FEDERAL UNIVERSITY OF TECHNOLOGY, MINNA

SOFTCOPIES OF PUBLICATIONS

NAME: Dr. Abdullateef Adewale Shittu

FILE NUMBER: PF 00963

DEPARTMENT: Quantity Surveying

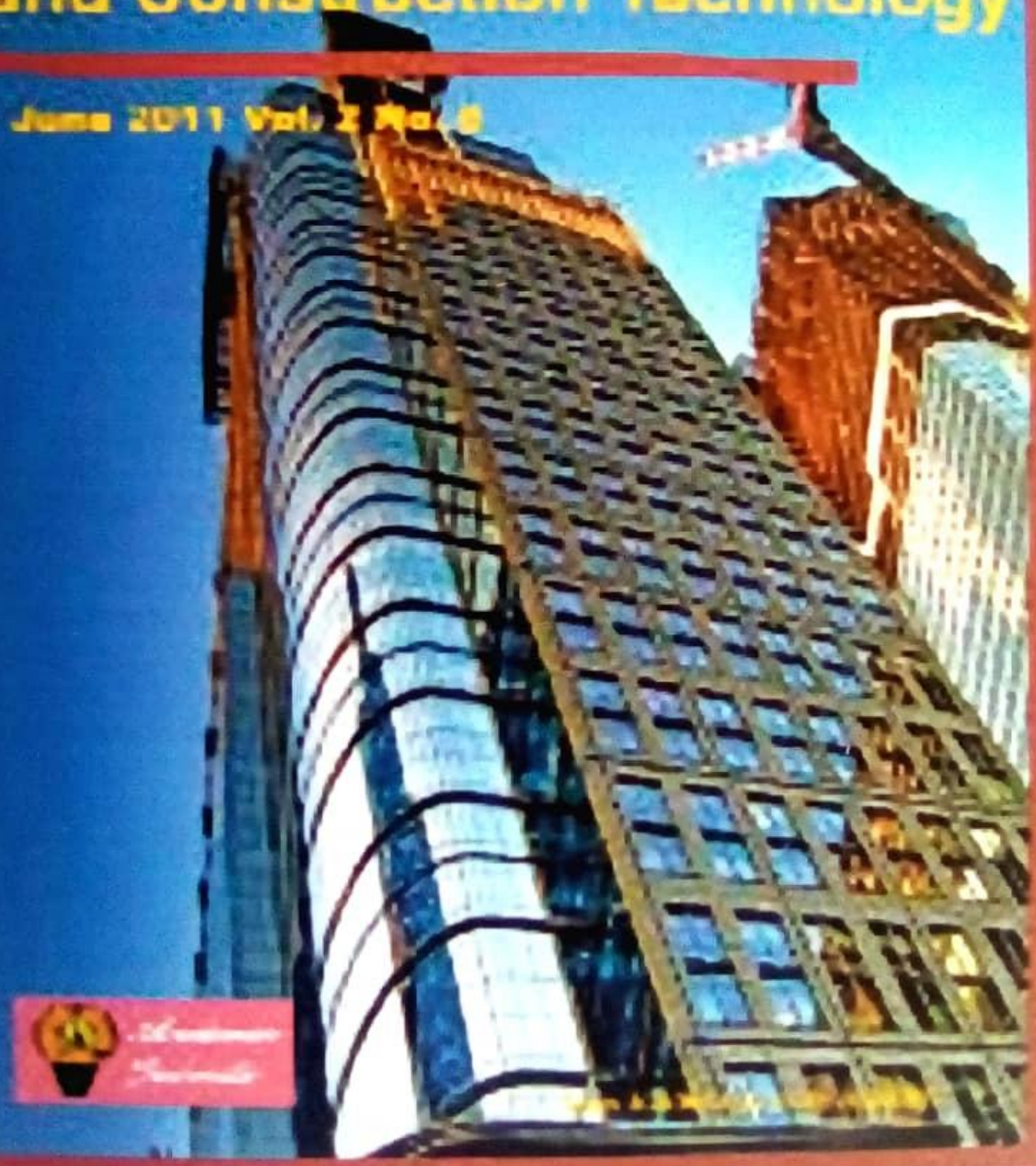
SCHOOL: Environmental Technology

INTERNATIONAL JOURNALS

JOURNAL 1

Journal of Civil Engineering and Construction Technology

June 2011 Vol. 2 No. 6



Quick Links

Submit Manuscript

Track your Manuscript

Subscribe to RSS

Subscribe to TOC Alert

Abbreviation: J. Civ. Eng. Constr. Technol.

Language: English

ISSN: 2141-2634

DOI: 10.5897/JCECT

Start Year: 2010

Published Articles: 120

Subscribe to JCECT

Full Name*

Email Address*

Subscribe

Editors - JCECT

These positions are voluntary.

Subscription Form

Full Name:

E-mail address:

Please select a journals you wish to subscribe for

No matches found

Medical Sciences

African Journal Of Pharmacy And Pharmacology

Clinical Reviews And Opinions

International Journal Of Medicine And Medical Sciences

Submit

ISSN 2141-2634 ©2011 Academic Journals

Full Length Research Paper

The effect of project types on the occurrence of rework in expanding economy

L. O. Oyewobi[1]*, A. A. Oke[1], B. O. Ganiyu[1], A. A. Shittu[1], R. B. Isa[2] and L. Nwokobia[1]

[1]Department of Quantity Surveying, Federal University of Technology, Minna, Niger State, Nigeria.
[2]Department of Building, Federal University of Technology, Minna, Niger State, Nigeria.

Accepted 30 March, 2011

Construction projects are complex in nature because they entail complex activities characterized with uncertainties and changes that are capable of increasing time and cost of construction projects. Rework is a waste that involves doing certain task more than once, it may not be totally eliminated but it is avoidable. It occurs as a result of so many factors ranging from omission or error in design, construction failure, and change order to inadequate coordination and communication among stakeholders on the project. Hence, to enhance project performance it becomes imperative to identify the influence of project type on the occurrence of rework. This paper presents analyses and discusses the rework costs experienced by the studied projects and the findings revealed that the cost of rework for new buildings understudied was averagely 5.06% as against 3.23% recorded by refurbished buildings of the completion cost. Therefore, to improve project performance and to reduce the menace of rework costs, it is asserted there is need for consensus to be reached on a workable mechanism to bring together the client and the contractor to minimize change orders and introduction of additional works during construction phase.

Key words: Rework, project type, expanding economy, building projects.

INTRODUCTION

The construction industry occupies a focal position in the economy of any nation because it is an important contributor to the process of development. Kazie (1987) affirmed that construction expenditure accounts for about 50% of the Nigerian government's expenditure. This assertion was corroborated by Ajanlekoko (1990) who viewed the industry to be a prime motivator of Nigerian economy and that it represents 60% of the capital investment.

The construction industry in Nigeria is of paramount importance for employment and economic growth as opined by Annunobi (1997) that it generates employment opportunity which places it second only to Agriculture in the employment of labour. The sector contributed an average of about 5% to the Annual Gross Domestic Product (G.D.P) and average of about one-third of the Total Fixed Capital (Olaloku, 1987). The World Bank attested to this by attributing the industry to account for between 3 to 8% to the GDP in developing countries, Nigeria inclusive.

Despite these huge contributions noticed in the pa the industry has become a shadow of its former through the contribution it makes to the GDP which reported to be 1.72% in 2007 by the Federal Bureau statistics which was below 3 to 8% reported by Wo Bank for developing nations while Ghana recorded 8. contribution of the industry to her GDP (Fugar a Agyakwah-baah, 2010). This persistence reduction in industry's contribution was as a result of many factors industry is being plagued with; from time and c overrun to defects traceable to design and construct interfaces. These defects either through design erro contract documentation errors, and deviation in quality construction phase or poor workmanship that has to done again to offer client value for money could regarded as rework. Rework takes its name from defe noticed due to non-conformance to specification deviation in quality.

Construction Industry Institute (CII) (2001) view rework as activities that have to be done more than on or activities which remove work previously executed part of the project regardless of source, where no chang

*Corresponding author. E-mail: oyekunlehassankay@yahoo.com

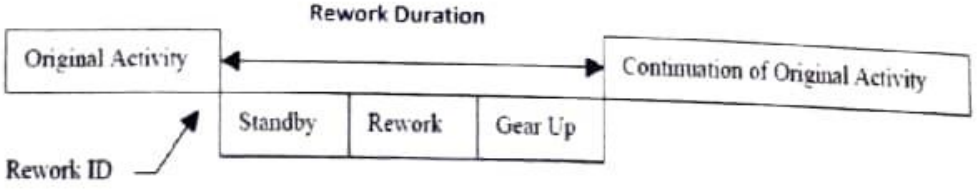


Figure 1. Components of reworks. Source: Fayek et al. (2003).

order has been issued and no change of scope has been identified by the owner. Rework can occur from errors, omissions, failures, damage, and change orders throughout the design and construction interface process (Love, 2002).

Rework is a significant factor that contributes negatively to the construction process and directly leads to client dissatisfaction, reduces profitability and in extreme conditions, leads to acrimonious relationship between participants which either be settled through a recourse to law court or arbitration (Love, 2002a, b). However, a reduction in rework can significantly improve the overall project performance (Love et al., 2000; Low and Yeo, 1998). Love et al. (1999) concluded that causes of rework in various countries differ as the situation and contract culture are not the same and therefore, the costs of rework between countries should not be considered authoritative, but merely indicative, as levels and interpretations of quality will differ between each country. Local practices, industry culture, and contractual agreements contribute immensely to the incidence and cost of rework in any situation and environment (Love et al., 1999). Therefore, the paper evaluated the effect of project types on the occurrence of rework in expanding economy with the mind that the result of the research would be widely applicable in other nations

Reducing rework costs – eliminating waste

Rework costs are tracked from the point where rework is identified to that time when rework is completed and the activity has returned to the condition or state it was in originally. The duration of the cost tracking includes the length of the standby/relocation time once rework is identified, the time required to carry out the rework, and the time required to gear up to carry on with the original scope of the activity (Fayek et al., 2003). The sequences of events that constitute rework are shown in Figure 1.

Ibrahim et al. (2008) opined that the use of virtual reality models and 3D animations could be a useful tool in communicating constructability problems which is the major course of rework at design-construction interface by leading to better understanding of design information, thus, reducing waste, rework and, ultimately, cost of projects. Also, this assertion was supported by (Enache-Pommer and Horman, 2009) they suggested tha integrating the sustainable project's objectives with othe delivery aspects during programming of design an construction will eventually results in reducing delays costs, and rework on the project.

Importance of eliminating waste and reducing rework

From many reported cases it could be affirmed tha rework have negative impact on the performance o projects in term of cost overrun, time overrun an dissatisfaction of the participants on the project. Impact are enormous on project; Palaneeswaran (2006) argue that the direct impact of rework on project where it identified consists of; additional time to carry out th rework, additional cost to rectify the occurrence, mor materials for rework and wastage, and consequentia increase in labour cost to fix the defect plus relate extensions of manpower supervision. Hence, if rework i to be reduced or avoided there is need for client initiating a construction activity to reduce changes o alteration to design after commencement of work Christopher et al. (2009) argued that decision changes i capable of creating waste, such as rework, and tha decisions are ideally made with sufficient certainty to b considered commitments upon which subsequen decisions can rely. It was reported that the actual cost o rework for a contractor may actually be less than on percent of a contract value (Love et al., 1998), and that a contractor will invariably always try and off load any additional costs on to their client and subcontractors. In fact a contractor's estimate/tender figure may also allow for some degree of rework (in the form of a contingency) based on their knowledge and experience from previous and similar projects that they have undertaken. Thus the actual cost of rework to a contractor may even be negligible, especially projects procured under a design and construct arrangement with a guaranteed maximum price (Love et al., 1998).

Earlier studies have shown that rework costs vary between 3 and 15% of project's contract value (Burati et al., 1992; Abdul-Rahman, 1997; Josephson and Hammurlund, 1999). In addition, Rethinking construction, 1998 in Aminudin (2006) stated that: up to 30% of construction is rework, labour is used at only 40 to 60% of

potential efficiency and at least 10% of materials are wasted. It was posited that rework costs could be significantly higher than figures reported in articles relating to standards (Love and Smith, 2003). Indeed, Barber et al. (2000) suggested that rework costs could be as high as 23% of the contract value.

RESEARCH METHODOLOGY

This paper presented the research conducted on twenty-five federal government construction projects that had already been completed between 1999 and 2008 in tertiary institution in Niger State and the building projects were executed by different companies in four different institutions. The purposive samples of twenty-five projects (educational building) were selected based on their proximity and availability of archival data with relevant information to the research and the projects used for this study includes both new construction and renovation/ repair works. The researcher visited the stakeholders on the project instead of seeking the opinion of the respondent with a research schedule to retrieve archival data that bear relevance to the study as rework cost was not recorded separately.

Data collection procedure

Data collection was done from single source through documentary sources such as recorded variation account, architect instruction that varied the work, client request changes, information sought by the contractors, final accounts, progress of work report and claims granted through extension of time. The data was collected personally by the researcher by visiting all the stakeholders involved in the projects. Also design or construction errors that give rise to rework were sought but this not reported by this paper.

ANALYSIS AND RESULTS

Project type and characteristics

From Table 1, it could be deduced that virtually all the selected projects overrun its initial time except project "number 6" which was completed within time frame. Time overrun for all the projects as shown in the table indicated nine projects overrunning its initial time by 50% and above, while those projects that exhibit overruns in time ranging from 10-40% are thirteen leaving only 3 projects having less than 10% over its initial contract period. Averagely the percentage overrun in time for the 25 projects considered by this research is 37.294% above its initial period which could be concluded. This is on the high side. Cost and time overruns have been identified as major contributors to high cost of construction projects in Nigeria where Niger state is just a unit (Okpala and Aniekwu, 1988; Elinwa and Buba, 1993; Aibinu and Jagboro, 2002; Ogunsemi, 2002). They continued by asserting that projects are known for overrunning its initial time and cost budget in many of the projects undertaken in the country which this research work is also corroborating. Furthermore, projects number 7,9,12 and 25 exhibited high percentage of cost overrun of 37.98, 23.66, 23.08 and 25.02% respectively. Others have shown less than 20% cost overrun and on the average, percentage in cost overrun stood at 12.47% for the projects under consideration. Rework which has been identified as one of the major contributors to high cost of building or construction works has not been widely reported in Nigeria despite the fact that it's capable of causing overruns in term of cost and time. Egan (1998) asserted that up to 30% of construction is rework. labour is used at only 40 to 60% of potential efficiency and at least 10% of materials are wasted. This research also finds out that cost of rework of project "number 21" was as high as 9.88% of the final contract sum but as low as 3.47% on the average for the entire projects considered; this is as a result of the source of cost data available for the research. Reworks instituted by the client through the consultant of whom the records are available were used for this research work. It is worthwhile to note that only the direct costs of rework for the failures observed were estimated, the indirect rework costs such as site overheads and work undertaken for the site from head office have not been included in estimates for rework of quality failures (Barber et al, 2000). This means that there is an under-estimate of their full rework cost through the exclusion of overheads.

The study revealed from Table 2 that new buildings are more prone to rework than refurbishment or renovation projects as against the assertion made by Love (2002) because of poor contract administration and lack of constructability of designs. The average rework costs for newly constructed building is 5.06% as against 3.23% recorded for refurbished building projects. This may be as a result of inexperience of the personnel, poor planning and conflicting information as precipitated by the study. This was supported by Hammurland and Josephson (1991) that large part of rework costs could be attributable to poor skill of site management and operatives.

Furniture and fittings exhibits the highest contribution to rework costs 15.06% of the total cost of this amount to rework costs. next to it is mechanical installation with roof and covering showing the lowest contribution to rework costs with 0.99% of the total cost. From the result of the refurbished/renovated buildings, wall experienced the highest contribution to rework costs 13.59%, followed by doors and windows 6.07%, next to this is finishing 5.603%, the result of this is not unexpected due to the degree of uncertainty and complexity of the work to be done.

DISCUSSION

From a total number of twenty-five completed projects understudied the average estimated cost of rework for new building was 5.06% while that of refurbished building was found to be 3.23%, though there was no any percentage given in the previous research undertaken on project type but this research asserted that new building

Table 1. Details of the case study projects.

Project	Project type	Initial contract sum (millions)	Additional work claims etc (millions)	Rework cost (millions)	Final contract Sum (millions)	Percentage of rework in final sum	Contract period (weeks)	
							initial	final
1	NB	111.14	4.54	1.35	117.03	1.15	32	34
2	NB	122.38	1.76	1.50	125.64	1.19	40	60
3	NB	119.80	4.80	3.20	127.80	2.50	40	72
4	NB	104.40	14.47	8.50	127.37	6.67	40	76
5	RF	4.56	0.32	0.27	5.15	5.24	8	10
6	RF	7.40	0.40	0.23	8.03	2.86	3	3
7	NB	8.11	2.65	0.43	11.19	3.84	12	14
8	RF&EXT	4.50	0.14	0.11	4.75	2.32	4	5
9	RF	9.72	1.73	0.57	12.02	4.74	12	14
10	NB	113.93	9.21	5.64	128.78	4.38	40	64
11	RF&EXT	6.77	0.73	0.55	8.05	6.83	4	6
12	RF	12.48	2.10	0.78	15.36	5.08	12	15
13	RF&EXT	17.99	0.55	0.23	18.77	1.23	12	19
14	NB	29.88	0.91	0.39	31.18	1.25	16	20
15	NB	21.00	1.65	0.41	23.06	1.78	12	16
16	NB	60.89	1.85	0.79	63.53	1.24	40	52
17	NB	35.00	1.58	0.42	37.00	1.14	12	16
18	NB	33.17	1.33	0.90	35.40	2.54	24	32
19	NB	16.74	1.62	0.78	19.14	4.08	24	36
20	NB	26.35	0.74	1.04	28.13	3.70	40	48
21	NB	109.94	6.72	12.79	129.45	9.88	26	30
22	NB	53.06	2.06	1.21	56.33	2.15	24	26
23	RF	116.31	6.72	1.44	124.47	1.16	28	31
24	NB	67.36	8.66	4.64	80.65	5.75	40	72
25	NB	70.71	19.87	3.74	94.32	3.96	40	76
Total		1,283.59	97.11	51.91	1,432.60	86.67	585.00	847.00
Average		51.34	3.88	2.08	57.3	3.47	23.4	33.88

NB-New building, RF- refurbishment, RF&EXT- Refurbishment& Extension.

is more prone to rework which is in line with Love et al. (1999) who posited causes of rework in various countries differ and therefore, the costs of rework between countries should not be considered authoritative, but merely indicative, as levels and interpretations of quality will differ between countries. Local practices, industry culture, and contractual agreements may also have a significant influence on the incidence and cost of rework. Cnuddle (1991) reported that 10 to 20% of total project cost represents nonconformance costs of projects while, 46% of total deviation costs created during design, 22% for construction deviations. Hammarlund et al. (1990a, b) also supported the previous reported cases that 79%

Table 2. Summary of elemental contribution of project type to rework (%).

Elements	NB	RF & EXT	Combined
Substructure	3.11	0.48	2.627
Frame, Upper Floors and Stairs	4.23	1.215	3.866
Roof and Covering	0.99	2.714	1.17
Wall	2.17	13.509	2.806
Door and Window	4.47	6.07	4.57
Furniture and Fittings	15.06	0	12.859
Mechanical installation	11.05	4.157	10.245
Electrical installation	1.05	2.527	1.19
Finishing	3.75	5.603	3.973
Painting	3.65	0	3.138
External works and Drainage	6.13	0.28	2.968
Total	55.66	36.56	49.412
Average	5.06	3.323	4.492

of failure cost arose from 20% of quality failures. In total, cost of quality deviation is reported to be 11% of total project cost. Hammarlund and Josephson (1991) asserted 51% of failure costs were design related, 26% related to poor installation of materials, and 10% to material failure and that 4% of the total cost represents nonconformance costs. Burati et al. (1992) found that 79% of total deviation costs were created during design and 17% construction deviation costs (12.4% of total cost constitutes rework). Josephson (1990; 1994), Josephson and Hammarlund (1999) argued 50% of total costs of defects originated on site and further 32% originated from client or design organizations. Thus, the cost of nonconformance of the project is between 2.3 to 9.4% of contract value.

Barber et al (2000) in his study examines of the cost of quality failure cost in Civil engineering projects, reported that the costs of quality failure were 16 to 23% when the costs of delay were included. But, if the costs of delay were excluded, the corresponding quality failure costs were 3.6 to 6.6%. Fayek et al. (2003) from the study conducted in Canada, 108 field rework costs were summarized as; engineering and reviews 61 to 65%, human resource capability 20-49%, materials and equipment supply 14.81%, contract planning and scheduling 2.61% while leadership and communication 0.45%. Rhodes and Smallwood (2002) in another research reported in South Africa, rework cost was found to be 13% of the value of completed project. It was also reported in the paper, that rework cost in a research conducted by the Association General contractors of American on Time projects was 12.4% of the project cost.

Construction Industry Development Authority in Australia found that average rework cost in projects without a formal quality management system is 6.5% of contract value and that this is high under lump sum project, 15%. However, the average rework cost for projects with a quality system was found to be 0.72% (Love and Edwards, 2004). Love (2002), in another Australia based research conducted on 161 projects, the mean cost for direct and indirect rework cost were reported to be 6.4 and 5.6% respectively of the original contract value. Though, the research asserted that procurement type has no significance influence on rework. Marosszeky (2006) in a research conducted in New South Wales of Australia found that rework costs were 5.5% of contract value; this includes 2.75% as direct costs, 1.75% indirect costs for main contractor and 1% indirect cost for subcontractor (Josephson et al., 2002). A Swedish based study revealed that the estimated cost for correcting a total number of 2.87 construction errors or defects was 4.4% of the construction value for the observation period.

Palaneeswaran (2006) an Hong Kong based research, in a sample of private building project (new building) the direct cost of rework was reported to be 16.1% of the original contract value and the corresponding value for indirect costs was 4.8%, the time overrun for the same project was approximately 58% of the contract period. In another report rework cost in a new private construction project, the direct cost of rework was found to be 3.5% of the original contract value; the corresponding indirect cost was 1.7% and the time overrun was 8.3%. On the average for the entire projects considered, total rework costs was 3.47%, this result was not too far from 2.3 to 9.4% of contract value as reported by the normative literatures and also, the time overrun was reported to 37.26%. Thus, the result showed that the average rework costs and time of the selected projects were lower than what has been reported across the Globe.

Conclusion

In order to examine rework cost of selected building projects, the study has been able to explore archival data

of completed building projects and the following conclusions were drawn that the project delivery indices showed that projects are known for overrunning their initial time and estimated cost in Nigeria of which Niger State is a subset. This research reported 37.26% of time overrun and 9.88% of cost overrun. The average percentage of rework costs of 3.47% was recorded on the entire project considered while the rework cost for new building was found to be 5.06 and 3.23% for refurbished building projects. Therefore, it was concluded that to improve project performance and to reduce the menace of rework costs, there is need for consensus to be reached on a workable mechanism to bring together the client and the contractor to minimize change orders and introduction of additional works during construction phase.

REFERENCES

Abdul-Rahman H (1997). Some observations on the issues of quality cost in construction. Int. J. Qual. Reliab. Manag., 14(5): 464-481

Aibinu AA, Jagboro GO (2002). The effects of construction delays on project delivery in Nigerian construction industry. Int. J. Proj. Manag., 20: 593-599

Ajanlekoko JO (1990). The rise in Costs of Building Materials and the Structural Adjustment Programme – How Proportionate? Niger. Quan. Surveyor, 9: 44-52

Annunobi A (1997). Construction in the context of national Economy AARCHES J., 7(4): 4-5

Barber P, Sheath D, Tomkins C, Graves A (2000). "Quality failures costs in civil engineering projects." Int. J. Qual. Reliab. Manage., 17(4/5): 479–492.

Burati JL, Farrington JJ, Ledbetter WB (1992). Causes of quality deviations in design and construction. J. Constr. Eng. Manag., 118(1): 34-49

Christopher SM, Sinem K, Leidy EK, David RR (2009). A Design Process Evaluation Method for Sustainable Buildings. Archit. Eng Des. Manag., 5: 62-74.

CII (2001). An investigation of field rework in industrial construction, Research summary Construction Industry Institute, Austine, Texas, USA, pp. 153-511.

Cnuddle M (1991). Lack of quality in construction – economic losses, Proceedings of 1991 European Symposium on Management, Quality and Economics in Housing and other Building Sectors, pp. 508-515.

Elinwa A, Buba S (1993). Construction Cost Factors in Nigeria. J. Constr. Eng. Manag., 119(4): 69.

Enache-Pommer E, Horman M, (2009). "Key Processes in the Building Delivery of Green Hospitals," Build. Sustain. Future, pp. 636–645.

Fayek RA, Dissanayake M, Campero O (2003). Measuring and classifying construction field rework: a pilot study. Department of Civil and Environmental Engineering, University of Alberta. Presented to the Construction Field Rework Committee, Construction Owners Association of Alberta, pp. 1-4.

Fugar FDK, Agyakwah-Baah AB (2010). Delay in building construction projects in Ghana. Aust. J. Constr. Eco. Build., 10(1/2):103-116.

Hammarlund Y, Jacobsson S, Josephson P (1990a). "Quality failure costs in building construction." Proceeding CIB W55/W65 Joint Symposium, International Council for Building Research Studies and Documentation, Sydney, Australia, pp. 77-89.

Hammarlund Y, Jacobsson S, Josephson P (1990b). "Quality observer—a new role at the construction site?" Proceeding CIB W55/W65 Joint Symposium, International Council for Building Research Studies and Documentation, Sydney, Australia, pp. 90-102.

Hammarlund Y, Josephson PE (1991). "Sources of quality failures in building." Proc., European Symposium on Management, Quality and Economics in Housing and Other Building Sectors, pp. 671-679.

Ibrahim YM, Kaka AP, Aouad G, Kagioglou M (2008). As-built Documentation of Construction Sequence by Integrating Virtual Reality with Time-lapse Movies. Archit. Eng. Des. Manag., 4, 73-84.

Josephson PE, Hammarlund Y (1999). "The causes and costs of defects in construction. A study of seven building projects." Autom. Constr., 8(6): 681-642.

Josephson PE, Larsson B, Li H (2002). Illustrative benchmarking rework and rework costs in Swedish construction industry. J. Manag. Eng., 18(2): 76-83.

Kazie MI (1987). The Development of Indigenous Contracting in Nigeria. Niger. Eng., 4(2): 41.

Love PED, Li H (2000). Quantifying the Causes and Costs of Rework in Construction, Constr. Manag. Eco., 18(4): 479-490.

Love PED (2002a). Influence of project type and procurement methods on rework costs in building construction projects. J. Constr. Eng. Manag., 128(1): 18-29.

Love PED (2002b). Auditing the indirect consequences of rework in construction: Case based approach. Manag. Aud. J., 17(3): 138-146.

Love PED, Smith J (2003), "Benchmarking, bench-action and bench-learning: rework mitigation in projects", ASCE J. Manag. Eng., 19(4): 147-59.

Love PED, Edwards DJ (2004). Determinants of rework in building construction projects. Engineering, Constr. Archit. Manag., 11(4): 259-274.

Love PED, Smith J, Li H, Mandal P (1998). Overcoming the Obstacles Associated with Quality Certification. proceedings of the Royal Institution of Chartered Surveyors.

Low SP, Yeo HKC (1998). A construction quality costs quantifying system for the building industry. J. Qual. Reliab. Manag., 15(3): 329-349.

Okpala D, Aniekwu A (1988). Causes of high costs of construction in Nigeria. J. Constr. Eng. Manag., 114(2): 233-245.

Olaloku FA (1987). The second – tier Foreign Exchange Market (SFEM) and the Construction Industry in Nigeria – Options and Challenges. Constr. Niger., 4(1): 4-8.

Marosszeky M (2006). Performance Measurement and Visual Feedback for Process Improvement, A Special Invited Lecture presented in the SMILE SMC 3rd Dissemination Workshop on 11th February 2006, Centre for Infrastructure and Construction Industry Development of The University of Hong Kong, Hong Kong, 25 Slides. Available at: http://smile.hku.hk.

Palaneeswaran E (2006). Reducing Rework to Enhance Project Performance levels. Proceedings of the one day seminar on "Recent development in project Management in Hong Kong, 5.1 – 5.10.

Rhode B, Smallwood JJ (2002). Defects and Rework in South African Construction Projects. proceedings of the Royal Institution of Chartered Surveyors.