DETERMINANTS OF COST OVERRUNS IN CONSTRUCTION PROJECTS IN KENYA: A CASE OF MAKUENI COUNTY

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ABSTRACT

The problem of overruns in construction industry is an international phenomenon, although the situation varies from nations. The rate of variation is influenced by lots of factors based on general economy and construction environments in those nations. Overruns in construction project could be multi-faceted ranging from cost, time. Makueni County experiences cost overruns in most of the 296 construction projects being implemented by the year 2015. As a result, the study sought to establish the determinants of cost overruns in construction projects in Kenya. The specific objectives of the study were to establish the influence of materials procurement inflation, project planning, project risk analysis and project complexity on overruns in construction projects in Kenya. This study adopted a descriptive survey design. The target population of the study was 296 project managers in the construction projects that were ongoing in Makueni County by the year 2015. The descriptive, correlation and regression analysis were used to achieve the research objectives. The study findings indicated that all the investigated factors, that is materials procurement inflation, project planning, project risk analysis and project complexity significantly affect cost overruns. Project planning and project risk analysis negatively affected cost overruns while materials procurement inflation as well as project complexity positively affect cost overruns. The study recommends that the County government of Makueni should put in place measures to curb tendering maneuvers by contractors which leads to cost overruns in construction projects. Furthermore, e-procurement can be applied for procurement of materials so as to reduce cases of price inflation. The study also recommends that the project managers of construction projects in the County should implement project planning practices like pre-planning before execution of construction, planning during implementation stage of construction projects, ensuring enough material delivery on site before construction starts,
proper scheduling before construction starts and contractors following project schedule during construction so as to reduce cost overruns in construction projects.

**Key words:** Materials procurement inflation, Project planning, Project risk analysis, Project complexity

**Background of the Study**

A construction project is completed as a result of a combination of many events and interactions, planned or unplanned, over the life of a facility, with changing participants and processes in a constantly changing environment (Chan & Chan, 2004). Construction project development involves numerous parties, various processes, different phases and stages of work and a great deal of input from both the public and private sectors, with the major aim being to bring the project to a successful conclusion.

The level of success in carrying out construction project development activities will depend heavily on the quality of the managerial, financial, technical and organizational performance of the respective parties, while taking into consideration the associated risk management, the business environment, and economic and political stability. According to Wang & Chou (2003), as construction is becoming more complex, a more sophisticated approach is necessary to deal with initiating, planning, financing, designing, approving, implementing and completing a project.

According to Chan and Kumaraswamy (2006) a project is usually regarded as successful if it is completed on time, within budget and to the level of quality standard specified by the client at the beginning of the project. Balogun (2005) emphasized that the ultimate goal of any construction is to be delivered in the shortest possible time, at the lowest possible cost, with the highest quality while for many projects, this goal seems unachievable. In addition to ensure the success of projects, project management techniques and tools should be effectively utilized. Project management is about managing the resources, workers, money, equipment and machines, materials and methods to ensure projects success.

However Projects that are not managed effectively experience many cost overruns. In the past several decades, large construction projects have been known for their cost overruns and late completion times (Pickrell 2000; Flyvberg Holm & Buhl, 2003). Many factors are responsible for these cost overruns such as underestimation of costs to make the projects more viable, addition of scope during later stages of project planning and even during construction, changed conditions. One of the most important contributing factors to the magnitude of cost overrun in large transportation projects are project delays. Furthermore, the length of project development phase from planning to construction seems to be a major factor in the extent of cost overrun (Flyvbjerg, Holm & Buhl, 2004). The longer, larger projects tend to be more prone to cost overruns (Touran and Lopez, 2006)

**Statement of the problem**

The problem of overruns in construction industry is an international phenomenon, although the situation varies. The rate of variation is influenced by lots of factors based on general economy and construction environments in those nations. Overruns to construction project could be multi-faceted ranging from cost, time and other factors. According to a research
done by Flyvbjerg (2002) in global construction, it was found that 9 out of 10 projects had overruns.

In Kenya the Government and its development partners continue to allocate huge financial resources to finance infrastructure development in Kenya. However, the intended benefits are partly or never realized due to unsuccessful project implementation (Morris 2010). Most of the construction projects have been experiencing overruns. For example according to the Medium Term Expenditure Report, 67% of the civil works projects carried out by the Ministry of works and its sub-sectors in Mombasa County, 39% of those carried out by the Constituency Development Fund within the Mombasa County in the financial year 2010-2011 experienced Cost overruns. Projects in Makueni County have also been having cost overruns. Another example of a project that has failed to be sustainable is Mukindi Water Project in Mbooni Sub-County which has been funded by the County Government. Cost overruns hinder the project's progress, since it decreases the contractor's profit leading to huge losses leaving the project in a big trouble and thus there was a need for this study.

Past studies have been conducted on cost overruns in construction projects. Internationally, Durdyev, Ismail and Bakar, (2012) conducted a study on factors causing cost overruns in construction of residential projects; case study of Turkey. This study focused on improper planning, inaccurate project cost estimation, high cost of needed resources (money, men, materials and machinery), lack of skilled workforce, price of construction materials and high land prices as the factors that caused cost overrun thus presenting a conceptual gap. Ramabodu, and Verster (2010) conducted a study on factors contributing to cost overruns of construction projects in South Africa. This study used desktop study research design and thus presenting a methodological gap. The current study used descriptive survey design. Kaming, Olomolaiye, Garry and Harris (2006) conducted a study on factors influencing construction time and cost overruns on high rise projects in Indonesia. This study focused on both cost and time overruns thus presenting a conceptual gap. The current study focused on cost overruns. Locally, Kagiri (2005) conducted a study on time and cost overruns in power projects in Kenya: A case study of Kenya electricity generating Company limited. The study focused on power projects thus presenting a scope gap. Mwawasi (2015) conducted a study on time and cost overruns in road construction projects in Kenya under Kenya National Highways Authority. This study adopted a multiple case study and thus presenting a methodological gap.

Objectives of the Study

i. To establish the influence of materials procurement inflation on overruns in construction projects in Kenya

ii. To determine the influence of project planning on overruns in construction projects in Kenya

iii. To find out the influence of project risk analysis on overruns in construction projects in Kenya

iv. To assess the influence of project complexity on overruns in construction projects in Kenya
LITERATURE REVIEW

Theory of Construction Management

Theory of Construction Management was developed by Milan and Bennett (2012). CMT provides a “rigorous theory” based on a “tool kit of concepts and relationships” that will improve the efficiency and quality of “construction products”. The distinction between the conventional approach of CMT, where contractors deliver projects, and the idea of companies producing a product is an important element in the thinking behind the theory proposed here. Following that intention they identify and define the concepts needed to understand CMT.

Radosavljevic and Bennett (2012) self-consciously developed their theory without drawing on general management theories, rather wanting to base their ideas on construction industry projects and practice, which makes these definitions extremely important to their CMT and to the understanding of that theory.

The CMT is critical in construction project management and thus relevant to this study since it focuses on the concepts, construction products, processes, organizations, interactions, relationships, and learning and performance that constitute the successful project management principles. The theory, thus presents a model by which project managers can put in place critical success factors including communication, feedback loops, and how well established relationships are (called internal) or not (called boundary relationships).

Theory of Planning

This theory was developed by Brooks in 2002. According to this theory the term last planner refers to the hierarchical chain of planners, where the last planner acts at the interface to execution. Thus, this method concentrates on the detailed planning just before execution, rather than the whole planning process. The method of last planner distinguishes planned tasks according to can, should and will modalities. The tasks pushed from the higher planning levels belong to the ‘should’ category. In look-ahead planning (with a time horizon of three to four weeks), the prerequisites of up-coming assignments are actively made ready; they are transferred to the ‘can’ category. This, in fact is a pull system (Ballard 1999) that is instrumental in ensuring that all the prerequisites are available for the assignments. In conventional project management, the plan pushes tasks to execution; only the ‘should’ category is recognized.

The PT is relevant to construction project management and thus relevant to this study given the fact that the model enables project managers mitigate the risk of variability propagation to the downstream flows and the tasks reducing the need for large material buffers on site. The last planner effectively combines the control and the improvement to fight back against variability and the waste caused by it. Thus, last planner combines the flow and the transformation view in short term planning, execution and control.

Resource Based View Theory

Resource based view (RBV) is an approach to achieving competitive advantage that emerged in 1980s and 1990s, after the major works published by Wernerfelt (1980). The resource-based view (RBV) is a model that sees resources as key to superior firm performance. Resources of the right quality and quantity are important for strategy implementation (Aosa, 2011). Resource based view of the firm starts with the assumption that the desired outcome of managerial effort within the firm is a sustainable competitive advantage (SCA). Achieving a SCA allows the firm to earn economic rents or above-average returns. In turn, this focuses attention on how firms achieve and sustain advantages. The resource-based view contends that the answer to this question lies in the possession of certain key resources, that is,
resources that have characteristics such as value, barriers to duplication and relevance. A SCA can be obtained if the firm effectively deploys these resources in its product-markets. Therefore, the RBV emphasizes strategic choice, charging the firm’s management with the important tasks of identifying, developing and deploying key resources to maximize return (Aosa, 2011). Resources comprise three distinct sub-groups, namely tangible assets, intangible assets and capabilities. Tangible assets refer to the fixed and current assets of the organization that have a fixed long run capacity. Intangible assets include intellectual property such as trademarks and patents as well as brand and company reputation, company networks and databases (Williams, 1992).

Capabilities have proved more difficult to delineate and are often described as invisible assets or intermediate goods (Itami, 1987). Essentially capabilities encompass the skills of individuals or groups as well as the organizational routines and interactions through which all the firm’s resources are coordinated (Grant, 1991). This theory is deemed relevant to the study topic since it informs the independent variable which is planning. This is because in project planning resources are required.

Theory of Control

According to PMI (1999), this is divided into two sub-processes: performance reporting and overall change control. Based on the former, corrections are prescribed for the executing processes, and based on the latter; changes are prescribed for the planning processes. Here we consider only performance reporting, based on performance baseline, and associated corrections to execution. They clearly correspond to the cybernetic model of management control (thermostat model) that consists of the following elements (Hofstede 1978): There is a standard of performance; Performance is measured at the output (or input); the possible variance between the standard and the measured value is used for correcting the process so that the standard can be reached. This thermostat model is identical to the feedback control model as defined in modern control theory (Ogunnaike & Ray 1994). The theory is relevant to the study as it informs both the independent that is project planning as well as project complexity and the dependent variable, cost overruns which is an indicator of performance of the project. The theory indicates that from performance reporting, changes can be made to the project execution style or based on the overall change control; changes can be made to the plan. The project experiences changes as a result of complexities and hence there should be a change of plan.

Conceptual Framework
RESEARCH METHODOLOGY

This study adopted a descriptive survey design. According to Upagade and Shende (2013) a descriptive survey is mainly concerned with description of facts only. Descriptive survey was appropriate for this study whose intention is to present a situation, what people currently believe in, what people are doing at the moment and so forth with no control of the variables under investigation which is a limitation. There were approximately 296 construction projects that are ongoing in Makueni County (County government of Makueni, 2015). The target population of the study was all the 296 projects managers in the construction projects that are ongoing in Makueni County. The study used Krejcie & Morgan (1970) formula below to determine the sample size. Krejcie & Morgan (1970) formula is considered to be better than the Fisher (1982) formula since it considers the population size. Because of this, it was adopted.

Figure 1: Conceptual Framework
Where:

\[ S = \frac{X^2NP(1-P)}{d^2(N-1)+X^2P(1-P)} \]

\[ S \quad = \quad \text{Required Sample size} \]
\[ X \quad = \quad Z \text{ value (1.96 for 95% confidence level)} \]
\[ N \quad = \quad \text{Population Size} \]
\[ P \quad = \quad \text{Population proportion (expressed as decimal) (assumed to be 0.5 (50%))} \]
\[ d \quad = \quad \text{Degree of accuracy (5%), expressed as a proportion (0.05); It is margin of error} \]

Substituting the values in the formula gives,

\[ = (1.96)^2(296) (0.5) (0.5) \]
\[ (0.05)^2(295) + (1.96)^2(0.5) (0.5) \]
\[ = 167 \]

Therefore sample size was 167 which represent 56% of the target population.

A questionnaire was used to collect data. SPSS v. 20 was used to produce frequencies, descriptive and inferential statistics which were used to derive conclusions and generalizations regarding the population. The particular descriptive statistics were frequencies, mean scores and standard deviation. The particular inferential statistic will be regression and correlation analysis. A multivariate regression model was used to link the independent variables to the dependent variable as follows;

\[ Y = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \mu \]

Where;
\[ Y = \text{Cost overruns in construction projects} \]
\[ X_1 = \text{Material Procurement Inflation} \]
\[ X_2 = \text{Project Planning} \]
\[ X_3 = \text{Project risk analysis} \]
\[ X_4 = \text{Project Complexity} \]

RESULTS

Response rate

The number of questionnaires that were administered was 167. A total of 116 questionnaires were filled and returned. This represented an overall successful response rate of 69% as shown on Table 1. This was adequate for the study. Babbie (2004) argues that a return rate of 50% is acceptable to analyze and publish, 60% are good and 70% are very good. A response rate of 69% was hence very good for the study. The high response rate was achieved because the method of drop and pick was effective. The respondents who were busy were given more time to respond to the questionnaire.

Table 1 Response rate

<table>
<thead>
<tr>
<th></th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Filled Questionnaires</td>
<td>116</td>
<td>69</td>
</tr>
<tr>
<td>Unfilled Questionnaires</td>
<td>51</td>
<td>31</td>
</tr>
<tr>
<td>Total</td>
<td>167</td>
<td>100</td>
</tr>
</tbody>
</table>

Demographics Analysis
Respondents Gender

The study sought to establish the gender of the respondents so as to establish whether the County has met the constitutional requirements of a third of workers being female. The results indicate that of the surveyed 116 project managers in construction projects in Makueni County, only 25.9% are female. This implies that the construction department of Makueni County has not met the constitutional requirements of a third of the workers being female (Kenyan Constitution, 2010). But on the other hand, the findings are consistent with the findings of a study by Barnabas, Anbarasu & Paul (2009) who argued that majority of the construction workers in both developed and developing economies are male. Furthermore, the findings are consistent with national figures from the Kenya National Bureau of Statistics (2016) which indicated that the Construction sector in Kenya is male dominated with male making up 88.6% of the total workforce in the industry. The results are as shown in Figure 2.

![Figure 4.1 Respondents Gender](image1)

Respondents age

The study sought to establish the age bracket of the respondents. The study findings indicate that of the 116 respondents, 45 were aged between 26 years and 35 years while 40 were aged between 36 years and 45 years. Only 31 respondents were aged above 45 years. The study findings imply that majority of the project managers of construction projects in Makueni County are above 36 years. These results are consistent with the results of a survey conducted by Mitullah & Wachira (2003) to determine the demographic characteristics of the construction sector in Kenya and established that majority of the workers in the construction sector I management positions are aged above 30 years. The results are as shown in Figure 3.

![Figure 3 Respondents age](image2)

Level of Education of Respondents

The study sought to establish the level of education of the respondents. The findings indicated that majority of the respondents, 81%, are graduates while 6% of the respondents have post graduate and 12.9% of the project managers surveyed construction projects in Makueni County have diplomas. The results are as shown in Figure 4. The findings imply that project managers of construction projects in Makueni are literate. This indicates that they
could easily read and understand the questions in the questionnaire and respond as required. This hence contributed to a higher reliability of the results. The findings are consistent with Menz (2012) that the educational level of employees is associated with their cognitive orientation and knowledge base. Other scholars for instance Kinuu et al (2012) and Kasomi (2015) have also linked high educational attainment with greater knowledge, skills and understanding.

The findings are also consistent with the results of a survey by Wells (2007) who indicated that the education level of workers in the construction sector in developing countries is improving and is high compared to the 90s.

**Figure 4 Level of Education of Respondents**

**Duration of work**

The respondents were asked to indicate the number of years they had worked in the construction industry. The findings indicated that majority of the respondents, 57.8%, indicated that they had worked with construction projects at Makueni county for a period above 10 years, 19.8% of the respondents indicated they had a period between 5-9 years while the remaining percentage, 22.4% had worked for only between 4-5 years. The results are as indicated in the figure 5. These findings imply that majority of the project managers working in the construction sector in Makueni County have a work experience of over 10 years. The findings also imply that there is low turnover among construction project managers at Makueni County. The findings are consistent with the findings of a study by Molony (2008) who indicated that high work experience is required to manage construction projects.

**Figure 5 Duration of work**

**Descriptive Analysis**

**Materials Procurement Inflation**

The study sought to find out the effect of materials procurement inflation on the cost overruns in construction projects in Makueni County. Respondents were asked to rate statements on materials procurement inflation. The statements were ranked on a five point Likert scale from 1 to 5 where 5= Strongly Agree, 4= Agree, 3= Moderately Agree 2= Disagree, 1 = Strongly Disagree.
Disagree. The descriptive findings in Table 4.3 indicated that only 46.5% of the respondents indicated that some tendering maneuvers by contractors, such as frontloading of rates affects overruns of construction projects, 52.6% of them agreed that there has been under estimation of contingencies estimation costs while 61.2% indicated that there has been an inflationary increase in material prices. Only 20.7% of the respondents indicated that there has been inaccurate material estimation in the county while 12.1% indicated that there has been underestimation of project costs. On average, the respondents were neutral on the statements concerning materials procurement inflation. The implication of these results is that there is problem of material procurement inflation in construction projects at Makueni County. There are presence of some tendering maneuvers by contractors in Makueni, there has been under estimation of contingencies estimation costs as well as an inflationary increase in material prices. All these activities lead to cost overruns in construction projects at Makueni County. The findings are also consistent with the findings of a study by Nyabwari (2013) focusing on investigating the causes and effects of cost overrun on civil works projects in Mombasa County and indicated that materials cost increase, tendering manoeuvres by contractors, ignoring items with abnormal rates during tender evaluation; especially items with provisional quantities are among the major causes of cost overrun.

**Table 2 Materials Procurement Inflation**

<table>
<thead>
<tr>
<th>Statement</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>Some tendering maneuvers by contractors, such as frontloading of rates affects overruns of construction projects</td>
<td>12.90%</td>
<td>6.90%</td>
<td>33.60%</td>
<td>26.70%</td>
<td>19.80%</td>
<td>3.34</td>
<td>1.24</td>
</tr>
<tr>
<td>There has been under estimation of contingencies estimation costs</td>
<td>6.00%</td>
<td>0.00%</td>
<td>41.40%</td>
<td>45.70%</td>
<td>6.90%</td>
<td>3.47</td>
<td>0.87</td>
</tr>
<tr>
<td>There has been an inflationary increase in material prices</td>
<td>6.00%</td>
<td>6.90%</td>
<td>25.90%</td>
<td>48.30%</td>
<td>12.90%</td>
<td>3.55</td>
<td>1.01</td>
</tr>
<tr>
<td>There has been inaccurate material estimation in the county</td>
<td>12.90%</td>
<td>34.50%</td>
<td>31.90%</td>
<td>20.70%</td>
<td>0.00%</td>
<td>2.60</td>
<td>0.96</td>
</tr>
<tr>
<td>There has been underestimation of project costs</td>
<td>12.90%</td>
<td>41.40%</td>
<td>33.60%</td>
<td>0.00%</td>
<td>12.10%</td>
<td>2.57</td>
<td>1.11</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>3.11</strong></td>
<td><strong>1.04</strong></td>
</tr>
</tbody>
</table>

**Project planning**

The second objective of the study was to determine the influence of project planning on overruns in construction projects in Kenya. Respondents were asked to rate statements on project planning. The statements were ranked on a five point Likert scale from 1 to 5 where 5= Strongly Agree, 4 = Agree, 3= Moderately Agree 2= Disagree, 1 = Strongly Disagree. The results in table 4.4 indicate that 26.7% of the respondents indicated that there is proper Preplanning before execution of construction projects in the county as proper construction planning during implementation stage of construction projects while 33.6% indicated that there is enough material delivery on site before construction starts. The results also indicated
that only 26.7% of the respondents stated that there is proper scheduling before construction starts while those who indicated that the contractors follow project schedule during construction were only 13.8%. On average, majority of the respondents were neutral on statements involving project planning. The findings imply that construction projects planning in Makueni County is poorly conducted. Important project planning practices for instance pre-planning before execution of construction, planning during implementation stage of construction projects, ensuring enough material delivery on site before construction starts, proper scheduling before construction starts and contractors following project schedule during construction is not well conducted in Makueni County and that leads to cost overruns in the projects. The findings are consistent with Apolot (2011) who investigated the causes of delay and cost overrun in construction projects in Uganda’s public sector and established and stated that other causes of delays and cost overruns include, apart from those ranked among top ten in their study were corruption, poor planning at the design stage, political interference and delayed project implementation after the design stage. Eight main causes of delays and seven main causes of cost overruns were identified using the factor analysis of the impact of the factors on project time and cost.

### Table 3 project planning

<table>
<thead>
<tr>
<th>Statements</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Mean</th>
<th>Std Dev</th>
</tr>
</thead>
<tbody>
<tr>
<td>There is proper Pre-planning before execution of construction projects</td>
<td>6.90%</td>
<td>25.00%</td>
<td>41.40%</td>
<td>13.80%</td>
<td>12.90%</td>
<td>3.01</td>
<td>1.09</td>
</tr>
<tr>
<td>There is proper construction planning during implementation</td>
<td>6.90%</td>
<td>25.00%</td>
<td>41.40%</td>
<td>13.80%</td>
<td>12.90%</td>
<td>3.01</td>
<td>1.09</td>
</tr>
<tr>
<td>There is enough material delivery on site before construction starts</td>
<td>6.90%</td>
<td>26.70%</td>
<td>32.80%</td>
<td>27.60%</td>
<td>6.00%</td>
<td>2.99</td>
<td>1.03</td>
</tr>
<tr>
<td>There is proper scheduling before construction starts</td>
<td>6.90%</td>
<td>26.70%</td>
<td>39.70%</td>
<td>26.70%</td>
<td>0.00%</td>
<td>2.86</td>
<td>0.89</td>
</tr>
<tr>
<td>The contractors follow project schedule during construction</td>
<td>6.90%</td>
<td>66.40%</td>
<td>12.90%</td>
<td>13.80%</td>
<td>0.00%</td>
<td>2.34</td>
<td>0.80</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td><strong>2.84</strong></td>
<td><strong>0.98</strong></td>
</tr>
</tbody>
</table>

**Project risk analysis**

The third objective of the study was to find out the influence of project risk analysis on overruns in construction projects in Kenya. Respondents were asked to rate statements on project risk analysis. The statements were ranked on a five point Likert scale from 1 to 5 where 5= Strongly Agree, 4 = Agree, 3= Moderately Agree 2= Disagree, 1 = Strongly Disagree. The findings in Table 4.5 show that majority of the respondents, 59.5% indicated that there has been underestimation of risk and losses in the county, only 13.8% of the respondents stated that the risk associated with the project is always defined, 47.4% stated that time allowance is given in a project to cater for delay and the respondents who indicated that cost allowance is given in the project cost estimate to account for the residual risk accepted by the project manager were only 20.7%. The results also showed that the respondents who agreed that there is development of cost reimbursable schemes were only
19.8%. The results showed that overall; respondents were neutral on statements on project risk analysis. This implies that there is poor project risk analysis in Makueni County before implementing construction projects. There is poor definition of risks associated with construction projects, time allowance to cater for delay is not given, cost allowance in the project cost estimation to account for the residual risk is not given and that there is poor development of cost reimbursable schemes. The findings are consistent with Apolot (2011) who investigated the causes of delay and cost overrun in construction projects in Uganda’s public sector and established that the top ten ranking causes of delays and cost overruns in construction projects were found to be: change of work scope; delayed payments; poor monitoring and control; high cost of capital; political insecurity and instability; unreliable sources of materials on the local market; fuel shortage; differing site conditions; inadequate/inefficient equipment, tools and plant, poor project risk analysis and poor communication.

### Table 4 project risk analysis

<table>
<thead>
<tr>
<th>Statements</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Std Dev</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>There has been underestimation of risk and losses in the county</td>
<td>6.90%</td>
<td>20.70%</td>
<td>12.90%</td>
<td>40.50%</td>
<td>19.00%</td>
<td>1.21</td>
<td>3.44</td>
</tr>
<tr>
<td>The risk associated with the project is always defined</td>
<td>19.00%</td>
<td>47.40%</td>
<td>19.80%</td>
<td>13.80%</td>
<td>0.00%</td>
<td>0.93</td>
<td>2.28</td>
</tr>
<tr>
<td>Time allowance is given in a project to cater for delay</td>
<td>0.00%</td>
<td>25.90%</td>
<td>26.70%</td>
<td>33.60%</td>
<td>13.80%</td>
<td>1.02</td>
<td>3.35</td>
</tr>
<tr>
<td>Cost allowance is given in the project cost estimate to account for the residual risk accepted by the project manager</td>
<td>6.90%</td>
<td>25.90%</td>
<td>46.60%</td>
<td>20.70%</td>
<td>0.00%</td>
<td>0.84</td>
<td>2.81</td>
</tr>
<tr>
<td>There is development of cost reimbursable schemes</td>
<td>6.90%</td>
<td>53.40%</td>
<td>19.80%</td>
<td>12.90%</td>
<td>6.90%</td>
<td>1.03</td>
<td>2.59</td>
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<tr>
<td>Average</td>
<td>2.90</td>
<td>1.01</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Project complexity

The fourth objective of the study was to assess the influence of project complexity on overruns in construction projects in Kenya. Respondents were asked to rate statements on project complexity. The statements were ranked on a five point Likert scale from 1 to 5 where 5= Strongly Agree, 4 = Agree, 3= Moderately Agree 2= Disagree, 1 = Strongly Disagree. The results in Table 4.6 indicate that 65.5% of the respondents agreed that there are a large number of different systems that need to be put together in the county projects, 53.4% agreed that construction projects in Makueni experiences less project complexity due to technical ability, 93.1% agreed that most projects in Makueni County requires efficient coordinating, control and monitoring from start to finish while 65.5% of the respondents indicated that most projects requires series of revisions during construction to handle complexity due to duration of the project. Only a few, 26.7%, of the respondents indicated that there is proper handling of project complexity related to environment of operation. On
average, majority of the respondents agreed on statements of project complexity. The results imply that project complexity influences cost overruns in construction projects at Makueni County. The county has not done enough to counter this influence. There is a need for efficient coordinating, control and monitoring of projects from start to finish, there is also a need for series of revisions during construction to handle complexity due to duration of the project as well as proper handling of project complexity related to environment of operation.

**Table 5 project complexity**

<table>
<thead>
<tr>
<th>Statements</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>Std Dev</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>There are a large number of different systems that need to be put together in the county projects</td>
<td>0.00%</td>
<td>6.90%</td>
<td>27.60%</td>
<td>26.70%</td>
<td>38.80%</td>
<td>0.97</td>
<td>3.97</td>
</tr>
<tr>
<td>Construction projects in Makueni experiences less project complexity due to technical ability</td>
<td>0.00%</td>
<td>12.90%</td>
<td>33.60%</td>
<td>53.40%</td>
<td>0.00%</td>
<td>0.71</td>
<td>3.41</td>
</tr>
<tr>
<td>Most projects in Makueni County requires efficient coordinating, control and monitoring from start to finish</td>
<td>0.00%</td>
<td>0.00%</td>
<td>6.90%</td>
<td>61.20%</td>
<td>31.90%</td>
<td>0.57</td>
<td>4.25</td>
</tr>
<tr>
<td>Most projects requires series of revisions during construction to handle complexity due to duration of the project</td>
<td>0.00%</td>
<td>13.80%</td>
<td>20.70%</td>
<td>40.50%</td>
<td>25.00%</td>
<td>0.98</td>
<td>3.77</td>
</tr>
<tr>
<td>There is proper handling of project complexity related to environment of operation</td>
<td>6.90%</td>
<td>19.00%</td>
<td>47.40%</td>
<td>19.80%</td>
<td>6.90%</td>
<td>0.97</td>
<td>3.01</td>
</tr>
<tr>
<td><strong>Average</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>**3.68</td>
</tr>
</tbody>
</table>

**Cost overruns in Construction Projects**

The study sought to establish whether the project managers are able to complete projects within the set budget. The results in figure 6 indicated that majority, 67%, of the respondents indicated that they are able to complete projects within the set budget.

**Figure 6 Duration of work**

The respondents were also asked to indicate the approximate percentage of completed projects within the set costs for the last five years as indicated in Table 6. The results indicate
that majority of the respondents indicated that the completion rate of projects was between 25% and 50%.

Table 6 Project completion rate annually

<table>
<thead>
<tr>
<th>Year</th>
<th>Less than 25%</th>
<th>25%-50%</th>
<th>Between 51 - 75%</th>
<th>Above 75%</th>
</tr>
</thead>
<tbody>
<tr>
<td>2015</td>
<td>0.00%</td>
<td>53.40%</td>
<td>25.90%</td>
<td>20.70%</td>
</tr>
<tr>
<td>2014</td>
<td>12.90%</td>
<td>47.40%</td>
<td>32.80%</td>
<td>6.90%</td>
</tr>
<tr>
<td>2013</td>
<td>26.70%</td>
<td>47.40%</td>
<td>25.90%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2012</td>
<td>25.90%</td>
<td>61.20%</td>
<td>12.90%</td>
<td>0.00%</td>
</tr>
<tr>
<td>2011</td>
<td>40.50%</td>
<td>40.50%</td>
<td>12.90%</td>
<td>6.00%</td>
</tr>
</tbody>
</table>

A trend analysis of the project completion rate within the set costs was also drawn and presented in Figure 7. The findings showed that on average, there was a project completion rate of between 25% and 50% from the year 2011 to 2014. In the year 2015, the rate improved to between 51 and 70%. In general, the project completion rate within budget has been improving though at a slow rate. The results confirm the problem statement which indicates slow completion rate of construction projects as indicated by cost overruns (Morris, 2010).

Figure 7 Project completion rate annually

Correlation Analysis Results

The study findings indicated that materials procurement inflation is positively and significantly correlated with cost overruns in construction projects in Makueni County (R = 0.397, Sig = 0.000). This shows that the higher the materials procurement inflation the more the cost overruns in construction projects. This indicates that an increase in practices related to materials procurement inflation such as tendering maneuvers by contractors in Makueni, under estimation of contingencies estimation costs as well as an inflationary increase in material prices leads to cost overruns in construction projects in Makueni County. The study findings are consistent with the findings of a study by Limbo (2014) who indicated that low
productivity of labour, lack of skilled labor, escalation of material prices, material quality issues, high cost of machineries and poor cash flow management are among the important factors for cost overrun. The results also indicated that project planning is negatively and significantly correlated with cost overruns in construction projects in Makueni County (R = -0.550, Sig = 0.000). This shows that an increase in project planning practices reduces cost overruns in construction projects in Makueni. This indicates that the more project managers engage in project planning practices for instance pre-planning before execution of construction, planning during implementation stage of construction projects, ensuring enough material delivery on site before construction starts, proper scheduling before construction starts and contractors following project schedule during construction leads to a reduction in cost overruns in the construction projects in Makueni.

The results are consistent with the findings of a study by Durdyev, Ismail and Bakar, (2012) conducted on factors causing cost overruns in construction of residential projects; case study of Turkey and established improper planning, inaccurate project cost estimation, high cost of needed resources (money, men, materials and machinery), lack of skilled workforce, price of construction materials and high land prices as the major determinants of cost overruns in construction projects. The results further indicated that project risk analysis is negatively and significantly correlated with cost overruns in construction projects in Makueni County (R = -0.196, Sig = 0.035). This shows that an increase in project risk analysis practices leads to a reduction in cost overruns in construction projects in Makueni. This implies that an increase in project risk analysis practices for instance definition of risks associated with construction projects, time allowance to cater for delay, cost allowance in the project cost estimation to account for the residual risk and development of cost reimbursable schemes are associated with a decrease in cost overruns in construction projects. These results are consistent with Ubani, Okorocha and Emeribe (2013) who indicated that both time and cost overruns are caused by poor project risk analysis due to a failure in contractor’s responsibilities, consultant’s responsibilities and client’s responsibilities to do so. The study findings also showed that project complexity is positively and significantly correlated with cost overruns in construction projects in Makueni County (R = 0.203, Sig = 0.029). The findings imply that project complexity is positively associated with an increase in cost overruns. The more complex construction project is, the higher the cost overruns. Efficient coordinating, control and monitoring of projects from start to finish, having a series of revisions during construction to handle complexity due to duration of the project as well as proper handling of project complexity related to environment of operation will lead to a reduction in project complexity. The findings agree with Ramabodu and Verster (2010) who indicated some of the determinants of cost overruns in construction projects is misinterpretation of the client’s brief, incomplete design at tender stage, procurement strategies, complexity level of the projects and contractual claims such as contract instructions.

Table 7 Correlation analysis

<table>
<thead>
<tr>
<th></th>
<th>Materials procurement inflation</th>
<th>Project planning</th>
<th>Project risk analysis</th>
<th>Project complexity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials procurement inflation</td>
<td>Pearson Correlation Sig. (2-tailed)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project planning</td>
<td>Pearson Correlation Sig. (2-tailed)</td>
<td>.421**</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Project risk analysis</td>
<td>Pearson Correlation Sig. (2-tailed)</td>
<td>0.067</td>
<td>.064</td>
<td></td>
</tr>
</tbody>
</table>
Regression analysis

The model summary findings in Table 8 indicated that jointly, materials procurement inflation, project planning, project risk analysis and project complexity account for 40.4% of cost overruns in construction projects in Makueni County. This is as shown by a coefficient of determination of 0.404. The findings imply that other determinants of cost overruns in construction projects not included in the model in this study account for the remaining 59.6%.

Table 8 Model Summary

<table>
<thead>
<tr>
<th>R</th>
<th>R Square</th>
<th>Adjusted R Square</th>
<th>Std. Error of the Estimate</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.635</td>
<td>0.404</td>
<td>0.382</td>
<td>0.4446</td>
</tr>
</tbody>
</table>

The regression findings also indicated that the model linking the determinants of cost overruns to cost overruns in Makueni County was significant as indicated by a significant F statistic value when tested at 5% level of significance (Sig = 0.000). The same results are obtained when the calculated F statistic of 18.796 is compared against the critical F statistic value read from the F distribution table using numerator degrees of freedom of 4 and denominator degrees of freedom of 111 to give 2.453. Since F calculated value of 18.796 is greater than F critical value of 2.453, there is conclusion that the model is significant in predicting cost overruns.

Table 9 Model Fitness

<table>
<thead>
<tr>
<th></th>
<th>Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>14.863</td>
<td>4</td>
<td>3.716</td>
<td>18.796</td>
<td>.000</td>
</tr>
<tr>
<td>Residual</td>
<td>21.944</td>
<td>111</td>
<td>0.198</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>36.807</td>
<td>115</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The study established the beta coefficients linking the independent variables to the dependent variable as indicated in Table 4.11. The results indicated that holding other factors constant at zero, cost overruns in construction projects is constant at 0.119. The findings also indicated that all materials procurement inflation had a positive (Beta = 0.200) and significant (Sig = 0.003) effect on construction projects overruns in Makueni County. This implies that an increase in materials procurement inflation by one unit increases cost overruns by 0.200 units. The findings confirm the correlation findings that an increase in practices related to materials procurement inflation such as tendering maneuvers by contractors in Makueni, under estimation of contingencies estimation costs as well as an inflationary increase in material prices leads to a significant increase in cost overruns in construction projects in...
Makueni County. The findings are also consistent with the findings of a study by Mwawasi (2015) which indicated that some of the factors determining cost overruns in projects are delayed payments to contractors, poor or inadequate specifications in the contract, foreign exchange rate fluctuations, unpredictable weather and poor cost control mechanisms.

The findings also indicated that project planning has a negative (Beta = -0.407) and significant (Sig = 0.000) effect on construction projects overruns in Makueni County. This implies that an increase in procurement planning practices by one unit decreases cost overruns by 0.407 units. The results also confirm the correlation results that an increase in project planning practices for instance pre-planning before execution of construction, planning during implementation stage of construction projects, ensuring enough material delivery on site before construction starts, proper scheduling before construction starts and contractors following project schedule during construction leads to a significant reduction in cost overruns in the construction projects in Makueni. The findings are consistent with the findings of a study by Durdyev, Ismail and Bakar, (2012) conducted on factors causing cost overruns in construction of residential projects; case study of Turkey and established improper planning, inaccurate project cost estimation, high cost of needed resources (money, men, materials and machinery), lack of skilled workforce, price of construction materials and high land prices as the major determinants of cost overruns in construction projects.

The regression findings also indicated that project risk analysis has a negative (Beta = -0.287) and significant (Sig = 0.002) effect on construction projects overruns in Makueni County. This implies that an increase in procurement risk analysis practices by one unit decreases cost overruns by 0.287 units. The findings confirm the correlation results that an increase in project risk analysis practices for instance definition of risks associated with construction projects, time allowance to cater for delay, cost allowance in the project cost estimation to account for the residual risk and development of cost reimbursable schemes leads to a significant decrease in cost overruns in construction projects in Makueni. These results are consistent with Ubani, Okorocha and Emeribe (2013) who indicated that both time and cost overruns are caused by poor project risk analysis. On project complexity, the results showed that project complexity has a positive (Beta = 0.296) and significant (Sig = 0.005) effect on construction projects overruns in Makueni County. This implies that an increase in project complexity by one unit increases cost overruns by 0.296 units. The findings show that the more complex a construction project is, the higher the cost overruns. Efficient coordinating, control and monitoring of projects from start to finish, having a series of revisions during construction to handle complexity due to duration of the project as well as proper handling of project complexity related to environment of operation will lead to a significant reduction in project complexity. The findings agree with Waihenya (2011) who indicated that the major causes of cost overruns in non-traditional contracts are, variation in the cost of building materials, changes in the design of the building, changes in finishes by the client, contractor running out of money to run the project for some time, hiring of extra tools during construction not anticipated, under estimation of the cost of construction by the quantity surveyor and complexity of the projects (in that order of merit).

Table 10 Model Coefficients

<table>
<thead>
<tr>
<th>Variable</th>
<th>Beta</th>
<th>Std. Error</th>
<th>t</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Constant)</td>
<td>0.119</td>
<td>0.413</td>
<td>0.288</td>
<td>0.774</td>
</tr>
<tr>
<td>Materials Procurement inflation</td>
<td>0.200</td>
<td>0.065</td>
<td>3.055</td>
<td>0.003</td>
</tr>
<tr>
<td>Project planning</td>
<td>-0.407</td>
<td>0.098</td>
<td>-4.144</td>
<td>0.000</td>
</tr>
<tr>
<td>Project risk analysis</td>
<td>-0.287</td>
<td>0.091</td>
<td>-3.169</td>
<td>0.002</td>
</tr>
<tr>
<td>Project complexity</td>
<td>0.296</td>
<td>0.104</td>
<td>2.863</td>
<td>0.005</td>
</tr>
</tbody>
</table>
Based on the study findings, the overall model linking cost overruns to its determinants was established as indicated.

\[ \text{Cost overruns in construction projects} = 0.119 + 0.200 \times (\text{Materials Procurement inflation}) + 0.296 \times (\text{Project complexity}) - 0.407 \times (\text{Project planning}) - 0.287 \times (\text{Project risk analysis}) \]

**Conclusion**

Materials procurement inflation is positively and significantly related to cost overruns in construction projects in Makueni County implying that an increase in practices related to materials procurement inflation such as tendering maneuvers by contractors in Makueni, under estimation of contingencies estimation costs as well as an inflationary increase in material prices significantly increase cost overruns in construction projects in Makueni County. Project planning is negatively and significantly related to cost overruns in construction projects in Makueni County indicating that an increase in project planning practices for instance pre-planning before execution of construction, planning during implementation stage of construction projects, ensuring enough material delivery on site before construction starts, proper scheduling before construction starts and contractors following project schedule during construction leads to a significant reduction in cost overruns in the construction projects in Makueni. Project risk analysis negatively and significantly affect cost overruns in construction projects in Makueni County implying that an increase in project risk analysis practices for instance definition of risks associated with construction projects, time allowance to cater for delay, cost allowance in the project cost estimation to account for the residual risk and development of cost reimbursable schemes leads to a decrease in cost overruns in construction projects. There is a positive and significant effect of project complexity on cost overruns in construction projects in Makueni County which implies that the more complex a construction project is, the higher the cost overruns.

**Recommendations of the Study**

The study recommends that the County government of Makueni should put in place measures to curb tendering maneuvers by contractors which leads to cost overruns in construction projects. Furthermore, e-procurement can be applied for procurement of materials so as to reduce cases of price inflation. The project managers should ensure that there is no under estimation of contingencies estimation costs which is one of the materials procurement inflation practice that leads to cost overruns. The study also recommends that the project managers of construction projects in the County should implement project planning practices like pre-planning before execution of construction, planning during implementation stage of construction projects, ensuring enough material delivery on site before construction starts, proper scheduling before construction starts and contractors following project schedule during construction so as to reduce cost overruns in construction projects.

Efforts should be made by the project managers, contractors, stakeholders and the county government in ensuring that effective project risk analysis in Makueni County is conducted before and during implementation of projects. This can be done through definition of risks associated with construction projects, giving time allowance to cater for delay, having a cost allowance in the project cost estimation to account for the residual risk and having poor development of cost reimbursable schemes. This will significantly reduce cost overruns.

Another recommendation by the study is that project managers should put in place strategies to counter the external factors of project complexity. This can be done through efficient
coordinating, control and monitoring of projects from start to finish, conducting a series of revisions during construction to handle complexity due to duration of the project as well as proper handling of project complexity related to environment of operation.

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