

Key drivers of construction cost underruns and overruns during the project life cycle in South Africa

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Abstract:

Many construction projects have experienced cost underruns with no research to investigate the drivers for the cost underruns. Hence, this study investigated the key drivers of construction cost changes in the South Africa. A quantitative method research approach was employed in obtaining data for this study. The significant finding of this study shows that inadequate project preparation and planning leads to having incomplete designs at the time of tender and unrealistic pre-contract estimates. Also, it was found that unrealistic pre-contract estimates lead to inadequate financial provisions, which may result in delayed contractor payments and in turn cause cost overruns. The study concludes that most of the causes of cost overruns emanate from actions by the client, project team, and contractor. The study also concludes that it is important for client to have a clear and comprehensive project brief at the inception stage in order to minimise variations during the construction stage, as well as allow for sufficient time for planning and scheduling of work to be done.

Keywords:

Drivers of construction cost changes; cost changes; cost overrun; cost underrun; project life cycle.

1 Introduction

Construction cost changes encompass cost overruns and underruns. Changes in construction costs mean an increase or decrease in the budgeted cost of a project. While cost overrun refers to an increase in the budgeted cost of a project (Mustefa, 2015); cost underrun refers to a decrease in the budgeted cost of a project (Ahsan & Gunawan, 2010; Blanc-Brude & Makovsek, 2013). Construction cost changes on construction projects is an important issue for both developed and developing countries because of its multiplier effect on the economy, resources, and infrastructural development (Ubani *et al.*, 2013). Construction cost changes on construction projects usually occur as a result of changes in the cost information (Cho *et al.*, 2010), construction methods (Mao *et al.*, 2016), and economic conditions in the markets (Hwang, 2011). A collective investigation of the drivers of construction cost changes on construction projects becomes imperative because the drivers of cost overruns are as important as the drivers

of cost underruns. This is because the knowledge of the drivers of cost overruns is important to reducing the project failure rate and the knowledge of the drivers of cost underruns is useful in increasing the project success rate (Rachid *et al.*, 2019). According to Arcila (2012), the drivers of cost underruns determine the achievement of the construction project's objectives and enhance the quality and time performance of projects. Iyer & Jha (2005) state that understanding the drivers of cost overruns provides the measures for correcting cost overruns in construction projects. The study by Mukuka (2014) and Ilori and Omopariola (2018) suggests that improvements in the cost performance of a project result from the correct application of the knowledge of the drivers of cost underruns.

The focus of research in the field of construction cost changes on construction projects has been limited to cost overruns (Baloyi & Bekker, 2011). This misinterpretation of construction cost changes is responsible for failure to deliver project within budget and the narrow focus of studies on cost overruns (Venter, 2015). In recent years, research on cost overruns still remains the mainstay of studies on construction cost changes (Chen *et al.*, 2019; Rachid *et al.*, 2019; Alaghbari *et al.*, 2019). This provides evidence that studies on construction cost changes in relation to cost overruns and underruns are still lacking. A pressing concern is, however, the fact that many construction projects have experienced cost underruns with no research to investigate the drivers for the cost underruns. This research therefore aims to add to the body of knowledge by investigating the key drivers of construction cost changes in the South Africa.

2 Literature Review

Cost overrun is defined as the cost difference between the actual completion cost and the estimated completion cost (Mustefa, 2015). *Ibid* further defines construction cost overruns as the positive difference between the final and actual cost of a construction project at completion and the contract amount agreed by the client and contractor. Liu & Zhu (2004) defined cost overruns as the change in the contract amount divided by the original contract award amount.

The drivers of construction cost overruns have been well investigated (Ali & Kamaruzzaman, 2010; Mbachu & Cross, 2015). According to Ali & Kamaruzzaman, (2010), poor site management is a major driver of construction cost overruns because it reflects the failure and inability of contractors to supervise the site and manage the overall project, while Mbachu & Cross, (2015) described poor site management as a lack of proper analysis and geotechnical tests prior to the design.

The key drivers of construction cost changes includes fluctuation of material costs, shortage of skilled labour, and project complexity (Omopariola *et al.*, 2019a; Durdyev *et al.*, 2012). Eshofonie (2008) stated that fluctuations in material prices are due to the variation of the exchange rate which in turn affects the overall construction cost. Ali & Kamaruzzaman (2010) state that high inflation caused fluctuation in the price of raw materials which in turn leads to project cost overruns. It can then be concluded that material price fluctuations are influenced by other factors such as inflation, market demand and supply as well as the state of the local economy (Durdyev *et al.*, 2012).

Baloyi & Bekker (2011) ranked shortage of skilled labour and project complexity as other key factors that contribute to project cost overrun. *Ibid* claimed that from the contractor's point of view shortage of skilled labour is the most significant delay factor followed by project complexity. Although Baloyi and Bekker (2011) mentioned the shortage of labour and project complexity as key factors.

Several authors have classified and described the drivers of construction cost underruns differently (Arcila 2012; Olawale & Sun, 2010). Nega, 2008; Ramabodu & Verster, 2010). For example, Mukuka (2014) described the drivers of drivers of construction cost underruns as critical factors in the project lifecycles. Olawale & Sun (2010) described the drivers of construction cost underruns as mitigating factors for cost overruns and classified them into four broad categories, namely, preventive measures, predictive measures, corrective measures and organisational measures. Preventive measures are precautionary measures put in place during the planning stage of a project as a defence to the inhibiting factors; while predictive measures are measures put in place in order to spot potential problems to the control process in the future so that they can be stopped from happening. Corrective measures are measures that are used to mitigate the effect of the project control inhibiting factors and are usually only used after the event has occurred and organisational measures are general practices that go wider than the actual control process but have an effect on project control. These are usually put in place because of the company's belief, orientation, management style or philosophy (Olawale & Sun, 2010).

3 Research Methodology

This research aims to examine the drivers of cost changes during the project life cycle in the Western Cape, South African construction industry. The target group in this research included the following construction industry professionals: quantity surveyors, architects, construction project managers, construction managers, engineers and clients that are involved in construction projects in Western Cape, South Africa. The population of this study comprised of 4449 built environment professionals in the Western Cape, registered on the directory of the cidb and with their contact emails uploaded on CON4047W survey monkey account. The research incorporated practicing construction professionals in the Western Cape. Probability sampling technique was used for identifying the respondents, by using a descriptive statistic to calculate the sample size required for the population of 4449.

Although a total of 122 respondents completed the questionnaire only 96 respondents completed the questionnaire by the time the studies had to be conducted. Data were obtained through the distribution of a questionnaire via surveymonkey.com given its easy real time monitoring tools, data analysis techniques and overall simplistic nature. The data obtained investigated the drivers of change in construction costs, the presence of cost overruns and underruns in the Western Cape; the nature of the impact of the driver of construction costs as well as solutions aimed at mitigating factors causing cost overruns will also be evaluated.

The questionnaire is designed in order to obtain statistical data relating to the respondents first, before evaluating their knowledge on the research topic. Demographics in terms of profession, experience in the industry and type of client were

investigated. The rest of the questionnaire is focussed on evaluating whether the respondents have been involved in projects that have experienced cost overruns and the factors driving it. The information which was dealt with in this research is very sensitive as it relates to the cost of projects. Due to the sensitivity of this information, the respondents answered the questions anonymously.

4 Findings and Discussion

4.1 Profile of respondents

The questionnaires sought out to determine professions of the respondents. The responses obtained from this question are shown in Figure 1. Figure 1 shows that 54.9% of the respondents are quantity surveyors while only 12% are architects. 6.6%, 4.9% of respondents identified as construction project managers, clients respectively. 8.5% are project managers and 9% are construction managers, while 4.1% of the respondents are engineers (civil, mechanical, electrical and structural).

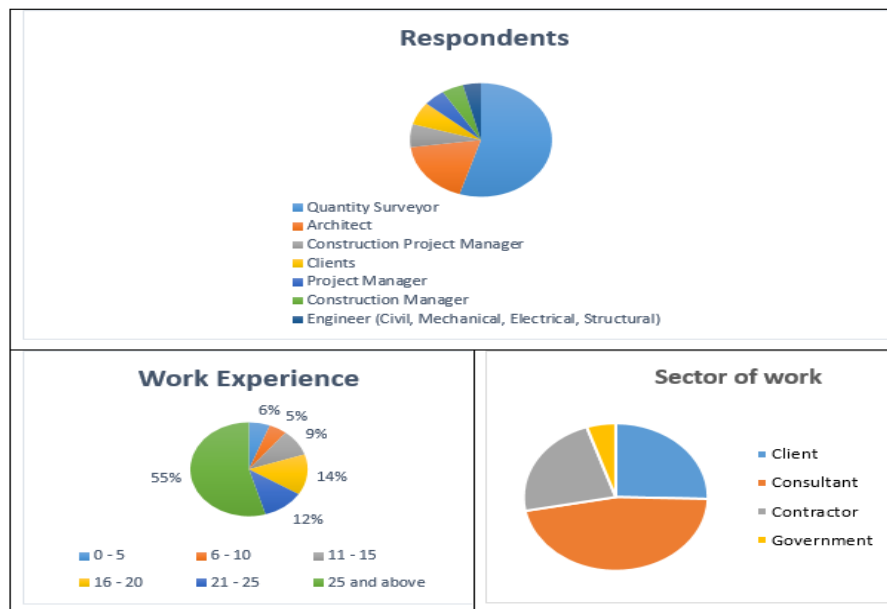


Figure 1: Profile of respondents

4.2 Key drivers of construction cost changes during the project life cycle

A list of factors that were obtained from Table 1 below was presented as options and the respondents were asked to indicate whether they are in agreement or not using the Likert scale of 1 to 5 where 1 referred to strongly disagree and 5 referred to strongly agree. Table 3 below represents the key drivers of construction cost overruns ranked according to the mean item score. Table 1 shows the list of factors causing cost overruns ranked according to their Mean Item Score. The factors that ranked high from the respondents' perspectives are design changes, incomplete design information at the time of estimating and inadequate planning with mean item score of 0.88, 0.83 and 0.73 respectively. Project complexity, late contract awards by the client and poor project management assistance all ranked fourth, with a mean item score of 0.68. The factors

that ranked lowest were collusion and cartels (price fixing), high demand for material and high use of equipment versus labour with a mean of 0.55, 0.55, 0.50 respectively.

Table 1: Mean score of the key drivers of construction cost changes during the project life cycle

Factor	Mean item score
Design changes	0.88
Incomplete design information at the time of estimating	0.83
Inadequate planning	0.73
Project complexity	0.68
Late contract awards by client	0.68
Poor project management assistance	0.68
Inability to analyse risk	0.67
Poor site management	0.66
Fluctuations of material costs	0.65
Inadequate financial provisions	0.64
Lack of cost planning and monitoring	0.62
Shortage of skilled labour	0.62
Inaccurate material estimates	0.60
Traditional procurement methods (lump-sum) cost reimbursable	0.57
High subcontractor utilisation	0.57
Transportation costs	0.57
Availability of the materials	0.56
Collusion and cartels (price fixing)	0.55
High demand for material	0.55
High use of equipment versus labour	0.50

4.3 Key remedies/measures to construction cost changes during the project life cycle

Table 2 shows the respondent's ranking of measures aimed at addressing factors causing project cost overruns in the Western Cape. As seen in Table 2 the top five ranked measures of addressing cost overruns on projects as perceived by the respondents are the proper project implementation and management with a mean item score of 0.93 and appointment of experienced contractors and highly experienced consultants with mean scores of 0.92. Completed designs at the time of tender as well as reliable pre-contract estimates, adequate project preparation and planning and clear project scope and proper costing are also among the top five most effective remedies with a mean score of 0.90 and 0.88 respectively. The least effective measures are ongoing training on competition law as a means of combating fraud with a mean item score of 0.56, the use of alternative procurement methods with a mean item score of 0.62, the use of up-to-date technology with a mean score of 0.69 and finally adequate planning of logistics to site location with a mean score of 0.78.

Table 2: Mean score of the key measures of addressing construction cost changes

Factor	Mean Item Score
Proper project implementation and management	0.93
Appointment of experienced contractor	0.92
Appointment of highly experienced consultants	0.92
Completed designs at the time of tender	0.90
Reliable pre-contract estimates	0.88
Adequate project preparation and planning	0.88
Clear project scope and proper costing	0.88
Consistent cost reporting during the construction stage	0.86
Good workmanship	0.86
Employment of experienced site workers	0.83
Decrease number of variation orders	0.83
Risk management during project execution	0.81
Allowing for material price escalations in the original tender document	0.81
Ordering the right materials	0.79
Timely supply of materials	0.79
Upskilling of workers	0.75
Use of locally available materials	0.75
Adequate planning of logistics to site location	0.72
Use of up-to-date technology	0.69
Use of alternative procurement methods	0.62
Ongoing training on competition law	0.56

5 Discussion

The findings from the results indicate that design changes was the most dominant key drivers of construction cost changes. It clearly shows that design change is an overwhelming factor which occurs due to the presence of indecisive clients, lack of design specification, and lack of enough information at the time of tender. The effect of design change is often underestimated by construction professionals despite the fact that it has an impact on the project cost and programme (Monyane, 2013). Incomplete designs mostly arise because project stakeholders try to rush to get the job out to tender which in turn makes these designs to be subjected to a series of revisions which have high cost implications to the project (Monyane, 2013). Inadequate planning is another factor that ranked high based on the respondents. This study supports the outcome of earlier studies by Dibonwa (2009) who ranked inadequate planning as a key factor influencing cost overrun. Eshofonie (2008) states that proper planning and scheduling is important to ensure effective utilisation of resources which will help avoid an increase in project costs.

Furthermore, inadequate planning occurs often as the stakeholders' rush to have projects started without allocating sufficient time for preparation leading to future cost implications. Incomplete design information at the time of estimating was ranked second and was found to have a high impact. This finding agrees with the findings of earlier by Ramabodu and Verster (2013) who found that incomplete design information at the time of estimating is a high impact factor. Also found in the top five ranking factors are the internal factors, inadequate planning and project complexity. The study

by Memon et al. (2011) which found that inadequate planning is a significant factor impacting cost overruns confirms the findings of this study which found the factor to be among the top 3. Project complexity can be due to large volumes of working groups on site, complex designs as well as the response time of decisions required. This is supported by Mbachu and Cross (2015) who found that project complexity has a medium impact on construction cost overruns. All of the above factors, ranked in the top five factors, were classified as internal factors. These findings of this study also found that poor site management was ranked seventh and was found to have a medium impact which is not aligned with the results of earlier studies by Mbachu and Cross (2015) as well as Le-Hoai et al. (2008) who highlighted poor site management as being a high and severe impact driver, respectively. Similarly, Baloyi and Bekker (2011) found that fluctuations of material costs are a high impact factor which is in contrast to the findings of this study, making it a medium impacting factor.

All five of lowest ranking factors were found to have a low impact on construction cost overruns which included: collusion and cartels (price fixing); high subcontractor utilisation; high demand for materials; traditional procurement methods (lump-sum) cost reimbursable, and high use of equipment versus labour. This is not aligned with the study by Mbachu and Cross (2015) who found that high subcontractor utilisation and the use of traditional procurement systems had a medium and high impact on construction cost overruns, respectively. This discrepancy may be attributed to the fact that the study by Mbachu and Cross (2015) focussed solely on construction projects in New Zealand which can be assumed to have different specific conditions than the Western Cape, South Africa. Four out of the five lowest ranking factors are internal factors, the only external factor being the high demand for materials. This implies that a project that is well implemented and managed is likely not to have cost overruns. This finding aligns to findings of earlier studies by Monyane (2013), but does however not align to the findings of Mukuka (2014) which found adequate planning to be the most effective remedy. Also, this finding indicates that employing experienced contractors and consultants is beneficial to the project success. This finding is once more aligned to the finding of Mukuka (2014). Finally, having a completed design at the time of tender has cost-saving endeavours. This finding is aligned to that of Arcila (2012).

The bottom four effective measures are found to be the adequate planning of logistics to site information, the use of up-to-date technology, use of alternative procurement methods and the ongoing training on competition law. The findings above are aligned to studies by Mukuka (2014), but do however not agree the study by Mbachu and Cross (2015) which found the use of the alliancing procurement model to be one the most effective remedy.

6 Conclusion and Further Research

Cost overrun is still a chronic problem globally. In the Western Cape Province, public projects experience more cost overruns than private projects and the contract value can be used as a determinant of cost overruns. This study has shown that an increase in the contract value results in a decrease in the cost overrun which can be attributed to better project management and implementation on larger projects. Also, the study has shown that the key drivers of cost overruns are design changes, incomplete design information at the time of tender, inadequate planning, project complexity and late contract awards

by clients. There is, however, a strong relationship between most of the drivers of cost overruns and should therefore not be viewed in isolation. Inadequate project preparation and planning leads to having incomplete designs at the time of tender and unrealistic pre-contract estimates. This results in design changes during construction which could cause cost overruns. Furthermore, unrealistic pre-contract estimates could lead to inadequate financial provisions, which may result in delayed contractor payments and in turn cause cost overruns.

This study established that internal factors have a more significant impact on cost overruns compared to external factors, which therefore means most of the causes of cost overruns emanate from actions by the client, project team and contractor. If the professional team wish to minimise the occurrence of cost overruns on projects, attention should be placed on addressing factors that are within the teams control i.e. internal factors. Although internal factors have the most impact on cost overruns at a point in time, an increase in the severity of the internal factor does not lead to a change in the percentage cost overrun. This is in contrast to external factors where the increase in the severity is directly proportional to the percentage cost overrun. Based on the results of this study, this study concludes that a project which allows a sufficient time for planning and preparation results in having completed designs at the time of tender and reliable pre-contract estimates which subsequently leads to a better managed project.

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