

1. Introduction

Construction cost management in many countries have been using the same conventional cost management systems since the 1920s from inception (Kern & Formoso, 2006; Owens, Burke, Krynovich, & Mance, 2007; Rad, 2002). Johnson and Kaplan, (1993) as cited by Kern and Formoso (2006) stated that the same cost management system which has been used in the 1920s is still in use in many construction firms. Ostrenga et al., (1998) as cited by Kern and Formoso (2006) noted that traditional cost management cannot provide the precise product cost and the system cost estimation does not include managerial decision making approach which eventually brings a positive impact on the project. Traditional cost management system is the conventional cost management system used since the 1920s. This term is used because of modern systems such as value management system and earned value management system which are operation in many construction firms around the world. However, systems such as the value management system, earned value management system, expert systems, benchmarking and building information modelling have emerged over the last sixty years to redefine the art and science of construction cost management. The enormity of negative factors influencing cost estimates at the pre-tender phase as stated by Ashworth (2010); Oyedele (2015) and Samphaongoen (2010), cost estimates always have latent errors which arises during the construction phase. Therefore, the need to focus more on post-contract cost control by project managers and cost managers during a construction project is imperative.

Cost estimation in construction has set rules by the Royal Institute of Chartered Surveyors and other Quantity Surveyor bodies in the various countries when construction cost estimates are prepared. Nonetheless, the same problems of cost and time overruns, variations during construction, construction disputes have always plagued construction activities. Ashworth (2010) noted the factors which influence the accuracy of cost estimates as being difference in design information, market conditions, experience of the project manager, project complexity and historical data. In a developing economy such as Nigeria, the challenges facing cost estimation is peculiar.

2. Literature review

This section addresses the challenges facing the conventional cost estimating system in Nigeria, the importance of kaizen costing as an effective panacea to the prevailing cost management challenges and the justifications for this investigation.

2.1 Factors affecting traditional cost estimation in the Nigerian construction industry

The unique challenges facing most cost and project managers during estimate preparation are related to a number of factors. Oyedele (2015) highlighted the various influencing factors as:

- a) Political situation: Most cost estimates are accurate during stable political times
- b) Government policy: Influence of local content investment policies, importation policies, taxes, method of procurement, number of foreign contractors or expatriates are some of the policies which may affect accuracy of cost estimates at a point in time.
- c) Economic condition such as inflation, monetary rate, interest rate on lending.

- d) The construction season such as rainy season and dry season may affect on-going construction work
- e) Geographical location of the project may also affect accuracy of estimates. In places such as the Niger Delta and Northern parts of Nigeria, the accuracy of estimates may be influenced by the topography, swamp or soil conditions
- f) Risk emanating from security may also have a drastic effect on the accuracy of construction cost estimates, especially in the Northern parts of Nigeria where there is high level of Islamic insurgency.
- g) Years which are close to the general elections in Nigeria have a lot of influence on the cost estimates because prices of building materials are lower and there are a lot of procurement activities and award of contracts.
- h) Corruption is a factor which affects cost estimates in Nigeria. Most cases of kickback during procurement have led to inflated cost estimates.

These factors can mar a construction project during the execution phase if they are not addressed. Although, other construction cost management systems, methods and techniques such as earned value analysis, value management, building information modelling may have been applied to curb the excessive cost and time overruns.

2.2 What is Kaizen costing?

Kaizen costing is a continuous improvement technique which emanates from kaizen, a product of the lean philosophy (Suárez-Barraza & Lingham, 2008; Suárez-Barraza & Miguel-Dávila, 2014; Suárez-Barraza, Ramis-Pujol, & Dahlgaard-Park, 2013). Kaizen costing mean continuous improvement of the cost of production, it was first introduced in the 1960s in Toyota (Arya & Jain, 2014; Brunet & New, 2003; Prošić, 2011; Puvanasvaran, Kerk, & Ismail, 2010). *Therefore, kaizen costing is the cost management aspect of kaizen which is usually utilized during the production phase.* The benefits of kaizen has been transferred to other sectors such as manufacturing , business management, development of small and medium scale industries and construction (Arya & Jain, 2014; Berger, 1997; Puvanasvaran et al., 2010). Several case studies by (Puvanasvaran et al., 2010; Suárez-Barraza & Lingham, 2008; Suárez-Barraza, Ramis-Pujol, & Kerbach, 2011) concluded that kaizen is very useful for improving manufacturers' profit in this instance contractors, enhancing the quality of products, providing more client satisfaction and encouraging better employee-employer relationship. This aspect of kaizen is the continuous improvement in the work place. However, the costing aspect involved the process which stems from a Plan-Do-Check-Action (PCDA) process. This process is based on an incremental approach of maintaining and reducing production cost.

This process stands on standardized production. Imai (1997) noted that the three M's in kaizen are muda (waste), Mura (irregularity) and muri (strain). These three words are the major check points of the kaizen process. Wastes are identified during the course of construction and eliminated. This lean related concept ensures adequate stakeholders involvement in the overhead cost reduction process. A kaizen costing team comprising the project manager, architect, cost manager and other relevant stakeholders take on the responsibility of identifying waste and elimination processes. Follow up activities are also carried out during this process for incremental cost reduction.

2.3 Activities for incremental cost reduction during construction

Post-contract cost control activities are based on techniques such as interim valuations, preparation of monthly statement of accounts, cash flow, variation management and monitoring of all activities related to the construction work. There is no technique for continuous cost maintenance and reduction. The traditional cost management technique available in most construction companies do not consider cost maintenance and reduction during construction. Kaizen costing during construction involves specific activities related to transportation, handling of materials on site, overhead cost monitoring and reduction, variations, equipment and plant cost, purchase orders, suppliers' and sub-contractors' cost, planning and preliminary items of work (IFS, 2010; Lin et al., 2001; Ashworth, 2010; Sanni and Hashim, 2013). These activities are very delicate and may lead to cost and time overrun if they are not monitored. In kaizen costing, these activities are monitored for waste, irregularities and strain. The continuous cost reduction process are based on these activities. They are summarized in table 1 below.

Table 1: Cost reduction activities required for incremental cost reduction

<i>S/N</i>	<i>COST REDUCTION ACTIVITY</i>	<i>REFERENCES</i>
<i>1</i>	<i>Continual reduction of plant and equipment depreciation overhead cost throughout the construction phase will keep the project cost within budget</i>	<i>Shang and Pheng, 2013; Granja et al., 2005; Suárez-Barrazaa and Lingham, 2008</i>
<i>2</i>	<i>Continual cost reduction of overhead cost of activities related to mobilization and equipment setup will keep the project cost within budget</i>	<i>Granja et al., 2005; Prošić, 2011</i>
<i>3</i>	<i>Continual reduction of activities related to drawing reviews and other variations or alterations will eliminate unnecessary cost thereby keeping the project cost within budget</i>	<i>Suárez-Barrazaa and Lingham, 2008; Granja et al., 2005; Martin, 1993; Kaur and Kaur, 2013</i>
<i>4</i>	<i>Ensuring activities related to construction variations are continually minimized will create more profit for the contractor</i>	<i>Ashworth, 2010; Dada and Jagboro 2007</i>
<i>5</i>	<i>Cost of activities related to purchase orders and material deliveries can be reduced continually throughout the construction phase to control the project cost for optimum profit</i>	<i>Lin et al., 2001; Mansuy, 2002</i>
<i>6</i>	<i>Overhead cost related to paying suppliers, sub-contractors and labourers can be reduced continually throughout the construction phase to keep the project cost within budget</i>	<i>Lin et al., 2001; Mansuy, 2002;</i>
<i>7</i>	<i>Continual reduction of overhead costs related to construction cost planning, general planning, resource planning and project reports will create more profit for the contractor</i>	<i>Sanni and Durodola, 2012, Sanni and Hashim, 2013; Lin et al., 2001; Granja et al, 2005</i>
<i>8</i>	<i>Continual reduction of overhead costs associated with preliminary items of work such as site office, storage, security, electricity, water supply, first aid and so on will</i>	<i>Sanni and Hashim, 2013; Sanni and Durodola, 2012; Lin et</i>