

## Assessment of Technical Factors Influencing Buildability of Building Projects in Osogbo, Osun State, Nigeria

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### ABSTRACT

*In any construction project, the desire of the clients, contractors, and consultants is to guarantee that projects are carried out to meet the requirements and expectations of the customer and end users. However, many problems arise during project construction in which buildings could not be built as designed, schedule plans not critically followed, cost plans and client requirements not considered. This can be traced back to the technical elements impacting the building projects. This study assessed the technical factors influencing buildability of building projects in Osogbo, Osun State, Nigeria. Questionnaires were created to gather information from stakeholders (Ministry of Works, professionals, contractors, and direct users of the projects) on the technical challenges that influence the buildability of building projects and their effects on the project delivery. Using the Taro Yamane technique of sample size determination, 195 copies of questionnaires were administered with a total of 189 questionnaires recovered. The results obtained were subjected to descriptive and inferential statistics. The main findings of the study showed that there is significant relationship between the technical factors and buildability of building projects with F- value of 20.197, P-value of 0.000, correlation coefficient (R) of 0.766 and coefficient of Multiple Determination ( $R^2$ ) of 0.586. The results also showed that the relationship between technical factor and number of building project executed was significant with F-value of 20.077 and P-value of 0.000. It is concluded that consideration of the technical factors remains optimum for achieving effective public project delivery in Osun State, Nigeria. It is therefore recommended that the professionals always comply with all specifications as outlined in the contract documents and adopt appropriate constructional techniques to produce long lasting building projects.*

### 1. INTRODUCTION

Buildability refers to how well a project is designed make possible ease of construction, allowing for the most efficient and cost-effective use of resources while meeting the project's overall needs. In the construction industry, buildability is a crucial criterion. Project delivery is a multi-step process that comprises planning, design, and construction to execute and complete construction projects such as building facilities (Whole Building Design Guide, 2017). Majority of the public building projects are complex and

require inputs of the construction professionals in handling the aspects of workmanship, quality, and performance. Project buildability necessitates all the team members involved in the design and production of buildings (the clients, designers and constructors) to work together to achieve a satisfactory outcome. To secure the notion of buildability, the concept of building performance discloses that sufficient site organization and techniques must be carried out to the highest level of integrity and competence (James, 2013).

It is critical that the ultimate outcome of a successful project meets the client's expectations (Osuizugbo, 2019). It is vital to determine the attributes that are necessary to meet the customers and end users goals and expectations once the project has been delivered and is in use. In the construction industry, clients are always searching for the best price/quality ratio in terms of the speed with which work is finished (Amade *et al.*, 2017). The majority of building projects faced with buildability problems can be traced back to technical issues influencing project outcome such as the failure to carry out a buildability evaluation on a building project design during the design stage (Mohammed and Ghaffar, 2014).

Failure to meet buildability goals might result in poorer construction standards and more rework (Taylor and Li, 2011). The impact of buildability problems on customers is typically significant, and individuals with little project management experience are frequently stumped as to how to deal with the problems since buildability issues are typically complex and time consuming to overcome. Clients often wind up absorbing these expenditures in the face of the timing pressures that prospective tenants of new facilities typically face. Serious technical issues could cause a project to overspend its budget and possibly become a societal issue as a result of future repairs, hassles, and other risks, such as fire. Consequently, considering buildability in the design can help to generate new results and prevent the emergence of a variety of negative concerns, such as rework, time and expense overruns, delays, lawsuits, errors, building collapse in the worst-case scenario and complete abandonment are all possible outcomes (Li and Taylor, 2011).

Factors (improper project planning and design, improper project estimates, improper project budgeting, project manager incompetence) identified by Tijani and Ajagbe (2016) as leading causes of project abandonment can be solved by including buildability in construction process. According to Bustani *et al.* (2012), the design team's responsibility is to incorporate buildability throughout the entire design process. Bamidele and Olamoju (2017) reiterated that buildability results in significant cost savings for clients, designers and builders. The designers and builders must be able to look at the entire construction process with each others eyes to accomplish buildability (Othman, 2011). Experience has demonstrated that buildability speeds up construction, improves standards and lowers costs (Aina and Wahab, 2011). Any time or money saved during the design process by not considering technical factors that influence the buildability of building project is a wasted time or cost (Bustani *et al.*, 2012).

The use of buildability concepts in countries like United Kingdom, the United States of America among others has contributed in the improvement of project delivery procedures (Aina, 2015). However, the buildability concept is being overlooked in Nigeria, as seen by the inclination for traditional design and construction separation, which has provided the perfect environment for the rise of technical problems and their consequences (Wong *et al.*, 2006). According to Aina (2015), buildability is an emerging notion in Nigeria. Many problems happen during construction, such as buildings not being built as designed, schedule plans not being closely followed, cost plans not being addressed, and client requirements not being taken into account (Aina and Wahab, 2011). In order to improve project performance, it is necessary to improve design practice by addressing the buildability approach, while also lowering construction time and improving quality (Bustani *et al.*, 2012). As a result, this study assess the technical factors influencing buildability of building projects in Osogbo, Osun State, Nigeria.

## 2. METHODOLOGY

This study took a qualitative approach to its research design. The qualitative technique used a survey method to gather information from respondents in Osogbo, Osun State, Nigeria, using a structured questionnaire. The surveys were designed to collect data from project stakeholders such as the Ministry of Works, professionals, contractors, and direct users on the technical factors that influence the buildability of building projects and their effects on building projects delivery. To provide a good representation of the study, 195 copies of questionnaires were distributed using the Taro Yamane sample size determination method as shown in Equation 1. A total of 189 questionnaires were retrieved and deemed to be useful, with a return rate of 96.92%. To measure the variables and derive agreement indices, a Likert scale was utilized. The Likert scales are as follows: very low (1), low (2), average (3), high (4), very high (5).

$$n = N/1+N(e)^2 \quad (1)$$

Where n is the sample size required

N is the number of people in the population

e is the allowable error

Substitute numbers in the formula

N= 380

e = 0.05

$380/1 + N(0.05)^2 = 195$

Rating scale was used to weigh the degree of level of technical factors influencing buildability of building projects. This was done by attaching values of weight to different degrees of responses; 5 = highly significant, 4 = significant, 3 = moderately significant, 2 = insignificant and 1 = highly insignificant. The Summation Weight Value (SWV) was obtained by summing up the product of the total numbers of responses (Frequency) to each variables and the weight attached to each ratings i.e.  $(a \times 5) + (b \times 4) + (c \times 3) + (d \times 2) + (e \times 1)$ . The mean used in the course of computation was also obtained by summing up the SWV and dividing it with the total number of variables. The mean weighted value (MWV) was also obtained by dividing summation weighted value with the total number of responses (NR). The mean weighted value was used to explain the dominance and hierarchy of importance of variables of technical factors influencing buildability of building projects.  $MWV = SWV/NR$ .

### Model Specification

Multiple Regression analysis was used to assess the technical factors influencing buildability of building projects in the study area. The evaluation of relationship between independent and dependent variables were carried out using the multiple regression models. The first step consisted of defining the variables of interest. The variables of buildability of public buildings as independent variables (x), represented by  $x_1, x_2, x_3, x_4, \dots, x_n$ . This was to determine the relationship between technical factors variables and the buildability of public buildings. The dependent variable (y) consists of buildability of public buildings variables which include: team skill, achieving desired quality, completion within time and budget, construction knowledge, corporate objectives, absence of disputes, standardization of component and processes, clients' satisfaction and eliminate perceived problems. The ten (10) variables of buildability factors were summarized into a single composite variable using "Compute Variable" of SPSS. The buildability of building projects (Dependent) variable was however regressed on variables of technical factors (independent variable). The most general form for the model is presented in Equation 2.

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + \dots + b_nx_n + e \quad (2)$$

Where; Y = Dependent variable (Building projects delivered)

a = constant

$x_1, x_2, x_3, \dots, x_n$  are independent variables (Technical factors)

$b_1, b_2, b_3, \dots, b_n$  are the regression coefficients which determines the contribution of the independent variables.

$e$  = residual of stochastic error (which reveals the strength of  $b_1x_1 \dots b_nx_n$ ; if  $e$  is low the amount of unexplained factors will be low and vice versa.

The multiple regression analysis is relevant to this study as it assists in predicting, making inferences, testing the hypotheses and modeling the relationships between the variables. To determine the weight of each of the components/factors of technical, reference is made to the regression coefficients. Using the standardized beta coefficients, the constant “ $a$ ” would disappear (Ronald *et al.*, 1983) and the regression equation is of the form presented in Equation 3.

$$Y = a + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5 + b_6x_6 + b_7x_7 + b_8x_8 + b_9x_9 + b_{10}x_{10} + e \quad (3)$$

Where  $X_1$  = Conformance to specification

$X_2$  = Sequencing of work according to schedule

$X_3$  = Achievable and appropriate tolerance modularization

$X_4$  = Flexibility in design

$X_5$  = Dimensional coordination

$X_6$  = Appropriate construction technique

$X_7$  = Suitability of materials

$X_8$  = Realistic schedule

$X_9$  = Quality of works to match standard

$X_{10}$  = Adequacy of plans and specifications

### 3. RESULTS AND DISCUSSION

#### 3.1 Respondents' Profession

Figure 1 shows the distribution of respondents' profession. According to the figure, 11.4%, 30.3% and 26.0% of respondents belong to Architecture, Building Technology and Civil Engineering professions, while the respondents who indicated their profession to be Quantity Surveying, Estate Surveying and other professions accounted for 14.6%, 6.1% and 11.6% respectively. The figure revealed that most of the respondents (30.3%) for this study are builders. This is a clear indication that the respondents are very capable of providing reliable information concerning buildability issues in the study area.

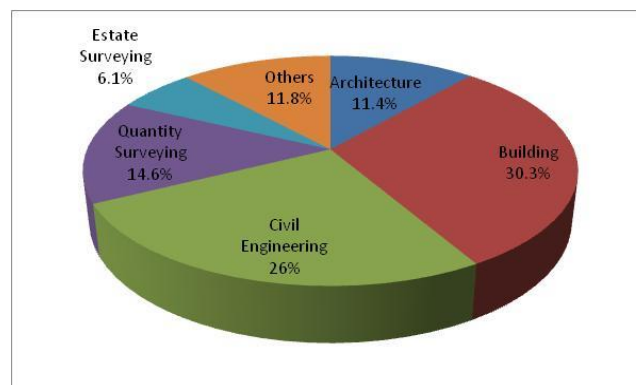
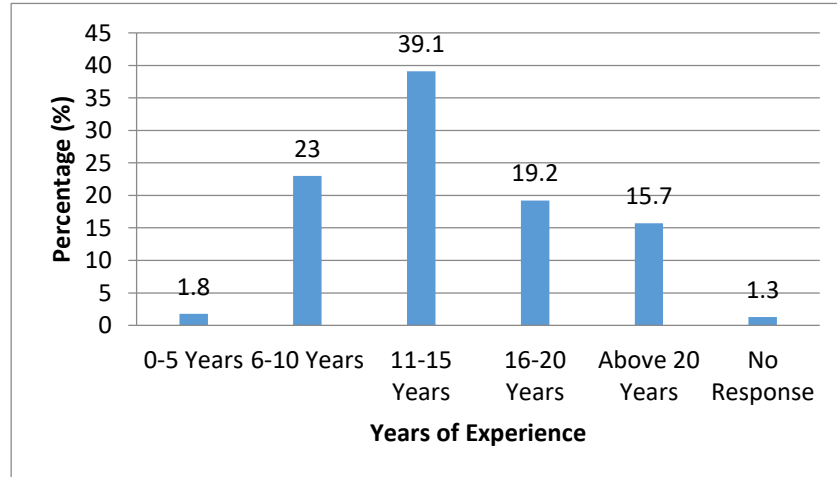


Figure 1: Respondent' Profession

#### 3.2 Years of Professional Work Experience

Figure 2 shows the years of professional work experience of respondents. The data from the figure show that 1.8% of the respondents had 5 years and below, 23.0% and 39.1% of the respondents had between 6-10 years and 11-15 years of work experience while 19.2% and 15.7% of the respondents had 16 years and above 20 years of professional work experience respectively. It was noted that 1.3% of the respondents did

not respond. Therefore, the highest proportion of the respondents (39.1%) had professional work experience of 11-15 years in the study area. This implies that 15 years of professional work experience has contributed to acquiring the rudiments of building projects. This shows that they possess necessary wealth of experience required for the study.



**Figure 2:** Years of Professional Work Experience

### 3.3 Technical Factors Influencing Buildability of Building Projects

Table 1 shows the ratings of technical factors influencing buildability of building projects in Osogbo, Osun State. The mean weighted values of the respondents vary from 4.2234 to 3.6436, thus, all the respondents have different perceptions on the technical factors influencing buildability of building projects in Osogbo. As revealed by the table, the factors: cross discipline coordination (4.2234), simplification of design (4.0701), appropriate construction techniques (3.9871) were ranked 1<sup>st</sup>, 2<sup>nd</sup> and 3<sup>rd</sup>. Furthermore, adequacy of plans and specification (3.7553), conformation to specifications (3.7227), and availability of competent staff (3.6436) were rated moderately significant and ranked in the order of 19<sup>th</sup> 20<sup>th</sup> and 21<sup>st</sup> positions.

Out of all the twenty-one perceived factors raised, it was observed that availability of competent staff, conformation to specifications, adequacy of plans and specification, advanced technology and innovations, have the least mean weighted value and are the least rated technical factors that respondents considered as being trivial in influencing buildability of building projects in Osogbo. This situation therefore requires urgent attention so as to enhance the quality of construction projects and prevent the incidence of building failures in the study area. This is in line with Ayodeji *et al.* (2017) who stated that one of the primary variables affecting the performance quality of construction projects is the use of inexperienced and incompetent trade contractors and construction workers. Argument abound in the literature that non-conformance to specification is also major factors that influences building to give ways untimely (Chapman, 2000; Ede, 2010; LASPPDA, 2011; Ibrahim, 2013). There is no denying in the fact that if building failure is to be avoided, conformance to specification is one of the major factors that is absolutely essential for long lasting building projects. This agrees with Shofoluwe (2013) that reiterated that both the designers and constructors must strictly conform to specifications if building failure must be prevented. Also, adoption of innovation methods of construction will reduce the use of labour on site and increase productivity. This agrees with Franky *et al.* (2011) who identified innovative as a buildability attribute related to the design process that reduces waste and enhances economic use of materials. Moreover, the construction industry is dynamic globally as a result of technological changes. Technology makes construction site safer, workers



are more efficient and more complex projects are tackled. Related to this finding is that of Inno (2014), who claimed that the building sector has been slow to incorporate change into its construction processes. In order to compete, the industry should consider technology as a long-term strategic advantage. Companies that can adopt and embrace technology developments are more likely to succeed in today's competitive business environment.

**Table 1:** Technical Factors Influencing Buildability of Building Projects

S/N	Technical Factors	Ranking					NR (f)	SWV	MWV	Rank
		5	4	3	2	1				
1	Cross discipline coordination	940	556	129	30	9	394	1664	4.2234	1 <sup>st</sup>
2	Simplification of design	725	616	192	24	10	385	1567	4.0701	2 <sup>nd</sup>
3	Appropriate construction techniques	735	572	171	56	13	388	1547	3.9871	3 <sup>rd</sup>
4	Sequencing of work according to schedule	575	740	192	42	6	391	1555	3.977	4 <sup>th</sup>
5	Flexibility in design	615	632	210	58	4	384	1519	3.9557	5 <sup>th</sup>
6	Suitability of materials	695	564	201	54	12	386	1526	3.9534	6 <sup>th</sup>
7	Availability of materials and labour	625	600	234	50	7	385	1516	3.9377	7 <sup>th</sup>
8	Quality of work to match standards	575	768	219	28	10	392	1540	3.9286	8 <sup>th</sup>
9	Quality of equipment and raw materials	550	676	249	40	6	388	1521	3.9201	9 <sup>th</sup>
10	Realistic schedule	600	668	189	44	15	387	1516	3.9173	10 <sup>th</sup>
11	Dimensional coordination	605	604	246	42	14	389	1511	3.8843	11 <sup>th</sup>
12	Quality assessment system in organization	515	660	213	56	8	375	1452	3.872	12 <sup>th</sup>
13	Achievable and appropriate tolerance	455	776	198	58	6	386	1493	3.8679	13 <sup>th</sup>
14	Modularization	500	724	234	50	9	393	1517	3.8601	14 <sup>th</sup>
15	Realistic cost and time estimate	570	612	270	52	9	392	1513	3.8597	15 <sup>th</sup>
16	Control of sub contractors' work	515	648	261	42	14	387	1480	3.8243	16 <sup>th</sup>
17	Innovations	545	548	285	70	12	388	1460	3.7629	17 <sup>th</sup>
18	Advanced technology	455	680	258	46	17	387	1456	3.7623	18 <sup>th</sup>
19	Adequacy of plans and specification	440	620	303	56	8	380	1427	3.7553	19 <sup>th</sup>
20	Conformance to specification	430	640	246	66	14	375	1396	3.7227	20 <sup>th</sup>
21	Availability of competent staff	465	552	312	74	18	390	1421	3.6436	21 <sup>st</sup>

Mean of  $\sum MWV/n = 81.685/21 = 3.8898$ , Mean Rating: 1- very low, 2- low, 3- moderate, 4- high, 5- very high.

The findings of the Multiple Regression Analysis of the relationship between technical factors and building project buildability are shown in Tables 2 and 3 respectively. Table 3 shows that the relationship between technical factors and buildability of building projects is significant, with an F-value of 20.197 and a P-value of 0.000. Furthermore, as indicated in Table 2, with a correlation coefficient (R) of 0.766 and a coefficient of Multiple Determination ( $R^2$ ) of 0.586, approximately 58.6% of variation in buildability objectives may be attributed to a magnitude change in technical factors. In other words, close to 59% of the variability in observed technical factor is explained by buildability of building projects in the study area. The remaining 41% as observed here is due to other factors that affect buildability of building projects.

**Table 2:** Regression Model Summary for Influence of Technical factor on Buildability of building projects

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.766 <sup>a</sup>	.586	.502	.77079094

a. Predictors: (Constant), Quality of work to match standards, Suitability of materials, Achievable and appropriate tolerance, Sequencing of work according to schedule, Realistic schedule, Conformance to specification, Dimensional coordination, Adequacy of plans and specification, Appropriate construction techniques, Flexibility in design

**Table 3:** Test of Statistical Significance for Influence of Technical factor on Buildability of Building Projects

ANOVA <sup>a</sup>						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	119.994	10	11.999	20.197	.000 <sup>b</sup>
	Residual	161.006	271	.594		
	Total	281.000	281			

a. Dependent Variable: Buildability of Building Projects

b. Predictors: (Constant), Quality of work to match standards, Suitability of materials, Achievable and appropriate tolerance, Sequencing of work according to schedule, Realistic schedule, Conformance to specification, Dimensional coordination, Adequacy of plans and specification, Appropriate construction techniques, Flexibility in design.

### 3.4 Influence of Technical Factors on Number of Building Project Executed

Tables 4, 5, and 6 are the findings of a multiple regression analysis evaluating the relationship between a technical factors and the number of construction projects completed in the study area. Table 5 shows that the association between technical factors and number of completed building projects is significant, with F-value of 20.077 and P-value of 0.000. Furthermore, as indicated in Table 4, with a correlation coefficient (R) of 0.798 and a coefficient of Multiple Determination ( $R^2$ ) of 0.637, about 63.7% of variation in the number of building projects completed may be attributed to a magnitude change in technical factors. In other words, close to 64% of the variability in observed technical factor is explained by number of building project executed in the study area. The remaining 36% as observed here may be due to other factors that affect building project execution like corruption, poor quality material, poor funding among others, which were not capture in the model.

**Table 4:** Regression Model Summary for Influence of Technical factor on number of building project executed

Model Summary				
Model	R	R.Square	Adjusted R. Square	Std. Error of the Estimate
1	.798 <sup>a</sup>	.637	.326	.87822248

a. Predictors: (Constant), Quality of work to match standards, Suitability of materials, Realistic schedule, Sequencing of work according to schedule, Achievable and appropriate tolerance, Flexibility in design, Conformance to specification, Dimensional coordination, Appropriate construction techniques, Adequacy of plans and specification

**Table 5:** Test of Statistical Significance for Influence of Technical factor on number of building project executed

ANOVA <sup>a</sup>						
Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	154.845	10	15.485	20.077	.000 <sup>b</sup>
	Residual	296.169	384	.771		
	Total	451.015	394			

a. Dependent Variable: Number of building project executed

b. Predictors: (Constant), Quality of work to match standards, Suitability of materials, Realistic schedule, Sequencing of work according to schedule, Achievable and appropriate tolerance, Flexibility in design, Conformance to specification, Dimensional coordination, Appropriate construction techniques, Adequacy of plans and specification.

The regression coefficients of each of the technical factors were used to calculate their weight, as indicated in Table 6. The constant "a" disappears when using standardized beta coefficients and the regression equation 3 becomes:

$$Y \text{ (i.e. number of building project executed)} = 0.126x_1 - 0.032x_2 + 0.093x_3 - 0.184x_4 - 0.044x_5 - 0.158x_6 + 0.012x_7 + 0.028x_8 + 0.122x_9 - 0.0480x_{10} + e \quad (4)$$

The regression coefficients for factors 1 to 10, as obtained from Table 6 are 0.126, 0.032, 0.093, - 0.184, - 0.044, - 0.158, 0.012, 0.028, 0.122, and 0.0480 respectively. This shows that factor 9 (quality of works to match standard) is of more effect. Closely followed to factor 9 is factor 1 (conformance to specification) than the remaining factors, while factor 4 (flexibility in design) is of less effect in explaining number of building project executed in the study area. Besides, with P-values of 0.00, 0.005 and 0.012 for factor 9, factor 1 and factor 4, it is observed that they have significant relationship with number of building project executed in terms of efficient and effective buildability success in the study area. Furthermore, the result of regression coefficient also implies that for a one unit change in technical factor of "Quality of Works to Match Standard", number of building project executed will change with a unit of 0.480. Concerning a one unit change in conformance to specification, achievable and appropriate tolerance modularization, flexibility in design, dimensional coordination, appropriate construction technique, suitability of materials, realistic schedule, quality of works to match standard, adequacy of plans and specifications; Number of building project executed will change with a units of 0.0126, 0.032, 0.093, - 0.184, - 0.044, - 0.158, 0.012, 0.028, and 0.122 respectively in the study area. This is in agreement with Whole Building Design Guide (2017) that stated that it is very essential to establish the qualities of the projects that are necessary to satisfy clients and end-users needs and expectations. Ibrahim (2013) also opined that if building failure is to be avoided, conformance to specification is one of the major factors that is absolutely essential for a long lasting building projects.

**Table 6:** Regression Coefficients for Influence of Technical factor on number of building project executed

Model		Coefficients <sup>a</sup>		Standardized Coefficients Beta	T	Sig.
		Unstandardized Coefficients B	Std. Error			
1	(Constant)	-.020	.049		-.413	.680
	Conformance to specification	.131	.046	.126	2.830	.005
	Sequencing of work according to schedule	-.050	.067	-.032	-.738	.461
	Achievable and appropriate tolerance	.126	.059	.093	2.125	.034
	Flexibility in design	-.207	.054	-.184	-3.823	.000
	Dimensional coordination	-.054	.056	-.044	-.955	.340
	Appropriate construction techniques	-.150	.045	-.158	-3.314	.001
	Suitability of materials	.016	.056	.012	.289	.773
	Realistic schedule	.034	.053	.028	.648	.518
	Adequacy of plans and specification	.128	.051	.122	2.530	.012
	Quality of work to match standards	.416	.045	.480	9.270	.000

a. Dependent Variable: Number of building project executed



#### 4. CONCLUSION

This study assessed the technical factors influencing project delivery in Osogbo, Osun State Nigeria with a view to enhance the quality of building projects delivery. The findings revealed that technical factors like: availability of competent staff, conformation to specification among others were not highly rated in the study area. Furthermore, there is a strong link between technical factors and building projects buildability. Likewise, a substantial relationship was identified between technical factors and the number of projects completed. The study concluded that there is significant relationship between the technical factors and buildability of building projects. It is recommended that professionals should always comply with all specifications outlined in the contract documents and adopt appropriate constructional techniques to produce a long lasting building projects. Also, projects' team leaders should always display skills capable of ensuring project success, respond to problems in a timely manner and create good communication among projects' team so as to achieve project buildability.

#### References

- Aina, O. and Wahab, A. (2011). Assessment of Buildability Problems in the Nigerian Construction Industry. *Global Journal of Research Engineering*, 11 (2): 1-11.
- Aina, O. (2015). Buildability Problems in Construction Projects in Nigeria - Causes and Impacts. *European Scientific Journal*, 11(27): 353-366.
- Amade, B., Akpan, E. and Okon, P. (2017). Investigation of the Effects of Cost Overrun Factors on Project Delivery Methods in Nigeria. *Project Management Journal*, 6(2): 1-28.
- Ayodeji, E. A., Clinton O. and Ernest, D. (2017). Quality Performance of Infrastructure Developments in Swaziland. *Proceeding of 6th International Conference on Infrastructure Development in Africa*, 21-29.
- Bamidele, E. and Olamoju, A. (2017). An Evaluation of Impact of Buildability Assessment on Real Estate Investment. *Journal of Engineering Research and Application*, 7 (10): 35-40.
- Franky W., Patrick T., Edwin H. and Francis, K. (2011). Factors Affecting Buildability of Building Designs. *Canadian Journal of Civil Engineering*, 33 (7): 795-806
- Ibrahim, R. B. (2013). Monumental Effects of Building Collapse in Nigerian Cities: The Case of Lagos Island, Nigeria. *Basic Research Journal of Engineering Innovation*, 1(2): 26-31.
- James, H. (2013). Enhancing Buildability through Improving Design-Construction Feedback Loops within Complex Projects. A Doctoral Thesis Submitted to Loughborough University.
- LASPPDA (Lagos State Physical Planning Development Authority) (2011). List of Collapsed Building from 1978 to 2011 in Lagos State.
- Li, Y. and Taylor, T. (2011). The Impact of Design Rework on Construction Project Performance. *Proceedings of 29<sup>th</sup> International Conference of the System Dynamics Society, Washington DC*, 1-15.
- Mohammed, A. and Ghaffar, A. (2014). Buildability Concept Influencing Quality of Building During Design Process in UNRWA Projects. MSc thesis is submitted to Islamic University, Gaza.
- Osuizugbo, I. (2019). Project Failure Factors Affecting Building Project Success In Nigeria; Design and Construction Phase. *IOSR Journal of Mechanical and Civil Engineering*, 16(1): 205- 213.
- Othman, A. (2011). Improving Buildability Performance through Integrating Constructability in the Design Process. *Organization, Technology and Management in Construction*, Pp 333-347.
- Shofoluwe, M., Ofori-Boadu, A., Waller, L. and Bock-Hyeng, C. (2013). Quality Improvement Practices of Award-Winning Residential Builders and Housing Developments. *International Journal of Industrial Engineering and Production Research*, 23(1): 7-12.
- Tijani, M. A. and Ajagbe W. O. (2016). Professionals View on the Causes and Effects of Construction Projects Abandonment in Ibadan Metropolis, Nigeria. *Ethopian Journal of Environmental Studies and Management*, 9 (5): 593 – 603.
- Whole Building Design Guide (2017): Project Planning, Delivery, and Controls. Project Management Committee. Accessed on 5 July 2017 at <https://www.wbdg.org>
- Wong, W., Lam, T., Chan, H., Wong, K. (2006). Factors Affecting Buildability of Building Designs. *Canadian Journal Civil Engineering*. 33: 795–806.