

AN APPRAISAL OF FACTORS RESPONSIBLE FOR ERRORS IN NIGERIAN CONSTRUCTION DOCUMENTS

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Abstract

The paper presents an empirical study of factors responsible for errors in Nigerian construction documents and aims at identifying the significant factors that are responsible for errors in the Nigerian construction documents. Information was obtained from both consultants (the producers of construction documents) and contractors (the user of construction documents) for the purpose of comparing the significant factors identified by the two sets of respondents. Out of the two hundred and sixty questionnaires administered, eighty six were retrieved and used for the analysis of the study. The statistical methods used for analysis are frequencies, percentages and mean item scores. The findings of the research show that while the contractors agreed that the consultants and management are the main factors responsible for errors in the Nigerian construction documents, the consultants agreed that the management and clients are the main factors responsible for them. However, the collective agreement of the consultants and contractors was that the consultants and management are the main factors responsible for errors in the Nigerian construction documents. The study concludes that the consultants and management are the main factors responsible for errors in the Nigerian construction documents and that they were just not willing to blame themselves for the misfortunes of Nigerian construction documents, hence they blame clients and management before themselves. The recommendation of the study is that to prevent and reduce errors in Nigerian construction documents, the significant factors that fall under the category of consultants and management need to be avoided when preparing construction documents.

Key words: Construction documents, Consultants/designers, Contractors, Errors, Nigeria

Introduction

In almost all countries, the construction industry has underperformed when compared with industries like manufacturing (Wan *et al.*, 2006). The reason for this situation is most likely to be due to consultants' errors which are mostly noticed in the construction documents of proposed projects and at the construction stages rather than the design stages. Design, according to Love *et al.* (2008) is a complex, challenging and creative process that is often driven by personal motivation coupled with the desire to satisfy clients' needs. It is also the personal need to satisfy creative desire which is restrained within the confines of what is possible in the architectural and engineering process by economic constraint. The National Building Code (2006) however defined construction documents as contract drawings, schedules and specifications prepared by registered architects and registered engineers; priced bill of quantities prepared by registered quantity surveyors; quality management plan.

construction programme and project health and safety plan prepared by registered builders; conditions of contract and all-risk insurance for building works, personnel and equipment.

Error is an unsafe act and procedural violations of people at the sharp end (Reason, 2006). Unintended deviations from correct and acceptable practice that are avoidable (Love *et al.*, 2008). Deviation from a code of behaviour; an act involving an unintentional deviation from truth or accuracy; an act that through ignorance, deficiency, or accident fails to achieve what should be done (The Webster's New encyclopaedic dictionary (1996) cited in Rauterberg and Felix (1996). Rooney, *et al.*, (2002) defined error as any human action that exceeds the tolerances defined by the system with which the human interacts while Love and Josephson (2004) defined it as a deviation from what is intended and caused by human action.

Researchers (Norman, 1983; Palaneeswaran, *et al.*, 2007) have traced many factors to errors in

construction documents. However, the ones that are peculiar to Nigerian construction documents are yet to be identified and that is the problem to be solved by this study. Moreover, the effects of errors in construction documents are both numerous and devastating on construction projects. Some of the effects that are identified in literatures include design-induced rework (Love, 2002; Love *et al.*, 2008), propagation of failure (Vrouwenvelder, *et al.*, 2009), structural collapse, financial loss, inconvenience, deterioration of buildings, personal injury and sickness, time delay, damaged equipment (Barkow, 1995), defects, wastages and inconveniences (Palaneeswaran, *et al.*, 2007), conflicts and ambiguities (Olatunji, 2011). Others are cost overrun (Mohammed, 2007), procurement systems (Rashid, *et al.*, 2006), incomplete designs, change order, rework, construction delay, etc (Alarcon and Mardones, 1998).

As a result of the adverse effects of errors in construction documents, it is important to identify the factors that are responsible for them so that the professionals involved in the preparation of the documents can know the factors upon. When construction documents are error free, the reputations of the consultants involved would be improved and the rigours of re-designing and correcting errors would be eliminated. On the part of the client also, unrealistic estimates will be eliminated and confidence in consultants and contractors would be established for future projects. Excessive rigours of claims, variation/reworks are eliminated for the contractor and their profit is also increased. Better housing provisions are provided at lower cost for the citizens of the country and the contribution of the construction industry to national GDP will improve. Finally, global competition in international markets would be sustained and international recognition would be earned.

It is worth mentioning that it is not only consultants' errors that affect construction project success, construction errors also takes its toll on it. However, this study concentrates on errors in construction documents (consultants' errors) because it seems to be neglected by Nigerian authors and it also appears to be a major area of error that adversely affects project success in any country. This was substantiated when Mohammed (2007) noted that project consultants play a major role in

project cost overrun due to errors in construction documents.

The research carried out in Australia reveals that ninety-two percent (92%) of the variation in their construction industry were attributable to errors in construction documents (Choy and Sidwell, 1991) and the consultant team share 60% of the variation. Diekman and Nelson (1985) also noted that the largest proportion of change orders and modifications originate from the owner (client) or their representatives (consultants) and these account for 46% of claims in federally funded projects. The study conducted by Burati *et al.* (1992) on nine fast-track industrial construction projects show that while construction deviations average 16% of the total number of deviations, design deviations averaged 78% of the total number of deviations. Hence, the need to determine the significant factors responsible for these errors in construction documents.

Some of the factors linked to errors in construction documents by various researchers in the construction industry include lack of consistency (Norman, 1983), re-use of notes and details of similar projects, wrong assumptions of standard practice, inexperience, lack of clarity and poor interface co-ordination, etc (Palaneeswaran, *et al.* 2007), unreliable and incompetent staff, acceptance of low design fee (Love *et al.*, 2011), time boxing (Love *et al.*, 2000). Other factors are planning/programming, stress, repetitive tasks (Shelton, 1999), limited attention, biases, modification of rules (Cheng-Wing and Davey, 1998), unavailable data, memory loss, misperception of data, over-reliance on default values, etc (Endsley, 1999). Further to these, Barkow (1995) identified negligence, lack of adequate design references, lack of knowledge, poor team work, human error, inadequate design checks, poor communications and complexity of task as factors causing errors in construction documents.

Contradiction of information, untried new technologies, adaptation of technology to human beings, physical and mental conditions (Vrouwenvelder *et al.*, 2009), extra works, delays/disruption, conflicts, incompatibility/inconsistency, omission, inadequate detail/description, insufficient legibility (Long, 2011), motivation, cooperation, (Love and Josephson, 2004), carelessness, lack of diligence,

ineffective use of computer aided design, unrealistic client demands, low task awareness, overload, fatigue, lack of awareness of changes in standards and not knowing what is required (Love, *et al.*, 2008) are other causes of consultants' errors.

As a result of the enormity of these factors, they were classified into management related factors, consultants' factors, clients' factors, project characters and industry related factors (Mohammed, 2007). Atkinson (1998) categorized them into primary factors (e.g. self inspection, education/training), managerial factors (e.g. delegation of duties, change controlling, concurrent working control, communications) and global factors (e.g. organizational culture, economic pressure, time pressure, political pressure and societal pressure).

Methodology

A structured close ended questionnaire was designed to capture data on the factors responsible for errors in Nigerian construction documents. Two hundred and sixty copies of a questionnaire was administered on consultants (Architects, Engineers, Quantity Surveyors, Builders and others) and contractors in the Nigerian construction industry. Consequently, seventy-eight of them was returned thus giving a return rate of 30%. The questionnaire was divided into socio-economic characteristics of respondents and factors responsible for errors in Nigerian construction documents. The data for the study was basically collected from consultants and contractors whose offices are based in Lagos state, Table 1 General information of respondents

Nigeria. Lagos state was chosen for the study not only because of accessibility to useable information, also because it houses the bulk of construction activities going on in Nigeria.

A list of Lagos based registered contractors was obtained from the register of the Corporate Affairs Commission (CAC) while those of consultants were obtained from professional Registration Boards like Architect Registration Council of Nigeria (ARCON), Council for Regulation of Engineering (COREN), Council of Registered Builders of Nigeria (CORBON) and Quantity Surveyors Registration Board of Nigeria (QSRBN). The reason for obtaining information from the contractors is to be able to compare their significant factors with those of the consultants. The questions on factors responsible for errors in the Nigerian construction documents were based on a 5 point Likert scale ranging from 1, not significant to 5, very significant so that statistical analysis could be used to extract the important factors from the non-important ones.

The reliability of the questionnaire used for the study was tested using the Cronbach's Alpha co-efficient which gave 0.908 for the sixty-three factors that were itemised. The data from the study was analysed using the Statistical Package for Social Sciences (SPSS 17). The frequencies, percentages, mean scores and analysis of variance were the statistical methods used to obtain the significant factors that are responsible for errors in the Nigerian construction documents. The results of the study were presented in tables.

	Frequency	Percentage (%)
Position of respondents		
Architecture	26	33.3
Civil/structural engineering	8	10.3
Quantity surveying	10	12.8
Building	14	17.9
Others	20	25.6
Total	78	100.0
Type of Services Rendered by Firms		
Consultancy	47	60.3
Contracting	31	39.7
Total	78	100.0
Type of Project Handled by Firms		
Public	39	50.0
Private	39	50.0
Total	78	100.0

Work Experience of Respondents		
Less than 10years	52	66.7
10-15 years	16	20.5
16-20 years	4	5.1
Above 20 years	6	7.7
Total	78	100.0
Highest Educational Qualification of Respondents		
Diploma	16	20.5
First degree	46	59.0
Second degree	12	15.4
Others	4	5.1
Total	78	100
Number of Employees in Organisations		
1-10	16	20.5
11-50	24	30.8
Above 50	38	48.7
Total	78	100

Table 1 shows the general information of respondents and their organizations. Architects were 33.3%, civil/structural engineers were 10.3%, quantity surveyors were 12.8%, builders were 17.9% and other related professions were 25.6%. This indicates that the respondents' professions were evenly spread. Also, 60.3% of the firms used for this study engage in consultancy while 39.7% engage in contracting. 50% of the organizations engage mostly in public projects and 50% engage mostly in private projects. 66.7% of the respondents for this study had less than 10 years of work experience, 20.5% had 10-15 years of work experience, 5.1% had 16-20 years work

experience and 7.7% had over 20 years of work experience.

The educational qualifications of the respondents revealed that 20.5% of the respondents for the study had Diploma, 59% had first degree, 15.4% had second degree and 5.1% had other degrees apart from the ones listed. This shows that majority of the respondents were first degree holders. The number of employees in the respondents' organizations was revealed to be 20.5% for 1-10 employees, 30.8% for 11-50 employees and 48.7% for more than 50 employees.

Table 2 Overall factors responsible for errors in construction documents

S/N	Factors	Category	Cons	Rank	Cont	Rank	Overall	Rank
1	Designer experience	Designer	4.15	2	4.68	1	4.36	1
2	Lack of design reviews, value engineering studies and constructability	Designer	3.97	5	4.52	2	4.21	2
3	Erratic decision making	Management	4.19	1	4.16	9	4.18	3
4	Lack of coordination between disciplines	Management	3.98	4	4.48	3	4.18	4
5	Lack of planning and inspection of project	Client	3.97	5	4.30	6	4.11	5
6	Design management experience	Designer	3.96	7	4.32	5	4.10	6
7	Lack of awareness of changes in standards	Designer	4.04	3	4.13	10	4.08	7
8	Communications	Designer	3.83	8	4.30	6	4.03	8
9	Unclear and ambiguous Requirements for design specifications	Client	3.75	10	4.33	4	4.00	9
10	Availability of information	Designer	3.78	9	4.30	6	4.00	10

5= very significant, 4= significant, 3= Indifferent, 2= slightly significant, 1= not significant. (Cons = Consultant, Cont = Contractor, Overall= Contractors and consultant)

Table 2 reveals the contractors, consultants and overall means of the significant factors that are responsible for errors in Nigerian construction documents. Sixty-three factors were identified and classified into five categories (management,

consultants, clients, project and industry related). However, factors with mean scores below 4.0 were not regarded as significant factors that are responsible for errors in Nigerian construction documents. On the overall, the order in which the

factors influence errors in Nigerian construction documents is designer's experience (4.36), lack of design reviews, value engineering studies and constructability (4.21), erratic decision making (4.18), lack of co-ordination between disciplines (4.18), lack of planning and inspection of project (4.11), design management experience (4.10), lack of awareness of changes in standards (4.08), communications (4.03), unclear and ambiguous requirements for design specifications (4.00) and availability of information (4.00). This indicates

that the consultants', management and client related factors are the most rated by both the consultants and the contractors. However, table 3 reveals that the consultants rated the management and clients' factors above the consultants. This may be due to the fact that they do not want to apportion blame of errors in construction documents to themselves, thus heap the blames of their misfortunes on other stakeholders (management and client).

Table 3 Factors responsible for errors in construction documents according to consultants

S/N	Factors	Category	Consultants	Rank
1	Erratic decision making	Management	4.19	1
2	Insufficient fund to create quality document	Client	4.17	2
3	Designer experience	Designer	4.15	3
4	Lack of awareness of changes in standards	Designer	4.04	4
5	Violations	Designer	4.00	5
6	Construction start/finish time	Client	4.00	6

5= very significant, 4= significant, 3= Indifferent, 2= slightly significant, 1= not significant.

The factor responsible for errors in Nigerian construction document as rated by consulting practitioners are erratic decision making (4.19), insufficient fund to create quality document (4.17), consultants' experience (4.15), lack of awareness of changes in standards (4.04), violations (4.00) and construction start/finish time (4.00). The consultants were not able to come up with many factors. However, out of the six they selected they agreed to possess three of the factors responsible for errors in the Nigerian construction documents.

Table 4 Factors responsible for errors in construction documents according to contractors

S/N	Factors	Category	Contractors	Rank
1	Designer experience	Designer	4.68	1
2	Lack of design reviews, value engineering studies and constructability	Designer	4.52	2
3	Lack of coordination between disciplines	Management	4.48	3
4	Unclear and ambiguous requirements for design specifications	Client	4.33	4
5	Design management experience	Designer	4.32	5
6	Designer professional education	Designer	4.32	6
7	Communications	Designer	4.30	7
8	Availability of information	Designer	4.30	8
9	Lack of planning and inspection of project	Client	4.30	9
10	Design team efficiencies	Designer	4.29	10
11	Inadequate documentation	Designer	4.26	11
12	Design process	Designer	4.19	12
13	Carelessness, lack of due diligence and negligence	Designer	4.19	13
14	Erratic decision making	Management	4.16	14
15	Lack of awareness of changes in standards	Designer	4.13	15
16	Errors in design assumptions, concepts and calculations	Designer	4.11	16
17	Project manager's experience	Management	4.06	17

5= very significant, 4= significant, 3= Indifferent, 2= slightly significant, 1= not significant.

Table 4 shows that the factors identified by contracting organizations as being responsible for errors in the Nigerian construction documents are consultants' experience (4.68), followed by lack of design reviews, value engineering studies and constructability (4.52), Lack of coordination between disciplines (4.48), Unclear and ambiguous requirements for design specifications (4.33), design management experience (4.32), designer professional education (4.32), Communications (4.30), Availability of information (4.30), Lack of planning and

inspection of project (4.30), design team efficiencies (4.29), Inadequate documentation (4.26), design process (4.19), carelessness, lack of due diligence and negligence (4.19), erratic decision making (4.16), Lack of awareness of changes in standards (4.13), Errors in design assumptions (4.11) and concepts and calculations (4.06). Out of the seventeen factors that were identified, the consultants had twelve while the management and client shared the remaining six. This shows that the consultants are the causes of errors in construction documents

Table 5 Factors responsible for errors in construction documents according to respondents that carry out public sector projects

S/N	Factors	Category	Public respondents	Rank
1	Designer experience	Designer	4.31	1
2	Erratic decision making	Management	4.28	2
3	Lack of coordination between disciplines	Management	4.23	3
4	Lack of design reviews, value engineering studies and constructability	Designer	4.18	4
5	Design management experience	Designer	4.10	5
6	Lack of awareness of changes in standards	Designer	4.08	6
7	Communications	Designer	4.05	7
8	Carelessness, lack of due diligence and negligence	Designer	4.03	8

5= very significant, 4= significant, 3= Indifferent, 2= slightly significant, 1= not significant.

From table 5, the respondents that majorly carry out public projects noted in descending order that the factors responsible for errors in construction documents of public projects are designer's experience (4.31), erratic decision making (4.23), lack of co-ordination among disciplines (4.23), lack of design reviews, value engineering studies and constructability (4.18), designer management experience (4.10), lack of awareness of changes in standards (4.08), communications (4.05) and carelessness, lack of due diligence and negligence (4.03). This shows that the consultants, having shared six of the eight factors identified, are the main causes of errors in Nigerian construction documents.

While organisations that execute public projects identified eight factors, those that carry out private project identified seventeen factors as shown in table 6. Designer experience (4.41) topped the table, followed by lack of planning and

inspection of project (4.32), insufficient fund to create quality document (4.24), lack of design reviews, value engineering studies and constructability (4.24), errors in design assumptions, concepts and calculations (4.20), availability of information (4.16), lack of co-ordination among disciplines (4.13), unclear and ambiguous requirements for design specifications (4.12), design management experience (4.10), erratic decision making (4.08), identification of project risk (4.08), lack of awareness of changes in standards (4.08), inadequate design time (4.04), deficient procedure for producing documents (4.04), completeness or co-ordination of information (4.04), attitude of client (4.04) and communications (4.00). This indicates that the organisations that work on private projects blame errors in construction documents on basically the consultants and the clients, although the management had two out of the seventeen factors.

Table 6 Factors responsible for errors in construction documents according to respondents that carry out private sector projects

S/N	Factors	Category	Private respondents	Rank
1	Designer experience	Designer	4.41	1
2	Lack of planning and inspection of project	Client	4.32	2
3	Insufficient fund to create quality document	Client	4.24	3
4	Lack of design reviews, value engineering studies and constructability	Designer	4.24	4
5	Errors in design assumptions, concepts and calculations	Designer	4.20	5
6	Availability of information	Designer	4.16	6
7	Lack of coordination between disciplines	Management	4.13	7
8	Unclear and ambiguous requirements for design specifications	Client	4.12	8
9	Design management experience	Designer	4.10	9
10	Erratic decision making	Management	4.08	10
11	Identification of project risk	Client	4.08	11
12	Lack of awareness of changes in standards	Designer	4.08	12
13	Inadequate design time (time boxing)	Designer	4.04	13
14	Deficient procedure for producing document	Designer	4.04	14
15	Completeness or contradiction of information	Client	4.04	15
16	Attitude of client	Client	4.04	16
17	Communications	Designer	4.00	17

5= very significant, 4= significant, 3= Indifferent, 2= slightly significant, 1= not significant

Discussion

The study aimed at identifying the significant factors that are responsible for errors in the construction documents that are prepared in Nigeria. Unlike other studies (Mohammed, 2007; Love *et al.*, 2009, Suther, 1998), the opinions of both the consultants and contractors were used for this study so that comparisons can be made between them. The study suggests that, although errors in construction documents are mostly related to consultants, contractors are also aware of the factors responsible for errors in construction documents, hence they are included in the study population. Also, the study compared the respondents that engaged in public projects with those that engage in private projects.

The results of this research show that the consultants are mostly responsible for the errors in Nigerian construction documents. This result is found to be consistent with that of Choy and Sidwell (1991) and contrary to Diekman and Nelson (1985) who found out that clients are responsible for larger proportion of change orders in federally funded projects. However, on privately funded projects, the clients' factors were rated second by respondents as being responsible for errors in Nigerian construction documents.

Also, out of the factors identified by the respondents as being responsible for errors in construction documents, consultants experience and lack of design reviews, corresponds with the results of Palaneeswaran, *et al.* (2007). Erratic decision making corresponds with Cheng-Wing and Davey (1998), design management experience was highlighted by Barkow (1995) and lack of awareness of changes in standards was identified by Norman (1983) and Love *et al.* (2008). Barkow (1995) also identified communication, Long (2011) pinpointed unclear and ambiguous requirements for design specifications and availability of information. According to the contractors, the factors responsible for errors in construction documents are consultants' experience, lack of design reviews, value engineering studies and constructability, lack of co-ordination between disciplines, etc. basically, the contractors blamed the consultants, management of projects and clients for the errors that occur in construction documents. This result is consistent with the findings of Love *et al.* (2008), Love and Josephson (2004) and Long (2011).

The respondents that carry out public sector projects agreed that consultants experience, erratic decision making, lack of co-ordination between

disciplines, lack of design reviews, value engineering in studies and constructability, design management experience, lack of awareness of changes in standards, communication and carelessness, lack of due diligence and negligence are the significant factors responsible for errors in construction documents. The private project executors had more than the eight factors identified by the public sector project executors. This is likely going to be as a result of the autonomy of the private project clients. However, while the public projects respondents noted that the consultants and management factors are the generators of errors in construction documents; private project executors noted that consultants, clients and management factors are the significant factors responsible for errors in construction documents.

Conclusion and Recommendation

The aim of this study is to identify the major factors responsible for errors in Nigerian construction documents. The consultants and the contractors were the subject of the study and both their individual and collective responses were used for the analysis of the study. Also, respondents that carry out public and private projects were also used to determine the significant factors responsible for errors in the Nigerian construction documents. The findings of the study revealed that the consultants, management and client factors are core to the generation of errors in the Nigerian construction documents. However, among the three categories, the consultants' factors are found to be more responsible for the errors in Nigerian construction documents. The consultants' rating shows some disparity in the factors responsible for errors in construction documents as they rated management and clients' factors above their own.

Based on the finding of the research, the study concludes that in order to prevent the occurrence of errors in Nigerian construction documents, the consultants' experience, lack of design reviews, value engineering studies and constructability, design management experience, awareness of changes in standards, communications and availability of information (Designer's factors), erratic decision making, lack of co-ordination between disciplines (management factors) and lack of planning and inspection of project and

unclear and ambiguous requirements for design specifications (client factor) should be worked upon by the stakeholders concerned in order to prevent the occurrence of errors in construction documents. It is also recommended that all the factors selected by both consultants and contractors should be avoided when preparing construction documents. Moreover, factors in excess of the ones collectively selected by both consultants and contractors should be put into consideration when preparing construction documents for public projects (table 5) and private projects (table 6).

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