Occurrence of Rework on Components of Building Project in Lagos State, Nigeria

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Abstract

Rework is redoing an aspect of building work as a result of poor quality, wrong implementation, changes, and errors. The purpose of this study is to assess the frequency of occurrence of rework on the component of building projects in order to identify where the stakeholders needs to be careful to prevent re –doing the aspect of work. Literatures were reviewed on the sources, occurrence and effect of rework on building project components. Descriptive research design was used for this study and the population of the study was clients', consultants and contractors within the construction industry. Simple random sampling technique was used to select the respondents, thus each respondent has equal chance of being selected. Ninety – eight (98) questionnaires were distributed and fifty – two (52) were returned given an average response rate of 52%. Statistical package for social sciences (SPSS) 21st version was used for analysis. Frequency, percentage, Mean Item Score, Ranking and Mann-Whitey test were statistical tools used to generate the results. Poor communication with design consultant, use of poor quality materials and poor workmanship were identified as causes of rework. Consultants are mostly responsible for rework of foundation, blockwork, staircase, tiling, sanitary fitting, electrical work and external work. In conclusion, management skill is necessary for reducing rework and for project performance level. Consultants should work together as a team to ensure productivity and profit margin.

Keywords: *Building Projects, Components, Element, Occurrence, Rework*

1.0 Introduction

In Nigeria construction industry, construction project fails to meet clients' requirement (18). It has results to cost overrun, delays, low quality standard, litigation, abandonment, insolvency and collapse of building as a result of poor workmanship (16 - 17). According to Love, Irani and Edward (2004), Australian construction industry is also faced with all these factors affecting their construction projects. They all noted that the government had reported critically on this phenomenon affecting the industry despite the importance of the industry in any developing and developed nation. The stakeholders in the industry have also contributed to poor management practices, lack of coordination, communication problem, misunderstanding of design and specification in the construction process (6). It has lead to unnecessary cost, wastage, changes and errors. In order to, therefore, manage these problems; the concept of rework is necessary for project performance level. According to Anil and Danielraj (2016), rework had been ignored in construction projects despite its effect on the performance of project thus, rework is an intrinsic problem.

Rework is redoing a process or activity as a result of changes, wrong implementation and poor workmanship (8). It had been realized that the main factor of cost and time overruns is rework (8, 5). Rework cost is 10% -15% of the contract value as opined by CIDA (1994) (7, 4, 22, 5,1). It was also opined that rework cost could be higher than 10 -15% of the construction cost because the percentage cost excludes indirect cost, litigation cost and other costs indirectly proportional to poor quality.

Several studies have been done to identify the causes and sources of rework and also the impact of rework on project performance (12, 20,1,15) by applying total field rework factor, classification of rework sources and the used of system dynamics (10). There are also studies on organizational culture

and rework (21) and relating rework with project performance (2). Rework occurs in building, civil engineering, oil and gas projects and their causes are related (21). Thus rework in construction projects is due to unnecessary rectifying efforts of implementation process (10). Having seen the direct cost of rework on the total construction cost, it, therefore, becomes necessary to assess the frequency of occurrence of rework on components of the construction project.

The following objectives are postulated for the study:

1. To assess the causes of rework on building projects in Lagos state.
2. To identify and assess the perception of clients, consultants, and contractors on the frequency of occurrence of rework on building project component.

Hypothesis of the study:

1. There is no relationship between frequencies of occurrence of rework on building component.

2.0 Literature Review on Rework

Rework is redoing work due to non-conformance with the requirement (5). To prevent redoing a particular element of the work, it becomes necessary for management of rework by identifying the causes of rework. According to Love and Sohal (2003), engineering rework is caused by the scope of work and design errors while construction rework is caused by poor construction management policies. Burati, Farrington and Ledbetter (1992) identified that five areas of rework, they are design, construction, fabrication, transportation and operability while Oyewobi, and Ogunsemi (2010) identified the owner, designer vendor, transporter and constructor as the key areas of rework. It was however discovered by these researchers that rework occurs as a result of communication problems, leadership style, ineffective decision making and risk. Palaneeswaran (2006) categorized causes of rework in their study as client-related factors, design related factors, contractors related factors and subcontractors related factors.

The occurrence of rework related factors could be managed to minimize redoing the component of the work. However, in Nigeria Oyewobi and Ogunsemi (2010) as in Hong Kong, there is no framework for controlling rework occurrence. Nevertheless, contract management, quality management, project management and value management are management tools for minimizing rework.

Figure 1 shows a systematic management framework for rework occurrence (22). From Figure 1, the stages are spotting rework items (identifying rework occurrences), category mapping (developing taxonomy and ontology of rework items), responsibility tracking from design and construction stage, assessing the impact of rework on time, cost and quality, checking eligibility such as from client related factor, design and contractor related factors, recording corrective actions, recording lessons learned for knowledge management and benchmarking.

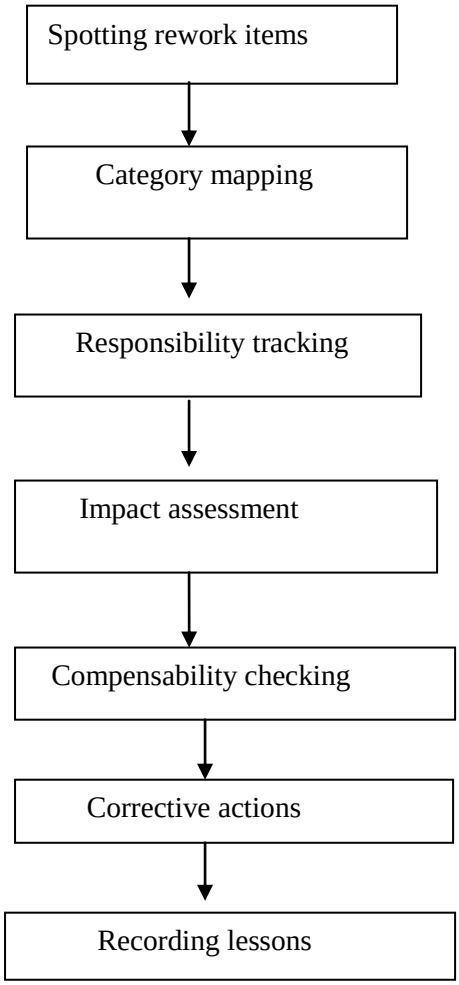

Figure 1: Systematic Rework Management framework

Source: Palaneeswaran (2006)

3.0 Methodology

The research was conducted by an examination of relevant literature followed by administration of structured questionnaires used as a principal instrument to construction professionals in the construction industry. The professionals comprise of Architects, Builders, Quantity Surveyors and Engineers working within consulting firms, contracting organizations and client organizations within the construction industry. A survey research design was used and random sampling technique was adopted for the study. A closed ended questionnaire was used to seek the opinion of the construction professional on their personal data and to obtain information on reworks based on past project handled. 98 copies of the prepared questionnaires were distributed, 52 completed copies were returned and used for the analysis. The average response rate to the questionnaires was at an average of 52%. This response rate is considered adequate as according to (23) for researcher in this part of the world. A descriptive research design is used for this study. The data were analysis using Social Statistic for Social Sciences (SPSS) package 17th edition. The statistic tools used are descriptive and inferential statistic.

4.0 Results and Discussions

4.1 Demographical information of respondents

Descriptive data generated from the study questionnaire are reported in this research. From Table 1, 24% of the respondents are senior/associate partner of their respective organisation. 20% are project manager, 9% are head of the department and only 7% are chief executive officer. It shows that the respondents are knowledgeable to provide adequate information in response to the questionnaire. 40% of the respondent are within the age of 31- 40years, while 2% are above 50years.In term of academic qualification, 56% have obtained a first degree certificate in their respective discipline.

It shows their level of skill and intelligent on this research.70% are registered member of Nigerian Institute of Quantity Surveyor (NIQS), 10% are member of Nigerian Society of Engineers (NSE), 7% are member of Nigerian Institute of Builders (NIOB) and 3% are member of Nigerian Institute of Architects (NIA). 65% are corporate member of their professional institute. It can be deduced that the respondent granted in terms of experience in the construction industry.

It can also be buttressed on the number of years in the construction industry. 60% are within the construction industry for 11- 20years, while 39% have been in the industry between 1-10years. 67% are from medium size organization and 58% of this organisation is consulting firms. 77% of the respondents are quantity surveyor; it could as a result of their unique role in the construction industry since they are involved in estimating rework cost. In the study of Love et al. (2004), contractors, architects and project managers accounted for approximately 81% of respondents. They were however of the view that, Quantity surveyors, structural, mechanical and electrical engineers are underrepresented because these consultants offer project manager services and as a result may have undertaken a role of project managers.

4.2 Causes of reworks

The causes of rework were grouped into client related, design related and subcontractor related causes as shown in Table 2. The most rank causes were poor communication with design consultant (mean =3.90), Use of poor quality materials (mean =3.83), poor workmanship (mean = 3.79), lack of experience and knowledge of design and construction process (mean = 3.75), incomplete design as at time of design (mean = 3.73), damages and inadequate managerial/supervisory skills (mean = 3.65), defects and poor coordination between the design consultant (mean =3.60). The least causes of reworks were lack of manpower to complete required task (mean =3.08), staff turnover/re-allocation to another project (mean = 2.97), lack of client involvement in the project (mean = 2.87).

Anil and Danielraj (2016) identified poor communication, changes by the client, poor coordination and low skilled labour were identified as the causes of rework. Mohamid (2016) also identified poor communication by the client and design consultants, poor site management and poor quality materials as the significant causes of rework. These findings are similar to this study. This shows that rework commences from the inception stage of construction projects and if not quickly rectified it could proceed to the construction stage. It will directly affect the performance of the project in terms of time, cost and quality standard of the project. Inexperienced on the part of the design team and the contractors on the site will lead to poor workmanship and quality standard. Thus, this becomes necessary that the design team especially the consultants representing the client should be knowledgeable and have the management skill in order to prevent the problems of reworks on construction projects.

Table 1: Socio-economic information of respondents

Background information	Frequency	Percentage (%)
Designation of respondent		
Chief executive officer	3	7
Senior/associate partner	11	24
Project manager	9	20
Head of department	4	9
Other	19	40
Total	46	100
Age of respondent		
Less than 20years	4	8
21-30years	18	34
31-40years	21	40
41-50years	5	10
51-60years	2	4
Above 60years	2	4
Total	52	100
Highest academic qualification		
HND/B.Sc./B.Tech.	29	56
Pg.d.	1	2
M.Sc./MBA	22	42
Total	52	100
Professional qualification		
NIA	1	3
NIOB	3	7
NIQS	30	70
NSE	4	10
Others	4	10
Total	42	100
Status of membership		
Graduate	14	35
Corporate	27	65
Total	41	100
Years of experience in construction		
1-10years	15	29
11-20years	31	60
21-30years	4	7
41-50years	2	4
Total	52	100
Professional background		
Architect	1	2
Quantity surveyors	40	77
Builder	6	12
Civil Engineers	2	4
Mechanical Engineers	2	4
Total	51	100
Type of organisation		
Contracting	19	37
Consulting	30	58
Client	3	5
Total	52	100
Size of organisation		
Small	9	17
Medium	35	67
Large	8	16
Total	52	100

Table 2: Causes of rework in building projects

Causes	SD	D	UD	A	SA	N	MIS	Rank
Poor communication with design consultant	2	-	14	21	15	52	0.78	1
Use of poor quality materials	-	6	9	25	12	52	0.77	2
Poor workmanship	1	1	18	20	12	52	0.76	3
Lack of experience and knowledge of design and construction process	1	8	12	13	18	52	0.75	4
Incomplete design as at time of design	1	7	12	17	15	52	0.74	5
Damages	-	4	22	14	12	52	0.73	6
Inadequate managerial/supervisory skills	-	9	12	19	12	52	0.73	6
Defects	-	6	14	27	5	52	0.72	8
Poor coordination between the design consultant	2	10	7	21	12	52	0.72	8
Insufficient time to prepare contract documentation	2	8	15	13	14	52	0.71	10
Incidence of conflicting opinion between design team	1	6	15	23	7	52	0.71	10
Inadequate briefing	1	8	16	16	11	52	0.70	12
Inadequate client brief to prepare detailed contract documentation	-	12	12	17	11	52	0.69	13
Poor planning of workload	1	6	16	23	6	52	0.69	13
Ineffective use of management practice	2	4	22	15	9	52	0.68	15
Inadequacies in contract documentation	2	8	18	17	7	52	0.67	16
Lack of funding allocated for site investigation	5	8	9	26	4	52	0.66	17
Constructability associated concerns	1	7	24	15	5	52	0.66	17
Ineffective use of information technologies	3	7	24	10	8	52	0.65	19
Omission of some activity or task	4	8	22	10	8	52	0.64	20
Time boxing /fixed time for the task	3	8	20	20	1	52	0.63	21
Poor site condition	4	8	23	13	4	52	0.62	22
Failure to provide protection for construction work	3	13	18	12	6	52	0.62	22
Lack of manpower to complete required task	1	15	19	13	4	52	0.61	24
Staff turnover/re-allocation to other project	1	19	16	13	3	52	0.59	25
Lack of client involvement in the project	3	15	17	11	3	52	0.57	26

SD =Strongly Disagreed, **D** =Disagree; **UD** =Undecided; **A**=Agree; **SA**=Strongly Agree;
N =Frequency, R=Rank

4.3 Perception of client, consultant and contracting organisations on rework for building component

Ccomparison of the level of perception of the client, consultant and contracting organisations on their contribution to rework based on the different component of construction projects is displayed in Table 3. For foundation, 17% of clients agreed that rework occurred at this stage is caused by them whereas 30% of the consultant are responsible for rework at foundation stage and 26% contractor agreed that they are responsible for rework at this stage. In all 51% level of rework occur at foundation stage. It shows that consultant who is involved in the design and writing the specification should have an understanding of the design, adequate communication is necessary and team patterning is important to ensure minimizing rework at the foundation stage. For the frame, 48% of the clients' are responsible for rework occurrence, 38% for consultant and 14% of the contractors are responsible for rework occurrence in frame component. 20% of the client are responsible for upper floor rework, 28% for consultant and 44% of contractors are responsible for upper floors rework occurrence.

Table 3: Perception of client, consultant and contracting organisation on rework component

Building components	Rework F(%)	Client responsible for rework F(%)	Consultant responsible for rework F(%)	Contractor responsible for rework F(%)
Foundation	25(51)	4(17)	9(30)	6(26)
Frame	33(67)	14(48)	11(38)	4(14)
Upper floor	23(47)	5(20)	7(28)	11(44)
Blockwork	37(76)	12(31)	21(54)	4(10)
Staircase	20(43)	6(27)	7(32)	5(23)
Roofing	34(69)	9(25)	19(53)	2(6)
Doors	29(59)	15(46)	13(39)	2(6)
Windows	29(59)	-	-	-
Tiling	39(80)	10(25)	22(54)	2(5)
Ceilings	26(53)	-	-	-
Partitions	20(51)	-	-	-
Sanitary fitting	31(80)	12(30)	30(50)	4(10)
Fitting fixtures	21(54)	14(48)	9(31)	2(7)
Electrical work	27(69)	7(20)	12(34)	10(29)
External work	-	7(27)	9(35)	6(23)

For blockwork, 31% clients' are responsible for rework, 54% for consultant while 10% contractors are responsible for block work rework. 27% clients' are responsible for staircase rework, 32% for consultant staircase rework and 23% for contractors staircase rework. While for roofing, 25% clients' are responsible, 53% for consultant and 6% of contractors are responsible for roofing rework. 46% of clients are responsible for doors rework, 39% consultants are responsible for doors rework and just 6% contractors are responsible for door rework. It is due to the fact of changes which is a form of rework on the part o the clients and the consultant. There is no comparison of perception for windows, ceilings, and partition. It shows that rework does not often occur in these elements of work. For tiling, sanitary fitting electrical work and external work, consultant level of responsibility for rework are 54%, 50%, 34% and 35% respectively. Ndihokubwayo and Haput (2008) opined that clients are largely responsible for the occurrence of reworks due to lack of defined needs and financial constraints. It mostly occurred due to variation on the part of the client. However, this study identified the occurrence of rework based on the components of the building projects. It shows rework could be caused by the client, consultant, and the contractor.

4.4 Relationship between frequencies of occurrence of rework

Hypothesis 1: There is no relationship between frequencies of occurrence of rework on building components

The hypothesis test of this study to verify if there is any relationship between frequencies of occurrence of rework on building component as indicated in Table 4.Mann Whitney (U) test of 2 independent samples test was used based on the data. From the results, contractors who carried out rework on foundation, frame, blockwork, staircase, roofing, doors, windows, partition, sanitary fitting, fixture fitting, electrical work and external incurred less average rework cost (Mean Rank (MR) =3.33, 5.00, 3.20, 4.00, 3.67, 4.00, 4.40, 4.00, 6.00, 4.75, 3.67, 6.00, 4.60, 3.67) than contractor who did not carried out rework (MR = = 4.50, 3.25, 2.50, 6.00, 4.00, 6.00, 4.00, 6.00, 4.00, 3.00, 0.00, 2.50, 3.00, 6.00).

Table 4: Mann-Whitney statistical test of relationship between frequencies of occurrence of rework

Building components	Rework		No rework		Mann-Whitney test			Sig.	Dec.
	F	MR	F	MR	Mann-Whitney U statistic	Zcal.	p-value		
Foundation	3	3.33	4	4.50	4.00	-0.707	0.629	NS	H_0 accptd
Frame	3	5.00	4	3.25	3.00	-1.061	0.40	NS	H_0 accptd
Upper floor	3	6.00	4	2.50	0.00	-2.12	0.05	S	H_1 accptd
blockwork	5	3.20	2	6.00	1.00	-1.549	0.19	NS	H_0 accptd
staircase	3	4.00	4	4.00	6.00	0.00	1.00	NS	H_0 accptd
roofing	6	3.67	1	6.00	1.00	-1.00	0.571	NS	H_0 accptd
doors	5	4.00	2	4.00	5.00	0.00	1.00	NS	H_0 accptd
windows	5	4.40	2	3.00	3.00	-0.78	0.571	NS	H_0 accptd
tiling	7	4.00	0	0.00	-	-	-	-	-
Ceilings	3	6.00	4	2.50	0.00	-2.12	0.05	S	H_1 accptd
Partitions	4	4.75	3	3.00	3.00	-1.061	0.40	NS	H_0 accptd
Sanitary fitting	6	3.67	1	6.00	1.00	-1.00	0.571	NS	H_0 accptd
Fitting fixtures	2	6.00	5	3.20	1.00	-1.549	0.19	NS	H_0 accptd
Electrical work	5	4.60	2	2.50	2.00	-1.162	0.381	NS	H_0 accptd
External work	3	3.67	4	4.25	5.00	-0.354	0.86	NS	H_0 accptd

F=Frequency; MR=Mean Rank; Sig. =Significant; NS=Not Significant; H_0 =null hypothesis; H_1 = alternate hypothesis; accptd =accepted

It implies that where rework is carried out on foundation there seemed to lower overall rework cost than where there is rework. However the z value derive from the Mann Whitney statistic was –0.707 with a two tail p-value of 0.629 and the z value tabulated at 0.05 level of significant was greater than the calculated z value hence there was no significant different in the rework cost as such the null hypothesis (H_0) was accepted which means there was no relationship between the frequencies of occurrence of rework on building components. For upper floor and ceiling, there was a significant relation because the z calculated was less than z tabulated at 0.05 level of significant hence the alternate(H1) was accepted and the null hypothesis (H0) was rejected. It implies that rework cost was less incurred where there was no rework (MR =6.00, 6.00) and more where there was rework (MR =2.50, 2.50).

5.0 Conclusion and Recommendations

This study is on identification of rework occurrence on components of building projects. The causes of reworks a shown from this study were poor communication with design consultant, use of poor quality materials, poor workmanship, lack of experience and knowledge of design and construction process, incomplete design as at time of design, damages, inadequate managerial/supervisory skills, defects and poor coordination between the design consultant. The research also demonstrated that consultants were mostly responsible for a certain element of the building components such as foundation, blockwork, staircase, tiling, sanitary fitting, electrical work and external work. It could be deduced that the aspect of management such as value management and team patterning are necessary for the consultant to achieve project performance level in order to reduce rework cost. Anil and Danielraj (2016) also agreed that design team consultant should have adequate management concept skill to ensure minimization of rework cost especially at the inception stage of the project.

Clients were responsible for rework of frames, doors and fixture fitting while contractors were responsible for rework of upper floors. Clients rework were mostly due to change which was one of the factors that lead to rework thus the consultants should advise the clients on the effect of change on the total construction cost. This is in support of the study of (14) that clients are mostly responsible for rework. In addition, this study also presented that there was no relationship between the frequencies of occurrence of rework on building components except for frame and ceiling through using Mann-Whitney statistical independent sample test. To ensure reducing the frequency of rework occurrence, the consultants should take the time to have an understanding of the design and plan through coordination, communication and team partnering to minimize rework cost and for productivity. Because rework leads to additional materials and labours, inter-organisational conflicts, extra time for carrying out the work and de-motivation of workers.

6.0 Reference

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