Causes and Control Measu res on Project Execution Cost in the Construction Industry in the Tamale Metropolis

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Abstract

This research looks at the sustainable construction project execution in Ghana and focuses on the influence of factors contributing to increase in projects execution cost, factors affecting project cost control, causes of materials waste generation on sites, materials waste generation effect on projects cost, and material cost reduction strategies in the building industry. The study employed stratified random sampling, simple random sampling and purposive sampling techniques in selecting the respondents. The study found that the influential factors that cause increase in project cost are fluctuation in price of raw materials (3.13) and unforeseen site conditions (3.03). The results also showed that unsuitable construction equipment and methods (2.96), shortage of skilled labour (2.80), and poor contract management (2.76) are the challenges in controlling a project cost increased. Furthermore, the lack of regular clerk supervision (33.3%), theft of materials (30.0%) and inability of site supervisor to read and interpret working drawings (20.0%) are the causal factors of waste generation. The findings also indicate that cost waste prevention activities (2.80), conducting periodic brainstorming session on how to reduce waste (2.73) and post jobsite waste reduction plan in central locations (2.70) are the waste reduction strategies on construction site. Based on the findings of the study, it is recommended that project managers should adopt acceptable management tools and measures, apply project waste reduction strategies and project cost control measures to enhance on project efficiency.

Key words: *Construction, Cost Control, Materials, Strategies, Waste Management*

I. INTRODUCTION

The construction industry plays a major role in economic development in the less industrialized nations since it constitutes a significant portion of both gross national product and of employment. Indeed, the creation of physical facilities constitutes more than one-half of the gross domestic investment of both developed and developing nations. The industry also plays a key role in satisfying a wide range of physical, economic, and social needs and contributes significantly to the fulfilment of various major national goals. The construction industry, being one of the vital constituents of any country's economy contributes about 10% of the gross domestic product (GDP). This showed a growth rate of 1.8% worldwide in 2001 (Cousins, 2002). The United States of America, Europe, Japan and Asia are the largest construction markets, controlling more than 70% of the market. This growth in construction activities increases the amount of construction waste generated (Chandrakanthi, 2002). Ganesan (2000) argued that construction materials account for the largest input into construction activities, in the range of 50%-60% of the total project cost. Unfortunately, this large portion of materials is not wholly utilized by the industry. Evidence shows that approximately 40% of the waste generated globally originates from construction and demolition of buildings (Muhwezi et al., 2012).

In recent years, the construction managers have often failed in identifying or addressing waste management problem in the construction processes at sites because of lack of appropriate tools for measuring them, which subsequently affects sustainability of the construction firms. In construction industry, it is important to have control on cost performance of projects to ensure the construction cost is within the estimated budget. In view of this, prudent project cost management is needed to keep the project within its defined budget. Project Management Institute (2004) defines project management as application of knowledge, skills, tools and techniques to project activities to meet project requirements. A project gets more scientific and systematic when the project gets larger and more complex.

II. Statement of the problem

The quest towards sustainable development, both nationally and globally, puts the construction industry at the forefront as the main consumer of natural resources. The industry has profound economic, social and environmental impacts.

Sustainable construction is one of the most challenged faced by the construction industry today. It is a broad and complex concept, which has grown to be one of the major issues in the construction industry. Consequently, there are proliferations of researches in this field. These researches are explicit on the material waste, cost overrun, time waste, labour waste, and process waste that affects sustainability execution of construction projects, for both strategic (company) and operational (private project). Admittedly, whilst there are hosts of managerial and tools in this domain, there are a lot of wastes being generated in the construction industry in the Tamale metropolis. Most of the wastes generated in the metropolis are project based, hence the need to integrate best waste management practices in other to achieve sustainability at the constructional level. Those that addresses sustainability issues at strategic level are either too complex to use or less comprehensive. As a result, major barriers still persist in integrating sustainability issues at the strategic level (Adetunji, 2005).

Furthermore, improper control of materials during different stages of construction has caused waste, delays and cost of projects and associated environmental problems (Wahab, 2011). The issue of waste management (cost and time) and how it is affecting the constru bhction industry among companies and private sector in the metropolis is an issue of concern. In this light, there is the need to have sustainable execution of projects in order to minimize waste that results in increased in projects execution cost in the industry. Indeed, responsible management of waste at site is an essential aspect of sustainable building. In this context, managing cost of projects execution means managing waste generation where possible; minimizing waste where feasible; and reusing materials which might otherwise become waste (Napier, 2012). There are four fundamental constraints needed to be considered when managing the construction projects. These are the scope, cost, time, and quality of the project. It is also found that, there are many problems in assessing cost performance of project and the major problem is cost overrun on construction projects (Ali & Kamaruzzaman, 2010). Also, project cost overrun is a major problem in project development and is a regular feature in construction industry. The situation is more emphatic whereby a construction project budgetary estimate exceeds estimation, budget exceeds budgetary estimate, and settlement exceeds budget becomes a universal phenomenon. Construction cost which is out of control adds to investment pressure, increases construction cost, affects investment decision-making and wastes the national finance might result in corruption or offence. Hence, it is important to identify the factors that contribute to cost overrun to avoid and reduce the problems (Ali & Kamaruzzaman, 2010).

III. Objective of the study

The main objective of the study is to explore construction practices affecting project cost in the Tamale Metropolis. The specific objectives of the study include

1. Investigate the causes of increase in projects execution cost in the Tamale metropolis
2. Determine the factors inhabiting the effective control of increase project execution cost among construction firms in the metropolis
3. Examine the effective techniques for controlling causes of increase of the execution cost of projects on sites.
4. Assess the extent to which construction firms employs effective management practices to reduce material waste during project execution in Tamale Metropolis
5. Examine the current rate of material waste generation and its impact on project execution cost on sustainable projects execution in the Metropolis.

IV. Literature review

Waste is a familiar term in the industry world-wide (Ekanayake & Ofori, 2000). Waste in the construction industry is important not only from the perspective of efficiency, but also its concern has been growing in recent years about the adverse effect of the waste of building materials on the environment (Formoso et al., 2002). The construction industry has been found to be a major generator of waste (Ekanayake & Ofori, 2000; Faniran & Caban, 1998). In the industry, waste has been considered to be a major problem in the construction industry not only does waste have an impact on the efficiency of the construction industry but also on the overall state of the economy of a country (Polat & Ballard, 2004).

Pinto (1989) developed a study based on one site only and pointing out for the fact that indirect waste can be higher than direct waste. Skoyles (1976) monitored material waste in 114 building sites and concluded that there is a considerable amount of waste that can be avoided by adopting relatively simple prevention procedures. In addition, storage and handling were pointed out as major causes of material waste. Most of the problems concerning waste on building sites are related to flaws in the management system, and have very little to do with the lack of qualification of workers. Furthermore, waste is usually caused by a combination of events, and not due to an isolated factor (Skoyles, 1976). In a study conducted by Soibelman (1993) on waste management in Brazil, he concluded that the waste of building materials is far

higher than the nominal figures assumed by the companies in their cost estimates. There is a very high variability of waste indices from site to site. Furthermore, similar sites might present different levels of wastes for the same material. This indicates that a considerable portion of this wastage can be avoided. As in the work of Skoyles (1976), most causes of waste are related to flaws in the management system, and have very little to do with the lack of qualification and motivation of workers. Arpad (2004) stated that as much as 50% of all materials extracted from the earth's crust are transformed into construction materials and products. The studies have also shown that not all materials procured and delivered to sites are used for the purposes for which they are ordered because of the number of processes they pass through before they are finally incorporated in a structure.

It is observed that, lack of onsite waste management plan, over mixing of material due to the lack of knowledge of the requirement , errors by tradesperson and labourer, changes in design, damage during transportation on site, contract document incomplete at time of construction commencement, and criminal waste due to damage or theft of equipment are among the major causes of material waste on construction site by project managers, contractors, site representatives and waste management supervisors (Urio & Brent, 2006). Muhwezi, Chamuriho and Lemamuh (2012) argued that the increased in economic growth and urbanization in developing countries has also led to extensive construction activities that generate large amounts of wastes. As such, material wastes on building projects have not only caused financial setbacks to contractors and government, but also caused significant impacts on health, aesthetics and the general environment. Therefore, management of these wastes is still a problem in the construction sites in Ghana, most especially in the Tamale metropolis and their causes need to be ascertained in order to pave way for their proper management.

V. Methodology

1. The study area

Tamale is the capital city of the Northern Region. The metropolis is bounded by Yendi Municipal to the East, Tolon District to the west, Savelugu Municipal to the North, Central Gonja Districts to the South west and East Gonja District to the south (Puopiel, 2010). People in the peripheral communities around Tamale area are mostly farmers whereas only a small proportion of the people in the city are engaged in farming activities.

2. Sampling techniques and sample size determination

In this research, the population includes construction companies of first (D1K1), second (D2K2) and third (D3K3) category respectively that have a valid registration with the Tamale Metropolitan Assembly. These three categories were selected based on the assumption that they have experience, efficiency, managerial and financial capability. According to the Tamale Metropolitan Engineer, there are sixty (60) registered construction companies with the assembly. There are several other contractors who execute won tendered projects with the Metropolis but are not registered members. Due to time, cost, and the appropriateness of the data collected, the researchers settled on only the registered construction companies with the Tamale Metropolis. The registered contractors' population was 60 and are grouped into three subgroups (strata) by virtue of grades. There are twelve (12) of grade D1K1 contractors representing (20%), twenty two (22) of grade D2K2 contractors which represents (36.7%) and the remaining twenty-six (26) are grade D3K3 contractors representing (43.3%) respectively. The researchers used the same proportions to select samples separately from each stratum. The sample size for the study was 30. Table 1 shows the registered contractors with the metropolis and the sample size selected.

Table 1: Sampling size determination

Item	Grade of Contractors	Number of contractors	Sample size
1	D1K1	12	**6**
2	D2K2	22	**11**
3	D3K2	26	**13**
		60	**30**

3. Data collection methods and procedure

The researchers used questionnaires and site observation for the data collection. The questionnaire was administered to project managers and site supervisors of the registered construction companies. The questionnaires were in two categories. Category one was administered to project managers, which collected data on (A) Personal data of project managers, (B) Factors contributing to increase in cost of projects execution (C) Factors affecting project cost control, and (D) Company material cost reduction management practice. The other category was administered to site supervisors which collected data on (A) Personal data of the site supervisors, (B) Company's waste reduction practices on site, and (C) Company cost management practice. The questionnaires also had Likert scale to measure some variables. The researchers conducted observation on six (6) different project sites. Two sites on each grades

categories in the Tamale Metropolis using mainly a participant observation method.

4. Data analysis

The data was analysed using the Statistical Package for Social Scientists. The results are presented in Tables, Figures and Means.

VI. Results

1. Factors that causes increase in project cost

Table 1 contains the ranking of factors that causes increase in project cost execution. The results indicate that fluctuation in price of raw materials (3.13) is ranked first as the most influential factor that causes increase in project cost. This is followed immediately by unforeseen site conditions (3.03). The findings also show that, shortage of skilled labour (2.46), unsuitable construction equipment and methods (2.30), and high cost of machineries (2.03) were the least influential factors that causes increase in project execution cost among constructors in Tamale Metropolis.

Table 1: Ranking factors that causes increase in project cost execution

Causes of increase in project cost	Weighted Mean	Ranking
Fluctuation in price of raw materials	3.13	1
Unforeseen site conditions	3.03	2
Improper planning	2.93	3
Inflation of project costs	2.90	4
Inaccurate / poor estimation of original cost	2.76	5
Poor project management	2.70	6
Construction cost underestimation	2.56	7
Shortage of skilled labour	2.46	8
Unsuitable construction equipment and methods	2.30	9
High cost of machineries	2.03	10

Source: (Computed).

2. Factors affecting project cost control

The results show that the respondents ranked inflation on material prices as the first most affecting factor with a mean weighted value of 3.23. This was followed by unstable government policies (2.90) and risk and uncertainty associated with projects. Furthermore, non-performance of subcontractors and nominated suppliers was ranked third with a mean weighted value of 2.86. The findings also show that the least ranked factors are lack of proper training and experience of project managers with a mean weighted value of 2.46 and lack of appropriate software with a mean weighted value of 1.53.

Table 2: Factors affecting project cost control

Factors affecting project cost control	Weighted mean	Ranking
Inflation on Material Prices	3.23	1
Unstable government policies	2.90	2
Risk and uncertainty associated with projects	2.90	2
Non-performance of subcontractors and nominated suppliers	2.86	3
Contract and specification interpretation disagreement	2.83	4
Discrepancies in contract documentation	2.83	5
Inaccurate evaluation of projects time/duration	2.76	6
Non-performance of subcontractors and nominated	2.70	7
Conflict between project parties	2.60	8
Lack of proper training and experience of PM	2.46	9
Lack of appropriate software	1.53	10

Source (Computed).

3. Cost management practice at construction site

The results of the study show that the actual costs of projects are more than the estimated cost due to unstable economic indicators ranked as the first cost management practice with a mean weighted value of 2.33. The findings indicate that the second ranked cost management practices at construction site is the application of the actual value and earned value concept in controlling cost for a project. The study findings however show that the least ranked cost management practices at construction site is the application of software to plan, monitor and control cost with a mean weighted value of 1.90.

Table 3: Cost management practices at construction site

Management practice	Weighted mean	Ranking
Are the actual costs of projects more than the estimated cost because of unstable economic indicators?	2.33	1
Do you apply the actual value and earned value concept in controlling cost for a project?	2.20	2
Do you have the cost schedule associated with the estimated construction plan?	2.03	3
Do you have a cost engineer who is only responsible for dealing with cost control?	2.16	4
Do you apply any software to plan, monitor, and control cost?	1.90	5

Source (Computed).

4 Causes of waste generations

Figure 1 shows the causes of material waste generation on site. The findings of the study show that 33.3% of the respondents indicate that lack of regular supervision by clerks of work to site causes some changes which normal lead to waste generation. Also, 30.0% of the respondents indicated that theft of construction materials causes' material wastes generation on site. Moreover, the findings of the study

reveal that, 20% of the respondents indicated that, the cause of material waste generation on site is the inability of site supervisor to read and interpret working drawings. The results also reveal that, errors by tradesperson and labourer are the causes of causes of materials waste generation on site.

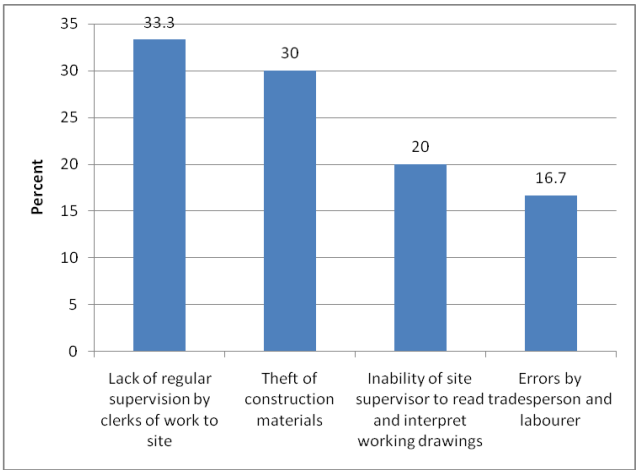

Figure 1: The causes of material waste generation on site
Source: (Computed).

5 Impact of material waste on project cost

Figure 2 shows the impact of material waste on project cost. The results indicate that 36.7% of the respondents asserted that, the impact of material waste on project cost is between 0.0-0.5 percent, while 16.7% of the respondents said that, the impact of material waste on project cost is between 1.6-20 percent.

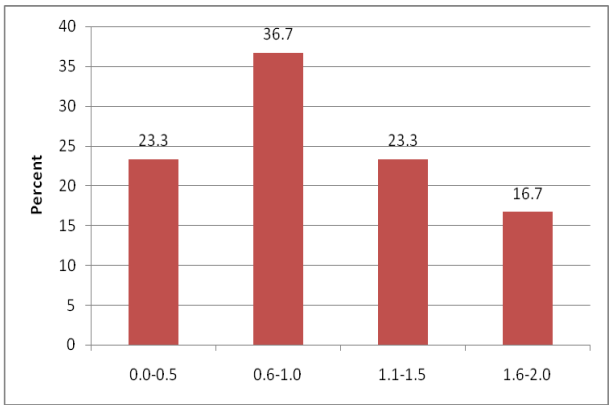

Figure 2: Impact of material waste on project cost
Source: (Computed)

6 Waste reduction strategies

Table 5 shows the waste reduction strategies. The results of the study indicate that the first ranked waste reduction strategies is the preparation of a construction waste management plan that include cost waste prevention activities with a mean weighted mean value of 2.80. This is followed by conducting periodic brainstorming session on how to reduce waste with a mean weighted value of 2.73. The findings of the study show that the least waste reduction strategy is reducing fuel and transportation cost on materials with a mean weighted value of 2.20.

Table 5: Waste reduction strategies

Strategies	Weighted Mean	Ranking
Prepare a construction waste management plan that include cost waste prevention activities	2.80	1
Conduct periodic brainstorming session on how to reduce waste	2.73	2
Develop and post jobsite waste reduction plan in central locations	2.70	3
Provision of positive incentive to workers on site	2.23	4
Reduce fuel and transportation cost on materials	2.20	5

Source: (Computed)

7 Waste control measures and methods

Table 6 presents the waste control methods on construction sites. The findings indicate that 36.7% of the respondents said that by regular taking stock of materials in store is a measure and method of waste control. Also, 26.7 of the respondents indicated that holding regular meetings and discussing pertinent issues on site is another measure or method of waste control. Furthermore, the results of the study show that 20.0% of the respondents said that construction companies employing more qualified tradespersons and labours a measure or method of controlling waste. The findings of the study also indicate that 16.6% of the respondents said that the use of integrated waste management.

Table 6: Waste control methods

Waste control methods	Responses	Percent
By regular stock taking of materials in store	11	36.7
Holding regular meetings and discussing pertinent issues on site	8	26.7
Employing more qualified tradespersons and labours	6	20.0
By the use of integrated waste management (IWM)	5	16.6

Source: (Computed).

6.8 Project cost management tools/techniques

Table 7 presents cost management tools/techniques adopted by construction companies in the Tamale Metropolis. The findings of the study indicate that the first ranked tool/technique is effective communication among workers with a mean weighted value of 2.93. The second ranked tool/technique of cost management is the critical path method to plan projects with a mean weighted value of 2.70. Furthermore, the findings of the study show that the bar chats, method statement of project and just in time are other important cost management tools/techniques

with a mean weighted value of 2.63, 2.56 and 2.30 respectively.

Table 8 shows the tools/techniques available and use in project sites. The results indicate that the use of critical path method to plan the projects is present in D1K1 and D3K3 construction companies. The findings also reveal that effective communication among workers and the bar chat tools/techniques are present in D1K1, D2K2 and D3K3 construction companies.

Table 7: Cost management tools/techniques

Tools/techniques	Weighted Mean	Ranking
Effective Communication Among Workers	2.93	1
Critical Path Method (CPM) to Plan The Projects	2.70	2
The Bar Chart	2.63	3
Method Statement (MS) of Project	2.56	4
Just In Time (JIT)	2.30	5

Source: (Computed).

Table 8: Management tools/techniques available and use in projects sites

Tools/techniques	D1K1	D2K2	D3K3
Critical Path Method to Plan The Projects	Present	Nill	Present
Just In Time	Nill	Nill	Nill
Method Statement of Project	Nill	Nill	Present
Effective Communication Among Workers	Present	Present	Present
The Bar Chart	Present	Present	Present

Source: (Computed).

7. Conclusion and recommendations

This research looks at the sustainable construction project execution in Ghana and focuses on the influence of factors contributing to increase in projects execution cost, factors affecting project cost control, causes of materials waste generation on sites, materials waste generation effect on projects cost, and material cost reduction strategies in the building industry. The findings indicated that, cost waste prevention activities (2.80), conducting periodic brainstorming session on how to reduce waste (2.73) and post jobsite waste reduction plan in central locations (2.70) are the waste reduction strategies on construction site. It is recommended that, acceptable management tools and measures, the use of project waste reduction strategies and project cost control measures should be adopted to enhance project efficiency by project managers of construction companies in the Tamale Metropolis. Furthermore, there should be a well plan training workshop for project managers and site supervisors on projects cost management techniques such as earned value analysis, progress reporting and work breakdown structure to help reduced the project cost management difficulty on site.

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