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Statistical Analysis of the Level of Awareness and Implementation of Quality Control Checklist Indices in the Nigerian Construction Industry

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Abstract: *Compliance is the most important measure of quality during the building production process using the checklist. One of the most important problems is the determination of the critical variables among the competing array of variables included in the checklist for quality control. Using field survey design, strucured questionnaire was administered to relevant professionals and stakeholders in the built environment. Data collected from the field survey were subjected to analysis. The computed Peason r in the implementation of checklist component was found to be 0.086 signifying weak association. The coefficient of determination r^2 is 0.07 which means 7 percent. The graph of the line of best fit reveals that only 19 variables are critical checklist components with a symbolic model represented as $y = 0.257x + 7.854$. As a panacea, the study recommended the use of quality control checklist and manuals in addition to greater advocacy by government and professional bodies to increase the level of awareness on the checklist document. The critical component of the quality control checklist variables will enhance the preparation of a typical framework for quality management of public building projects. The quality management framework developed for building project will in the long run reduce the cost of maintenance of public buildings and the incident of building collapse.*

***Keywords**: Checklist, compliance, quality control, quality management, building project, correlation,variables.*

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I. Introduction

Construction projects are usually designed to have a lifespan after which a certain degree of rehabilitation or re-construction occurs. The lifespan, commonly referred to as the design period, varies from project to project. For instance, buildings, as well as flexible and rigid road pavements are designed for a lifespan of 50 years, 15 years and 25 years respectively. Such can only be guaranteed if the projects are constructed strictly to the required specified quality standard Omotosho (2014).

Building projects in Nigeria are most of the time not completed within specifications. These constructed facilities begin to suffer infrastructure decay within months of commissioning despite their huge capital investments. Paradoxically, despite the fact that construction constitutes such a significant part of the developmental efforts, building project quality has always been ignored in the country. The actual design of all buildings are controlled by various codes of practice which often specify the step-by-step procedures to be followed in combining the various materials that will be involved in the project to achieve set objectives.

Defects or failure in constructed facilities can result in very large costs. Even with minor defects, re-construction or re-working may be required and facility operations impaired,failure may cause personal injuries or fatalities. The quality of a building project depends upon the appropriate application of materials, men, machines and construction conditions. The systematic control of these factors is the essence of quality control.

Good construction managers try to ensure that the job is properly handled the first time through quality control in the production process. The task before the construction manager during the construction phase of project development is therefore to ensure conformance with requirements already set at the design stage. The first of the requirements is to ensure that all physical construction work on site comply with working drawings and specifications. Most construction managers do not have control channels that will enable all other consultants (Engineers, Architects, Builders and Quantity Surveyors) to carry out their respective roles towards the achievement of specified quality standard at first attempt.

A checklist is a structured tool usually used to verify that a set of required steps has been performed. Many organizations do not have checklists available to ensure consistency in frequently performed tasks. The extent to which the constituents of quality control checklist are utilized in the appraisal of quality control tests in public building projects seem to be a mirage and needs to be investigated. The investigation will establish the correlation between compliance and awareness of government regulatory policies on quality control. The application of checklist will however, result in effective quality control in public building projects.

II. Methodology

Administration Of Questionnaire

Basically a survey research was adopted in this work. the mix method approach was adopted and data for the study was generated through questionnaire, personal interview and observations.

The questionnaire was structured in three sections. Section 'A' and section 'B' section 'A' was the classification section which seek information about respondents background such as area of specialization, years of professional practice. Section 'B' was on the assessment of awareness and implementation of building project quality control checklist. The questionnaire were administered to respondents on person to person basis. This enhanced the rate of return and secured other advantages of the method. Field assistants were used to reach the respondents in their different locations. 900 copies of the questionnaire were distributed in the south east states of Nigeria namely; Abia, Anambra, Ebonyi, Enugu and Imo States. The major actors in the population include Architects, Engineers, Builders, Quantity surveyors, Contractors, Clients and Financiaciers of public building projects.

Scaled questions were used in the assessment of awareness and implementation of building project quality control checklist. Eight different sections of the building project were acceded which amounted to 62 variables. Respondents were required to rank the degree of awareness and implementation of quality control checklist on public building projects.

The assessment of variables were carried out using the likert 5 point weighting as follows very high as 2, high as 1, undecided as 0, low as -1 and very low as -2. Respondents were required to tick the variables according to the degree of implementation and the level of awareness of the variables.

Data Analysis Techniques

The mean score (index) was used to establish the level of importance attached to each of the variable. Two – tailed t-test at n-1 degrees of freedom was used to assess the awareness level of the quality control checklist and the implementation level. The variables were subjected to a regression analysis and analysis of variance model.

Mean score numerical values were assigned to each of the statement that describes the variable being investigated in order to measure the intensity of agreement by the respondents. The mean score for each item was determined from the scores and the number or frequency of responses for each score. The mean score (M.S) is mathematically represented as

$$\text{Mean score (M.S)} = \frac{\sum aixi}{N} \quad (-2 \leq MS \leq 2)$$

Where

MS is the mean score

ai – the respective weighting of the factors (2,1,0, -1 and -2)

xi – the number of respondent for each weighting

N – the total number of respondents

∑ – capital Greek sigma which means summation, that is the sum of.

The weighted average formula was used in assessing respondent ranking of importance. The weighted average for each of the variables was obtained from the sum of the product of the proportion of the responses received from each group compared to the total number of receipts (n/N) and the corresponding mean score of that group in respect of individual variable. The weighted average is given as

$$WA = \sum \left[\left(\frac{n}{N} \right) \times MS \right] \quad \left(-2 \leq WA \leq 2 \right)$$

The decision rule will depend on whether the computed value of the test statistic t at 95 percent level of significance is greater than or less than the critical value. Thus the null hypotheses Ho will be rejected if $t_{cal} > t_{tab}$

Simple Regression Analysis: The basic relationship between the independent variable, represented by x and the dependent variable represented by y is expressed in a mathematical equation given as:

$Y = a + bx$

where

Y – is the dependent variable is quantity being predicted.

x – the independent variable

a – the value of y when x = 0 ie the intercept of the line with y– axis
b – the slope or gradient. It estimates the rate of change in y for a unit change in x.
It is positive for direct and negative for inverse relationships. It represents the regression line of y on x when graphed.

The mathematical relationships for the determination of the parameters 'a' and 'b' in the regression equation is given as

$$b = \frac{\Sigma xy}{\Sigma x^2}$$

$$a = \bar{y} - b\bar{x}$$

The correlation r is determined by

$$r = b\frac{\sqrt{\Sigma x^2}}{\sqrt{\Sigma y^2}}$$

The regression analysis function of the SPSS was employed. The significance of the awareness and compliance on quality control checklist was tested at 5 percent level of significance.

Analysis Of Variance (Anova)

The calculated F-value was used for finding out the significance of difference between the two variances by comparing it with the table value of F. If the F – calculated is greater than F – tabulated, it will be concluded that there are no significant difference between the sample means.
The decision rule was

- If the probability (P-value) of the test statistic is greater than critical value, reject H_0 and accept H_1
- If the probability of the test statistic (P-value) is less than critical value, accept H_0 and reject H_1

Evaluation of Results: The results were evaluated using coefficient of correlation, r; the coefficient of determination, r^2 and the analysis of variance F – using the SPSS.

III. Results And Discussions

The data in table 1 showed that 730 responded to the questionnaire out of the 900 distributed representing 81.1 percent.

Table 1: Spread of Respondents

Profession	**Number**	**Percentage**
Architect	195	26.7
Builder	104	14.3
Civil Engineer	185	25.3
Contractor	84	11.5
Project manager	55	7.5
Quantity surveyor	107	14.7
Total	**730**	**100**

The awareness/knowledge of the existence of public building quality control checklist has no significant effect on the implementation of quality control checklist on public buildings in south-eastern states of Nigeria. This hypothesis wants to determine if the knowledge of the existence of public building quality control checklist has any effect or relationship with the implementation of such checklist variables in the public building projects in the south eastern states of Nigeria.

The reactions of the 730 respondents to the 62 variables of the checklist were subjected to a two-tailed t-test at 729 degrees of freedom. It is hypothesized that knowledge of the existence of public building quality control checklist is low. The computerized analysis is shown in Table 2 and Table 3 for awareness level of quality control checklist indices, while the computerized analysis is shown in Table 4 and 5 for implementation level of quality control checklist.

Table 2: One-Sample Statistics of Awareness Level of Quality Control Checklist Indices

S/N	N	Mean	Std. Deviation	Std. Error Mean
C1	730	1.679	.6252	.0231
C2	730	1.221	1.1650	.0431
C3	730	1.619	.7106	.0263
C4	730	1.422	.8081	.0299
C5	730	1.570	.7095	.0263

C6	730	1.611	.6824	.0253
C7	730	1.660	.5313	.0197
C8	730	1.410	.8800	.0326
C9	730	1.600	.6363	.0236
C10	730	1.532	.8362	.0310
C11	730	1.321	1.0968	.0406
C12	730	1.551	.8483	.0314
C13	730	1.490	.7430	.0275
C14	730	1.379	.9251	.0342
C15	730	1.460	.8915	.0330
C16	730	1.610	.6705	.0248
C17	730	1.510	.7032	.0260
C18	730	1.590	.6506	.0241
C19	730	1.530	.6196	.0229
C20	730	1.440	.9854	.0365
C21	730	1.430	.9551	.0353
C22	730	1.526	.8623	.0319
C23	730	1.573	.6227	.0230
C24	730	1.555	.7011	.0259
C25	730	1.603	.6675	.0247
C26	730	1.364	1.0055	.0372
C27	730	1.377	.7938	.0294
C28	730	1.521	.7538	.0279
C29	730	1.590	.6693	.0248
C30	730	1.574	.8136	.0301
C31	730	1.421	.9924	.0367
C32	730	1.360	1.0022	.0371
C33	730	1.608	.7425	.0275
C34	730	1.010	1.2378	.0458
C35	730	1.423	.9074	.0336
C36	730	1.208	1.0977	.0406
C37	730	1.442	.7125	.0264
C38	730	1.367	.9352	.0346
C39	730	1.363	.7916	.0293
C40	730	1.604	.8153	.0302
C41	730	1.012	1.3151	.0487
C42	730	1.425	1.0306	.0381
C43	730	1.138	1.1612	.0430
C44	730	1.185	1.1440	.0423
C45	730	1.089	1.2826	.0475
C46	730	1.351	1.0438	.0386
C47	730	1.307	.9232	.0342
C48	730	1.670	.5561	.0206
C49	730	1.278	.8659	.0320
C50	730	1.160	1.0077	.0373
C51	730	1.019	1.2678	.0469
C52	730	1.252	1.0590	.0392
C53	730	1.385	.9721	.0360
C54	730	1.318	.9119	.0338
C55	730	1.577	.7876	.0292
C56	730	1.664	.5771	.0214
C57	730	1.660	.5877	.0217
C58	730	1.596	.7479	.0277
C59	730	1.623	.7728	.0286

C60	730	1.508	.8449	.0313
C61	730	1.597	.7459	.0276
C62	730	1.441	1.0034	.0371

Source: Author's Analysis of Field Data

TABLE 3: One-Sample Test of Awareness Level of Quality Control Checklist Indices

	Test Value = 0					
					95% Confidence Interval of the Difference	
S/N	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
C1	.525	729	.600	.02055	-.0563	.0974
C2	1.618	729	.106	.06301	-.0134	.1395
C3	.984	729	.325	.05479	-.0545	.1641
C4	.628	729	.530	.02466	-.0525	.1018
C5	23.609	729	.000	1.06027	.9721	1.1484
C6	26.087	729	.000	1.18356	1.0945	1.2726
C7	.870	729	.384	.03425	-.0430	.1115
C8	.862	729	.389	.04795	-.0612	.1571
C9	.698	729	.485	.02740	-.0496	.1044
C10	1.039	729	.299	.04384	-.0390	.1266
C11	26.423	729	.000	1.17123	1.0842	1.2583
C12	.349	729	.727	.01370	-.0633	.0907
C13	29.270	729	.000	1.18082	1.1016	1.2600
C14	.311	729	.756	.01233	-.0655	.0902
C15	1.030	729	.303	.05753	-.0521	.1672
C16	22.789	729	.000	1.03151	.9426	1.1204
C17	1.139	729	.255	.04795	-.0347	.1306
C18	25.141	729	.000	1.11918	1.0318	1.2066
C19	.664	729	.507	.02603	-.0510	.1030
C20	.959	729	.338	.05342	-.0560	.1628
C21	1.439	729	.151	.05616	-.0205	.1328
C22	22.564	729	.000	1.03562	.9455	1.1257
C23	21.722	729	.000	1.00274	.9121	1.0934
C24	1.008	729	.314	.03973	-.0376	.1171
C25	.766	729	.444	.03014	-.0471	.1074
C26	.912	729	.362	.05068	-.0585	.1598
C27	.801	729	.424	.03151	-.0458	.1088
C28	32.248	729	.000	1.31370	1.2337	1.3937
C29	1.264	729	.207	.04932	-.0273	.1259
C30	.803	729	.423	.03151	-.0456	.1086
C31	1.198	729	.231	.04658	-.0298	.1229
C32	.840	729	.401	.03288	-.0440	.1097
C33	1.074	729	.283	.04247	-.0351	.1201
C34	1.336	729	.182	.05205	-.0244	.1286
C35	1.155	729	.249	.04521	-.0316	.1221
C36	24.579	729	.000	1.10137	1.0134	1.1893
C37	38.944	729	.000	1.34247	1.2748	1.4101
C38	39.496	729	.000	1.36712	1.2992	1.4351
C39	1.312	729	.190	.05205	-.0259	.1300
C40	.734	729	.463	.02877	-.0481	.1057
C41	1.044	729	.297	.04110	-.0362	.1184
C42	30.056	729	.000	1.30137	1.2164	1.3864
C43	1.111	729	.267	.04384	-.0336	.1213
C44	.736	729	.462	.02877	-.0479	.1055
C45	.940	729	.348	.03699	-.0403	.1142

C46	34.963	729	.000	1.35068	1.2748	1.4265
C47	.901	729	.368	.03562	-.0420	.1132
C48	1.075	729	.283	.04247	-.0351	.1200
C49	24.624	729	.000	1.03014	.9480	1.1123
C50	.807	729	.420	.03151	-.0451	.1081
C51	1.252	729	.211	.04932	-.0280	.1267
C52	.938	729	.349	.03699	-.0405	.1144
C53	1.384	729	.167	.05479	-.0229	.1325
C54	27.522	729	.000	1.15890	1.0762	1.2416
C55	.971	729	.332	.03836	-.0392	.1159
C56	22.750	729	.000	.97808	.8937	1.0625
C57	22.201	729	.000	.95890	.8741	1.0437
C58	1.250	729	.212	.04932	-.0281	.1268
C59	.832	729	.406	.03288	-.0447	.1105
C60	.766	729	.444	.03014	-.0471	.1074
C61	.911	729	.362	.03562	-.0411	.1124
C62	29.264	729	.000	1.28082	1.1949	1.3667

Source: Author's Analysis of Field Data

TABLE 4: One-Sample Statistics of Implementation of Building Project Quality Control Indices

	N	Mean	Std. Deviation	Std. Error Mean
C1	730	.0205	1.05714	.03913
C2	730	.0630	1.05220	.03894
C3	730	.0548	1.50436	.05568
C4	730	.0247	1.06159	.03929
C5	730	1.0603	1.21341	.04491
C6	730	1.1836	1.22581	.04537
C7	730	.0342	1.06326	.03935
C8	730	.0479	1.50232	.05560
C9	730	.0274	1.06022	.03924
C10	730	.0438	1.13951	.04218
C11	730	1.1712	1.19762	.04433
C12	730	.0137	1.05920	.03920
C13	730	1.1808	1.09000	.04034
C14	730	.0123	1.07145	.03966
C15	730	.0575	1.50881	.05584
C16	730	1.0315	1.22294	.04526
C17	730	.0479	1.13754	.04210
C18	730	1.1192	1.20278	.04452
C19	730	.0260	1.05961	.03922
C20	730	.0534	1.50578	.05573
C21	730	.0562	1.05455	.03903
C22	730	1.0356	1.24009	.04590
C23	730	1.0027	1.24722	.04616
C24	730	.0397	1.06435	.03939
C25	730	.0301	1.06274	.03933
C26	730	.0507	1.50223	.05560
C27	730	.0315	1.06334	.03936
C28	730	1.3137	1.10067	.04074
C29	730	.0493	1.05424	.03902
C30	730	.0315	1.06076	.03926
C31	730	.0466	1.05045	.03888
C32	730	.0329	1.05748	.03914
C33	730	.0425	1.06811	.03953
C34	730	.0521	1.05280	.03897
C35	730	.0452	1.05767	.03915

C36	730	1.1014	1.21066	.04481
C37	730	1.3425	.93138	.03447
C38	730	1.3671	.93522	.03461
C39	730	.0521	1.07217	.03968
C40	730	.0288	1.05825	.03917
C41	730	.0411	1.06366	.03937
C42	730	1.3014	1.16987	.04330
C43	730	.0438	1.06612	.03946
C44	730	.0288	1.05565	.03907
C45	730	.0370	1.06316	.03935
C46	730	1.3507	1.04378	.03863
C47	730	.0356	1.06772	.03952
C48	730	.0425	1.06682	.03948
C49	730	1.0301	1.13029	.04183
C50	730	.0315	1.05427	.03902
C51	730	.0493	1.06460	.03940
C52	730	.0370	1.06574	.03944
C53	730	.0548	1.06947	.03958
C54	730	1.1589	1.13769	.04211
C55	730	.0384	1.06762	.03951
C56	730	.9781	1.16160	.04299
C57	730	.9589	1.16697	.04319
C58	730	.0493	1.06588	.03945
C59	730	.0329	1.06780	.03952
C60	730	.0301	1.06274	.03933
C61	730	.0356	1.05609	.03909
C62	730	1.2808	1.18254	.04377

Source: Author's Analysis of Field Data

TABLE 5: One-Sample Test of implementation of Building Project Quality Control Management Indices

	Test Value = 0					
					95% Confidence Interval of the Difference	
	t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
C1	.525	729	.600	.02055	-.0563	.0974
C2	1.618	729	.106	.06301	-.0134	.1395
C3	.984	729	.325	.05479	-.0545	.1641
C4	.628	729	.530	.02466	-.0525	.1018
C5	23.609	729	.000	1.06027	.9721	1.1484
C6	26.087	729	.000	1.18356	1.0945	1.2726
C7	.870	729	.384	.03425	-.0430	.1115
C8	.862	729	.389	.04795	-.0612	.1571
C9	.698	729	.485	.02740	-.0496	.1044
C10	1.039	729	.299	.04384	-.0390	.1266
C11	26.423	729	.000	1.17123	1.0842	1.2583
C12	.349	729	.727	.01370	-.0633	.0907
C13	29.270	729	.000	1.18082	1.1016	1.2600
C14	.311	729	.756	.01233	-.0655	.0902
C15	1.030	729	.303	.05753	-.0521	.1672
C16	22.789	729	.000	1.03151	.9426	1.1204
C17	1.139	729	.255	.04795	-.0347	.1306
C18	25.141	729	.000	1.11918	1.0318	1.2066
C19	.664	729	.507	.02603	-.0510	.1030

C20	.959	729	.338	.05342	-.0560	.1628
C21	1.439	729	.151	.05616	-.0205	.1328
C22	22.564	729	.000	1.03562	.9455	1.1257
C23	21.722	729	.000	1.00274	.9121	1.0934
C24	1.008	729	.314	.03973	-.0376	.1171
C25	.766	729	.444	.03014	-.0471	.1074
C26	.912	729	.362	.05068	-.0585	.1598
C27	.801	729	.424	.03151	-.0458	.1088
C28	32.248	729	.000	1.31370	1.2337	1.3937
C29	1.264	729	.207	.04932	-.0273	.1259
C30	.803	729	.423	.03151	-.0456	.1086
C31	1.198	729	.231	.04658	-.0298	.1229
C32	.840	729	.401	.03288	-.0440	.1097
C33	1.074	729	.283	.04247	-.0351	.1201
C34	1.336	729	.182	.05205	-.0244	.1286
C35	1.155	729	.249	.04521	-.0316	.1221
C36	24.579	729	.000	1.10137	1.0134	1.1893
C37	38.944	729	.000	1.34247	1.2748	1.4101
C38	39.496	729	.000	1.36712	1.2992	1.4351
C39	1.312	729	.190	.05205	-.0259	.1300
C40	.734	729	.463	.02877	-.0481	.1057
C41	1.044	729	.297	.04110	-.0362	.1184
C42	30.056	729	.000	1.30137	1.2164	1.3864
C43	1.111	729	.267	.04384	-.0336	.1213
C44	.736	729	.462	.02877	-.0479	.1055
C45	.940	729	.348	.03699	-.0403	.1142
C46	34.963	729	.000	1.35068	1.2748	1.4265
C47	.901	729	.368	.03562	-.0420	.1132
C48	1.075	729	.283	.04247	-.0351	.1200
C49	24.624	729	.000	1.03014	.9480	1.1123
C50	.807	729	.420	.03151	-.0451	.1081
C51	1.252	729	.211	.04932	-.0280	.1267
C52	.938	729	.349	.03699	-.0405	.1144
C53	1.384	729	.167	.05479	-.0229	.1325
C54	27.522	729	.000	1.15890	1.0762	1.2416
C55	.971	729	.332	.03836	-.0392	.1159
C56	22.750	729	.000	.97808	.8937	1.0625
C57	22.201	729	.000	.95890	.8741	1.0437
C58	1.250	729	.212	.04932	-.0281	.1268
C59	.832	729	.406	.03288	-.0447	.1105
C60	.766	729	.444	.03014	-.0471	.1074
C61	.911	729	.362	.03562	-.0411	.1124
C62	29.264	729	.000	1.28082	1.1949	1.3667

Source: Author’s Analysis of Field Data

The last column of Table 5 indicates that for all the 62 variables, the t-statistics are below the critical value of 1.645 at 95 percent significance level. Consequently, the null hypothesis is accepted and so it is affirmed that the respondents have low knowledge of the existence of most of the checklist variables. It needs to be emphasized here that knowledge of the existence of the checklist parameters is a prelude to their eventual implementation.

In order to assess the level of implementation or application of the checklist variables in public building quality control, the data under review were subjected to a regression analysis using Pearson's Product Moment Correlation Coefficient Model, simply referred to as Pearson's r. The dependent variable y is the implementation of public building quality control checklist while awareness or knowledge of the existence of public building quality control checklist is the independent variable. The computed Pearson's r is found to be 0.086. The result is indicative of positive correlation symbolizing that increase in knowledge of quality control brings about a corresponding increase in the implementation of those parameters in the checklist for public building quality control in the South-eastern states of Nigeria. However, the magnitude of the association is very low. Pearson's r of 0.5 and above is rated high, 0.3 to 0.499 is termed moderate 0.1 to 0.299 is said to be weak relationship and below 0.1 is referred to as very weak relationship. Consequently, a correlation coefficient of 0.086 as in this case signifies very weak association. This can be interpreted to mean that the existence of checklist does not impact much on the professionals' implementation of public building quality management.

To assess the contribution of the knowledge of the existence of quality control checklist, the coefficient of determination, r^2, is computed. The result is 0.07. This means that knowledge of the existence of quality management of public building checklist accounts for only 7 percent of what building practitioners consider while implementing public building projects. The residual of 93 percent is overwhelming and is indicative of the negligence accorded the quality control checklist in public building projects. Here may be an explanation why some public buildings collapse or are not durable.

To ascertain the reliability or otherwise of the Pearson's r statistics, the students' t-test is used for the analysis. Students' t-test model is defined by:

$$t = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}} \quad \text{at n-2 degrees of freedom}$$

Plugging the data under consideration into this model, the students' t-statistic is computed to be 2.329. A null hypothesis that states that the results are not reliable is set up. Testing at 95 and 99 percent significance levels at 728 degrees of freedom, the critical values at these two levels are 1.645 and 2.326 respectively. Since the t-statistic is greater than the two critical values, it is concluded that the results are reliable and highly reliable. The finding of this analysis in terms of the percentage ratio of the residual should stimulate stakeholders in the building industry to mount a serious campaign of greater awareness of the checklist in order to enhance its implementation of quality management.

To round up the regression analysis, the graph of the linear function of the line of best fit is plotted using the 62 checklist variables in the form of y = mx +c

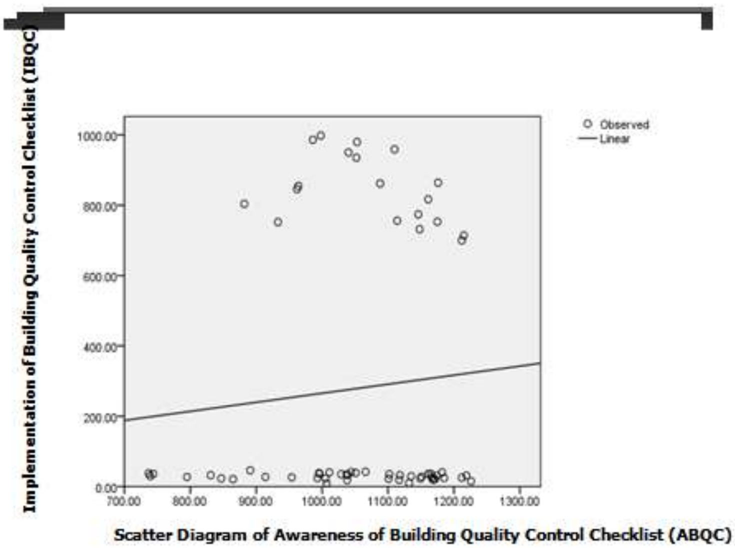

Fig 1: Graph of the line of best fit in the Relationship levels of Awareness and Implementation of Quality Control Checklist

A careful study of the graph reveals that the 19 variables whose t-statistics in Table 4 are in two digit numbers are those above the line of best fit while the remaining 43 variables cluster below the line of best fit. From the graph, a symbolic model represented as y = 0.257x + 7.854 is derived or simply as:
IBQC checklist = 0.257 ABQC checklist + 7.854
The inference from the graph is that only 19 out of 62 checklist parameters are well known by builders and are the ones they are likely well disposed to implement. They variables are:

- Subsoil investigation carried out on proposed site
- Mix design carried out as approved for design mixes
- Timber properly seasoned and treated
- Timber runner properly lapped and nailed
- Formwork material resistant to action of cement and water
- Joint sufficiently tight to prevent leakage of grout and avoid formation of fines and other blemishes
- Formwork braced and strutted to prevent deflection
- Formwork propped sufficiently to prevent deflection
- Excavations and framework made dry prior to placing concrete.
- Spacing of reinforcement in line with the approved drawings and schedules
- Reinforcement steel free from deleterious matter
- Steel reinforcement cut and bent cold
- Blockwork properly tied to structural frames
- Blockwork properly aligned vertically and horizontally
- Finished thickness of rendering adequate
- Rendered walls free of shrinkage cracks
- Rafters and purlins adequately maintain roof profiles
- Slopes and falls of roof frame of designed angle/profile
- Roofing sheets firmly secured to the roof frame.

To investigate further the relationship between the implementation of quality control checklist on public building projects in South-eastern states and the awareness or knowledge of the existence of such checklist, the data are subjected to Analysis of Variance Model. To operationalise this, a null hypothesis that states that there is no significant difference between knowledge of the existence and the implementation of quality control checklist on public building projects in the South-eastern states is set up. After processing the data in an ANOVA model, the F-statistic is found to be 0.449.

TABLE 6: ANOVA OF QUALITY CONTROL CHECKLIST

	Sum of Squares	df	Mean Square	F	Sig.
Regression	66349.967	1	66349.967	.449	.505
Residual	8870058.372	60	147834.306		
Total	8936408.339	61			

The independent variable is Awareness of Building Quality Control Checklist.

From the Statistical Table, the critical value for F at 95 percent significance level at 1 over 60 degrees of freedom, that is, $F(0.05)_{1/60}$ is 4.0. It follows that the critical value is greater than the computed F-statistic, therefore the null hypothesis is accepted. It is therefore affirmed that there is a difference between awareness or knowledge of the existence of quality control checklist and its implementation in public building management in South-eastern states of Nigeria.

IV. Findings

1. There is a positive correlation between the use of quality control checklist and quality control implement.
2. Only 19 variables out of the 62 checklist parameters are well known by the professionals in the study area.
3. Drawing provided and material specifications given, quality control checklist and its usage were low.
4. Quality control supervision of most building projects were with subjective judgments.
5. Adequate regulation and sanctions were not followed by the various state holders in the public building projects.

V. Recommendations

1. Building production stakeholders to provide quality control checklist and approval system for building project monitoring using a developed quality management framework as a guide.

2. The Built Environment Professionals bodies to establish authentic standards relevant and appropriate to local conditions in all aspects of building production.
3. Stakeholders in the building industry to mount serious campaign for greater awareness of the importance of checklist
4. Like most other aspects of construction technology and management, quality control has to be planned. Planning seeks order and a quality control system for a building project reflects this sense of order
5. The building drawings, material specification and bill of Engineering measurement and evaluation (BEME) to be used in the preparation of quality control checklist in building production.
6.

VI. Conclusion

The reactions of the 730 respondents to the 62 variables of the checklist subjected to a two-tailed t-test at 729 degrees of freedom. The null hypothesis was accepted and so it was affirmed that the respondents have low knowledge of the existence of most of the checklist variables. Only 19 variables out of the 62 checklist parameters are the ones they are likely disposed to implement. Consequently, a correlation coefficient of 0.086 signifies very weak association.

The 19 variables established as critical components of the quality control checklist variables will enhance the preparation of a typical framework for quality management of public building projects. The use of the accepted and verified checklist component in the framework will reduce the process time of quality management, reduce the cost of building production and increase the conformity of building projects to the established standards.

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