Journal of Contemporary Research in the Built Environment ISSN: 2636-4468
Volume 3, Number 1, March 2019

EFFECTS OF OVERHEAD COST OF CIVIL ENGINEERING PROJECTS IN NIGERIA

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ABSTRACT

Purpose: "General items" is an important cost center in civil engineering projects given the complexities of facilitative works and support services that are normally required in such projects. However, extant literature makes little or no difference between preliminaries in building projects and general items in civil engineering projects. This study, which focuses on overhead costs in civil engineering projects, was carried out to: (1) assess the factors affecting overhead cost of civil engineering projects, (2) determine the relationship between the factors and the overhead costs of civil engineering projects and; (3) determine the frequency of use of overhead cost items in civil engineering projects.
Design/methodology/approach: Respondents were conveniently selected from civil/structural engineers and quantity surveyors who have participated in civil engineering projects (n=73) in Nigeria. The data were analyzed using percentages, relative importance index, multiple regression and factor analysis.
Findings: It was found that the most important factor affecting the overhead cost of civil engineering projects is delayed payment. Based on factor analysis, it was concluded that the factors affecting overhead costs of civil engineering projects are either project or contractor-related. These two groups of factors were found to have significant effects on the overhead cost of civil engineering projects. Provisions for water supply, setting out and handover were found to be the predominant general items allowed in civil engineering projects. The possibility of payment delays should be assessed while estimating the cost of general items, and only applicable general items should be priced.
Research limitations/implications: Many types of civil engineering projects were considered in this study. Future studies may look at how overhead costs differ for different types of civil engineering projects.
Social implication: Delayed payment avoidance by the government will have a positive effect on the overhead and, ultimately, the overall costs of civil engineering projects.
Originality/value: This study ascertained the frequency of use of general items in civil engineering projects. It also determined the domains of the variables that affect the overhead cost of civil engineering projects. Most previous studies on construction project overhead costs were based on building projects.

Keywords: Civil engineering projects; general items; overhead cost; preliminaries.

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1. INTRODUCTION

Nowadays, the competitiveness of the construction industry forces contractors to tender for projects with low margins – profit, incidental expenses, project overhead costs and company's overhead (Plebankiewicz & Leśniak, 2013). Lowering a contractor's overhead costs could be a veritable way of increasing his profit on a project. Nevertheless, contractors' overhead costs will not go down on their own without conscious efforts by the contractors. The construction industry is an extremely competitive market largely controlled by prices. To maintain competitiveness, construction firms have to continuously seek to reduce their project cost while concurrently providing quality products and service to their clients (Patil & Bhangale, 2014). Experience shows that direct cost items are estimated with higher accuracy than overhead costs (Chan & Pasquire, 2004). This reflects a lack of understanding of the factors affecting project overhead costs. With the increasing complexity of construction projects, overhead cost estimates have become complicated and require expertise from contractors' planners and estimators. Although overhead costs may not be regarded as the most significant cost center, they constitute an important cost center for winning and executing projects at a profit (Hesami, & Lavasani, 2014). A contractor should understand his overhead costs to be able to make appropriate allowances for them in his bids (Siskina *et al*., 2009). Assaf *et al*. (2001) stated that the unbalanced construction market makes it problematic for contractors to decide on the optimal level of overhead costs that allow the contractors to win open tenders and to manage huge projects without financial losses.

Civil engineering projects are frequently complex. Usually, the projects require the deployment of heavy construction equipment with attendant logistical planning and estimating. Additionally, the complexities of such projects often necessitate more expensive preliminary (general) items than those normally used for building projects. Beside the general items expressly required by clients, the Civil Engineering Standard Method of Measurement Fourth Edition (CESMM4) provides for contractors to state the methods they intend to use in the execution of projects and to price same under method related charges. This provision, which does not apply to building projects, is necessary to compensate contractors for the huge expenditure on overheads in civil engineering projects. Irrespective of this, extant literature on factors affecting project overhead costs make no distinction between overhead costs of civil engineering and building projects.

Existing studies have attempted to identify the factors affecting overhead costs of construction projects (Enshassi *et al*., 2008; Ujene, Idoro & Odesola, 2013), but they have poorly shown the extent to which the factors affect the costs. Such a perspective is necessary in order to adequately inform contractors on the relatedness between the factors and the overhead costs themselves. Furthermore, the frequently used overhead cost items in construction sites should be identified to aid contractors' estimators to know which preliminary cost items are likely to be necessary in a typical civil engineering project. Juszczyk and Leśniak (2019) noted that it is difficult to unambiguously determine which preliminary cost item is of highest importance in construction projects. Contractors' estimators will benefit greatly if they are able to prioritize the attention given to the factors affecting civil engineering overhead costs, which will lead to overhead cost optimisation in the long run. Consequently, this paper: (1) assesses the factors affecting overhead cost of civil engineering projects, (2) determines the relationship between the factors and the overhead costs of civil engineering projects and; (3) determines the frequency of use of overhead cost items in civil engineering projects.

2. Factors Affecting Project Overhead Costs in Civil Engineering Projects

Civil engineering projects are diverse and require high construction expertise for execution. Such projects as roads, railways, tunnels, dams, ports and harbors are examples of civil engineering projects. While they present opportunities for contractors to shore up their turnovers due to the large sums of money involved, they also present huge risks of losses should things go contrary to plans. Overhead cost items often provide the framework for managing and controlling cost-risk events due to their facilitative and supportive nature.

Construction project overhead cost is defined as the cost that cannot be classified with or charged to a unit of construction production (Plebankiewicz & Leśniak, 2013). Cilensek (1991) viewed overhead cost items as supportive works that do not form part of the intended permanent works. Project overhead costs include items that can be identified with a particular job, but are not materials, labor, or production equipment. They are expenses that cannot be charged directly to a particular branch of work, but are required to construct the project (Dagostino, 2002). In general, a building contractor's overhead costs are divided into two categories: project (field) overhead costs and home office overhead costs (Peurifoy & Oberlander 2002; Nabil & El-Riyati, 2015; Ronald & Lumbantoruan, 2019). Home office overhead costs are also called general or administrative overhead costs. Overhead costs represent fixed operational costs which must be expended by the contractor in order to do business (Leśniak & Juszczyk, 2018). Home office overhead costs include all those expenses made by the home office that cannot be tied directly to a given project such as home-office building rental, clerical staff and utility bills. These costs are distributed over all company projects by some basis. The overhead cost referred in this study includes both home office and project (field) overhead costs given that both types of overhead costs are included in the general items of civil engineering projects.

It is a commonly held opinion that the more complex a project is, the more its overhead cost. Also, there are misconceptions about the factors affecting overhead costs in the construction industry in Nigeria. Related past studies (El-sawy *et al.*, 2011; Hesami & Lavasani, 2014; Ujene *et al*., 2013; Chan, 2012; Chao, 2008) show that project duration is an important factor affecting project overhead cost. The authors further viewed some overhead cost elements like telephone tariff, electricity bill, staff salaries, plant rental as time-related. Project type, project location and contract type are among other variables affecting construction project overhead costs (El-sawy *et al.,* 2011; Hesami & Lavasani 2014; Ujene *et al*., 2013). Hesami and Lavasani (2014), Ujene *et al*. (2013) and Chan (2012) identified project complexity as also affecting overhead cost. Presently, there exists numerous unorganized suggestions on the factors affecting overhead cost of projects. It is necessary to statistically group these variables in order to ascertain their categories for effective management of project overheads. Secondly, most of the studies shown in Table 1 were based on building projects. Hence, given the often significant difference between overhead costs in civil engineering and building projects, it is important to ascertain the prevalent factors affecting overhead costs in civil engineering projects.

Table 1: Factors affecting overhead cost of construction projects

S/N	FACTORS AFFECTING OVERHEAD	El-Sawalhi and El-Riyati (2015)	El-sawy *et al.* (2011)	Patil and Bhangale (2014)	Hesami, and Lavasani (2014)	Ujene *et al.*, (2013)	Chan (2012)	Chao (2008)
1	Difficulties in obtaining materials	√						
2	Financial liquidity of the company/contractor's cash availability	√			√	√		
3	Schedule/Mechanism of contract payments	√			√	√		
4	The experience in implementing similar projects	√			√			
5	Construction Firm Category		√					
6	Project Size		√		√			√
7	Project Duration		√		√	√	√	√
8	Project Type		√		√	√		√
9	Project Location		√		√	√		√
10	Type-Nature of Client		√			√		
11	Type of Contract		√		√	√		
12	Contractor-Joint Venture		√					
13	Site Terrain and Preparation Requirements		√					
14	Project need for Extra-Man Power		√					
15	Delay payment			√				
16	Lack of new project			√				
17	Cost inflation			√	√			√
18	Government regulation			√				
19	Firm's growth			√				
20	Similar Project Availability				√			
21	Site layout (Shape of site)				√		√	√
22	Contractor's designing necessities				√		√	
23	Extent of bond/warranty requirement				√		√	
24	Stakeholders' Profit				√		√	
25	Familiarity and Influence in Area				√			
26	Work Scope				√			√
27	Required quality level of projects				√			√
28	Country in performing the project,				√			
29	Company classification				√			
30	Assigning work to subcontractors				√	√		
31	Number of competitors				√	√		
32	Method of performing the project				√			
33	Project Management method				√			
34	Tendering method				√		√	
35	Contractor's need for work				√	√		
36	Regional Economic condition				√		√	
37	The client' s strictness in supervision				√			
38	Project complexity				√	√	√	
39	The type, size and policy of construction firm					√		
40	Contractor's experience with client					√		
41	Type of consultants					√		
42	Level of available information					√		
43	Fraudulent practices and kickbacks					√		

3. RESEARCH METHODOLOGY

This study examines the relationship between overhead cost factors and overhead cost of civil engineering projects. The population of interest to the study was on-going or recently completed civil engineering projects. A sample frame could not be obtained for such projects in Nigeria. Consequently, engineers and quantity surveyors who normally manage the cost of such projects were contacted by emails and personal contacts, and requested to fill the questionnaire, or forward them to other colleagues who are better suited to provide the responses. Seventy-three (73) suitably filled copies of the questionnaire were returned and used in the analysis. For each project, the study obtained the importance of the factors affecting its overhead costs on a Likert scale (5- very important, 4- important, 3- moderately important, 2- less important, 1-not important), identified the overhead cost items used for the project as well as the percentage of overhead cost to the contract sum of the project.

The overhead cost items included in the questionnaire were obtained from the list of preliminary items (n=61) in the Building and Engineering Standard Method of Measurement Fourth Edition (BESMM4) (Nigerian Institute of Quantity Surveyors, 2015). Some adjustments were, however, made on the list. For example, the employer's requirements section of the list was expunged since the items there were equally captured in the Main Contractor's Cost Item section. Similarly, in the Mechanical Plants section, roadwork and earthwork plants were included because this study primarily focuses on civil engineering projects. These and similar adjustments brought the total number of items to 50. The frequencies of occurrence of the preliminary items on site were grouped into always (>80%), often (>60≤80%), average (>40≤60%), sometimes (>20≤40%), and seldom (≤20%). The respondents were asked to select the project overhead cost items applicable to their projects, and to rank the factors affecting overhead costs identified from literature based on their experience on their respective projects.

3.1. Data analysis

Based on the argument that mean and standard deviation are poor indicators of ranking since they do not reflect the relationship between the variables being ranked, this study used relative importance index to rank the variables affecting overhead cost in civil engineering projects (Doloi, et al., 2012).

$$RII\ (Relative\ Importance\ Index) = \frac{\sum w}{AN}$$

W - Weight given to each attribute by respondent
A - Highest weight
N - Total number of respondents

Using factor analysis, the factors affecting overhead costs were reduced to a more parsimonious set of variables. The factor analysis was carried out using the Statistical Package for Social Sciences (SPSS) version 22 and varimax rotation. In factor analysis, the minimum allowable value for the Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy test is 0.6, and Bartlett's test of sample sphericity should be significant (i.e. $p<0.05$) (Fellows & Liu 1997; Field 2005). Variables with loading ≥0.50 were considered to have loading significantly following the recommendations of Kaiser (1974). The factors were saved as variables for use in multiple regression analysis. Using multiple regression analysis, the factors were related to the percentage of overhead cost to contract sum of the projects.

4. Presentation of Results

4.1. Demography of the respondents

Table 2 shows the characteristics of the respondents and types of projects covered by the study. Most of the respondents were civil/structural engineers (n=46, 63.01%), while road construction projects dominated in the type of projects (n=34, 46.58%). Majority (n=25, 34.25%) of the respondents have had 6 – 10years construction industry work experience. Overhead cost to contract sum percentage of the projects was grouped in ranges of 1-5%, 6-10%, 11-15%, 16-20% and above 20%. Table 2 shows that for most (n=26, 35.62%) of the projects, the overhead cost was 6-10% of the contract sum. This is partly within the range of 8-15% reported in literature by Enshassi *et al*. (2008). These results support the use of the data gotten from the study for the analyses that follow.

Table 2: Demography of the respondents

Criteria	Categories	Frequency	Percentage (%)
Profession	Civil/Structural Engineering	46	63.01
	Quantity Surveying	27	36.99
Project Type	Road construction	34	46.58
	Drain construction	14	19.18
	Power infrastructure	8	10.96
	Oil and gas related	4	5.48
	Erosion control	7	9.59
	Others	6	8.22
Construction industry work experience	1 – 5year	17	23.29
	6 – 10years	25	34.25
	11 – 15years	14	19.18
	16 – 20years	12	16.44
	Above 20 years	5	6.85
Overhead cost to Contract sum in percentage	1-5%	6	8.22
	6-10%	26	35.62
	11-15%	18	24.66
	16-20%	19	26.03
	Above 20%	4	5.48

4.2. Analysis of factors affecting overhead cost of civil engineering projects

Table 3 shows the RII ranking of the factors affecting overhead cost of civil engineering projects based on the respondents' opinions. Delayed payment (RII=0.882) is the overall most important factor affecting the overhead cost of civil engineering projects. Normally, when payments are delayed, the contractor may stop work altogether, while retaining personnel and heavy construction equipment on site. Overhead cost losses due to interruptions in the progress of construction owing to delayed payment are normally contested by the client, making it difficult for the contractor to be adequately compensated in this regard. The 2nd ranking variable is site layout (RII=0.852). An uneconomical site layout will impede project progress and therefore affect the contractor's overhead cost. In the same vain, it can affect the length of access road required, the extent of materials storage on site, and the general work flow. Table 3 shows that all the factors obtained from literature affect civil engineering project overhead cost to some degree since all the variables have RIIs of ≥0.5, except project need for extra man power (RII=0.447). The engagement of extra manpower in a project does not necessarily increase the project overhead cost since site labour is more production related than time-related.

Table 3: Ranking of factors affecting overhead costs of civil engineering projects

Code	Factors affecting overhead cost	RII	RANK
x15	Delay payment	0.882	1
x21	Site layout (Shape of site)	0.852	2
x6	Project Size	0.844	3
x43	Fraudulent practices and kickbacks	0.819	4
x4	Experience in implementing similar projects	0.803	5
x40	Contractor's experience with client	0.803	6
x30	Assigning work to subcontractors	0.797	7
x32	Method of performing the project	0.797	8
x7	Project Duration	0.795	9
x9	Project Location	0.792	10
x38	Project complexity	0.792	11
x25	Familiarity and Influence in Area	0.778	12
x13	Site Terrain and Preparation Requirements	0.775	13
x27	Required quality level of projects	0.764	14
x10	Type/Nature of Client	0.753	15
x26	Work Scope	0.753	16
x39	The type, size and policy of construction firm	0.753	17
x33	Project Management method	0.742	18
x29	Company classification	0.74	19
x16	Lack of new project	0.737	20
x23	Extent of bond/warranty requirement	0.734	21
x36	Regional Economic condition	0.734	22
x42	Level of available project information	0.732	23
x19	Firm's growth	0.726	24
x28	Country of performing the project	0.726	25
x3	Schedule/Mechanism of contract payments	0.723	26
x34	Tendering method	0.723	27
x24	Stakeholders' Profit	0.718	28
x8	Project Type	0.712	29
x37	The client' s strictness in supervision	0.71	30
x17	Cost inflation	0.704	31
x5	Construction Firm Category	0.693	32
x22	Contractor's designing necessities	0.688	33
x35	Contractor's need for work	0.679	34
x2	Financial liquidity of the company/contractor's cash availability	0.66	35
x20	Similar Project Availability	0.655	36
x31	Number of competitors	0.655	37
x41	Type of consultants	0.655	38
x11	Type of Contract	0.638	39
x18	Government regulation	0.586	40
x1	Difficulties in obtaining materials	0.581	41
12	Contractor-Joint Venture	0.51	42
x14	Project need for Extra-Man Power	0.447	43

4.3. Factor analysis

The factor analysis was conducted using Varimax rotation, and the results are displayed in Table 4.

Table 4: Factor analysis result

		FACTOR	
CODE		1	2
x6	Project Size	0.889	
x7	Project Duration	0.852	
x43	Fraudulent practices and kickbacks	0.844	
x27	Required quality level of projects	0.837	0.501
x32	Method of performing the project	0.835	
x4	The experience in implementing similar projects	0.831	
x39	The type, size and policy of construction firm	0.826	0.517
x38	Project complexity	0.823	0.526
x13	Site Terrain and Preparation Requirements	0.822	0.525
x21	Site layout (Shape of site)	0.818	
x9	Project Location	0.807	0.519
x42	Level of available information	0.775	0.601
x40	Contractor’s experience with client	0.769	0.58
x28	Country of performing the project	0.767	0.61
x10	Type/Nature of Client	0.755	0.607
x30	Assigning work to subcontractors	0.755	0.597
x26	Work Scope	0.754	0.618
x3	Schedule/Mechanism of contract payments	0.75	0.63
x15	Delay payment	0.745	0.56
x36	Regional Economic condition	0.74	0.642
x8	Project Type	0.736	0.646
x33	Project Management method	0.726	0.653
x22	Contractor’s designing necessities	0.724	0.622
x35	Contractor's need for work	0.714	0.648
x25	Familiarity and Influence in Area	0.703	0.652
x17	Cost inflation	0.701	0.684
x11	Type of Contract	0.676	0.672
x16	Lack of new project	0.67	0.665
x14	Project need for Extra-Man Power		0.918
x12	Contractor-Joint Venture		0.874
x18	Government regulation		0.861
x1	Difficulties in obtaining materials	0.541	0.811
x19	Firm’s growth	0.532	0.776
x24	Stakeholders’ Profit	0.603	0.748
x5	Construction Firm Category	0.62	0.744
x31	Number of competitors	0.605	0.741
x41	Type of consultants	0.638	0.735
x37	The client' s strictness in supervision	0.603	0.729
x2	Financial liquidity of the company/contractor's cash availability	0.653	0.726
x20	Similar Project Availability	0.67	0.698
x29	Company classification	0.652	0.698
x23	Extent of bond/warranty requirement	0.644	0.697
x34	Tendering method	0.673	0.694
	Eigenvalue	39.032	1.147
	Percentage of variance explained	51.101	42.338
	Cumulative percentage of variance explained	51.101	93.439

The KMO measure of sampling adequacy was appropriate at 0.910, while the Bartlett's Test of Sphericity was suitable at 9181.560 (df = 903. Sig.= 0.000). Loadings ≤0.50 were suppressed. A two-factor solution was obtained based on the point of deflection on the Scree plot (Figure 1).

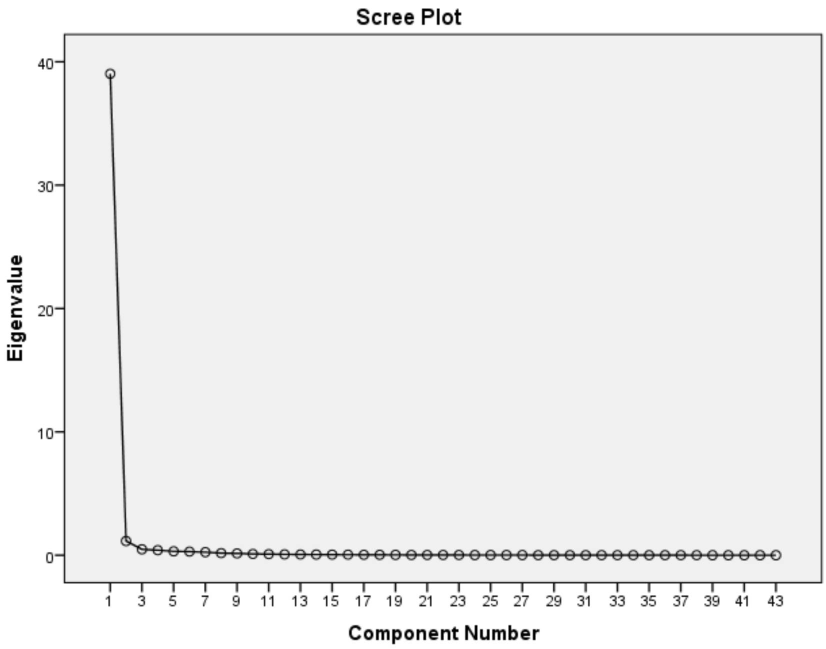

Figure1: Scree plot

5. Discussion of Findings

5.1. Factor 1: Project-related factors

Project-related factors form the first domain of factors affecting the overhead cost of civil engineering projects. The first factor was named “project-related factor” on account of the high loading on variables such as project size (0.889), project duration (0.852) fraudulent practices and kickbacks (0.844) and required quality level of projects (0.837). These overhead cost factors vary relative to projects. For instance, project sizes differ. Whether measured in terms of cost of construction or complexity, overhead cost will tend to increase with increasing project size. A number of other authors have identified project-related factors such as project complexity, location and size as affecting the overhead cost of projects (Hesami & Lavasani, 2014; Ujene *et al*., 2013), which aligns with the findings of this study. Assaf *et al*. (2001) ranked delayed payment and lack of new project as 1st and 2nd reasons for increase in company overhead cost of contractors. Enshassi *et al*. (2008) ranked the variables as 4th and 2nd respectively. ElSawy *et al*. (2011) equally concluded that project type, size, location and site conditions are important determinants of project overhead cost. Consistent with the results of this study, these previous findings point to the issues surrounding the project as the major determinant of its overhead cost. Project related factors explain 51.101% of the variance in the data, which means that they are better predictors of overhead cost in civil engineering projects than contractor-related variables. This agrees with Kumaraswamy and Chan (1998), where the respondents ranked project-related factors as more important than contractor-related factors in terms of effects on project delay.

5.2. Factor 2: Contractor related factors

Factor 2 is related to variables that point towards issues within the contractor's control. Essentially, the contractor's role is site assemblage or construction of a designed project. Ultimately, how much he spends on facilitative resources and works will depend on his managerial abilities at the project site level. The major variables underpinning factor 2 include project need for extra-man power (0.918), contractor joint venture (0.874), government regulation (0.861), difficulties in obtaining materials (0.811) and firm's growth (0.776). In the event of supervisory personal or technical man power becoming necessary at the site level, the project overhead cost is bound to increase, although such an event could arise from poor planning on the part of the contractor. The high loading of government regulation reflects the effects of government's policies on the contractor's overhead cost budget in civil engineering projects. For instance, policies requiring registration with certain public bodies before a contractor could tender for public projects, or local taxes and permits demanded by state and local governments have influences on contractors' overall cost of project overheads. Previous studies by Kumaraswamy and Chan (1998) and Lo, et al. (2006) identified contractor-related factors among the factors responsible for delays in construction projects. The present result suggests that such delays eventually lead to higher overhead costs.

5.3. Influence of factors on the overhead cost of civil engineering projects

The data obtained showed that, generally, the overhead costs of the projects ranged from 3% to 25% of the total project cost, with a mean of 11.9315% and a standard deviation of 5.508%. Table 5 shows the summary of the regression analysis between the factors affecting overhead cost of civil engineering projects and the overhead costs of the projects.

Table 5: Regression Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.441[a]	.194	.171	5.01439

a. Predictors: (Constant), Project related factors, Contractor related factors

Table 6: Relationship between factors and overhead costs of civil engineering projects

Model		Unstandardized Coefficients		Standardized Coefficients		
		B	Std. Error	Beta	t	Sig.
1	(Constant)	11.932	.587		20.330	.000
	Project Related Factors	2.013	.591	.365	3.406	.001
	Contractor Related Factors	1.358	.591	.247	2.298	.025

a. Dependent Variable: overhead cost

The predictive power of the model though considerably low, (adjusted R^2=17.1%), Table 6 shows that the independent variables are significant since $p<0.05$ for both project-related and contractor-related factors. This result confirms that the project overhead variables indeed affect the overhead cost of civil engineering projects in line with expectations in previous studies. However, it gives room for researchers to investigate other factors which may contribute to overhead costs in such projects given that the adjusted r^2 is 17.1%.

Table 7: The frequency of use of general items in civil engineering projects

CODE	**COMPONENT**	**TICK**	%	FREQUENCY
C13	Temporary Water Supply	73	100.0%	
C24	Setting Out	73	100.0%	
C39	Handover	73	100.0%	
C12	Sundries	72	98.6%	
C18	Security Staff	72	98.6%	
C31	Concrete Plant	70	95.9%	ALWAYS
C2	Project Specific Management and Staff	68	93.2%	
C1	Management and Staff	66	90.4%	
C11	Consumable and Services	66	90.4%	
C48	Performance/advance payment/bid bonds	66	90.4%	
C25	Protection of Work	64	87.7%	
C6	Staff Establishment	58	79.5%	
C37	Site Records	58	79.5%	
C33	Earthwork plant	56	76.7%	
C35	Access Scaffolding	51	69.9%	
C36	Temporary Works	51	69.9%	OFTEN
C43	Professional fees	51	69.9%	
C41	Site Tidy	45	61.6%	
C8	Temporary Works in Connection with Site Establishment	44	60.3%	
C15	Temporary Electric Supply	44	60.3%	
C20	Hoarding Fence and Gates	44	60.3%	
C44	Charges	44	60.3%	
C7	Site Accommodation	40	54.8%	
C26	Test Samples	40	54.8%	
C3	Visiting Management and Staff	37	50.7%	
C34	Other Plant	37	50.7%	
C38	Testing and Commissioning Plan	37	50.7%	
C32	Road work plant	34	46.6%	AVERAGE
C9	Furniture and Equipment	33	45.2%	
C10	IT Systems	33	45.2%	
C5	Staff Travel	29	39.7%	
C17	Temporary Drainage	26	35.6%	
C23	Environmental Protection Measures	23	31.5%	SOMETIMES
C40	Post-completion Services	18	24.7%	
C42	Maintenance of Work Paths and Paving	15	20.5%	
C30	Access Plant	12	16.4%	
C4	Extraordinary Support Costs	11	15.1%	
C16	Project dedicated temporary telecommunication systems	10	13.7%	
C22	Barriers and Safety Scaffolding	9	12.3%	
C19	Security Equipment	7	9.6%	
C49	Guaranties	7	9.6%	
C28	Mobile Crane	5	6.8%	
C21	Safety Programs	4	5.5%	SELDOM
C27	Tower Crane	4	5.5%	
C46	Public Liability Insurance	4	5.5%	
C47	Employer's (Main Contractor's) Liability Insurance	4	5.5%	
C29	Hoists	3	4.1%	
C14	Temporary Gas Supply	0	0.0%	
C45	Works Issuance	0	0.0%	
C50	Warranties	0	0.0%	

5.4. Frequency of use of overhead cost items in civil engineering construction sites

Table 7 shows the frequency of use of overhead (preliminary) cost items in the civil engineering sites covered by the study. Foremost overhead cost items reported to be applicable in most of the sites are temporary water supply, setting out and handover costs. Other cost headings like personnel, consumables, security provisions and protection of the work are within this category. These overhead cost items were in 80 – 100% of the projects, which means that they are always applicable in civil engineering construction sites in Nigeria. Ujene *et al*. (2013) identified personnel, consumables and temporary works costs as affecting the cost performance of educational and administrative building projects. The present study builds on that result by isolating the preliminary items that are always found on civil engineering projects sites in Nigeria. Further, it shows that preliminary items such as gas supply, warranties and insurance of works are hardly used in civil engineering projects in Nigeria, which means that contractors should carefully justify the pricing of any general item to be included in their bids by avoiding unnecessary overhead cost items. Use of percentages in the pricing of general items as noted by Jimoh and Adama (2011) should, therefore, be discontinued.

6. CONCLUSION

This study examined the factors affecting overhead costs and how they influence the overhead cost of civil engineering projects, as well as identified the frequency of use of overhead cost items in civil engineering projects. Firstly, it was discovered that the most important factors affecting the overhead cost of civil engineering projects are delayed payment, site layout and project size in decreasing order of magnitude. A factor analysis of the variables revealed that the factors affecting overhead costs of civil engineering projects can be summarized as either project-related or contractor-related although the former is more important than the latter. These two domains of overhead costs were found to have significant influences on the overhead cost of civil engineering projects. Eleven general items were found to be used always in civil engineering projects covered by the study. They include items such as temporary water supply, setting out and handover.

Based on the findings of this study, civil engineering project cost estimators should carefully examine the possibility of delayed payment occurring in the course of a project and factor this risk into their estimates for general items in their bids. Government should work harder to prevent payment delays in civil engineering projects due to its impacts on the overhead cost of the projects. Ultimately, this will lead to a significant drop in the overhead cost of infrastructural projects in Nigeria.

For project supervisors, careless site layout will be expensive in civil engineering projects. It is recommended that civil engineering project supervisors should carefully plan and optimize the layout out of their sites prior to commencement of site operations. This study has provided contractors will a checklist of the frequency of use of general items in civil engineering projects to which they can make reference in the course of bid preparation to avoid omission of important cost items. Furthermore, civil engineering estimators should ensure that only relevant general items are priced in their bids, instead of reducing their chances of winning the project by putting a price against every general item some of which may not be used in the project. This result further implies that the use of percentages in the computation of cost of general items should not be practiced in civil engineering projects.

This study confirms that the overhead cost influencers in civil engineering projects are project and contractor-related. Future studies should, however, investigate how overhead costs differ for different types of civil engineering projects.

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