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ANALYSIS OF FACTORS RESPONSIBLE FOR EFFICIENCY LOSSES IN CONSTRUCTION PROJECTS IN NIGERIA

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ABSTRACT

The construction industry is the economic prime mover of nations and it influences and propels infrastructural provision and development. Labour Efficiency losses on construction works have denied the reaping of the full benefits of the industry; as it has led to cost and time overruns, poor quality, claims and disputes. This study adopts exploratory factor analysis to analyse the factors responsible for efficiency losses in construction projects in Abuja, Nigeria. The data gathered through the self-administration of questionnaires using simple random sampling techniques, were analysed using Percentages, frequencies and factor analysis (FA). The study found that the major cluster of factors responsible for efficiency losses are; construction method and poor documents, Communication and materials related causes, Poor supervision and planning, Equipment installation related causes, and industrial action and weather related causes. It was concluded that both private and public construction projects suffer s from efficiency losses. Accurate timing and scheduling of projects activities, efficient communications, use of experienced supervisory staff and staff training and retraining on modern construction methods were advocated to eliminate labour loss efficiencies.

Keyword: *efficiency losses, productivity, factor analysis, construction project, Nigeria*

INTRODUCTION

The construction industry and its activities act as catalyst that stimulates economic growth and infrastructural provisions (Adegboyega et al. 2019). Similarly, Eze et al. (2020), posit that the construction industry is the economic prime mover of nations and it influences and propels infrastructural provision and development. The industry is however, characterised by poor quality of products, poor workmanship, low productivity, fragmentation, and divided responsibility and conflicting objectives (Hassan and Salim, 2014). According to, Eze et al. (2020), the decline in labour productivity and efficiency of operations of the contracting organisation is a problem that has negatively influenced the industry's contribution to national economy. The declining labour productivity is due to the fact that the industry is labour-intensive, and labour productivity issue is among the critical issues facing the construction project managers and other professionals and supervisors on a regular basis, as they strive to deliver project on target (Attar et al., 2012). The goal of a contract or the end of a contract is that the procurement of any good or service should be successful project completion (Davison and Wright, 2004).

In a labour-intensive building construction Industry, skilled workers such as masons, iron benders, carpenters amongst others, form a large part of the site labour force whose input determine to a great extent, the quality of the industry's products (Obiegbu, 2005). These skilled workers however, are most endangered in Nigeria as they lack inadequate training, technical education and experience to recommend them for work (Simire, 2010). Thereby, affecting their performance and productivity on construction projects which in turn could lead to cost and time overruns of the project. Productivity loss is experienced when a contractor is not accomplishing its anticipated achievable or planned rate of production. Consequently, leading to efficiency losses (Gibson, 2015). The major outcome of efficiency losses is usually decline in productivity. Dieterle and Gaines (2010) observed that virtually every project in which a contractor makes a claim for delay, damages associated with loss of labour efficiency contributed to such delay. Ismail *et al* (2019) observed that timely delivery of construction projects lies largely on the performance of labour. Unfortunately, labour performance growths in Nigerian construction industry have been unsatisfactory. The abysmal performance of labour have remained one of the key problems of the construction industry, as it constitutes a major claim head in the construction industry of Nigeria (Egwunatum and Ovie, 2015), especially as it has to do with the relationship between clients, consultant, and contractors. Decline in labour productivity has been blamed for the poor construction project delivery, and it have been the leading causes of schedule and cost overruns, quality issues, claims and conflicts, especially in key capital construction projects globally (Eze et al., 2020). Construction productivity is dependent on labour productivity; even though labour productivity is a sub-domain of overall construction productivity (Rao et al., 2015). Effective management of construction labour can lead to a reduction of labour cost; as labour cost constitute about 30% to 50% of total construction projects cost (Gopal and Murali, 2015; Shashank et al. 2014).

According to Dieterle and Gaines (2010) efficiency losses claims are prevalent in many construction disputes. They are of the opinion that efficiency losses are not well understood and often difficult to quantify. This was further buttressed by Egwunatum and Ovie (2015) who were of the opinion that efficiency loss calculation or estimation is one of the most contentious areas in construction industry. According to Gledson et al (2018), construction project delivery is considered successful if time, scope, cost and quality outputs are attained, with any shortcomings in one or more of these representing a failure of sorts.

Focusing only on the criteria of 'time', it is noticeable that more recent research efforts have been concentrated on poor time predictability but minimal attention is retained on planning labour efficiency to facilitate timely completion of construction projects. It is based on this knowledge that this study entitled 'analysis of factors responsible for efficiency losses in construction projects in Nigeria' was carried out. The outcome of this study would beneficial to students, researchers and educators, and the industry's practitioners who are interested in the matter of efficiency losses, productivity as well as the time performance of construction projects. Knowing the root causes of efficiency losses is the best possible solution to ensuring their elimination or prevention on construction projects.

LITERATURE REVIEW

The Concept of Efficiency Loss

AACE (2004) defined efficiency loss as the increased cost of performance caused by a change in the contractor's anticipated or planned resources working conditions or methods of work. According to the independent project Analysis group, an average of over 35% of all construction projects will have major change (Integraph, 2012). A change in a project of any kind usually means there will be associated productivity impacts that can be attributed to inefficiencies as well. Project owners often demand for the same completion date despite the added work scope. This may require overtime, second shift work, additional crafts and many other impacts. Efficiency losses occur through the inefficient use of labour and this leads to decline in productivity arising from unanticipated conditions (Sykes, 2009).

According to Egwunatum and Ovie (2015), the resulting damage (cost) from efficiency losses are an outgrowth of the change in output/input been the difference between baseline productivity and that actually achieved.

i.e. Efficiency losses = $\text{productivity}_{\text{Baseline}}$ - $\text{productivity}_{\text{Actual}}$

According to Egwunatum and Ovie (2015), baseline productivity can be determined by measurements of input and output in unimpacted or the least impacted periods of time on the project. This makes, efficiency losses the difference between the productivity actually observed and the productivity that might reasonably have been expected if not for the unanticipated condition.

Factors Responsible for Efficiency Losses on construction projects

A review of some publications results in the following list of causes which fairly well covers the majority of situations encountered on a construction project. The circumstances set forth below may all impact labour efficiency. However, for a contractor to successfully recover damages due to lost productivity from a project owner, the contractor will need to clearly demonstrate that the main cause of the event was something for which the owner or one of the owner's agents was to blame. Additionally, the contractor must be able to show a cause and effect relationship between the event and the impact to labour productivity in order to recover damages (i.e., costs and/or time). However, the recoverable damages are not limited to direct costs.

[1] ***Construction method, Complexity of design and Project scale:*** A simple, familiar work is easier to execute than unfamiliar, complex work.

[2] ***Clarity of the drawings and project documents:*** Mistakes in Design before project tendering, easy and accurate design should be prepared. Mistakes in design delay the project construction activities which can lead the project to time overrun (Aziz, 2013)

[3] *Project Characteristics (Size, layout, Type, Location):* Physical conditions (such as saturated soils); logistical conditions (such as low hanging power lines); environmental conditions (such as permit requirements prohibiting construction in certain areas during certain times of the year); legal conditions (such as noise ordinances precluding work prior to 7:00 AM [0700 hours] or after 6:00 PM [18:00 hours]) may all negatively impact productivity on a project. Restricted site Can lead to the following: Excessive travel time from an assembly area to the work area, crowding on the site, Limited access that results in delays and excessive use of labour instead of equipment, Inadequate work areas for storage.

[4] *Construction Management:* Ineffective communication, inadequate planning scheduling, lack of sufficient supervisory training (Dozzi and AbouRizk, 1993)

[5] *Education and Training:* Lack of management training and supervision, project management (Dozzi and AbouRizk, 1993)

[6] *Absenteeism and turnover:* When a crew hits its productive peak the absence of any member of the crew may impact the crew's production rate because the crew will typically be unable to accomplish the same productivity rate with lesser resources or, possibly, a different combination of skill and experience levels. If a crew suffers from persistent craft turnover, it is improbable that they will achieve good productivity simply because one or more members of the crew may be on the learning curve, and thus reduce the general productivity of the entire crew.

[7] *Low level of Skill and experience/learning curve:* To be productive, a contractor must have sufficient skilled labour in the field. To the extent that skilled labour is unavailable and a contractor is required to construct a project with less skilled labour it is probable that productivity will be impacted. At the outset of any project, there is a typical learning curve while the labour crews become familiar with the project, its location, the quality standards imposed, laydown area locations, etc. This is to be anticipated and is typically incorporated in as-bid costs. However, if the work of the project is shut down for some period of time and labour crews laid off, then when work recommences the labour crews returned to the project may have to undergo another learning curve. This is

probably an unanticipated impact to labour productivity. If this happens frequently, then each time a work disruption occurs another learning curve productivity loss impact may occur. Shortage of skilled labour is one of the main causes of time overrun in the construction industry. Another cause of shortage of skilled labour is that many construction projects are running simultaneously (Sambasivan *et. al* 2007).

[8] ***Inability to adapt to changes and new environment and Lack of motivation:*** When work is constantly changed or has to be torn out and redone, etc. the enthusiasm for their work is expected to suffer. When this occurs, productivity may decline.

[9] *Excess overtime:* Numerous studies over many years have consistently documented the fact that productivity typically declines as overtime work continues. The usually stated reasons for this result are fatigue, increased absenteeism, reduced morale, reduced supervision effectiveness, poor workmanship leading to unusual normal rework, increased accidents, etc. One author has gone so far as to suggest that "...on the average, no matter how many hours a week you work, you will only achieve fifty hours of results" (AACE, 2004). The thought this statement is that while overtime work will initially result in increased output, if it is continued for a lengthy period, the result may actually decline for the reasons stated earlier. Thus, prolonged overtime may lead to increased costs but decreased productivity. The effect of continued overtime work on labour productivity is, perhaps, one of the most studied productivity loss factors in the construction industry. Working prolonged periods of overtime will lead to fatigue, low morale and possibly increased accidents

[10] ***Worker's lack of integrity and Number of breaks and duration:*** Craftsmen who are tired tend to slow down work, make more mistakes than normal, and suffer more accidents and injuries, thus productivity may decrease for the entire crew. As mentioned by Jerome (2013), reasonable working hours and necessary breaks are critical to achieve above outcome. Most developed countries have adopted the national laws that set working hours and the limitation of numbers for consecutive working hours, weekly maximum work hours and minimum duration for breaks during work (Seo, 2011).

[11] *Strikes/Disruptions by Unions and Political Parties:* When there are union jurisdictional issues, industrial relations issues, unsafe working conditions or other safety issues, multiple evacuation alarms in existing facilities, untimely issuance of permits, access issues, etc. labour productivity maybe adversely impacted in multiples ways. Interruptions to work in progress can reduce productivity. Halligan *et. al* (1994) categorized disruptions into short duration and long duration. They found that a long disruption or delay may interrupt productivity rates because of training. The most skilled workers may leave the job and become unavailable for rehire. Also, work that is continued during a disrupted phase happens at a less productive pace (Sanders and Thomas, 1991). In a study of short duration disruptions of piping insulation installation, productivity was reduced by 70 % when work was disturbed by two or more interruptions per section of pipe (Hester, 1987).

[12] *Adverse Weather:* Construction projects, in general, are executed in an outdoor environment, and therefore are affected by weather conditions. The weather impact is one of the main factors causing delay and cost overruns on construction projects. According to Rashid (2015), it is well known that there is a relationship between climate and labour efficiency in construction industry. According to him, it is intuitive that extreme climatic factor can affect construction projects by disrupting and impairing the project's labor efficiency. Researches have shown that almost 50% of construction activities are sensitive to weather conditions. The weather impact on construction activities can be in the form of reduced labour productivity and/or work stoppage. Reduced labour efficiency is generally attributed to reduced human performance due to the combined effect of temperature, humidity, and wind velocity. The weather-related work stoppage is attributed either to the inability of construction personnel to work under severe weather conditions such as heavy rain, snow, and (or) gusting winds, or simply to the compliance with safety regulations in such adverse weather conditions. Changes in production and timing especially when it results in protracted disputes and litigation is a serious and expensive problem for the construction industry

RESEARCH METHODOLOGY

In order to ascertain the factors responsible for efficiency losses on construction projects, this study adopted survey research design approach. According to Robson (2005), a survey research design is a cross-sectional design where data are collected using a structured questionnaire or interview administered to the research objects for self-report at a time when quantifiable data are required. Survey design is quantitative in nature, as it involves the formal, objective, systematic process of describing a relationship, examining causes and effects among variables (Oladun, 2012). The questionnaire was the tool for data collection in this study. Questionnaire survey is a systematic method of obtaining data based on a sample (Tan, 2011); and it has been used extensively to solicit opinions on surveys based on impact of efficiency losses from construction professionals and contractors (Xue et al., 2016; Zhu et al., 2017).

This study adopted a well-structured questionnaire administered to construction professionals in both the public and private construction-based organisations (contractors/subcontractors and consultants inclusive) based in Abuja, using simple random sampling method. These professionals are registered Architects, Builders, Engineers and Quantity surveyors practicing in public and private organisation in Abuja, Nigeria. Abuja is the administrative headquarters of Nigeria and there are a lot building development going on. Abuja also houses a lot of privately own construction and consultancy firms. Furthermore, there are numerous construction projects being executed on a daily basis in Abuja (Onyeagam *et al.*, 2019). As one of the metropolitan cities in the country with one of the highest construction based professionals working either in constructing or consulting firms within the built environment (Saidu and Shakantu, 2016); Abuja is undoubtedly suitable for the study. The reason for the considering contractors/subcontractors is that they are the entities involved in the carrying out of the actual building construction and production of the finished buildings and are involved in the management of labours (skilled and unskilled). Thus, their participation is critical to the success of this study. The questionnaire used was divided into part A which sort about the general information of the respondents, and Part B which asked Questions on the factors responsible for the occurrence of efficiency losses in construction, based on a 5-point Likert scale in which (1 is the lowest scale and 5=highest scale). According to Manu (2015), Likert scale reduces uncertainty and it is easy to use.

The population of this study is 10,300, comprising (Architects (NIA)=625; Builders (NIOB)=600; Engineers (NSE); Quantity surveyors (NIQS)=1200), there information was obtained from the register of the various professionals such as; Nigerian Institute of Building (NIOB), Nigerian Institute of Quantity Surveyors (NIQS), Nigerian Institute of Architects (NIA) and Nigerian Society of Engineer (NSE). The sample size for this study is 370, obtained using the formula from Krejcie and Morgan (1970) at 95% confidence level.

$$s = X^2 NP (1 - P) \div d^2 (N - 1) + X^2 P (1 - P) \quad \text{.........................} (1)$$

Where;

s = sample size from finite population; X = based on confidence level 1.96 for 95% confidence was used for this study; d = Precision desired, expressed as a decimal (i.e. 0.05 for 5% used for this study; P = Estimated variance in Population as a decimal (i.e. 0.5 for this study); and **N=** total number of population, 10,300

At the end of the sampling period, 159 questionnaires were retrieved out of the 370 distributed. 3 were discarded for poor and incomplete responses. The remaining 156 were deemed adequate for further analysis and were used for all the analysis of this present study. A response rate of 42.16% was obtained from the number of usable and completely filled questionnaire, and based on what has been proposed in construction management literature; this response rate is considered suitable and adequate. Aaccording to Moser and Kalton (1999) and Akintoye (2000), a response rate of over 20-30% is ideal for good quality construction based survey.

Descriptive statistics and factor analysis were used to analyse the collected data. Percentage and frequency were used to analyse the respondents' general information, and Factor analysis was used to examine the factors responsible for efficiency losses in construction projects

Prior to the actual factor analysis, the reliability and internal consistency of the gathered data and research instrument was determined using a Cronbach's Alpha test for reliability analysis. An alpha value of 0.845 for the 25 items related to the factors of efficiency losses, and based on this, the gathered data and research instrument was said to be reliable and have high internal consistency. This decision is supported by the submissions of (Kasim et al., 2019) who submitted that an alpha value of greater than 0.70 indicates a good internal consistent and reliability. The entire methodology for the study is summarised in the methodology flow chat (Figure 1)

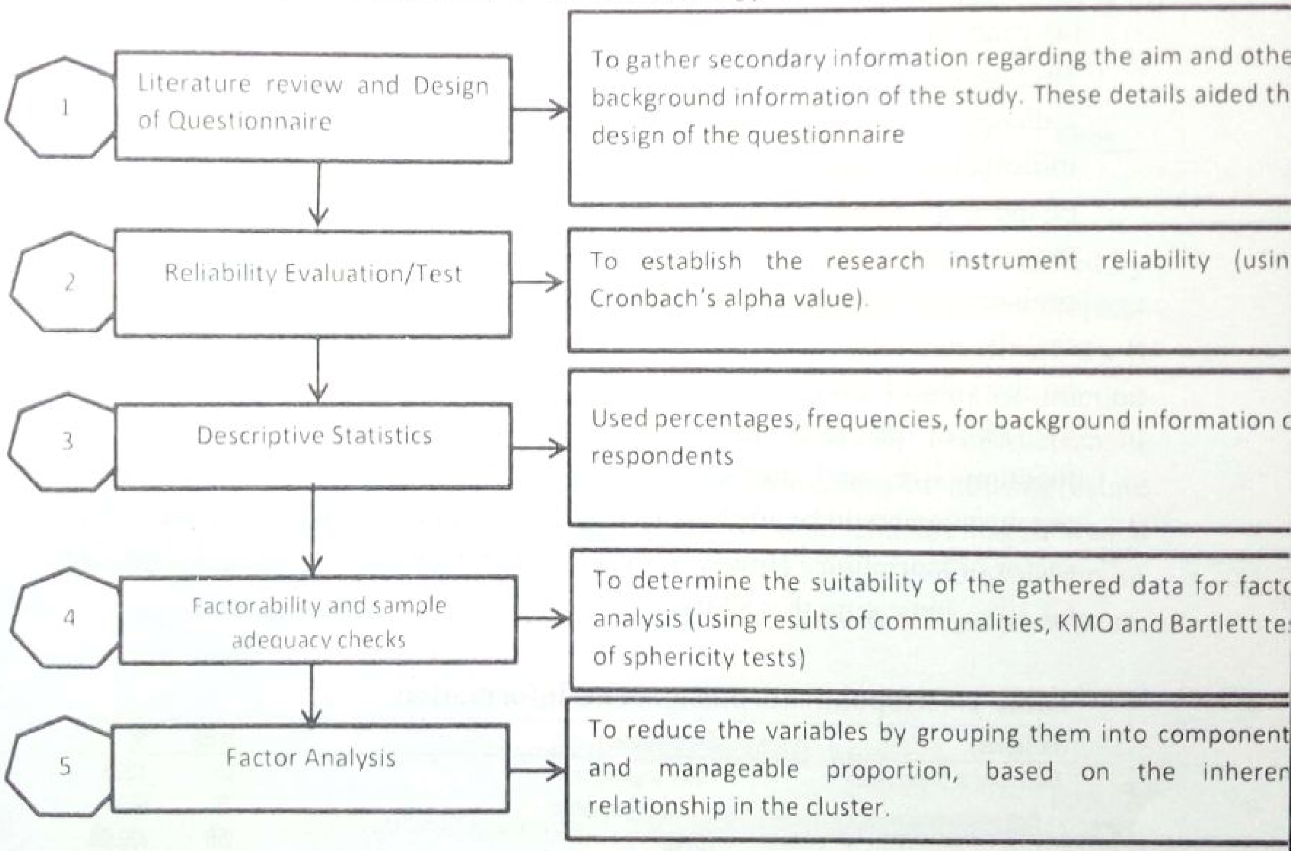

Figure 1: Methodology flow chat

RESULTS AND DISCUSSION

Respondents background information

Table 1 shows the results of the analysis of the information gathered on the respondents' background. It can be seen that 35.26% of the respondents' work with the public organisations and 64.74% work with private organisations. This however, shows a fair representation of both private and public experiences. Furthermore, in terms of professional composition, 22.44% are architects, 17.95 % are builders, 30.77% are engineers, and 28.85% are quantity surveyors. This is a fair representation of the key construction professional experiences. The highest educational qualification of the respondents shows that 23.7% had HND, 13.47% have PGD, 35.26% hold BSc./B.Tech., 26.28% are MSc./M.Tech holders and 1.28% hold PhD. This shows that the participants are educationally qualified to give an information response that would aim the study. The years of experience showed 11.56% have spent 1-5 years in the industry, 32.69% have spent 5-10 years in the industry, 37.18% had spent 11-15years, 12.18% had spent 16-20years and 6.41% have spent over 21 years in the industry. This indicates that the participants are experienced enough to give reliable information regarding the subject of this study. The professional affiliation of the respondents shows that 88.46% of them are corporate members of their various professional organisations, and only 11.54% are still probationer members of the various professional organisations. This shows that the participants are professionally qualified to give quality information on the subject matter of this present study. In terms of organisational size, 41.67% of the respondents' organisations are small sized, 22.44% are medium size, and 36.54% are large organisations. The 36.54% large organisation could be attributed to the number of participants from the public sector organisations. However, the small and medium size organisations are 64.10%, indicating that SMEs

Table 1: Respondents background information

Variables	Classification	Freq.	%
Ownership of Organisation	Public organisation	55	35.26
	private organisation	101	64.74
	TOTAL	156	100.00
Respondents' Profession	Architects	35	22.44
	Builders	28	17.95
	Engineers (Civil & Services)	48	30.77
	Quantity surveyors	45	28.85
	TOTAL	156	100.00
Highest educational qualification	Higher national Diploma (HND)	37	23.7
	Postgraduate Diploma (PGD)	21	13.46
	Bachelor of Science/technology (B.Sc/B.Tech)	55	35.26
	Master's Degree (MSc./M.Tech	41	26.28
	Doctorate degree (PhD)	2	1.28
	TOTAL	156	100.00
Years of experience	1-5years	18	11.54
	5-10 years	51	32.69
	11-15 years	58	37.18
	16-20 years	19	12.18
	21-above	10	6.41

	TOTAL	156	100.00
professional affiliation	MNIA	28	17.95
	NIOB	23	14.74
	NSE	45	28.85
	NIOS	42	26.92
	Probationer	18	11.54
	TOTAL	156	100.00
Classification of organisation	Small	65	41.67
	medium	35	21.79
	large	57	36.54
	TOTAL	156	100.64

Projects upon which assessment was based

The respondents were asked to nominate a project among those handled by their organisation to base their assessment on. The summary of the projects undertaken based on their functional requirement is shown in (figure 2). It can be seen that construction of shopping mall is 25 (16.03%). Construction of residential building projects duplex was 35(22.44%). Construction of office building/complex was 10 (6.41%). Construction of housing estate project was 8(5.13%). Construction of estate road and drainages was 8 (5.13%). renovation of public schools was 21(13.46%). construction of public school was 34 (21.79%) and construction hotel projects were 15(9.62%).

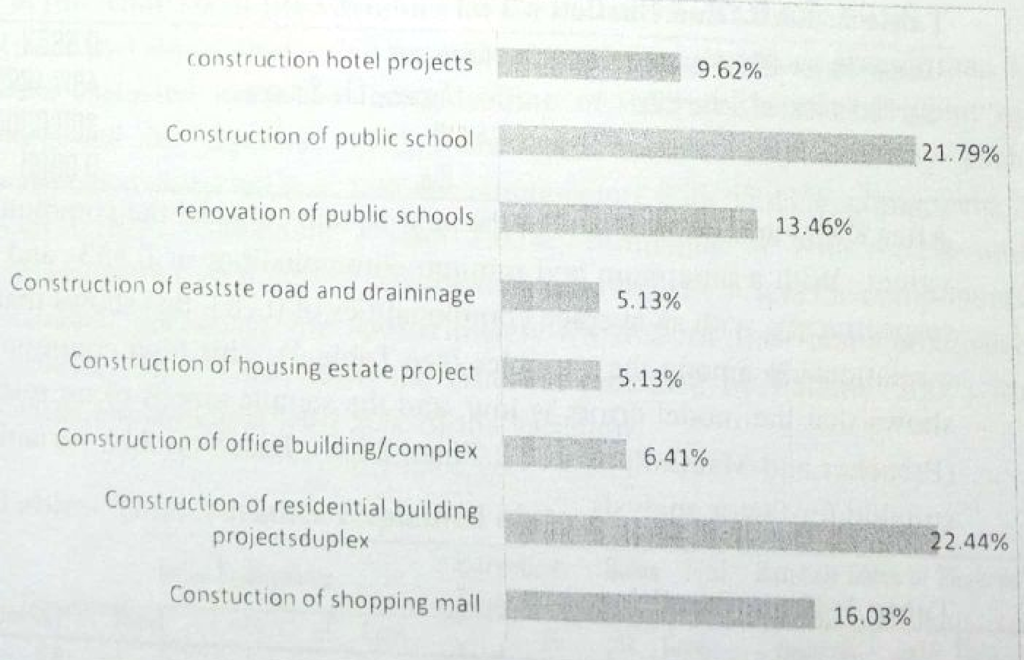

Figure 2: Project upon which assessment was based

Factors responsible for efficiency losses in construction projects

Factor analysis (FA) was conducted using principal component analysis (PCA) with varimax rotation as the extraction method. The essence is to group assessed variable reagrding the cause of efficiency lossess into more significant and manageable portion.

Factoriability and suitability evaluation of the gathered data is usually the first step towards performing factors analysis. This evaluation was done by looking at the number of variables, sample size, commonalities, Kaiser–Meyer–Olkin (KMO) measure of sampling adequacy and Bartlett's test of sphericity.

The sample size of 156 and number of variables which is 25 is adequate and subsequently considered satisfactory for factor analysis. This decision was based on the reports of (Pallant, 2005; Tabachnick and Fidell , 2007; Mundfrom et al., 2005). The KMO value is 0.8853, and this is higher than the range of 0.5- 0.7 which is adequate and suitable for factor analysis.

With a Bartlett's test of sphericity with p-value (or sig.) of 0.0000,df=300, this shows that the variablea are adequate for FA. The sign is below 0.05 and this is the condition that shows that variables involved have patterned relationships (see Table 2)

Table 2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.8853
Bartlett's Test of Sphericity	Approx. Chi-Square	4817.4669
	df	300.0000
	Sig.	0.0000

After KMO and Bartlett's tests, the next is tom consider the communalities values. With a amximum and minimu commonalities of 0.553 and 0.976 respectivcely, with an average commonalities of 0.783. this shows that there a relationship among the variables (see Table 3). This high commonalities shows that the model errors is low, and the sample size is of no relevance (Preacher and MacCallum, 2002; Zhao, 2008). Based on this, variables are suitable for factor analysis.

Table 3: Communalities

S/no	variables	Initial	Extraction
1	Scarcity of highly-skilled workmen	1	0.71
2	Installation difficult of equipment	1	0.771

3	Difficulty in procuring specialist contractor	1	0.66
4	errors in dimension prefabricated components can cause installation delays	1	0.606
5	Use of unfamiliar construction methods reduces productivity	1	0.883
6	Formwork installation takes longer time owing to complexity of design	1	0.856
7	Change in construction method due to design complexity	1	0.8
8	Clarity of Drawings and Project Documents	1	0.879
9	Project Characteristics (Size, Layout, Type and Location)	1	0.822
10	Ineffective communication	1	0.774
11	Inadequate Planning Schedule	1	0.828
12	Lack of sufficient Supervisory Training	1	0.76
13	Lack of supervision	1	0.735
14	Lack of Management Training	1	0.656
15	Poor Management	1	0.733
16	Unavailability of Materials	1	0.857
17	Absenteeism and Turnover	1	0.553
18	Low Level of Skills and Experience/Learning Curve	1	0.775
19	Lack of Motivation	1	0.762
20	Inability to Adapt to Change and New Environment	1	0.792
21	Excessive Overtime	1	0.84
22	Workers' Lack of Integrity	1	0.67
23	Number of Break and Resting Period	1	0.895
24	Strikes/Disruptions by Unions and Others	1	0.976
25	Adverse Weather	1	0.973

Extraction Method: Principal Component Analysis.

Factor Analysis of the variables on the causes of efficiency losses

Result in Table 4 shows that 4 components with eigenvalues greater than 1 were extracted using the factor loading of 0.50 as the cut-off point as suggested by (Spector, 1992). The total variance explained by each component extracted is as follows; component 1 with 53.41%, component 2 with 9.05%, component 3 with 7.02%, component 4 with 4.52% and component 5 with 4.52%. The final statistics of the PCA and the components extracted accounted for approximately 78.26% of the total cumulative variance. This, Thus, fulfil the criterion proposed by Pallant (2007) for factors explaining at least 50% of the variation.

Table 4 Total Variance Explained of the causes of efficiency losses

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %	Total	% of Variance	Cum. %
1	13.352	53.408	53.408	13.352	53.408	53.408	5.587	22.347	22.347

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2	2.262	9.048	62.456	2.262	9.048	62.456	5.473	21.891	44.238
3	1.755	7.019	69.475	1.755	7.019	69.475	4.174	16.696	60.934
4	1.129	4.517	73.992	1.129	4.517	73.992	2.18	8.722	69.656
5	1.068	4.27	78.262	1.068	4.27	78.262	2.152	8.607	78.262

The result in Table 5 summarizes the factor loading on each of the five extracted factors and their variables. The table contains variables with a significant factor loading of greater than 0.50. This is in line with the submission of Spector (1992), who submitted that a clear component structure is present when a variable has significant factor loading (loading > 0.50) on one component only.

Table 5: Rotated Components Matrix of causes of efficiency losses

	Component				
	1	2	3	4	5
Use of unfamiliar construction methods reduces productivity	0.834				
Clarity of Drawings and Project Documents	0.82				
Absenteeism and Turnover	0.696				
Change in construction method due to design complexity	0.678				
Formwork installation takes longer time owing to complexity of design	0.65				
Lack of supervision	0.636				
Ineffective communication		0.869			
Unavailability of Materials		0.802			
Number of Break and Resting Period		0.774			
Project Characteristics (Size, Layout, Type and Location)		0.681			
Low Level of Skills and Experience/Learning Curve		0.638			
Lack of Management Training		0.624			
Lack of Motivation		0.616			
Lack of sufficient Supervisory Training			0.811		
Inadequate Planning Schedule			0.682		
Excessive Overtime			0.66		
Poor Management			0.624		
Workers' Lack of Integrity			0.597		
Errors in dimension prefabricated components can cause installation delays			0.524		
Installation difficult of equipment				0.801	

Difficulty in procuring specialist contractor	0.637	
Scarcity of highly-skilled workmen	0.561	
Strikes/Disruptions by Unions and Others		0.984
Adverse Weather		0.983
Inability to Adapt to Change and New Environment		0.587

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

Naming of Extracted causes of efficiency losses

i. **Construction method and poor documents.**
The first component has a factor loading of 6 and accounted for about 53.41% of the total variance explained. The variables loading under this component are; use of unfamiliar construction methods reduces productivity, clarity of drawings and project documents, absenteeism and turnover, change in construction method due to design complexity, formwork installation takes longer time owing to complexity of design, and lack of supervision. These variables is observed to be associated with method of construction and documentation issues, and based on this, the components was named '*Construction method and poor documents*'.

ii. **Communication and materials related causes**
The second principal component accounts for about 9.05% of the total variance explained, and 7 variables are loaded under it. These variables are: ineffective communication, unavailability of materials, number of break and resting period, project characteristics (size, layout, type and location), low level of skills and experience/learning curve, lack of management training and lack of motivation. Following a critical examination of the features of these variables, the component was name '*Communication and materials related causes*'.

iii. **Poor supervision and planning**
The third component has 6 variables loading under it, and they account for 7.02% of the total variance explained. The causes are; lack of sufficient supervisory training, inadequate planning schedule, excessive overtime poor management, workers' lack of integrity, and errors in dimension prefabricated components can cause installation

delays. A cursory look at the latent characteristics of these variables shows they are related to reduction of supervision and planning issues. It is based on this that the component was named *'poor supervisory and planning'*.

iv. **Equipment installation related causes**

The fourth principal component accounts for about 4.52% of the total variance explained. The factors loaded on this component include; installation difficult of equipment, difficulty in procuring specialist contractor, and scarcity of highly-skilled workmen. After an critical examination of the latent characteristics of these variables shows they are related equipment installation issues. It is based on this that the component was named *'Equipment installation related causes'*.

v. **Industrial action and weather related causes**

The fifth principal component accounts for about 4.27% of the total variance explained. The factors loaded on this component include; strikes/disruptions by unions and others, adverse weather, and inability to adapt to change and new environment. These variables are closely related to worker's unrest and strike and natural causes. Based on this, the component was named *'Industrial action and weather related causes'*.

Based on the factor analysis carried out, it was found that the causes of efficiency losses are Construction method and poor documents, Communication and materials related causes, Poor supervision and planning, Equipment installation related causes, and industrial action and weather related causes. Education and upgrading of the expert's skills of workers is a key to ensuring that work is carrying out without efficiency losses. This is among the key cause of poor supervision, inadequate knowledge of modern construction methods. Dozzi and AbouRizk (1993) found that the top among the causes of efficiency losses are ineffective communication, inadequate planning scheduling, and lack of sufficient supervisory training. Also, a lack of management training and supervision, and project management deficiencies contributes greatly to efficiency losses construction projects.

This study is limited by its geographical boundary, and thus, care should be taken in generalising its findings. Based on this, the study recommends the following further research: similar study should be conducted to in other state, region or geo-political zones, this is for data available for comparison purposes. The contribution of efficiency losses to unsuitable construction as it's pertain to the environment, economic and social well-being of the community should be assessed.

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