Structural Equation Model of the Relationship between Project Performance Measures and the Critical Success Factors of Construction Projects: A Case of the Nigerian Construction Industry

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Received: 30 April 2020; Revised: 16 November 2020; Accepted: 2 December 2020; Published: 15 December 2020

ABSTRACT

This study investigated the relationship between project performance measures and the critical success factors (CSFs) of construction projects for the construction industry in Nigeria. Survey research method was adopted using questionnaire as the primary instrument for data collection. The questionnaire was designed to collect data on 19 project management performance measures and 54CSFs on a five point Likert scale. Altogether, 250 questionnaires were distributed to contractors, clients and consultants from 10 construction companies, out of which a total of 221 valid responses were obtained. The data collected was inputinto the SPSS 25 statistical software package where Crombach's alpha test was carried out on the constructs to determine their appropriateness for structural equation model (SEM). The data was finally imported from SPSS to LISREL where the final analysis was carried out using T-values and goodness of fit (GOF) indices. The SEM showed a high level of relationship between the project performance and the CSFs. This was shown by the justification of five out of the nine sub-hypotheses used for the data analysis with T-values greater than 1.96. These are: Client related factors directly influenced project performance, External environment factors directly influenced the project performance, Contractor related factors directly influenced the project success, Project planning and management factors indirectly influenced the customer satisfaction, and Project manager related factors directly influenced the project performance. Therefore, the null hypothesis that there is no significant relationship between project performance measures and the CSFs was rejected.

Keywords:*Project performance measures, critical success factors, construction projects, structural equation model*

1.0 INTRODUCTION

The construction industry is a key driver of the world economy accounting for approximately 13% of the global gross domestic product (GDP) which is a measure of the output, employment and income of the economy[1].

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By extension implies that the construction industry is on the forefront of the GDP of a nation because every year, both the government and private sector organizations invest resources into different categories of projects targeted at achieving some defined objectives.

Despite these huge investments by both the government and private sector in the last three decades in Nigeria, the objectives or desired outcome appear to be a mirage. This is evidenced by many recorded cases of poor performance of construction projects, abandonment of projects and outright failure of construction projects especially in building and road sectors of the construction industry which according to Okechukwu (2017) is retrogresses of a nation's economy [2]. This was corroborated by the continuous decline in the contribution of the industry to the GDP, increased poverty in the country and poor state of infrastructures.

Managing construction projects is a challenging task mainly because of the multivariate that have the capacity to impact project success and the multifaceted nature of project success. Apart from this, these multivariate which can be in the form of project management practices, critical success factors and project performance measures do not act in isolation but interact with each other [3]. In order to maintain competitiveness in the industry and foster project success, it is imperative for the construction companies and their professionals to understand the nature of these interactions. This study assesses the relationships between project performance measures and the critical success factors of construction projects using structural equation model (SEM) for the construction industry in Nigeria. The result of this study shall reveal the structure and strength of these relationships which will enable the project organization to effectively allocate resources, monitor and control project activities in order to achieve project outcomes. It will in addition create more awareness on the critical success factors that need more attention in the management of construction projects.

2.0 REVIEW OF LITERATURE

2.1 Project Performance Measures

In order to appropriately determine project success, some set of criteria or principles are essential to act as standards guiding or regulating project success. These standards are referred to as project success criteria or project performance measures. According to Atkinson (1999), the most conventional standard for determining project success is the 'iron triangle' which determines project success in terms of cost, time and quality performance[4]. This framework of criteria has proved to be limited in that it does not focus on a wide range or project stakeholders [5]. It gives only a measurement of the result of the project deliverable which relates to project efficiency. Another approach to determining project success is measuring success with respect to cost per unit, speed of construction and delivery, growth of schedule and cost, and other measures of quality [6]. Other areas of expectation of project success such as safety and health, the satisfaction of participants and the performance of the environment were added to the list of project performance measures [7]. The performance of a project with respect to time, cost, quality, and safety, was added as another dependable dimension of project performance measures [8]. Other performance measures identified in literature include design, change and rework ratios, safety, time, and cost [9], and a good understanding of customer requirement which leads to customer satisfaction [10].

2.2 Critical Success Factors (CSFs)

Rubin and Seeling (1976)were the first to introduce the concept of the CSFs of projects[11]but it was first used in the context of project management by Rockart (1982) [12] who defined CSFs as those relatively small matters associated with the management of a project which needs to be given adequate attention in order to achieve project success. Ika (2009) defines CSFs as conditions, circumstances or events the surrounds a project which have the capacity to influence project success. In order words, an effective management and utilization of those conditions or events will enhance project success and otherwise [13]. It was also defined as those factors that are critical to the success of an industry in question [14] or factors that the project stakeholders need to pay attention to in order to achieve project goals and objectives [15]. From the above definitions, it could be deduced that CSFs are constraints

According to Susil *et al*. (2016), there is no disputing the fact that understanding the concept of CSFs is vital tool for project managers in effectively managing projects and tracking progress made towards achieving project success [16]. Thus, it is vital to examine various models of CSFs available in literature. Avots (1969), established the first CSFs model which investigated the factors responsible for project failure [17]. Unplanned termination of projects, unsupportive top management and the wrong choice of the project manager were identified as the three factors that cause project failures. Project Implementation Profile (PIP) was a generic 10 factors model was proposed by Pinto and Slevin (1988) which was later extended to obtain a much applicable measures of project success [18]. Martin (1976), while looking in the dimension of the characteristics of the project organization and the project team, identified the selection of project team, clear goals, organizational philosophy, top management support and organize and delegate as CSFs of construction projects [19]. Chan *et al*. (2004), reviewed literatures on CSFs of construction projects in which they developed a framework of CSFs grouped into five categories of project related factors, project management related factors, external environment related factors, human related factors and project procedure related factors [20].

Viewing CSFs from the perspective of external project challenges, Gudiene *et al*. (2014) identified physical environment, economic environment, political environment, social environment and legal environment as critical to the project success [21]. While examining the impact of institutional related factors on project success, they pointed out the importance of maintaining standards and permit in construction projects. Based on project characteristics, Yong and Mustaffa (2013) proposed the CSFs to be the level of technology, project size, project complexity, project design requirements, project type and resource allocation [14]. From the foregoing, it is evident that the best approach to understand the concept of CSFs is to categorize into the different aspects and constraints or events involved in project management.

2.3 Structural Equation Model (SEM)

According to Yang and Ou (2008), SEM is a data analysis tool developed by professionals in the field of psychology and sociology to study the relationships that exist among multivariate [22]. As a multi-variate tool, it identifies the interaction and interconnectedness between latent variables or independent variables or constructs [23] pointing out the strength of the relationships and the nature of the influence. In order to achieve this, SEM uses two kinds of variables which are the latent and the measurable or observed variables. There are two types of latent variables used in SEM which are the dependent and the independent latent variables linked together by a regression model [1]. The latent variables cannot be directly measured but the observed variables are measurable. Generally speaking, SEM is a systematic combination of multiple regression analyses, confirmatory factor analyses and path analyses. This combination makes it superior to multiple regression analysis in investigating multivariate relationships [23]. It is a two in one model consisting of the structural model which is multiple regression analyses, the measurement model which is confirmatory factor analyses and the relationship between the latent variables which is shown by the path coefficients [24]

The general approach to SEM is the development of a hypothetical model based on literature review which is then tested and modified based on goodness of fit indices [24]. Kline (2005) recommends the use of four goodness of fit indices (*Chi*-square degree of freedom ratio, non-normed fit index, comparative fit index and root mean square error of approximation ratio) to account for absolute, comparative and parsimony adjusted fit [25].

2.4 Further Review of Related Studies

Alaloul *et al*. (2020) using SEM examined the impact of project related variables on the performance of construction projects [26]. Their study featured five constructs selected from the dimension of project coordination related variables which were analyzed to find their impact on project performance. Their research finding indicated that improved coordination efficiency increases the performance level of construction projects. In order words, the better the coordination of project activities, the higher the rate of performance. However, the findings of this study are limited because only three performance measures were used and factors utilized were only coordination related. Examining the impact of learning organization and commitment on the performance of organization, Khunsoonthornkit and Panjakajornsak (2018) assessed the performance of research organizations in Thailand using SEM [27]. Their research result indicated that organizational commitment was positively impacted by learning organization but commitment had no direct positive influence on performance. This result encourages organizations to imbibe the culture and practice of learning organizations. Unegbu *et al*. (2020) investigated the relationship between project performance measures and project management practices for the construction industry in Nigeria using SEM [28]. The result of their data analysis using SIMPLIS syntax validated 14 out of 20 hypotheses indicating that there is a strong relationship between project performance measures and utilization of project management practices.

Investigating the impact of the CSFs of knowledge management on the performance of construction companies in Nigeria, Idris and Kolawole (2016) utilized SEM [29]. Their research findings showed that the performance of the construction companies were positively impacted by their knowledge management processes. It also established the point that both organizational strategy, culture and technical processes positively impact their knowledge management processes. This implies that the organizational knowledge management process is a product of these three factors. Examining the CSFs and their interaction with one another using SEM, Samart and Paul (2016) used 40 variables and 7 constructs for their research study [30]. Their research finding indicated that the managerial skills of the project manager and material related factors directly impact the realization of the mission and objectives of projects. It also showed that the other 6 constructs had high level of interaction with the managerial skills of the project manager, thus, the project manager's skill is the core of the project CSFs. Ajayi and Oyedele (2018) examined the CSFs that positively influence the minimization of waste in material procurement for construction projects using SEM[1]. Their research results indicated that the minimization of waste in the material procurement was positively impacted by the support and commitment of the suppliers as well as the effectiveness and efficiency of the organization's procurement processes. In other words, it demands the cooperation and sincere commitment of both the suppliers' and organization's personnel.

The above reviewed studies indicated that some dimensions of the relationship between the CSFs has been covered but their relationship with respect to a wider perspective of the project performance measures and project stakeholders has not been addressed. In addition, in Nigeria, a developing country, no similar research effort has been carried out which makes it imperative for similar research work to be done to enable project management professionals to understand the mechanism of the relationships between these multivariate since the result obtained from a developed country cannot wholly apply to a developing country because of cultural, political and socio-economic reasons [31].

3.0 METHODS

Quantitative survey research method was adopted for this research. The primary instrument for data collection was a questionnaire which was administered to the participants. This approach was used because the study demanded the rating of the various categories of variables by the respondents which were used to determine their relevance and grouping. This study featured ten randomly selected construction companies operating in the North central geopolitical zone of Nigeria comprising of both foreign and indigenous construction companies in building, road and other infrastructure sector. From Cooperate Affairs Commission of Nigeria, the population of these registered construction companies was estimated at 650 professionals in the field of civil and structural engineering, architecture, quantity surveying and mechanical and electrical engineering. Respondents for this research study were drawn from this population.

3.1 Method of Data Collection

A total of 250 construction professionals with at least five years of experience were sampled using random sampling technique. This included both indigenous and expatriate professionals consisting of 195 contractor personnel (architects, civil and structural engineers, quantity surveyors and mechanical and electrical engineers) and 57 client/consultant personnel. The selection was based on the proportion of construction work carried out by these companies as recommended in[32]. The questionnaires were distributed through personal contact and collected within two months in order to allow enough time for the respondents to attend to the questions.

The survey was designed to verify the relationship between project performance measures and the critical success factors of construction projects.The questionnaire which was completed by contractor, consultant and client personnel was divided into three sections:

i. Section A was designed to collect data on the personal information of the respondents.
ii. Section B was designed to collect data on the project management performance measures adopted by the companies.
iii. Section C was designed to collect data on the CSFs that influence project success in the construction companies.

The respondents were requested to respond to the extent to which each of the performance measures, project management practices and CSFs has contributed to project success or performance based on a five point *Likert* scale according to [9]:

1 : undecided
2 : strongly disagree
3 : disagree
4 : agree
5 : strongly agree

Altogether, a total of nineteen project performance measures adopted from [33] and [34]were grouped into three categories (constructs) related to project performance, customer satisfaction and project success as shown in Table 1 to be rated using the 5-point *Likert* scale. For example, for cost performance, the followings can be used:

1 : undecided that the expectations were met
2 : strongly disagree that expectations were met
3 : disagree that expectations were not met
4 : agree that expectations were met

5 : strongly agree that expectations were met

Table 1: Performance measures adapted from [33] and [34]

S/N	Construct	Indicator	Label
1	**Project performance**	Cost performance	Y1
		Schedule performance	Y2
		Quality performance	Y3
		Safety performance	Y4
		Rework	Y5
		Change order	Y6
		Requirement performance	Y7
		Scope changes	Y8
		Scope coverage	Y9
		Risk of failure	Y10
2	**Customer satisfaction**	Meeting customer's expectations	Y11
		Satisfaction of quality	Y12
		Satisfaction of schedule	Y13
		Service quality of the contractor	Y14
3	**Project success**	Completed on time	Y15
		Completed within budget	Y16
		Meeting quality requirement	Y17
		Meeting design requirement	Y18
		Overall stakeholders' satisfaction	Y19

Section C was designed with the same *Likert* scale in which the respondents were requested to rate their level of approval of each of the 54 success factors based on their potential to affect the overall success and performance of a construction project [35]. These variables were grouped into nine constructs of project related, project planning and management related, client related factors, project manager related factors, consultant related factors, contractor related factors, procurement related factors, external environment factors and regulatory system. Table 2 shows the CSFs selected from the reviewed literatures.

Table 2: CSFs/variables

SN	Factor Grouping	Variables/Label	Label
1	**Project related factors (PR)**	Complexity of the project	X11
2		Size of project	X12
3	**Project planning and management (PPM)**	Mutual trust among project stakeholders	X21
4		Effective communication among project stakeholders	X22
5		Strong commitment among project Stakeholders	X23
6		Working relationships with other project stakeholders	X24
7		Goal setting	X25
8		Well-defined scope of work and project constraints	X26
9		Involvement of different project stakeholders in the early planning of projects	X27
10		Effective allocation of manpower	X28
11		Clear and detailed written contract	X29
12		Legal and contractual risk management	X291
13		Implementation of effective project monitoring mechanism	X292
14	**Client (CLT)**	Project financing (cash flow)	X31
15		Client's confidence in construction team	X32
16		Client's experience of construction project organization and management	X33
17		Client's responsiveness to the needs of the other stakeholders	X34
18		Demand and variation	X35
19		Top management support from client Organization	X36
20		Awarding bids to the right designers/ Contractors	X37

21		Nature of client whether he is privately or publicly funded	X38
22	**Project manager (PM)**	Competence (technical and managerial skills	X41
23		Adaptability to amendment in project plan	X42
24		Leadership and authority	X43
25		Early and continuous involvement in the project development	X44
26	**Consultant (CONS)**	Competence (technical and managerial skills)	X51
27		Providing adequate design details and Specifications	X52
28		Cooperation in solving problems among project stakeholders	X53
29		Involvement to monitor project progress	X54
30	**Contractors (CONT)**	Contractor's competence and experience	X61
31		Implementing an effective safety program	X62
32		Implementing an effective quality assurance program	X63
33		Supervision of subcontractors' works	X64
34		Skillful workers	X65
35		Emphasis on high quality workmanship instead of low and quick construction	X66
36		Effective project budget monitoring	X67
37		Site management and supervision	X68
38	**Project procurement (PROC)**	Competitive procurement	X71
39		Transparency in the procurement process	X72
40		Tendering method	X73
41		Escalation of material price influenced success	X74
42		Insufficient supply of material influences	X75
43	**External environment (EE)**	Economic (stable economy and sound economic policy)	X81
44		Social (public acceptance towards the project)	X82
45		Political	X83
46		Nature (weather conditions)	X84
47		Industry-related issues (availability of resources)	X85
48		Construction technology (IBS, IT and online platform, new construction method, etc.)	X86
49	**Regulatory system (RS)**	Unfavorable Contract Conditions	X91
50		Concurrent Construction Operations	X92
51		Corruption;	X93
52		Government Regulation	X94
53		Due Diligence	X95
54		Delayed Remuneration	X96

The constructs and variables used for the data collection were given their unique identification label for easy communication and recognition by the second data analysis software, LISREL (linear structural relationship) which does not recognize variable names with more than eight characters.

3.2 The Hypothetical Model

The hypothetical model for the SEM was developed using the 19 performance measures which were grouped into three constructs (project performance (PP), customer satisfaction (CS) and project success (PS)) and 54 CSFs which were grouped into 9 constructs (project related (PR), project planning and management (PPM), client (CLT), project manager (PM), consultant (CONS), (COM), contractor (CONT), project procurement (PROC), external environment (EE) and regulatory system (RS). The model was developed based on the recommendation of Chen *et al*. (2012) [35].

The following hypotheses were drawn from literature to form the hypothetical model as depicted in Figure 1 which is used to verify level of significance of the relationship between the critical success factors and project performance measures.

H_1: Project planning and management related factors directly influence project success.

H_2: Project planning and management related factors directly influence project performance.

H_3: Client related factors directly influence project performance.

H_4: Client related factors directly influence project success

H_5: Project manager related factors directly influence project performance

H_6: Project manager related factors directly influence project success

H_7: Consultant related factors directly influence project performance

H_8: Consultant related factors directly influence project success

H_9: Contractor related factors directly influence project performance

H_{10}: Contractor related factors directly influence project success

H_{11}: External environmental factors directly influence project performance

H_{12}: External environmental factors directly influence project success

H_{13}: Regulatory system directly influence customer satisfaction

H_{14}: Regulatory system directly influence project performance

H_{15}: Regulatory system directly influence project success

H_{16}: Project performance directly influences project success

H_{17}: Project performance directly influences customer satisfaction

H_{18}: Customer satisfaction directly influences project success

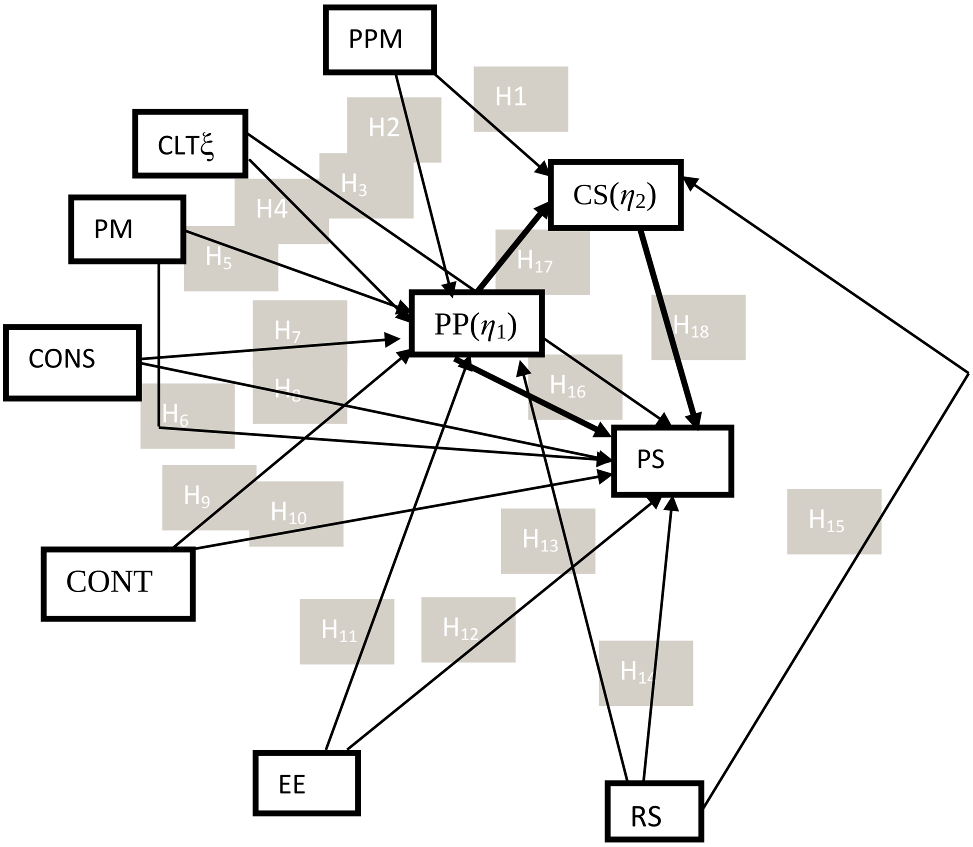

Figure 1: Hypothetical model for SEM

The hypothetical model was then analyzed in LISREL using the *SIMPLIS syntax* [24] developed using the relationships defined in the hypotheses to obtain the experimental model. This *SIMPLIS Syntax*can be expressed as:

SEM

Latent Variables PPCS PS PPM CLT PM CONS CONT
EE RS
Relationships
PP =PPM CLT PM CONS CONT EE RS
CS =PP PPM PM EE RS
PS =PP CS PM CONS CONT
Y1 Y2 Y3 Y4 Y5 Y6 Y7 Y8 Y9 Y10 =PP
Y11 Y12 Y13 Y14 =CS
Y15 Y16 Y17 Y18 Y19 =PS
X21 X22 X23 X24 X25 X26 X27 X28 X29 X291 X292 =PPM
X31 X32 X33 X34 X35 X36 X37 X38 =CLT
X41 X42 X43 X44 =PM
X51 X52 X53 X54 =CONS
X61 X62 X63 X64 X65 X66 X67 X68 =CONT
X81 X82 X83 X84 X85 X86 =EE
X91 X92 X93 X94 X95 X96 =RS
Path Diagram
End of Problem

3.2 Method of Data Analysis

The data collected was analyzed using *SPSS 25* statistical package software and *LISREL 8.80*. The software was selected respectively based on the suitability for descriptive data analysis and analysis of relationships between variables [35]. In the first phase, data on the personal and professional background of the respondents was analyzed using descriptive statistics in SPSS. This enabled analysis to be performed on the education, years of experience and their professional qualifications. The second phase involved exploratory factor analysis (EFA) to reduce the number of variables analyses of the variables to determine the reliability of the grouping of the performance indicators and CSFs for further analysis. This was carried out in SPSS using EFA and the *Crombach's* alpha test of reliability. Variables with factor loadings less than 0.5 are rejected in the EFA while a *Crombach's* alpha value greater than 0.6 is considered significant [36]. Thirdly, in order to find the relationship between the level of the project performance and the CSFs, SEM model was developed and modified based on goodness of fit statistics which featured the *Chi*-square degree of freedom ratio (X^2/df), the non-normed fit index or *Tucker Lewis* (NNFI or TLI), the comparative fit index (CF) and the root mean square error of approximation (RMSEA) [25]. The summary of the research methodology is shown in Figure 2.

4.0 RESULTS AND DISCUSSION

4.1 Responses

A total of 221 valid responses were received from the respondents which represents 88% response rate. This is considered satisfactory response for a survey questionnaire as stipulated in[37]. The following charts summarize the education, professional qualification and experience of the respondents. A higher proportion of the respondents (60.7%) were drawn from civil and structural engineering since the bulk of construction projects were carried out by them as suggested in[32].72.4% of the respondents have over five years work experience which is quite acceptable because the ability to rate the variables effectively depends on it [36].

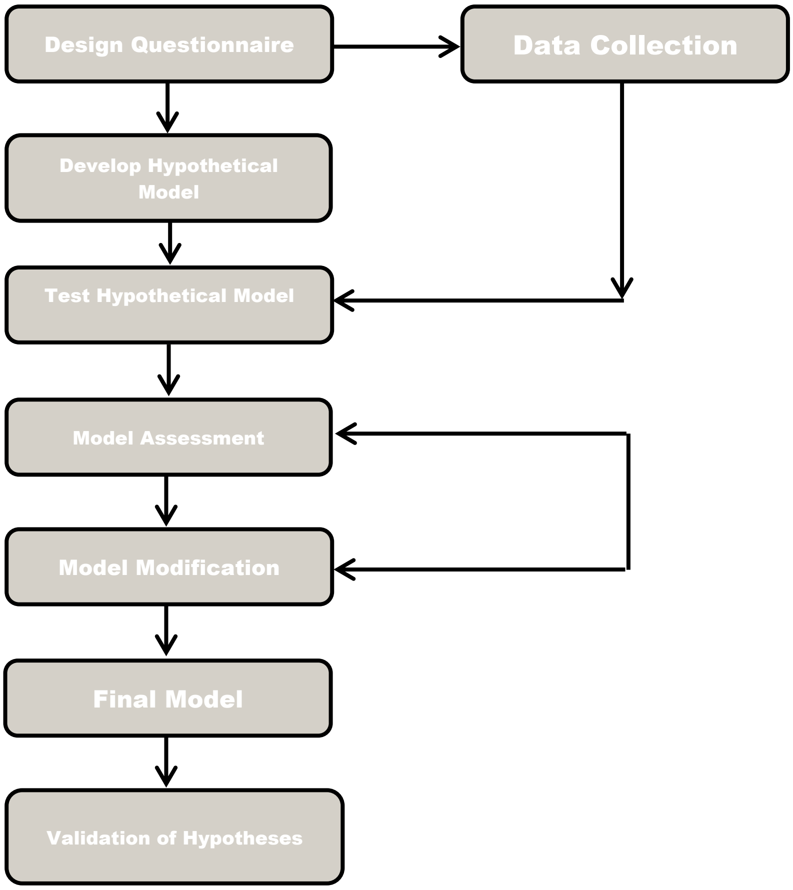

Figure 2: Flowchart for the research methodology

4.2.1 Educational qualification

Figure 3 shows the education qualification of the respondents which indicates that 85.5% of the respondents have at least their first degree in their area of profession which a good response rate [32].

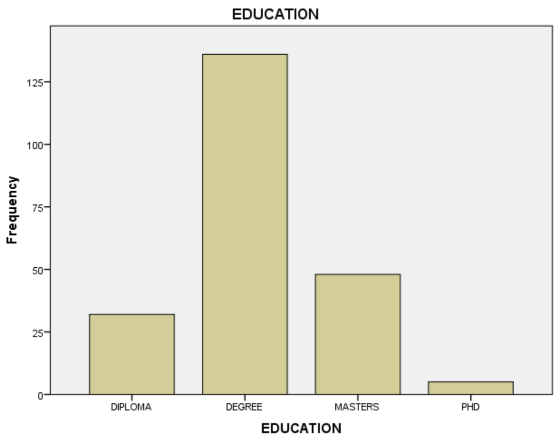

Figure 3: Educational qualification of respondents

4.2.2 Professional qualification

The professional qualification of the respondents is shown in Figure 4 which indicates that 50.7% of the respondents were drawn from the field of civil/structural engineering. According to Chen *et al*. (2012), bulk of the construction project works is executed by this profession; hence more of them should be involved in construction project research studies [35]. The spread of the distribution for the rest of the profession is also acceptable.

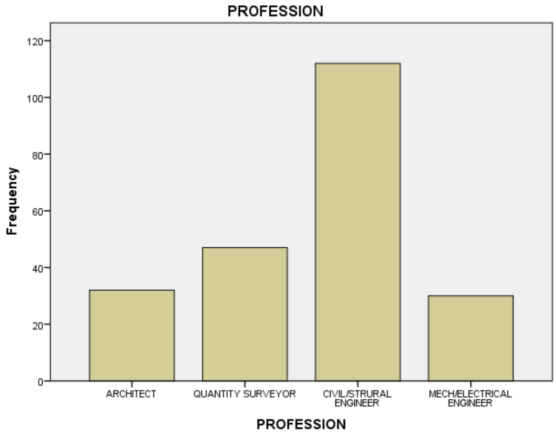

Figure 4: Professional Qualification of respondents

4.2.3 Work experience

A very important aspect of the background analysis of the respondents is their work experience. According to Chua *et al*. (1999), the ability of construction professionals to answer questionnaires on construction projects lie in the domain of their work experience[32]. Figure 5 shows the data analysis on the experience of the respondents which indicates that 72.4% of the respondents have at least five years of work experience in construction projects.

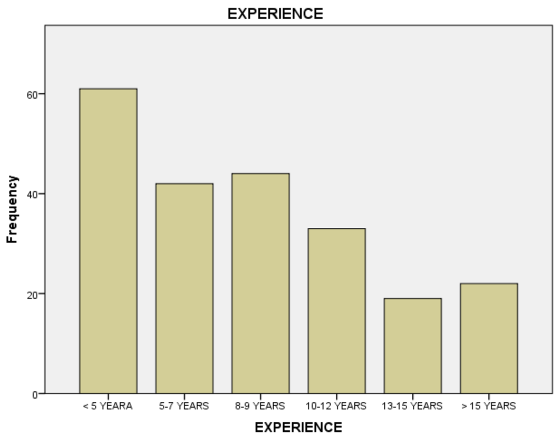

Figure 5: Work experiences of the respondents

4.2 Preliminary Analysis

The result of the EFA in Table 3 shows that 11 variables (Y5, Y6, Y8, Y15, X11, X12 and X71-X75) have factor loadings of less than 0.500 as a result of which they were eliminated from the SEM model. The *Crombach's* alpha tests failed for two constructs which are the project related and procurement related factors of CSFs with unacceptable values less than 0.6as shown in Table 4. Other constructs have values greater than 0.7 which indicate high reliability in the measurement obtained from their respective variables.Therefore, the project related and procurement related factors were excluded from the subsequent analyses in SEM.

Table 3: EFA results for the variables

SN	Variables	Factor loading
1	Y1	0.618
2	Y2	0.785
3	Y3	0.649
4	Y4	0.621
5	Y5	0.394
6	Y6	0.400
7	Y7	0.633
8	Y8	0.626
9	Y9	0.560
10	Y10	0.560
11	Y11	0.615
12	Y12	0.565
13	Y13	0.677
14	Y14	0.688
15	Y15	0.452
16	Y16	0.542
17	Y17	0.600
18	Y18	0.592
19	Y19	0.589
20	X11	0.513
21	X12	0.421
22	X21	0.430
23	X22	0.533
24	X23	0.516
25	X24	0.617
26	X25	0.705
27	X26	0.676
28	X27	0.682
29	X28	0.708
30	X29	0.524
31	X291	0.546
32	X292	0.617
33	X31	0.579
34	X32	0.570
35	X33	0.547
36	X34	0.597
37	X35	0.642
38	X36	0.653
39	X37	0.699
40	X38	0.647
41	X41	0.699
42	X42	0.638
43	X43	0.594

44	X44	0.675
45	X51	0.631
46	X52	0.548
47	X53	0.591
48	X54	0.601
49	X61	0.780
50	X62	0.648
51	X63	0.613
52	X64	0.707
53	X65	0.774
54	X66	0.716
55	X67	0.616
56	X68	0.632
57	X71	0.312
58	X72	0.399
59	X73	0.439
60	X74	0.360
61	X75	0.422
62	X81	0.722
63	X82	0.803
64	X83	0.638
65	X84	0.772
66	X85	0.734
67	X86	0.825
68	X91	0.745
69	X92	0.890
70	X93	0.850
71	X94	0.602
72	X95	0.718
73	X96	0.822

Table 4: *Crombach's* alpha (*a*) coefficients

SN	Construct	(*a*)
1.	Project performance	0.606
2.	Customer satisfaction	0.680
3.	Project success	0.752
4.	Project related factors	0.450
5.	Project planning and management factors	0.837
6.	Client related factors	0.863
7.	Project manager related factors	0.780
8.	Project consultant related factors	0.777
9.	Contractor related factors	0.905
10.	Project procurement factors	0.277
11.	External environment factors	0.889
12.	Regulatory system	0.792

4.3 Relationship Between the CSFs and Project Performance Measures (SEM)

The result of the hypothetical SEM is shown in Figure 6 which indicates a good performance in terms of the GOF. The experimental model was modified by deleting the paths CLT-PS (client related factors positively influences the project success) and EE-PS (external environmental factors positively influences the project success) which have low path coefficients and adding the paths PM-CS (project manager related factors positively influences the customer satisfaction) and CONS-CS (consultant related factors positively influences the customer satisfaction) to obtain the modified model (Figure 7) with a more acceptable GOF as shown in Table 5.

Table 5: GOF statistics

SN	GOF measures	Recommended values	Experimental model	Modified model
1	X^2/df	Levels from 1-3	2.4	2.23
2	NNFI or TLI	0 (no fit) to 1 (perfect fit)	0.632	0.653
3	CFI	0 (no fit) to 1 (perfect fit)	0.612	0.645
4	RMSEA	<0.05, very good fit, 0.05-0.08, fairly good fit, 0.08- 0.10 acceptable; > 0.10 unacceptable fit	0.080	0.077

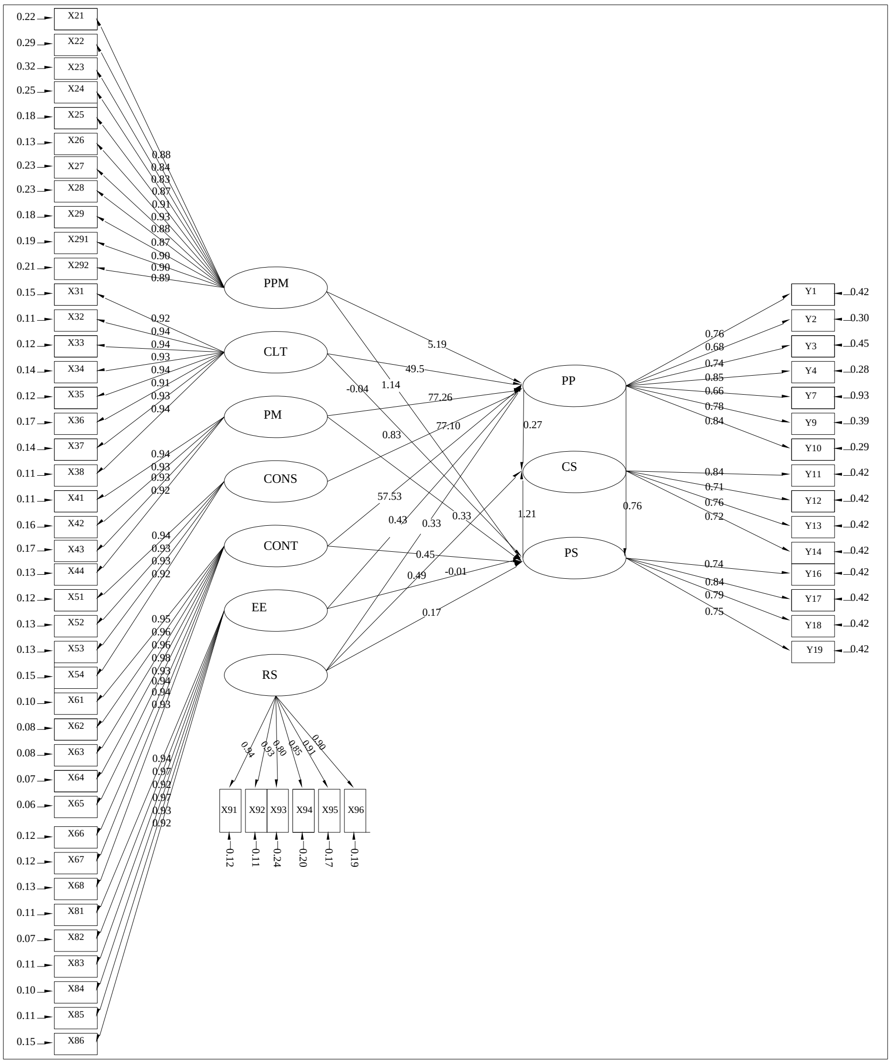

Figure 6: Experimental model

Since the GOF indices indicated a good fit, the following relationships were obtained from the modification or refined model based on the strength of their path diagrams as shown in Table 6[24].As shown in the table, 15 out of the 18 hypotheses were validated while the remaining three were rejected. The validated hypotheses were H_1, H_2, H_3, H_5, H_6, H_7, H_9, H_{10}, H_{11}, H_{13}-H_{18}. The strongest relationships exist between the consultant related factors and project performance, followed by the project manager related factors and project performance and contractor related factors and project performance. The first two hypotheses (H_1 and H_2) indicate that the project planning and management positively influences the project performance and project success. This implies that effective control of the variables under this construct will promote both project performance and project success. The impact of the client related factors on project performance was positive (H_3). Thus managing of the client related variables which capture their interest in the project will promote the project performance. This also implies that the client should be carried along throughout the project lifecycle.

The two hypotheses that captured the impact of the project manager related factors on the project performance and project success (H_5 and H_6) were validated with the impact on project performance emerging the second strongest relationship with a path coefficient of 77.26. This emphasizes the huge role the project manager is expected to play in enhancing the project performance and project success. In order to promote the project performance and success, the project manager has to effectively control the variables that influence his project activities.

In a similar way, the consultant related factors were seen to positively influence project performance (H_7) with the relationship emerging with the highest path coefficient of 77.40. This underscores the great responsibility the project consultant plays in managing construction projects either as an agent of the client or contractor, hence, optimizing the activities of the consultant will promote project performance. The contractor related factors were also found to have positive impact on the project performance and project success (H_9 and H_{10}) with the relationship between the contractor-related factors and project performance having the third strongest relationship with a path coefficient of 57.53. Improving the activities of the contractor and control of related variables will promote the project performance and success.

External environment factors were seen to have slight influence on the project performance (H_{11}) as indicated by the path coefficient of 0.43. This implies that monitoring the external environmental factors can slightly improve the project performance. On a similar note, the regulatory system was shown to slightly impact both the project performance, customer satisfaction and project success (H_{13}-H_{15}). Thus improved activities of the regulatory system will slightly promote the project performance, success and customer satisfaction. The last three hypotheses (H_{16}-H_{18}) were also validated, indicating that there is significant relationship between the project performance measures, project success and customer satisfaction.

Table 6: Hypotheses validated and rejected in the SEM model

Hypotheses	Validated	Rejected	Path
H_1	Yes		1.14
H_2	Yes		5.19
H_3	Yes		49.5
H_4		Yes	
H_5	Yes		77.26
H_6	Yes		0.33
H_7	Yes		77.40
H_8		Yes	
H_9	Yes		57.53

H_{10}	Yes		0.45
H_{11}	Yes		0.43
H_{12}		Yes	
H_{13}	Yes		0.49
H_{14}	Yes		0.33
H_{15}	Yes		0.17
H_{16}	Yes		0.76
H_{17}	Yes		0.27
H_{18}	Yes		1.21

Three hypotheses (H_4, H_8 and H_{12}) were rejected because their path coefficients were not significant for consideration. Apart from these hypothesized relationships, two additional relationships were discovered that facilitated the convergence of the SEM model. They were the project manager related factors and consultant related factors positively impacts the customer satisfaction. This further highlighted the impact of these two factors on the project outcome.

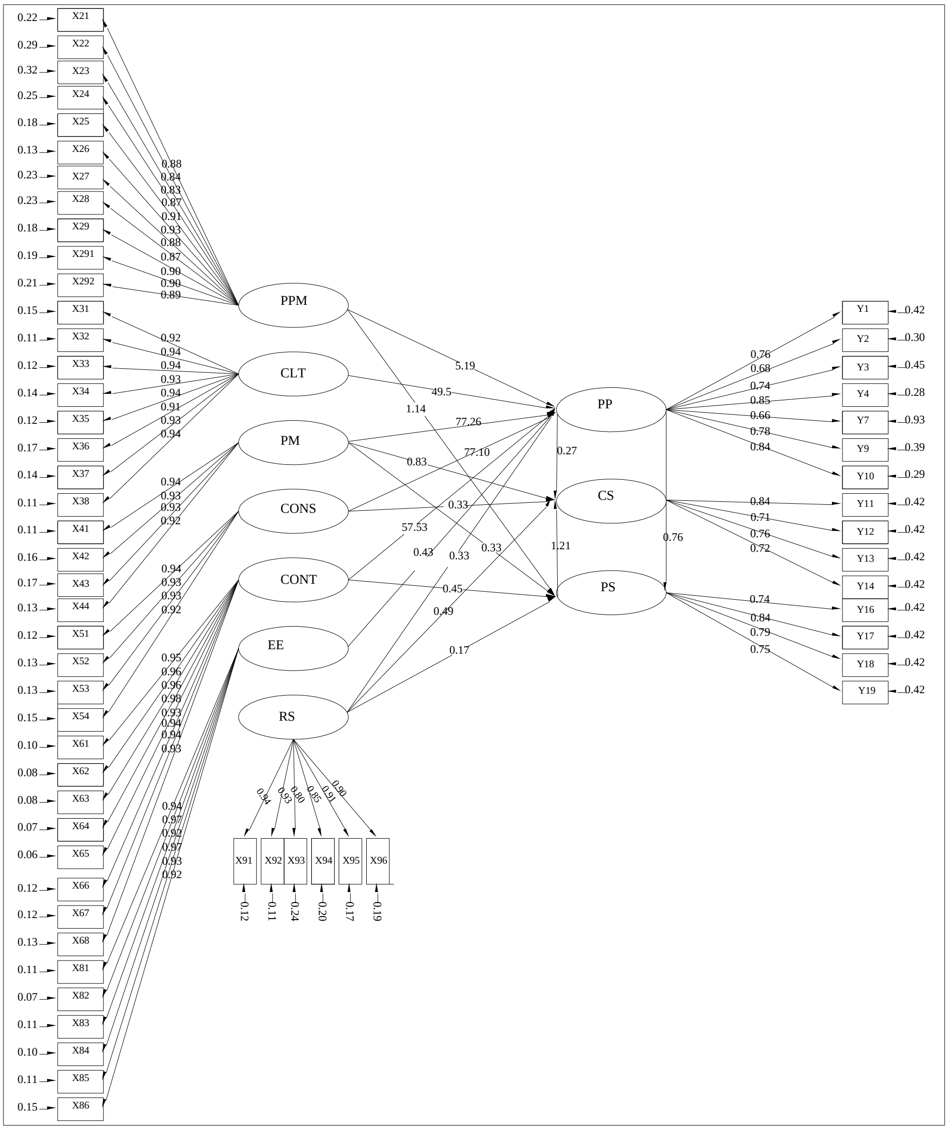

Figure 7: Modified SEM model

5.0 CONCLUSION

This research study assessed the relationship between project performance measures, and the critical success factors using SEM. From the results of the study, it was found that the strongest relationships exist between consultant related factors and project performance, followed by project manager related factors and project performance and contractor related factors on project performance. It could be inferred from this that these three constructs (consultant related factors, project manager related factors and contractor related factors) are key to promoting the performance of construction projects. The result also revealed effective regulation by relevant agencies and systems can significantly improve project performance, customer satisfaction and project success.

It has been shown that the achievement of project outcome does depend on a variety of variables which independently as well as in relationship with other variables impact project outcome. Altogether, 15 out of the 18 hypothesized relationships were validated and two additional relationships that enhanced the development of the SEM were discovered. This shows that there is a high level of interaction among the CSFs and the project performance measures. This research has clearly identified the structure of these relationships and their strength of their impacts as indicated by the path coefficients. This shall enable project management organization to have a better understanding of this structure for effective resource allocation, monitoring and control of project activities in order to achieve the desired outcome. This research study centred on construction project executed in the Nigerian construction industry with the focus on indigenous construction companies. The authors recommend similar studies to be carried out in the manufacturing industry and a comparison be made on the research findings. Further studies may also be carried out in identifying the relationships between the CSFs and project management practices. It is important to note that the findings of this study have shed more light on the mechanism of the relationships between the project performance measures and the utilization of CSFs in the construction industry of a developing country (Nigeria). It has also been shown that these relationships are similar to the results obtained in a developed a country, thus, the research findings could apply partially or wholly to other construction industries in the world.

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