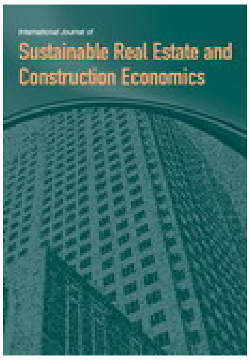

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Implementing building projects: considering construction waste, uncertainties and cost overruns

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Implementing building projects: considering construction waste, uncertainties and cost overruns

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Abstract: Increasing cost overruns in building construction projects have attracted concern from industry players and academicians since actual cost of completing the projects exceeds the original contract price by about 30%. This contributes to existing body of knowledge by examining the relationship between construction wastes, uncertainties, and cost overruns in building construction projects in Uganda. A cross-sectional research design and quantitative research approach was employed and data analysed using SPSS (v20). The findings indicate that construction waste and uncertainties are significant predictors of cost overruns and both account for 65.4% of cost overruns in building construction project. Particularly, construction waste (β = 0.426, t = 6.675, p = 0.000) is the greatest predictor of cost overruns compared to uncertainties ($\beta = 0.307$, $t = 4.381$, $p = 0.000$). Hence, project managers should aim at reducing construction wastes and uncertainties in minimising cost overruns in the building construction sub sector.

Keywords: construction waste; uncertainties; cost overruns; building projects; Uganda.

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1 Introduction

Globally, the construction sector contributes to the socio-economic growth of any nation by improving the quality of life through employment opportunities and providing the infrastructure, such as roads, hospitals, schools and other social facilities that promote people's welfare (Tawalare and Laishram, 2018; Saidu and Shakantu, 2016). Thus, it is imperative that construction projects are completed within the scheduled period of time, within the budgeted cost, in conformity with the agreed scope and meet the anticipated quality. Whereas this is the case, construction companies are frequently faced with the challenges of cost overruns. Notably, research on construction projects in both developed and developing countries indicate that by the time a project is completed, the actual cost exceeds the original contract price by about 30% (Marisa and Yusof, 2020; Paz et al., 2018; Cantarelli et al., 2012). Additionally, one of the most comprehensive studies of cost overruns in India found that 9 out of 10 projects experienced cost overruns of 50 to 100% (Prajapati et al., 2016; Iyer and Chapalkar, 2016). In the same way, a study by Durdyev et al. (2012) stated that cost overrun in building construction is a major problem in both developed and developing countries with an average of 33.3% of the construction project owners experiencing significant cost overruns.

Likewise, instances of cost overruns in Uganda are common where projects in private, public and institutional sectors regularly experience cost overruns. Recent examples of cost overruns in public institutions include the contract for extension of the Parliament Chambers Phase II in 2016. The PPDA report investigating the contract procurement found among other costs, consultancy fees by Ssentongo and Partners increased by 460% (Public Procurement and Disposal Authority (PPDA), 2016). This increase significantly impacted on the overall contract price. Similarly, Alinaitwe et al. (2013) found that that at the end of projects executed by Civil Aviation Authority (CAA), 53% had cost overruns while 40% had no significant changes and only 7% of the projects analysed had cost savings. Among those projects with cost overruns, the projects exceeded the original cost estimates, needed more time and ultimately faced delayed completion (Alinaitwe et al., 2013). Other reports of cost overruns in public sector in Uganda include the construction cost of the first phase of the Northern bypass in Kampala. In this project, funds meant to construct double carriage highway were used to construct a single carriage because of significant cost overruns by more than 100% (Alinaitwe et al., 2013). A project that had been scheduled to take two and a half years to construct instead took more than five years. In the private sector, data about cost overruns is scanty yet cost overruns are common occurrence.

Nevertheless, a review of management report of Nexus (U) Ltd. (2016), a local construction company showed between 30% and 40% cost overruns in the various projects the company executed within 2016. Nexus provides building construction service to private, public and institutional sector clients. The report further pointed that there is 60% chance that public and institutional sector projects run into cost overruns as compared to private sector projects.

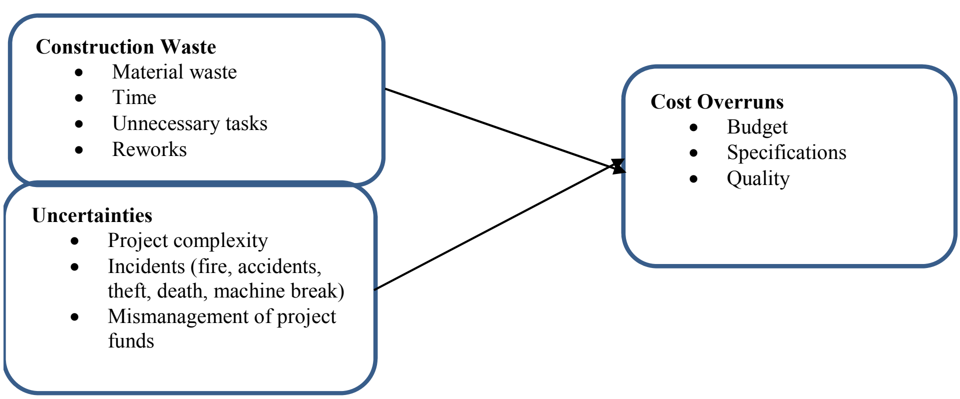
From literature, predictors of cost overruns among construction projects are varied and multidisciplinary ranging from material wastes (Saidu and Shakantu, 2016), uncertainties (Marinho et al., 2014), as well as inadequate planning and poor workmanship that give rise to reworks and hence additional costs among construction projects (Prajapati et al., 2016). In this study, the variables of construction wastes and uncertainties will be studied. Uncertainty is an expression of ambiguity and project indeterminacy faced by managers in allocation of scarce project resources (Ranadive and Dare, 2019; Ho and So, 2017). The concept of uncertainty has no independent existence nor can it be identified and eliminated in the same way that other project risks can be dealt with in the course of project implementation. This is because uncertainty arises naturally from complex situations and is therefore an inevitable factor for most projects. Construction waste refers to any human activity that consumes resources but creates no value, such as mistakes by project managers that require rectification, reworks, waiting time/waste of time, unnecessary tasks, material wastes, unwanted modifications, poor management of work programmes (schedules) and poor construction arising from poor workmanship (Sarhan et al., 2017; Sarhan and Fox, 2013; Nagapan et al., 2012). It is the difference between purchased and actual use of materials in respect to a given project.

Saidu and Shakantu (2016) noted that material wastes raise construction budgets upwards by creating significant variances between planned and actual expenditure. Similarly, uncertainties among construction projects tend to create confusion, indecisiveness and indeterminacy among managers causing a dynamic and unpredictable situation where costs cannot be predicted with reasonable accuracy and paving way for cost overruns (Perminova et al., 2008). In Uganda, whereas studies by Alinaitwe et al. (2013) and Muhwezi et al. (2012) conducted to investigate the predictors of cost overruns, they only focused on the public sector projects. Besides, these studies did not expound on issues of randomness and uncertainty in the cost variables which are common characteristics of construction projects. Thus, this study aims to examine the relationship between Construction waste, uncertainties and cost overruns in building construction projects in Uganda based on the conceptual framework (see Figure 1). This study is guided by the following research objectives with the corresponding hypothesis:

1 To determine the relationship between construction waste and cost overruns in building construction projects (*H1: There is a positive significant relationship between construction waste and cost overruns in building construction projects*)

2 To determine the relationship between uncertainties and cost overruns in building construction projects (*H2: There is a positive significant relationship between uncertainties and cost overruns in building construction projects*). The study was conducted in Uganda's capital city (Kampala) since it has high concentration of the building construction projects characterised by cost overruns.

Figure 1 Conceptual framework



Source: Adopted and modified by Nagapan et al. (2012), Saidu and Shakantu (2016), Marinho et al. (2014), Akanni et al. (2015) and Ramabodu and Verster (2012).

2 Literature review

2.1 Cost overruns within construction projects

In the construction sector, cost overruns have plagued construction projects for decades (Sudarsan and Sridharan, 2021). Cost overrun is a condition in which the amount of money used to buy raw materials for a project exceeds the original cost estimated at the planning phase of the project (Ogungbile et al., 2018). On the other hand, defined cost overrun as the excess between the actual cost and the cost estimated in the budget plan (Ramachandra and Bamidelerotimi, 2015; Prajapati et al., 2016). In both definitions, cost overruns refer to cost increases and involve unanticipated costs incurred in excess of the budgeted amounts. Thus, cost overruns may come from various factors, e.g., lack of experience of contractor, frequent changes in the structure and design of the project, inflation for materials, improper budget planning, fluctuation in prices of materials, un predictable weather conditions as well as poor project management and supervision. In line with the triple constraint concept, cost overruns to construction projects are multi-faceted involving cost, time and scope. According to Abhimanyu et al. (2016), the problem of cost overruns in the construction sector is an international phenomenon, although the situation varies from one country to another. The rate of variation is influenced by several factors based on general economy and construction environments in those nations (Kesto and Leulseged, 2022; Saxena and McDonagh, 2020; Chidambaram et al., 2012). For purposes of this study, cost overruns will be studied in relation to project budget, specifications and quality in line with Ramabodu and Verster's (2012) study findings.

2.2 Waste in construction projects

Construction waste refers to any human activity that consumes resources but creates no value, such as mistakes by project managers that require rectification, reworks, waiting time/waste of time, unnecessary tasks, material wastes, unwanted modifications, poor management of work programmes (schedules) and poor construction arising from poor workmanship (Sarhan et al., 2017; Sarhan and Fox, 2013; Nagapan et al., 2012). It is the difference between purchased and actual use of materials in respect to a given project. In the same way, Nagapan et al. (2012), contend that waste is any surplus or unwanted material persistently causing cost overruns and responsible for delayed completion of projects. In this study, material wastes will be conceptualised in terms of material wastes, time wasted, unnecessary tasks and reworks as suggested by Saidu and Shakantu (2016).

2.3 Uncertainties in construction projects

Within project management literature, uncertainty is an expression of ambiguity and project indeterminacy faced by managers in allocation of scarce project resources (Ranadive and Dare, 2019; Ho and So, 2017). The concept of uncertainty has no independent existence nor can it be identified and eliminated in the same way that other project risks can be dealt with in the course of project implementation. This is because uncertainty arises naturally from complex situations and is therefore an inevitable factor for most projects. Uncertainty is a two-sided coin where activities and processes could go better than planned or they could become worse (Jun et al., 2011). Much earlier, a study by Samset and Haavaldsen (2007) also asserted that uncertainty is a neutral concept that deals with the future outcome and the fact that project managers and other stakeholders on the project management team do not have all the information they need to make critical decisions. While it is an ambiguous concept, Marinho et al. (2014), noted that uncertainty in construction projects is reflected in various forms ranging from project complexity, incidents (fire, accidents, theft, death, machine breakdown) and mismanagement of project funds. Thus, it is recommended that project managers should use just as much time as possible to identify and analyse the opportunities the same way they do in identifying and analysing the threats.

2.4 Construction waste and cost overruns

According to Saidu and Shakantu (2016), construction waste has been described as any constituent generated as a result of construction work and abandoned, irrespective of whether it has been processed, or stocked before being abandoned on site. In addition, construction waste is generated throughout the project from inception to completion with the pre-construction stage accounting for a considerable amount over 30% in building construction projects (Hilton et al., 2021; Osmani et al., 2008). These wastes arise because buildings involve a range of materials and products, and various project stakeholders. The construction wastes include materials unused, reworks, and rejects among others. These are caused partly by Errors in contract documents, incomplete contract documents at commencement of construction, Design change, design and detailing complexity, unclear specification, poor coordination and communication, drawing revisions among others. This calls for construction waste minimisation and reduction through proper guidance to clients, initiating waste reduction at a project level; and improving design practices. All these and more would lead to reducing costs overruns within the building construction industry. Studies conducted by several scholars from different parts of the world have shown that material waste in the construction industry represents a relatively large percentage of the project costs. Consequently, the poor management of material waste leads to an increase in the total cost of construction projects thereby leading to unexpected overruns (Saidu and Shakantu, 2016). Likewise, Hassan et al. (2012) also noted that construction waste is a global challenge facing both construction practitioners and managers as it can have a significant impact on time, cost, quality and sustainability as well as on the overall success of projects. From this line of argument, construction waste and cost overrun are two aspects that have been identified by project managers as critical to the success of many construction projects.

In addition, Ameh and Itodo (2013) noted that material waste on construction sites can contribute to cost overruns in several ways. Firstly, material wastes in construction projects represent a relatively large percentage of the material costs. Consequently, the poor management of materials leads to an increase in the total cost of construction projects leading to overruns. Secondly, material waste such as waiting time and delays extend the time required to complete the project, which attracts additional costs that were not catered for at the planning stage. Since these wastes entail usage of additional resources, there is a relationship between construction waste originating from physical waste and cost overruns originating from non-physical waste (Formoso et al., 2012). Likewise, a study by Ping et al. (2009) observed that extra construction materials are usually purchased, due to the material wastage during the construction process. Adewuyi and Otali (2013) argued that the quantity of material waste generated on some construction sites exceeds, to some extent, the 5% allowance made to take care of material wastage in the course of implementing a given project.

In a related study, Osmani (2011) demonstrated that 10% of the materials delivered to sites in the UK construction industry end up as waste that may not be accounted for leading to overruns. Consequently, cost overrun is a common issue in both the developed and the developing nations, which makes it difficult for many projects to be completed within budget. Similarly, the majority of construction projects in developing countries experience overruns exceeding 100% of the initial budget attributed to wasted material (Memon et al., 2013). Moreover, Ameh and Itodo's (2013) studied in the UK reported that material waste accounts for an additional 15% to construction project cost overruns and for approximately 11% of construction cost overruns in Hong Kong. Similarly, a study done in India revealed a cost overrun of between 20% and 30% as a result of construction-material wastage (Ramaswamy and Kalidindi, 2009). However, whereas these studies present a relationship between material waste and cost overruns, the methodologies adopted to achieve these relationships were based on surveys, thereby presenting subjective findings. Therefore, in bridging this gap, this study will explore the relationship between construction waste, uncertainties and cost overruns in building construction projects in Uganda basing on the views of construction professionals.

2.5 Uncertainties and cost overruns

Uncertainties in on-site and off-site project activities increase risks of delays and cost overruns in building construction projects (Arashpour et al., 2016). Moreover, uncertainties in construction are caused by limited or lack of resources, poor risk attitudes and variations in workflows. Moore and Shangraw (2011) argued that project uncertainty is negatively associated with project success and a major cause of cost overrun among construction projects. In the same way, Marinho et al. (2014) and Meshram et al. (2021), concluded that uncertainty in construction projects in form of project complexity, incidents (fire, accidents, theft, death, machine breakdown) affects project schedule and planned activities which collectively increase project costs thus leading to overruns. Uncertainty is usually associated with inadequate knowledge either on the side of the client or contractor (Ranadive and Dare, 2019; Jelodar et al., 2015; Rotimi and Ramanayaka, 2015; Moore and Shangraw, 2011). Thus, the absence of client knowledge and understanding of requirements or the lack of information to guide proper decision-making during project implementation makes it difficult to define complete, unambiguous or consistent requirements, which can lead to cost overruns and ultimately decreasing project performance.

A study by Perminova et al. (2008) also observed that uncertainty and cost overruns have long been of interest to project managers especially during the initial phase of project planning because their proper management is the reason for the wide variations reported between successful and poorly implemented projects. The concept of dealing with uncertainty as part of project management theory was first expressed during the mid-1950s when the Program Evaluation and Review Technique (PERT) for estimating time in networks was developed. Since then, uncertainties have received increased attention from project experts with a view of helping them achieve predictability for all critical factors under project implementation and minimise cost overruns. This suggests that these two concepts are literally interlinked. More so, Winch and Maytorena (2011) noted that the initial solution to the question of how to handle uncertainty in minimising cost overruns in order to deliver on time and cost is to standardise work breakdown, develop standard methods for time planning such as Critical Path Method (CPM) and PERT and focus on optimisation to reduce chances where project managers could require additional materials leading to cost overruns. From this observation, it can be argued that uncertainties have a direct relationship to cost overruns since their availability is the difference between successful and poorly controlled projects.

In a related argument, Marinho et al. (2014) indicated that uncertainty is closely linked to ambiguity, project complexity, mismanagement of project funds and project indeterminacy by managers in allocation of scarce project resources. Such aspects are responsible for creating incremental budgets that result into cost overruns. For instance, the outcome of a poorly designed work schedule leads to miscalculations, misallocation of project resources, poor decision making and ultimately causing additional costs that were not catered for at the planning stage of the project. Likewise, Samset and Haavaldsen (2007) earlier asserted that uncertainty promotes cost overruns in situations where managers do not have all the information they need to make critical decisions. They therefore make decisions based on intuition and subjective judgements leading to inaccurate estimates. Thus, the absence of adequate information to guide proper decision-making during project implementation makes it difficult to define complete, unambiguous or consistent requirements and ultimately increasing chances for cost overruns among projects (Saliu, 2022). It is for this reason that Moore and Shangraw (2011) concluded in their study that uncertainty is negatively associated with project success and a major cause of cost overrun among construction projects.

Furthermore, Flyvbjerg (2007) indicated that uncertainty is also associated with the occurrence of optimism bias and strategic misrepresentation during the formation of a project's budget. According to Flyvbjerg et al. (2009), optimism bias is the demonstrated systematic tendency for people to be overly optimistic about the outcome of planned actions. This includes overestimating the likelihood of positive events and under estimating the likelihood of negative events. However, during project implementation, things turn out differently and the likely consequence is the creation of a cost overrun. Additionally, complexity is a major contributor for cost overruns especially among multi-billion construction projects (Samset, 2008). This is attributed to the fact that complex projects are associated with multiple phases and some vital steps and details could be missed out leading to unexpected overruns. This is in line with Perminova et al. (2008) who observed that uncertainty in construction projects characterises situations where the actual outcome of a particular event or activity is likely to deviate from the estimate or forecast value. The deviations are the ones that result into cost overruns. However, uncertainty can also come from the combined effect of the initiating events and all processes that cause and affect the project outcomes. Thus, project complexity must be understood at time of design if cost overruns are to be avoided.

3 Methodology

This research adopted a quantitative and cross-sectional research design because a cross sectional research design is quick, guarantees fast conclusions and recommendations regarding the phenomenon under investigation (Sedgwick, 2014). Besides, the quantitative research design was adopted because of its potential to clearly indicate the causal relationship that exists between study variables (Asuquo and Ogwueleka, 2019;

Wardana et al., 2019). The population under this study comprised of 113 fully approved building construction projects within Kampala Uganda (Kampala Capital City Authority, 2017) and these constituted the unit of analysis. These projects were selected because they were concentrated within the study area and has the big construction projects that require a significant number of resources to be implemented. A sample size of 86 building construction projects was determined using Krejcie and Morgan (1970) table. Three key respondents were purposively selected from each project making 258 potential respondents and these formed the unit of inquiry. These included project managers, site engineers and mansions officer. Purposive sampling technique was applied because it targets a specific group of respondents who are knowledgeable about the subject matter in the respective projects which increases data accuracy. After collecting data from the field, it was cleaned, classified, tabulated, coded and later entered into the Statistical Package for Social Sciences (SPSS ver20) for processing and analysis. Out of the 86 companies that were targeted, 73 companies successfully filled and returned the questionnaires, giving a response rate of 84.88% against the 13 (15.12%) that never responded. Similarly, at the individual level, while the study targeted 258 respondents, 219 questionnaires were successfully collected with a response rate of 84.88% of the total responses. Amin (2005) indicated that study results giving a response rate of 70 percent or more of the target population is fit for generalisation.

3.1 Data sources and collection instrument

The study obtained primary data from the project managers, site engineers and mansion officers. This form of data was selected because as articulated by Shetty (2016), it provides recent information about the phenomenon under investigation to enhance proper conclusions and recommendations which are applicable. The data was collected using the questionnaire instrument. The instrument contained closed ended questions which were gauged according to the 5-Point Likert scale. The scale was defined as 5 = strongly agree, 4 = Agree, 3 = Not sure, 2 = Disagree and 1 = Strongly Disagree. The scale is justified because it simplifies data coding and the respondents can easily tick the option that applies to them easily. The instrument was physically administered to increase data accuracy since any respondent with a query could easily be clarified on the spot before he or she participates.

3.2 Measurement of variables

From the conceptual framework in Figure 1, cost overruns are reflected to be influenced by three variables namely; construction waste and uncertainties. These variables were articulated by Nagapan et al. (2012), Saidu and Shakantu (2016), Marinho et al. (2014) as well as Akanni et al. (2015). The framework further indicated that the influence of construction waste is manifested through material wastes, time wasted, unnecessary tasks and reworks in conformity with Saidu and Shakantu's (2016) assertion.

Similarly, Marinho et al. (2014) noted that uncertainties in construction can be expressed in terms of project complexity, mismanagement of project funds and unplanned incidents such as fire, accidents, theft, death of project personnel and machine breakdown, while on their part, These measures were equally adopted in this study. Finally, consistent with Ramabodu and Verster's (2012) studied cost overrun was measured in terms of project budget, specifications and quality of work completed.

3.3 Demographic characteristics of respondents

The study obtained information in relation to gender, age bracket, education attainment, period of service and position held within the company. In relation to gender, males dominated the study with 72.6% in comparison to their female counterparts at 27.4%. This is because building construction companies are gender sensitive when distributing their positions to their workforce given the nature of construction jobs. In relation to educational attainment, an aggregate of 37.0% were degree holders, followed by diploma holders at 35.2%. In addition, certificate holders constituted 16.8% while the least category comprised of masters' degree holders at 11.0%. This implies that potential job seekers must have attained a minimum of a certificate to qualify for a job offer within construction firms in Uganda. More interestingly, the results imply that most employers perceive degree qualification as the most appropriate requirement for attaining a job vacancy within the construction sector.

Furthermore, the duration of employment was also analysed and most employees ranged between 5 years and 10 years (46.1%) while employees who had stayed in the same institution for less than 5 years constituted 36.5%. Additionally, an aggregate of 11.9% of total respondents had stayed in their respective companies for 11–15 years while a mere 5.5% had stayed for at least 16 years. This shows a moderate level of employee turnover within construction companies since majority employees are able to stay in the same company for 10 years. It also shows that construction firms have better employee retention strategies that motivate their staff to stay longer as experienced staffs commit fewer mistakes.

3.4 Firm characteristics for construction companies

Majority of building construction companies had turnover ranging from 500 m to 1 bn with 34.25%. This was followed by companies whose annual turnover was in the region 1 to 1.5 bn with 21.91%, 1.51 to 2 bn attracted 17.81% while the lowest income earners were those in the regions of above UGX 2 bn with 10.96%. In addition, 15.07% of the building construction firms were earning less than UGX 500 m, respectively. These findings signify a moderate level of turnover for players within the construction sector since every firm had some level of annual earnings. Similarly, the majority of building companies (52.05%) had at least 100 employees, followed by 27.40% who had between 51 employees and 100 employees while the least category (20.55%) employed at most 50 employees. These indicate that the construction sector is a significant employer providing job opportunities to a sizeable proportion of job-seeking graduates. In relation to period of existence, the findings revealed that an aggregate of 51.25% of the construction firms had stayed in operation for at least 15 years, 27.5% of the companies had stayed for 8–14 years while 21.25% were less than 8 years in operation. These findings signify stability for companies within the construction sector since the biggest proportion had sustained their operations for longer. More so, the findings revealed that privately owned construction firms constituted the majority at 82.19% followed by those that were jointly owned with a contribution of 10.96% while the least category were those building companies with 100% government ownership at 6.85%. This implies that there is a limited government shareholding in the operations of construction firms in Uganda.

3.5 Validity

According to Amin (2005), validity refers to the extent to which the data collection instrument is relevant in measuring what it is supposed to measure. In this study, validity of the questionnaire was determined by computing the Content Validity Index (CVI) (Srivastava and Bisaria, 2019). This method involved designing questions with five responses of 'very relevant, relevant, not sure, irrelevant and very irrelevant' for experts to highlight whether the dimensions and concepts used in the study are appropriate enough to give genuine results. The views obtained were used to rephrase some questions until the final version of the instrument was got. Using the formula, CVI = K/N where, K =Number of items considered relevant/suitable and N = Number of items considered in the instruments, the CVI ratio was ascertained. The study considered whether the instrument was valid or not based on the threshold of 0.7 (Amin, 2005). The content validity index portrays that each construct fulfils the threshold coefficient of at least 0.7 as suggested by Field (2009). Hence, the results were fit for generalisation.

3.6 Reliability

Reliability is a measure that indicates the stability and consistency with which the data collection instrument captures the variables under study and helps to assess the rightness (error free) of a data collection tool (Veuger, 2017; Sekaran, 2003). In this study, reliability of the research instrument was ensured by pretesting to a group of 10–15 respondents from a different area and their views formed a basis for improving the questions set in the questionnaire. In addition, the results were compared with Cronbach Alpha Coefficient to guide the researcher on whether the questionnaire instrument was able to ascertain reliable information. This ensured that the questions make similar meaning and could be consistently interpreted and understood the same way by different respondents. Nunnally (1978) asserted that instruments used in basic research should have reliability of 0.70 or better. The validity and reliability statistics are indicated in Table 1 hereunder. The results show that all the sub dimensions of construction waste, uncertainties, environmental factors and cost overruns exceeded the minimum acceptable threshold Cronbach alpha of 0.7. Hence, they are reliable and fit to be based upon to make valid conclusions and recommendations.

Table 1 Validity and reliability statistics for the study variables

Study variables	*Number of items*	*Cronbach's alpha coefficient*	*Content validity index*
Construction waste	11	0.745	0.937
Uncertainties	13	0.716	0.866
Cost overrun	20	0.758	0.804

Source: Primary data.

4 Results

The study obtained correlation and regression analyses 0074o address the research aim. The correlation and regression analysis provided coefficients indicating the relationship between the study variables and predictive power, respectively.

4.1 Correlation analysis

Pearson correlation coefficient was used as a statistical test to identify whether there was a significant association between construction waste, uncertainties and cost overruns. The results in Table 2 revealed a significant and positive relationship between construction waste and cost overruns (*r*=.496, *p*<.01). This implies that construction wastes and cost overruns are correlated in construction projects. While uncertainties are significant and positively related to cost overruns (*r*=.477, *p*<.01). Therefore, these findings imply that the more uncertainties faced by building construction projects, the more they are likely to experience cost overruns. Thus, it can be deduced from the results that it is necessary for project managers to control uncertainties if cost overruns are to be managed within an acceptable-levels during project implementation. Thus, an increase in construction wastes would lead to an increase in cost.

Table 2 Pearson correlation results

Variables		*1*	*2*	*3*	*4*
Construction waste	1	1			
Uncertainties	2	.294**	1		
Cost overruns	3	.496**	.477**	.465**	1

Source: Primary data; **. Correlation is significant at the 0.01 level (2-tailed).

4.2 Regression analysis

A multiple regression was estimated to examine the predictive potential of the independent variables (construction waste, and uncertainties) on cost overruns. The obtained results are summarised in Table 3.

Table 3 Regression estimates

	Unstandardised coefficients		*Standardised coefficients*	*T*	*Sig.*	*Co-linearity statistics*	
	B	*S.E.β*	*B*			*Tolerance*	*VIF*
(Constant	.310	.186		1.667	.097		
Const. waste	.403	.060	.426	6.675	.000	.502	1.094
Uncertainties	.350	.080	.307	4.381	.000	.415	2.408
	R	*R^2-square*	*Adj R^2-square*	*F*	*Sig.*	*Durbin-Watson*	
	.813[a]	.661	.654	107.657	.000[b]	1.638	

Source: Primary data; a. Dependent Variable: Cost overruns; b. Predictors: (Constant), Construction waste and Uncertainties.

Table 3 revealed statistical results of *F*=107.657, Sig.=.000 in relation to the predicting variables of construction waste and uncertainties which signal a statistically significant and predictive ability of the study variables in relation to cost overruns. Results further indicate that the model is free from multi-collinearity since the collinearity statistics in terms of VIF <5 and Tolerance value >0.1. Thus, the model fits the data well. Therefore, the regression model is fit to be based upon to derive valid conclusions and recommendations. Moreover, the obtained Adj r^2 = .654 implies that variations in construction waste and uncertainties can explain up to 65.4% of the variations in cost overruns among building construction companies in Kampala.

In addition, results show that construction wastes, and uncertainties are all significant predictors for cost overruns within construction projects. Similarly, the β-values for construction wastes (β=.426), and uncertainties (β=.307) further reveal that cost overruns are more influenced by construction wastes followed by uncertainties.

4.3 Discussion of findings

4.3.1 Relationship between construction waste and cost overruns

The findings revealed a statistically positive and significant relationship between construction wastes and cost overruns. This inference is attributed to the fact that construction wastes cause delays in completion of projects thereby affecting time, are responsible for variations in project scope and ultimately lead to changes in the bills of quantities with the end result being cost overruns. Based on these findings, the study indicated that wastage in form of material waste, time, unnecessary tasks and reworks would undoubtedly lead to cost overruns in building construction projects. Therefore, lack of experience of contractor leading to material wastages, frequent changes in the structure and design of the project resulting to reworks, inflation in materials prices, improper budget planning, fluctuation in prices of materials as well as poor project management and supervision are precursors for cost overruns. These findings shed light on the fact that project managers for construction firms need to minimise wastage of materials on construction sites, wasted time, unnecessary tasks and reworks in order to remain within the agreed project budget as agreed between the client and construction firms. In the same way, the study findings affirm that mistakes by project managers that require rectification, unwanted modifications, poor management of work programmes (schedules) and poor workmanship are all antecedents for cost overruns since they are related to construction wastes in one way or the other.

In support of these findings, different scholars have also echoed similar findings. Notably, Saidu and Shakantu (2016) and Ameh and Itodo (2013) observed that material waste in the construction industry represents a relatively large percentage of the project costs arguing that the poor management of material waste leads to an increase in the total cost of construction projects thereby leading to unexpected overruns. Likewise, a study by Hassan et al. (2012), also acknowledged that construction waste is a global challenge facing both construction practitioners and project managers because it can have a significant impact on time, cost, quality and overall success of the project. In another study, Ameh and Itodo (2013, p.745) also noted that material waste, waiting time and delays extend the time required to complete the project, which attracts additional costs that were not catered for at the planning stage. More so, material wastes usually exceed the 5% provision made to cater for material wastage in the course of project implementation and this leads to overruns in the process. Therefore, because of variations in budget for materials, it becomes difficult for many projects to be completed within budget.

4.3.2 Relationship between uncertainties and cost overruns

The study established a positive and significant relationship between uncertainties and cost overruns within building construction projects. The existence of this positive relationship is explained by the fact that uncertainties cause ambiguity and project indeterminacy among project managers while allocating scarce project resources to different activities. As per the study, attributes such as project complexity, incidents (such as fire, accidents, theft, death, machine break) and project funds mismanagement account for the occurrence of cost overruns among building construction projects. Thus, it is important to note that the model for uncertainties in this study is explained by a trilogy of project complexity, incidents and mismanagement of project funds of which these aspects are mutually exclusive. With these findings, it is clear that building construction firms through their managers must identify the best mechanism through which they can control uncertainties if cost overruns are to be managed within acceptable levels. Nevertheless, the concept of uncertainty has no independent existence nor can it be identified and eliminated in the same way that other project risks can be dealt with in the course of project implementation. This is because uncertainty arises naturally from complex situations and is therefore an inevitable factor for most projects.

These findings are consistent with earlier studies on the relationship between uncertainties and cost overruns among construction projects. For instance, Moore and Shangraw (2011) observed that project uncertainty is negatively associated with project success and a major cause of cost overrun among construction projects. Similarly, Marinho et al. (2014), concluded that uncertainty in construction projects in form of project complexity and incidents such as fire, accidents, theft, and death of project staff as well as machine breakdowns directly affect project schedule and planned activities which collectively increase project costs thus leading to overruns. Informatively, uncertainty is usually associated with inadequate knowledge or unambiguous either on the side of the client or contractor and the absence of client knowledge and understanding of requirements or the lack of information to guide proper decision-making during project implementation which can lead to cost overruns. Related findings were also revealed by Winch and Maytorena's (2011) study when they confirmed that uncertainties have a direct positive relationship to cost overruns since their availability is the defining line between successful and poorly managed projects.

5 Conclusions

Construction wastes and uncertainties are positively and significantly influence cost. Hence, wastage of resources used in building construction, occurrence of uncertain events and failure to scan environment within which a project is implemented, are contributors to cost overruns. These attributes stretch the original project budget projections leading to inclusion of additional activities leading to cost overruns.

Similarly, it can be concluded in this study that variations in budget estimates among building construction projects are explained by a combination of construction wastes, and uncertainties. Therefore, construction firms that embrace proper management of construction materials, uncertainties in their operations have higher chances of minimising cost overruns.

6 Recommendations

Findings indicate that construction waste, and uncertainties significantly predict cost overruns. Therefore, project managers need to stocktake of construction materials and their prices on a daily basis. This will ensure that it is easier to establish accurate balance for raw materials at the opening and end of project activities every day. Such a mechanism will provide a clear monitoring system for raw materials to identify wasted materials (if any), deviations from agreed schedules and projections as well as on spot identification of incidents that could cause delays that may lead to additional costs.

Project managers and consultants should also standardise work breakdown, develop standard methods for time planning such as critical path method and make continuous reviews of project progress to reduce chances where additional materials could be needed without the knowledge of the project owner. This will minimise overruns.

Project consultants should improve on methods of cost determination, designers should make the full designs available at every stage in construction process and contractors should also carry out adequate site visit to identify issues that require immediate attention.

Similarly, project managers should use just as much time as possible to identify and analyse the opportunities the same way they do in identifying and analysing the threats during the course of project implementation. This can be achieved through daily site visits by the project owners and project managers for better understanding of site conditions. This will help in identifying complex scenarios and incidents that could lead to cost overruns.

7 Study limitations and areas of further research

This research was limited to building construction projects in Kampala and left out other districts in Uganda. Accordingly, future researchers are encouraged to consider other districts in expanding the concept of cost overruns in Uganda. Additionally, this research based on construction waste and uncertainties in determining cost overruns. This calls for further inclusion of more factors to comprehensively tackle cost overruns.

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