Projects Management and the effect of Rework on Construction Works: A Case of selected Projects in Abuja Metropolis, Nigeria

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ABSTRACT

Rework in construction projects is an unwanted or undesirable menace which has more negative effect than positive. The negative effects include delays in works schedule, wastages, use of extra money which means reduction in profit margin to the contractor and a higher project cost. It is caused majorly by poor project planning and supervision, poor contractual arrangement, omissions, design/user change orders, defects and errors during construction, alterations to initial design and use of poor/inferior materials. This work adopts an inductive, qualitative method where two projects which were supervised by the authors who kept a record of rework activities from setting out of the projects to completion and hand over. Pictures of the completed projects were also taken. The result was presented and analysed using tables and simple percentage. Findings showed that rework in project one cause a total of 43 extra days which is 38% schedule over run an N3,341,805.00 (three million, three hundred and forty one thousand, eight hundred and five Naira only) which is 12.85% additional cost for the project to be completed. Project two also had 14 extra days used for rework activity which is 16.7% schedule over run. Based on the foregoing, the study recommends that rework can be reduced greatly if effective project planning and supervision is carried out and a deliberate implementation and enforcement of quality assurance put in place.

***Keywords**: Projects Management, construction works, rework, works schedule, project cost*

INTRODUCTION

In the construction industry, the aim of project control is to ensure that the projects are completed on time, within budget and achieving other project objectives (Kerzner, 2003 cited in Olowa, 2015). It is a complex task undertaken by project managers in practice, which involves constantly measuring progress, evaluating plans and taking corrective actions when required. This is truly project management. During the last few decades, numerous project control methods, such as Gantt Bar Chart, Program Evaluation and Review

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ISSN: 2360-7459

Technique (PERT) and Critical Path Method (CPM), have been developed (Nicholas 2001, Lester 2000 cited in Olowa, 2015). A variety of software packages have become available to support the application of these project control methods, for example Microsoft Project, Asta Power Project, Primavera, etc. According to Kerzner (2000) cited in Inuwa, Wanyona Githae and Diang'a Stephen, 2014), work flows and project coordination are arranged horizontally and vertically, thus resulting in an extensive planning and coordination. In their opinion, project management approach results in improved coordination and communication among employees and managers as well as, generates productivity, efficiency, and effectiveness.

It should be noted that management is concerned with getting things done through people. Therefore in case of a project, what is managed is not the house that is built, or the road that is constructed but the people doing the job are the ones managed. So project management does not preclude deciding who does what, where, when and how. If what to be done is not properly specified and the place it is to be done decided, then that marks the starting point of the failure or rework process. Similarly, knowing when (the time) the work or project is to commence and how it will be done, is a serious project management strategy a good project manager should understand.

Rework is defined as the unnecessary effort of re-doing a process or activity that was incorrectly implemented at the first time (Love and Edwards, 2004). Rework is also defined as the process by which an item is made to conform to the original requirement by completion or correction (Ashford, 1992). It is also defined as doing something at least one extra time due to non conformance to requirements (CIDA 1995 as quoted by Love, 2002). Rework is a silent consumer of time, resources and trust. It is the singular most potent destroyer of an excellently prepared works schedule as works are usually put on hold to attend to any rework that has arisen. Besides the failure of the schedules, it adds to the cost of the project, sometimes, significantly. This is because breaking down an already executed part of the structure is usually done so as to redo it and by this, new materials, labour and plant/machinery are mobilized afresh to get the activity done again, hence financial and time wastage. Looking at the causes of rework is very necessary so that project managers, designers, clients and contractors will take advantage of this to avoid their occurrence. This study highlights the causes, effects and remedies of rework so that it can be used as a guide to the aforementioned stakeholders of construction projects, so that rework can be reduced significantly, thereby adding to the contractors profit margin and encourage the delivery of projects on schedule. The challenge of rework costs which include labour, materials, equipment and sub-contractors can run from 2% to 20% of a projects' total contract amount (CII, 2012).

Rework has been identified as a significant factor that contributes to cost increases and schedule delays on projects (Love, 2002). Li, Love and Drew (2000) argue that rework transpires as overtime, additional hiring of resources (including labour and plant), schedule spillage, and reduction in project scope or quality. Ackermann, Eden and Williams (1997) say the adverse consequences of these difficulties include reduced profit, loss of market share and reputation, increased turnover of management and workforce, lower

productivity, higher costs and all too frequently, costly litigation between participants over responsibility for over runs and delays. The major problems of costs overrun, which translates into reduced profit margin for the contractor and an eventual higher cost of executing the project considered as wastages and the delay in project delivery on schedule, are all caused by the menace called rework. The above highlighted problems are the reasons behind the desire to undertake this study hoping that it will translate into a solution for the problem.

This study is needed as it will help project supervisors with information on the causes of project delay so that they can be avoided. It will also help designers to properly brief their clients on the anticipated performance of their projects when completed so that there will be a reduction in user change orders which is a major cause of rework activities on site. The study is also needed as it will help reduce project cost which translates into both more profit to the contractor or builder and reduced final project cost for the client. Love, Zahir and Edwards (2004) say that rework is the primary cause of time and schedule over runs in projects. Rounce (1998) examines the use of inexperienced staff that lack technical knowledge and concludes that they can lead to errors and omissions in contract documentation being made". Burati and Farrington (1989) say design related rework in the form of change orders is the major source of rework in construction projects.

According to Barber, Sheath, Tomkins and Graves (2000), the specific factors that contribute to rework include; inadequate supervision, damage to other trades due to carelessness, low skill level and poor use of materials. It is also worth mentioning that the use of substandard materials propelled by greed also results into rework. This means that a contractor who is driven by greed turns to using low quality products or materials so as to cut cost and maximize more profit ends up in rework. This is so because rework influences the progress of any project. Love (2002) posits that rework can be said to be that aspect of work that influences a project's progress and causes disruption of project schedule. Love also said rework has been identified as a significant factor that contributes to cost increases and schedule delays on projects. Josephson and Hammarlund (1999) identify the following factors as what contribute to rework during construction. Poor management and employee training, low skill level of sub-contractors, lack of supervision and on-site inspection damage due to carelessness, poor planning and co-ordination of site resources and poor workmanship and use of materials.

According to Love (2001), although design related issues form a significant proportion of rework costs, a greater number of rework related incidents tend to occur during construction and therefore likely to increase indirect costs due to consequential disruption and delays. Aside the aforementioned instances that lead to rework, other cases like getting kickbacks from contractors by the supervision team especially in government projects is one of the silent invoker of rework. This kickbacks invariably causes cutting corners by the contractor to recoup the sum spent on kickbacks. CIDA (1995) finds that projects with a formal quality management system in place recorded lower levels of rework. The average cost of rework as a percentage of contract value for projects with a quality system was found to be 0.72%. Whereas those projects without a quality system in place

have been found to have an average cost of rework 6.5% while projects procured using lump sum contracts were found to have rework costs as high as 15% of contract value (Burati and Farrington, 1989). Love, Zahir and Edwards (2004) argue that when Total Quality Management (TQM) is applied holistically in conjunction with reward schemes, rework can be significantly reduced or eliminated. Abdulrahman (1993) observes that a dearth in communication flow between the client and design team members can result in documentation errors and omissions occurring. Clients and design team factors that have been identified as contributing to rework include; inadequate funding provided during site investigations, inadequate time and funds attributed to the briefing process.

Payment of low fees for preparing contract documentation, ineffective use of information Technology (for instance, visualization) and poor design coordination between design team members. In agreement with Abdulrahman above, poor communication between project Supervisor/Engineers and artisan/workmen on site leads to most of the errors during production which ends in rework. Jim (2012) says "rework happens on every project …and the average cost is staggering". Love and Edwards (2004) suggest that the root causes of rework, can be categorized into different groups; client-related, design-related and contractor related factors including site management and sub contractor factors. Rework however, has become an accepted part of the construction process. Hence, this study is designed to evaluate the relationship between projects management and the effect of rework on construction works using selected projects in Abuja Metropolis, Nigeria as an eye opener.

METHOD

This study adopts the expository research design. Two projects in Abuja Metropolis which the authors were directly involved in their execution were used as a case study. Detailed documentation was kept of all activities that had to be done again and what caused the initial failure of these two projects. The total costs associated with the activities were recorded. The recorded information from the projects forms the primary data for this study. The first building belongs to Nigerian Educational Research and Development Council (NERDC) called "New Library Complex" awarded via a letter with reference no NERDC/N.433/11/54, dated 09/01/2006 for a contract sum of twenty five million, nine hundred and ninety eight thousand, seven hundred and sixty seven Naira only (N25,998,767.00). The duration was 16 weeks. It is a one storey building with a floor size of 31m x 30m = 930m^2 with a court yard of 30m^2 at its centre, it has 32 rooms, one conference hall on the first floor and a 100 capacity hall on the ground floor. It has a major staircase to the front area of the building and a smaller (exit) stair case at its rear side. The building has a roof gutter and a parapet and roofed with red colour oven baked long span aluminum (Fig. 1).

The second building belongs to Defense Headquarters, Area 10, Abuja called "DHQ Restaurant Building" awarded via a letter with reference number DHQ/Log/Vol.3/185 and dated 19th February, 2007, at a contract sum of Sixteen Million Seven Hundred and sixty four thousand, one hundred and ninety three Naira, fifteen Kobo (N16,764,193.15) only. The duration was 12 weeks. It is a one storey restaurant project measuring 18m x

16m = 288m^2 in size. The ground floor comprises a kitchen, store, office washing bay, a restaurant for junior personnel and toilet facilities. The first floor comprises the officers' restaurant, serving area an office and toilet. The two floors are connected with one major stair case.

Project 1: The NERDC new library complex at Sheda, Abuja. ***Source:*** Authors' Fieldwork, 2015

Project 2: Defence Headquarters Officers Restaurant at Area 10, Garki Abuja
Source: Authors' Fieldwork, 2015

RESULTS AND DISCUSSION

Causes of Rework in Project One

Contractor: Cutting corners, errors, poor supervision, hiring of unskilled labour.
Designer: Omission
Client: Change orders.

i Problem one was a deliberate attempt by the contractor to maximize profit. First rework activity on the site – causing delay of nine days to the project schedule.

The profit the contractor wanted to maximize was eroded and his profit depleted.

i Problem two was an omission by the contractor. Drawings showed the drain pipe, but omitted by the contractor during construction at first until error was discovered before correction was made (Abdulrahman, 1993).

iii The third problem was an omission by the structural Engineer who designed the structural details – as the beam was not shown in the beam layout plan (Love, 2002).

iv Problem four was a deliberate lowering of concrete quality by the contractor in an attempt to cut expenses, thereby maximizing profit in the long run, he re casted twenty one square columns from his resources since it was a poor quality issue as the initial job did not meet quality standards (Burati and Farrington, 1989).

v Problem five was mistakes caused by inexperience and lack of technical know-how of iron benders hired by the contractor as the reinforcement was supposed to be laid like that of a cantilever, laid on the upper side of the concrete with concrete cover up but the iron benders laid it like that of a normal slab on the lower part of the concrete with concrete cover down (Rounce, 1998).

vi Problem six was due to client's change orders which were as a result of improper brief to the designer who omitted the rear staircase that had to be constructed after work had gone past that level (Love, 2004).

Table 1: Summary of Rework Causes, Effects and Duration of Rework in Project One

S/N	Problems	Causess	Effects	Duration
1	Use of wrong reinforcement for columns starter bars	Contractors cutting of corners	Extra cost to contractor and schedule delay	9 days
2	Omission of a main drain pipe from court yard to outside drains (Gutter)	Error of contractor	Extra cost to contractor and schedule delay.	4 days
3	Omission of a major beam at the decking level	Omission by structural designer not detected by contractor	Extra cost to client, schedule delay and reduced project performance	7 days
4	Poor quality concrete columns erected in first floor	Poor supervision and cutting of corners to maximize profit	Lost of profit by contractor and schedule delay	4 days
5	Poor laying of reinforcement in suspended gutter and parapet	Inexperience and unskilled, workmanship/poor supervision	Extra cost to client, changed project look and schedule delay	11 days
6	Omission of a rear stair case in the design	Change orders by client	Extra cost to client and schedule delay	8 days
	Total Duration of rework			**43 Days**

Source: Fieldwork, 2015

Effects of Rework on Project One

The effects of rework include: Lost of profit by the contractor, extra project cost to the client, schedule delay, reduced project performance and changed project outlook (Love, Zahir and Edwards, 2004). A total of forty three (43) days were used for all rework activities on this project which was awarded for a duration of sixteen (16) weeks which equals one hundred and twelve (112) days. This then means that the project over ran its schedule by 38%, expending extra one third of its duration. This shows that due to rework activities, it was not possible for the contractor to deliver the project on schedule. This

ISSN: 2360-7459

confirms schedule overruns by Love, Zahir and Edwards (2004). On the matter of cost, the total amount put forward by the contractor requesting the client to pay him was put at three million, three hundred and forty one thousand eight hundred and five naira (N3,341,805) only. There was a long drawn battle as to what the exact figure should be, because the client agreed to pay for the cost of his change orders and designer's omissions, but the contractor's errors and poor quality rework were contested by the client. This figure gives 12.85% cost increase on the project sum (Jim, 2012).

Causes of Rework in Project Two

Contractor: Poor workmanship and poor supervision.
Designer: Omission

i This rework activity was due to poor quality work on the part of the contractor who did not properly compact fill material before laying hardcore and casting over site concrete which lead to its failure (CIDA, 1995 and Burati and Farrington, 1989).

ii This problem was an omission by the structural Engineer who designed the structural details and the contractor could not dictate the problem until the decking had been casted and forms stricken.

A total of 14 days were used for rework activities on project two which was awarded for a duration of twelve (12) weeks which equals eighty four (84) days. Since rework took fourteen (14) days out of the duration, this gives 16.7% schedule over run (Love, Zahir and Edwards, 2004). Due to rework activities, it was not possible for the contractor to deliver the project on schedule. The contractor also put up a claim of Two million, six hundred and thirty four thousand, four hundred and thirty naira (N2,634,430) only but the client bluntly refused to pay the contractor's claims for rework. Contractor's cost overrun was 15.7%, though not paid, so lost of profit to the contractor (Ackermann, Eden and Williams, 1997). Rework in project two also lead to schedule and cost over runs (Love, Zahir and Edwards, 2004).

Table 2: Summary of Rework, Causes and Duration of Rework in Project Two

S/N	Problems	Causes	Effects	Duration
1	Improper compaction of fill material leading to the sinking of a portion of the oversite concrete	Poor workmanship by the contractor and poor supervision	Reduced profit to contractor and schedule delay	3 days
2	Omission of a major central column by structural designer	Omission by designer	Reduced profit to contractor, reduced project performance and schedule delay	11 days
	Total duration of rework			**14 days**

Source: Fieldwork, 2015

The Effects of Rework on Project Two

There was delay in project delivery which means that the contractor's time was wasted, that is, time that he should have used for other projects or for some other activities, was

used for rework activities on the site. The contractor's reputation was seriously damaged particularly in project one. He could not win the award for the second phase of the same project as a result. In simple terms, there were wastages on both projects by the contractors. There is also lower productivity on the side of the contractor. The effect of rework on the client include extra cost of the project where he agrees to shoulder responsibility for rework activities. It also leads to delay in taking possession of the project by the client. The performance of the project is reduced particularly where breaking down of some elements took place before any activity was done again.

CONCLUSION AND RECOMMENDATIONS

The two projects presented in the case study shows that there was use of extra cost to redo the activities which translated into reduced profits. The causes of rework on projects can be reduced by carefully adopting the recommended ways of avoiding rework above. Checks against the use of inferior building materials which usually lead to stoppages and a complete removal or breaking down of already executed works to re-do the element over is a major cause of rework in projects. Therefore, the need for the project quality management plan (QMP) cannot be over emphasized. Designer and user change orders during project execution is another major cause of rework. If this is checked against, it can reduce rework drastically. There is also the need for project supervisors to carefully supervise their projects on a regular basis so as to reveal areas of errors and omissions. Again, care must be taken when employing work men, so that unskilled men are not employed instead of well trained men. Rework activities on site can be reduced drastically if all parties play their roles well in project delivery. Based on the findings of this study, these recommendations are made:

i. Checking and cross checking of the design as presented by the design team by the contractor and the production of a build ability analysis of the design by the contractor will help in unearthing errors and omissions in the design, which can help in reducing rework incidences in the cause of the project.
ii. Effective day to day project supervision by the project Engineer will go a long way in eliminating errors and defects, thereby reducing the incidences of rework.
iii. The hiring of competent and experienced skilled work men will reduce errors due to inexperience thereby reducing the incidences of rework in the project.
iv. Implementation and enforcement of project quality management plan on the project will simply lead to producing a quality project thereby reducing rework due to poor quality.
v. Improved communication between project Engineer and work men can help reduce rework due to poor communication.
vi. In order to avoid change orders by client in the cause of the project, there is the need for him to be properly educated on how the performance of his design will be when built. This will make him to make inputs into areas that he will need changes before project construction gets underway.

ISSN: 2360-7459

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ISSN: 2360-7459