401 | .068 | .564 | .368 | -.085 | -.163 |
| Experience and competent workforce (V7) | .741 | .089 | .175 | .080 | .008 | -.077 |
| Maintenance project planning and control (V8) | .078 | .448 | .043 | .657 | .387 | .175 |
| Project program and scheduling (V9) | -.010 | .251 | .738 | -.005 | .065 | .115 |
| Partnering (V10) | .343 | .631 | -.234 | -.214 | .170 | .025 |
| Effective maintenance cost allocation budgeting (V11) | .348 | -.231 | .674 | -.059 | .037 | .183 |
| Understanding the stakeholder's attitude (V12) | .484 | .137 | .178 | .201 | -.655 | .118 |
| Lean and just in time approaches (V13) | .153 | -.125 | -.070 | .767 | -.192 | .039 |
| Continued improvement (V14) | .650 | -.056 | .230 | .111 | .097 | .550 |
| Standardization (V15) | .127 | .462 | .560 | .126 | .388 | .106 |
| Communication and information flow (V16) | .219 | -.064 | .369 | -.070 | .633 | -.063 |
| Risk management in maintenance work (V17) | -.070 | .383 | .536 | -.272 | .018 | .510 |
| Working collaboration (V18) | .617 | .218 | .105 | .250 | .240 | .041 |

*Note: Shaded cells denote common variables in each component.*

From the results of the factor analysis, the maintenance project success factor variables were grouped into components. The underlying factors extracted were named as (1) Team integration and knowledge transfer, (2) Project learning and maintenance methodology, (3) Stakeholders early project assessment, (4) Planning and control, (5) Information and communication management within project stakeholders, and (6) Quality and risk control as presented in Table 7. Table 7 further shows the average score of the extracted factors with values greater than 2.50, which indicated that all the underlying factor groups were critical to maintenance project successful delivery.

Table 7: Factors categories

| **Factor** | **Variables (Initial factors)** | **Mean Score** | **Classification** | **Major focus (Extracted factors)** |
|---|---|---|---|---|
| 1 | V4, V7, V14, V18 | 2.53 | Critical | Team Integration and Knowledge Transfer |
| 2 | V1, V2, V3, V10 | 2.98 | Critical | Project Learning and Maintenance Methodology |
| 3 | V6, V9, V11, V15,V17 | 2.57 | Critical | Stakeholders Early Project Assessment |
| 4 | V8, V13 | 2.54 | Critical | Planning and Control |
| 5 | V12, V16 | 2.62 | Critical | Information and Communication Management within Project stakeholders |
| 6 | V5, V14, V17 | 2.58 | Critical | Quality and Risk Control |

### *4.2 Discussion of findings*

This study adds to existing knowledge by providing insights into the critical success factors in building maintenance projects. The present study is the first to report the critical success factors from the perception of the client, contractor and consultancy involved in building maintenance projects in developing countries in

construction-related literature. The results of the study show that simplicity of programs, effective maintenance cost allocation budgeting, ease of techniques used, risk management in maintenance work, communication and information flow, Project program and scheduling and continued improvement were the seven critical factors that affected the success of maintenance projects in Lagos, Nigeria (see Table 3). These findings are in accordance with several previous studies' results. For instance, the simplicity of the program and the ease of techniques adopted are seen as CSFs which is in line with the results of Ad Wahid and Corner (2009) and Al-Hammad and Assaf (1999). Furthermore, the findings of the recent study indicate that effective maintenance cost allocation and budgeting can facilitate project success. This outcome is in a similar view with Tucker, et al. (2014), that value for money must be attain in project transactions. Also, Saqid et al. (2008) and Straub (2011) attests that cash flow, and the knowledge and competences in calculations of costs in project implementation are required. The ease of techniques adopted in the execution of the project is crucial to successful achievement as shown; this is in accordance to the technical competence found in Al Hammad and Assaf study. Risk management in maintenance works entails the safety measures put into place during the pre contract and contract planning stages. These safety issues are also identified in the study of Al Hammad and Assaf (1996) and Edmond et al. (2010).

Njuangang, Liyanage, and Akintoye, (2015) and Straub (2011) believe that effective collaboration and communication is needful for maintenance project success. This relates to the issue of partnership and early involvement of all the team in the project as shown in the current study. In addition, information and communication technology usage is considered vital for project success, Njuangang et al. (2015) support this when they reiterate that liaison and communication with ICT is a key performance factor. In addition, Ali et al. (2006), confirm that knowledge sharing and quality information among stakeholder's advance positive project achievements. Project programming and scheduling is also a critical success factor that determines the performance of maintenance projects in a developing country. According to Al-Hammad and Assaf (1996), Al-Zahrani (2001) and Divalcar and Subramanian (2009) project planning and scheduling are vital project CSF. The ability of the maintenance contractor's to plan and schedule the maintenance project to be executed is paramount for performance enhancement. Inclusively, maintenance project success cannot be achieved without continuous improvement within the organisation and during contract execution. Tellingly, it was reiterated by Tucker et al. (2014) and Wahid and Corner (2009) that continuous improvement in an ingredient to a successful project delivery.

The influence of stakeholder behaviour on project success cannot be overestimated. Understanding of stakeholders or customer altitude is confirmed in the findings of Turker et al. (2014); attest that stakeholder opinion is paramount to achieve maintenance project success. Added to this fact, Njuangang et al. (2015) ascertain that customers' satisfaction as not being the prime focus of CSF as it suppose to be; which is also supported in Tan et al. (2014). Furthermore, trained, skilful and competent employee's also contributes to project success as indicated in the study, which is in accordance with the findings in Njuangang et al. (2015), Straub (2011) and Al-Hammad and Assaf (1999).

Four success factors were also perceived to be significant to the successful delivery of a maintenance project (in Table 4); these were partnering, risk management in maintenance work, training of employees in maintenance-related work, and project program and scheduling. These findings agree with the results of, such as Njuangang et al. (2015), Tan et al. (2014), Bamber, Sharp, and Hides (1999); and Al-Hammad and Assaf (1996). The effective integration of these four factors will enhance the continuous improvement in the maintenance organization performance.

In view of the extracted factors in Table 7, the CSFs are grouped under six major components as team integration and knowledge transfer; project learning and maintenance methodology; stakeholders early project assessment; planning and control, information and communication management within project stakeholders and quality and risk control. Project learning and maintenance methodology will go a long way to determine a successful maintenance project delivery. The lessons learnt and the methods employed from previous projects must be put into play as a preventative measure in any new project environment. This will reduce the effect of encountering similar challenges and mistakes made. Further, the understanding of the maintenance processes and procedures will assist the project stakeholders to effectively and efficiently manage the maintenance project activities. Also, the ability to manage information and communication flow within the project stakeholders is paramount to maintain a cordial relationship among the project participants and the smooth running of the project execution. In addition, team integration and knowledge transfer induced technical competence and reliability within the project stakeholders; it also facilitates project learning pathways. Effective planning and control is necessary to attain quality and reduce the risks involved in the maintenance project delivery. This can be achieved by an early assessment of the project by the stakeholders through a viability and feasibility study of the project. The consideration and implementation of all these success factors for a maintenance project identified in the study will improve the maintenance project cycle. According to Edmond, Lam Albert, and Chan Daniel (2010), "project success is an abstract concept, the identification of key performance indicators enables project performance to be improved and the quantification of the perceptions towards success even sets a benchmark for construction excellence".

## 5. Conclusion

The management aspects are vital to the successful completion of a maintenance project. The early involvement of all stakeholders is paramount in this regard. The critical factors identified from the results of the study should be effectively monitored by the project

team and the maintenance contractor project manager. The maintenance contractor team should liaise with the client and the consultant organization. This team integration and collaboration acts as a partnership in executing maintenance project and will facilitate a successful completion of such project. However, the results of the study may not be generalized to all project environments. The study recommends that the implementation of these factors will improve building maintenance project outcomes. Also, there is a need for further study to explore the relationship between critical success factors and maintenance project outcome in developing countries.

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