Factor Analysis of the Significant Drivers causing Cost Variation in Building Construction Projects in Tanzania

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Abstract - *The paper objectively focused on identifying significant drivers causing Cost Variation to building construction projects in Tanzania by using factor analysis of Principal Component (PCA). This was to establish the covariance of the drivers causing variation and reduce the 48 identified drives causing cost to vary to 19 drivers. As a result variation or change in the contract terms, and the narrower five groups of significant drivers causing cost variation with factor loading per group were identified. Group one has designer related drivers, group two is comprised of drivers in various elements of the building, group three has drivers at different stages in the building process, group four consist of general drivers causing cost variation and group five is of human related and external drivers. Conclusively, the first four drives in group one has high loading contributing to cost variation. In group two financial condition of the owner has the highest loading of .88 comparatively within the group contributing to variation whereas inclement weather had lower loading than other drivers. Likewise unforeseeable ground conditions recorded high loading in the group. Therefore the five groups formed are useful and have drivers that are significant, confirmed, to show a causative association within the group cost variation. It is recommended that despite the variation on loading between high, medium and low, all the confirmed drivers in the group have potential to causing cost variation and they should call for attention of construction practitioners on all stages of construction thereby to enhancing project information to appreciate drives that cause to cost variation.*

***Key Words*: Significant Drivers, Cost Variation, Building Construction projects**

1. INTRODUCTION

1.1 Context of cost variation

Cost variation is the mathematical difference between budgeted cost of work performed, and the actual cost of work performed. The focus of the paper is the problem of cost to vary contrary to the initial budgeted amount, and/ the contract sum. Cost variation can be cost or budget overruns i.e. increase or decrease and an escalation. Cost variation of 'increase' involves unexpected costs incurred in excess of budgeted amount due to an underestimation of the actual cost during budgeting, cost overrun is distinguished therefore from cost escalation, which is used to express an anticipated growth in a budgeted cost due to factors such as inflation. (Queensland Department of Housing and Public Works, 2006).

1.2 Cost Variation in Contractual Provision

Variations are always expressed in contractual provisions (Baker and Mackenzie, 2013) and can mean two things: that is, a physical 'variation' or change to the work parties (quantity or quality) required to be carried under the contract.

Variations are one of the most common causes of disputes between parties which revolve around the following issues:

(a) Was the work in question within or outside the scope of work?

(b) Did the parties comply with the procedural requirements under the contract regarding directing and claiming for variation?

(c) What is a fair or reasonable value of the varied work?

Disputes are often fuelled by the last issue of the value of the varied work due to the fact that in judging whether the value for the varied work is fair or reasonable. The value could have gone up (increased) beyond the contracted amount in a way that it becomes a burden for the client or project sponsors to pay. On the other hand, the value could have gone down (decreased) in a way that the contractor is worried about his profits and overheads.

From other literature sources, cost overrun is said to be common in *infrastructure*, *building*, and *technology* projects for insane in information technology projects. A study by the Standish Group (2004) reports an average cost overrun of 43 percent; whereas 71 percent of projects in the industry came in over budget, exceeded time estimates, and had estimated too narrow a *scope*; whereby total waste was estimated at $55 billion per year in the US alone (Standish group 2004). This happened despite the vast knowledge in project management, it was argued in the report.

In a study by Flyvbjerg *et.al* (2002), the argument put forward was that many major construction projects have incurred cost overruns and the cost estimates used to decide whether important transportation infrastructure should be built can mislead grossly and systematically. The study further affirmed that this is a worldwide phenomenon that affects both public and governments, and that no single sector is immune to the trend.

Consequently, in the construction industry, cost and time variations are pervasive, both in routine maintenance and new or "greenfield" construction. The rising expense can be crippling for governments, particularly in developing countries as they try to improve basic services. One study conducted by the World Bank Construction Sector Transparency Program in 10 developing countries found construction costs increased by an average of 64 percent from the initial plan to the final bill (World Bank, 2012).

Another study by Garry (2006) as cited in Futenge (2008) found that the problem of cost overrun, especially in the construction industry is a worldwide phenomenon, and its ripples are normally a source of friction among clients, consultants and contractors on the issue of project cost variation.

In Tanzania, the construction sector has continued to portray very exciting development trend in the economy. The growth which is currently being experienced is primarily driven by recent developments in road works, housing and mining. The growth rate of the construction sector is reported to have increased to 11.9% in 1995/06 from 10.8 in 2004/05 and the contribution of construction activities to the overall GDP rose to 5.7%, compared to 5.3% in 2004/05 (UNESCO Tanzanian Commission, 2016). This was the highest recorded growth, compared to 6.9% in 2011.That particular growth rate was achieved despite the projections of 9.9% which was deduced from the 10.2% growth of 2010. The differences in growth rates can mean different things depending on the focus of the study. However, they are beyond the scope of this paper.

Likewise, in the guidelines for the implementation of annual plan and budget for 2012/13, in the implementation of the five year development plan 2011/12 – 2015/16, parts I and II show the Tanzanian government investment goal in increasing construction activities. These include construction of regional roads and district roads, and training of students in engineering, which of course have a counter effect in the growth of the construction industry in terms of manpower. Furthermore, the sub-activities of construction were projected at 13.1% due to increased infrastructure developments, including roads bridges, construction and rehabilitation of railway lines, construction of railway lines and expansion of airports, commercial and residential dwellings as well as land development.

Therefore in any kind of investment whether public or private, it goes without saying that the cost performance of building construction projects is a key criterion for project sponsors. In essence, project cost performance is typically measured by comparing final cost against budget for the project. That being the case, a variation in cost whether expected or unexpected is never in the interest of the project parties

2.0 LITERATURE REVIEW

2.1 Cost Variation studies

Cost driver is the unit of an activity that causes the change in activity's cost. Cost driver is any factor which causes a change in the cost of an activity — *Chartered Institute of Management Accountants*. Alternatively "Cost drivers are the structural determinants of the cost of an activity, reflecting any linkages or an interrelationship that affects it"

2.2 Trend f Cost Variation in Tanzania

Conveniently selected projects revealed a trend as shown in Tables 2.1

Table -2.1: Trend of cost variation

Start Date	Contract Value	Final Cost	Cost Variation
2009	18,311,312,353	18,657,952,746	346,640,390
2009	782,755,680	770,494,420.00	- 12,261,260
2007	5,484,707,040	8,246,252,764	2,761,545,724
2010	662,724,445	910,761,111	248,036,666
2009	19,670,725,085	19,670,725,085	0.00
2012	1,464,563,112	1,464,563,112	0.00
2009	511,217,280	510,387,486	-829,794.
2008	330,704,690	424,646,388	93,941,698.
2012	1,953,040,824	1,919,476,991	-3,563,833.

Table -2.1 show, descriptively a bit of trend in cost variation, both of increase in cost from the initial contract and those that do not have any change in the cost, that is the contract sum is equal to the final account figure at project completion. likewise projects that have used less cost than the initial contacts, and ended up in saving for the project, for example the -33, 563,833 in one of the project, meaning that the project saved that amount of money from the contract sum. The foregone Table -2.1 is simple illustration of how the trend of cost variation signifies a problem of cost variation in building construction projects. No project, whether big or small, is immune to the riddles of cost variation. Cost variation is unnatural, as it is unwelcomed by parties to the project even if it is foreseen at the beginning. Therefore, deliberate efforts by project stakeholders are paramount to ensure efficiency in execution to, achieve value for money and the objectives of the project.

Further, the paper has reviewed studies to establish bases of drivers to be confirmed in the field for the Tanzanian case.

To begin with it is a study on Key drivers of discrepancies between initial and final costs of construction projects in New Zealand, by Mbachu and C. Cross; it investigated the factors underlying discrepancies between the initial and final contract prices of construction projects. Focus was on the factors along lines of responsibilities and accountability in the building development process. Results, revealed six broad sources of discrepant factors ranked from highly influential to the lowest, comprising of issues related to the owner, designers, main and subcontractors, project & environment, quantity surveyors/estimators and other external parties such as local councils and utility companies in 5-Point Likert scale.

Another study by N. Ahzar et al on Cost Overrun Factors in Construction Industry of Pakistan attempted to identify 42 major cost overrun factors in the construction sector of Pakistan whereby majority of cost overrun factors (88%) lie in medium severity impact zone (with a rating between 5 to 7.5 out of 10), signifying that major attention needs to be given to these factors as they collectively cause considerable cost overrun.

Therefore, the top ten factors were: fluctuation in prices of raw materials with 8.9 impact, unstable cost of manufactured materials, with impact 7.6, high cost of machineries with impact 7.6, lowest bidding procurement procedures with impact 7.0, poor project (site management/ poor cost control with impact 6.9, delays between design and procurement phases with 6.9 impact, incorrect methods of cost estimation with 6.9 impact, eight, additional work with 6.8 impact, improper planning with 6.8, and unsupportive government policies as tabulated below with 6.6 impact. Henceforth of the studies reviewed, 49 drivers were identified based on the relative index used to rank the factors, mean impact rating (cMRi), and those which affected the R^2 in the studies reviewed. The drivers are tabulated in the Table -2.2.

Table -2.2: Drivers of cost from literature

Drivers	**RI/R2/cMRi**
General causes of cost variation	
Funding problem	RI 67.59
Lowest bidding procurement method	RI 70.37
Bureaucracy in bidding/ tendering method	RI 68.52
Additional work	RI 69.44
Wrong method of estimation	RI 68.51
Financial condition of the owner	R^2 0.046
Cash flow of the contractor	R^2 0.201
Drawings detailed or not	R^2 0.08
Inaccurate material estimating	R^2 0.184
Owner related drivers causing project cost escalation	
Change orders resulting in variation to the contra ct	cRi4.39
Length of time allowed for proper risk analysis at the onset and for quality execution of the job	cMRi4.19
Choice of procurement system impacting on workflow integration and relationships in the development process	cMRi4.10
Choice of contract strategy impacting risks and risk allowances	cMi4.035
Choice of tendering and contract strategy impacting on risks and risk allowances	cMRi3.93
Speed and quality of decision-making and responsiveness to requests for information	cMRi3.36
Extent of fulfillment of contractual obligations	cMRi2.66
Additional work to be executed at day work	cMRi2.17
Quality of design information, documentation & Communication	cMRi4.63
Build ability issues resulting in slow pace of work and loss of productivity	cMRi4.33
Errors or omissions in design drawings	cMRi4.12
Not undertaking proper site analysis, geotechnical tests resulting in designs and drawings being inconsistent with site conditions/requirements of the Building Code	cMRi4.01
Delay in giving instructions/responding to contractor's requests for information	cMRi3.94
Inability to minimize variations by failing to comprehensively capture owner's stated and future needs and requirements at the inception stage and effectively translate these into final design & specifications	cMRi3.33
Ambiguous or conflicting information in the contract documents	cMRi 2.5

Failure to adequately analyze contractual risk at risks at the onset and apply cover imminent cost escalations arising from sufficient contingencies to future increase in scope of work	cMRi 3.2
Failure to detect unbalanced bidding at the tender evaluation stage where those items of work with prospects of significant put high rates to scope increase and low rates to those that may not change in scope.	cMRi 3.0
Failure to advise the owner or owner's other agents on the cost implications prior to instructing the contractor to carry out variation works.	cMRi 2.6
Inability to use negotiation skills to avoid potential claims and disputes for which the contractor has rights under the contract.	cMRi 2.5
Inability to dispute some of the contractor's claims, especially those not supported by accurate records or factual evidence.	cMRi 2.2
Unbalanced bidding at the tendering stage Putting high rates to those items of work Significant scope increase and low rates to those that may not change in scope.	cMRi4.36
Lack of involvement of contractors and specialist trades people in the design development.	cMRi3.88
Delays by nominated subcontractor prolonging completion time	cMRi3.36
Uncooperative attitudes and rivalry resulting in erosion of teamwork, loss of productivity, costly and time-consuming dispute resolution process	cMRi3.35
Cash flow problems and inability to continue with project resulting in employment of other contractors to complete the job	cMRi3.27
Lack of innovation and initiates for cost and time saving in the project execution.	cMRi3.09
Disposition to 'claiming all claimables' especially in lowest tender, lowest margin contracts.	cMRi2.27
Unforeseeable underground conditions requiring changes in design work method e.g. contamination/ rock	cMRi4.36
Inclement weather conditions	cMRi4.19
Innovative project with no known precedent to fo low	cMRi4.12
Congested/ site presenting planning &logistic challenge	cMRi3.36
Constraints from neighborhood characteristics traffic congestion topographical features, logistic issues	cMRi3.27
Project scale and complexity	cMRi2.72
Costs/ delays due to council officials in relation to consents, permits/ inspections	cMRi3.42
Cost/delays by utility companies in relation to service	cMRi3.33
Delays associated with sudden change in regulations or legislation having impact on the work execution, e.g. Workplace health & safety.	cMRi 3.0
Costs delays by the nominated supplier	cMRi3.27
Costs and delays relating to unforeseeable & uninsurable incidents which are borne by the owner e.g. Lightning strike.	cMRi2.25
Statutory fines/ penalties resulting from owner's negligence or work related levies for which the owner is reliable.	cMRi2.13

2.3 Introduction to factor analysis

Factor analysis is a method for investigating whether a number of variables of interest are linearly related to a smaller number of unobservable factors (Tryfos, 1997). Factor analysis has the advantage of removing redundancy or duplication from a set of correlated variables. After performing factor analysis fewer variables are obtained which represents the rest of the variables. This method was preferred because some of the variables used by Knapp and Mujtaba (2009) were seem to be the same. Through factor analysis variables are identified by forming groups of variables (subsets) that are relatively independent of each other.

It is common knowledge that there is an abundance of tools of parameter estimation in factor analysis. The three commonest are Principal Component Analysis, Principal Factor Analysis, and the Maximum Likelihood Method (Johnson and Wichern, 1988). In this paper of significant drivers of cost variation of building construction projects, the Principal Component Analysis (PCA) was used to conclude patterns of correlations among observed cost drivers of variation of building construction projects and to reduce a large number of observed drivers of cost variation to a smaller number of factors. PCA was adopted primarily due to the fact that the interest of the paper is on the empirical summary of the data set.

2.4 Literature Gap

A study on cost and time overrun on central government building construction projects in Tanzania (2000 – 2010) by Shaban Twahiri (2013) focused on analyzing the performance of public funded government buildings in Tanzania with respect to cost and time overrun, further, seeking solutions on how to improve from the five working objectives.

According to the study, the factors that contributed to cost and time overrun of the government building projects from 2000 to 2010 included financial difficulties of the owner, lack of experience of site location, design and changes during construction, poor project management, indecision by the supervising team, unpredictable weather conditions, and fluctuations in the cost of building materials.

The Chi square on the extent of the factors to cost overrun was 0.01, which significantly contributed to cost overrun in building construction projects in Tanzania. With regard to the degree or rather magnitude of cost overrun in the respective building projects, the findings of the study revealed the cost overrun to be between 5-100% with an average increase of 44.5%. This is unacceptably on the high side as nearly a half of the projects had their costs on the rise. Moreover, in relation to the third objective on the parties responsible to cost overrun, the study identified a number of owner related causes and consultant related causes contributing to cost overrun in building construction projects. These include additional works at owner's request, financial difficulties and suspension of works by owners and design changes, inadequate review for drawing and contract documents, incomplete design at the time of tender, indecision by the supervising team dealing with contractor queries resulting in delays, lack of experience of site location, and lack of coordination at design stage. The study also had a 5 project case study as shown in Table -2.3.

Table - 2.3: Case Study Results on Cost Overrun in Selected Projects

Construction of office block for Sumbawanga Municipal Council		
	Original contract amount	688.3mil
	Actual contract amount	963.62mil
	Cost overrun	275.32mil =40%
	Causes	Responsible
	Increased scope of work Delay in payment of completed works Late approval of contractors report to proceed with the work	Client Client Consultant and Client Client
	Delay in nominating electrical subcontractors Phasing of the project	Client
Construction of regional office block – Manvara		
	Original contract amount	2,896.7mil
	Actual contract amount	4,664.2mil
	Cost overrun	1,767.5mil =61%
	Causes	Responsible party
	Additional work due to changes in design Change of specification of \air condition by the client Re-measurement due to discrepancies between BOQ and drawings Inadequate funding on the client. Project implemented in phases Re-measurement of boundary wall and storm water drainage due to site layout Delayed payment of completed works	Client Consultant and Client Client Client Client
Construction of low cost houses at Pasiansi Mwanza		
	Original contract amount	300mil
	Actual contract amount	400.5mil
	Cost overrun	100.5mil = 30%
	Causes	Responsible party
	Increase of scope of work (12 – 14 units) Re-measurement of provisional sums (electricity and water) Re-measurement of substructure due to site location not known during design Extended preliminaries due to sow issue of instruction	Client Consultant Consultant and Client Client
Construction of Mvomero district office Block – Morogoro		
	Original contract amount	299.9mil
	Actual contract amount	389.9mil

	Cost overrun	90mil = 25%
	Causes	**Responsible party**
	Increased scope Additional works ordered by client Re-measurement of substructure due to change of location unknown at design Extended preliminaries due to slow issue of instructions Omission in the BOQ of concrete works for superstructure Delayed payment for completed works	Client Client Consultant and Client Consultant Consultant Client
Construction of AIDs Research clinic at Mbeya Hospital		
	Original contract amount	799.4mil
	Actual contract amount	999.25mil
	Cost overrun	199.85mil = 25%
	Causes	Responsible party
	Delayed payments of completed works Change of specification from hardwood to aluminum profiles Re-measurement of substructure	Client Consultant Consultant

As observed from Table -2.3, the study focused on analyzing time and cost performance of building projects by looking on the factors that cause overrun and degree of overrun in the selected projects together with establishing how significant a factor is in causing overrun. However, the study is silent on the criteria for inclusion and exclusion of the projects that were case studied in terms of nature, geographical location, duration, size and existence of trend in overrun, which led to choosing to study the particular projects in the respective locality. This somehow limits statistical inferences and generalization. Furthermore, the analysis of the degree cost overrun fails to portray how the overrun actually happens, how it is appreciated and what stages of the building project are more prone to overrun than others. Furthermore, buildings have elements that form the core stages or rather phasing, how is cost overrun reflected in these elements? Which elements are more prone to overrun than others and why? Finally the effects of cost overrun to the project parties and public in terms relations, duration, and efficiency in project implementation to attain value for money of the output need to be revealed.

3.0 METHODOLOGY AND APPROACH

3.1 Type of Data required

Data gathered were drivers causing cost variation in building construction projects in Tanzania. They were in category of general drivers of cost variation, drivers of cost variation in various elements of the building, drivers of cost variation at different stages of construction in the and human action and external drivers in causing variation

3.1.1 Population, Sample size and sampling technique

Because of the non-homogeneity nature of the samples to which be studied, stratified sampling (Mathers et al., 2007) was applied. The study population is registered Building Contractors class I to IV in Tanzania totaling at 421. The confidence level at 95% and level of precision is +/– 5%. The sample size is obtained by the formula $n=N/1+N(e)^2$ where n is sample size, N the total number Contractors and e is the level of precision at 95% confidence level (Glenn, 1992). The sample size was 205 contractors (Table -3.1).

3.2 Data Collection

The questionnaire was designed and piloted to ensure its viability and effectiveness, then, the survey progressed. Low cost, Freeness from bias and the fact that large samples can be reached which increases reliability were the major reason for adopting questionnaire tool (Kothari, 2004). Cost drivers were grouped by their correlations, that is all variables within a particular group are highly correlated among themselves but have relatively small correlations with variables in a different group. Each group is expected to represents a single underlying construct, or factor, that is responsible for the observed correlation (Shi, 2006).

Table -3.1: Actual data collection and statistics of the company contacted

Data collection	**Target**	**Actual collection**		
Projects	79	114	144.3%	
Companies	205	114	55.6%	
Companies statistics	**Year in business**	**Projects held at the moment**	**Permanent staff held**	**Project Duration**
Mean	11.61	15.25	26.40	1.305
Median	10.00	15.00	10.00	1.000
Mode	10	26	10	1.0
Minimum	1	2	4	.5
Maximum	55	26	100	5.0
Company Ownership		**Frequency**	**Valid Percent**	
Public		7	9.5	

Private	67	90.5
Unstated	40	N/A
Total	**114**	**100**

3.3 Ethics and Informed consent

Respondents were made aware of the objectives and no names of respondents or details of their response disclosed. Further the paper has not plagiarize the work of other or claim credit for results thereof, and it is not out to conceal objections that the study cannot rebut nor distort opposing views and, it has not destroyed data or conceal sources important for those who follow. Any research conducted is required to ensure ethical issues (Cohen 2000).

3.4 Data Analysis

The force behind analysis was to come up with findings that answers the objectives of the paper, It is therefore a computation of numbers, letters, symbols to express details of relevant facts pertaining this paper (Alreck, 2004) as quoted in Kothari (2004).

3.4.1 Identification of Drivers of Cost Variation

Drivers of cost variation of building construction projects covered by the first objective are determined through factor analysis. It should be known that factor analysis is a statistical procedure developed in the early twentieth-century by scientists interested in psychometric measurements. Since then the method has been used extensively despite misgivings over psychological interpretations of several early studies and the lack of powerful computing facilities which hindered its initial development as a statistical method (Johnson and Wichern, 1992.

Factor analysis in this case has four things at the core of: correlation matrix; factor extraction; factor rotation; and decision about number of factors to be involved. Through the matrix the interrelations between cost drivers of variation are presented and correlation between cost drivers is examined by looking highly correlated drivers with a group of other drivers but correlate very badly with variables outside of that group (Field 2000). Factor extraction on the other hand is to determine factors. It is a critical point in this paper in the sense that data is critical and so it requires a thorough examination, likewise best judgment is good practice. Among ways developed to extract the correct number of factors which includes the Guttman-Kaiser rule, Scree test, Bartlett's test, Minimum Average Partial, and Parallel Analysis. Factor analysis was adopted because drivers of cost variation cannot be measured by a single variable but rather with a combination of variables.

It should be known that there is abundance of tools for parameter estimation in factor analysis. The three commonest are Principal Component Analysis, Principal Factor Analysis, and the Maximum Likelihood Method (Johnson and Wichern, 1988). In this study, the Principal Component Analysis (PCA) was used to conclude patterns of correlations among observed cost drivers of variation of building construction projects and to reduce a large number of observed drivers of cost variation to a smaller number of factors. PCA was adopted primarily due to the fact that the interest of the researcher is on the empirical summary of the data set

4.0 FINDINGS AND DISCUSSION

Factor analysis reduced the divers of cost variation to 30 after data cleaning from 49 drivers identified from literature into groups(Table 4.1, 4.2), because the groups gives a better understanding of variables which determine cost variation. Ideally, factor analysis provides unobserved factors which are more interesting than observed quantities (Härdle, and Simar, 2007). Therefore, various estimation and optimal rotation procedures have been adopted as explained in this section;-

Table -4.1: Total Variance explained

Component	Initial Eigenvalues		
	Total	**% of Variance**	**Cumulative %**
1	8.198	27.325	27.325
2	2.859	9.530	36.855
3	2.618	8.728	45.583
4	2.327	7.757	53.339
5	1.718	5.726	59.066
6	1.489	4.964	64.030
7	1.275	4.249	68.278
8	1.166	3.885	72.163
9	1.133	3.776	75.940
10	1.027	3.425	79.365
11	.883	2.943	82.308
12	.766	2.555	84.862
13	.717	2.389	87.251
14	.619	2.065	89.316

15	.483	1.610	90.926
16	.448	1.492	92.418
17	.389	1.295	93.713
18	.339	1.130	94.843
19	.310	1.032	95.875
20	.236	.786	96.661
21	.202	.673	97.334
22	.196	.654	97.988
23	.157	.523	98.511
24	.109	.362	98.874
25	.098	.328	99.201
26	.080	.266	99.467
27	.056	.186	99.653
28	.043	.143	99.796
29	.036	.122	99.98
30	.025	.082	100.000
	Extraction Sums of Squared Loadings		
1	**Total**	**% of Variance**	**Cumulative %**
2	8.198	27.325	27.325
3	2.859	9.530	36.855
4	2.618	8.728	45.583
5	2.327	7.757	53.339
	Rotation Sums of Squared Loadings		
1	**Total**	**% of Variance**	**Cumulative %**
2	6.153	20.510	20.510
3	3.882	12.941	33.452
4	2.660	8.868	42.319
5	2.552	8.508	50.827
Extraction Method: Principal Component Analysis.			

In first round of factor analysis, the 30 identified driver's items identified were analyzed in order to determine unobserved factors. Kaiser-Meyer-Olkin (KMO) test were first computed to assess sampling adequacy and test whether correlation matrix is an identity matrix respectively. The test Kaiser-Meyer-Olkin (KMO) test on sampling adequacy results were .561(See Table 4.2) whereas Bartlett's Test of Sphericity shows approximate Chi. Square as having 1650.159 with df 435 and Sig .000.

Table 4.2: KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.561
Bartlett's Test of Sphericity	**Approx. Chi-Square**	1650.159
	Df	435
	Sig.	.000

This KMO as reported was 0.561 indicated that sampling was not adequate with 10 groups formed.

In this stage it was observed that, the 30 identified drivers items included in the analysis were not sharing common factors. Moreover, seven of identified driver's items had zero order negative correlation values. To resolve this problem, they were dropped from the analysis. The items dropped were: bureaucracy in bidding method, choice of contract strategy impacting on risks and risk allowances, speed and quality of decision making and responsiveness to requests for information, designer related factors causing project cost escalation, build ability issues resulting in slow pace of work and loss of productivity, not undertaking proper site analysis and geotechnical tests resulting in designs and drawings being inconsistent with site conditions or requirements of the building code, conditions requiring changes in design or work method e.g. contamination or rock.

After dropping the seven items, the remained 23 identified drivers were re-analyzed. Six groups were then formed (Table -4.3 and -4.4) and KMO increased from 0.561 to 0.702 which implies that sampling adequacy was good.

Despite this increase, individual identified drivers' items were further scrutinized and found that four items had either zero correlation, negatively related or had factor score of less than 0.4. The identified drivers' items were lowest bidding procurement method, additional work, change orders resulting in variations to the contract and project scale and complexity. These identified drivers items were dropped and factor analysis was performed gain.

Table -4.3 Rotated Component Matrix

Rotated Component Matrix[a]	Component
Group	**1**
Funding problem	.752
Financial condition of the owner	.613
Cash flow of the contractor	.743
Inaccurate material estimating	.471
Choice of procurement system impacting on workflow integration and relationship in the development process	.791
Choice of tendering and contract strategy impacting on risks and risk allowances	.529
Extent of fulfillment of contractual obligations	.820
Additional work to be executed at day work	.626
Errors or omissions in design drawings and	.577
Inclement weather conditions	.682
Innovative project with no known precedents to follow	.748
Constraints from neighborhood characteristics - traffic congestions	.469
Topographical features, logistic issues	.478
Group	**2**
Wrong method of estimation	.753
Drawings detailed or not	.647
Inaccurate material estimating	.671
Length of time allowed for proper risk analysis at the onset and for quality execution of the job	.533
Congested/restricted site presenting site planning and logistic challenges	.778
Constraints from neighborhood characteristics - traffic congestions	.757
Topographical features, logistic issues	.595
Group	**3**
Cash flow of the contractor	.472
Length of time allowed for proper risk analysis at the onset and for quality execution of the job	-.403
Build ability issues resulting in slow pace of work and loss of productivity	.703
Congested/restricted site presenting site planning and logistic challenges	.408
Group	**4**
Change orders resulting in variations to the contract	.450
Designer related factors causing project cost escalation	.661
Quality of design information, documentation & communication	.593
Conditions requiring changes in design or work method e.g. contamination or rock	.665
Group	**5**
Change orders resulting in variations to the contract	-.507
Choice of tendering and contract strategy impacting on risks and risk allowances	.503
Not undertaking proper site analysis and geotechnical tests resulting in designs and drawings being inconsistent with site conditions or requirements of the building code	-.740
Unforeseeable underground	.647
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.	
a. Rotation converged in 6 iterations.	

In the third round, nineteen identified drivers' items were included in the factors analysis. Results shows that KMO increased to 0.801 as five groups were formed.

Statistically the KMO value of 0.801 is good indicating that the groups formed are useful. Bartlett's test shows significant result that correlation matrix is not identity because p –value (0.000) < level of significant (0.05) (See appendix), it can be seen that there are five eigenvalues which are greater than 1. The principal component combination has accounted 72.070% amount of variance.

Component	Extraction Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	6.990	36.789	36.789
2	2.440	12.843	49.632
3	1.781	9.375	59.007
4	1.396	7.346	66.353
5	1.086	5.717	72.070
Extraction Method: Principal Component Analysis.			

Table -4.3: Total Variance explained

Component	Initial Eigen values		
	Total	% of Variance	Cumulative %
1	6.990	36.789	36.789
2	2.440	12.843	49.632
3	1.781	9.375	59.007
4	1.396	7.346	66.353
5	1.086	5.717	72.070
6	.943	4.961	77.032
7	.748	3.935	80.967
8	.642	3.379	84.345
9	.537	2.828	87.173
10	.474	2.494	89.667
11	.363	1.908	91.575
12	.316	1.666	93.240
13	.302	1.589	94.829
14	.248	1.306	96.135
15	.189	.992	97.127
16	.164	.863	97.990
17	.157	.826	98.816
18	.118	.619	99.434
19	.108	.566	100.00
Extraction Method: Principal Component Analysis.			

Component	Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %
1	3.300	17.369	17.369
2	3.294	17.335	34.704
3	2.866	15.083	49.786
4	2.637	13.877	63.663
5	1.597	8.407	72.070
Extraction Method: Principal Component Analysis.			

In order to minimize the number of identified drivers' items that have high loadings on a factor, factor rotation was computed (see Table -4.3). Here five groups were formed where as a result of the rotation.

The five groups are named as follows: group 1 is designer related drivers, group 2 is various elements, group 3 is cost at different stages of the building construction, group 4 is general drivers of cost variation and group 5 is Human actions & external drivers causing cost variation.

Table -4.4: Rotated Component Matrix

Group 1		
S/N	**Item**	**Value**
1	Wrong method of estimation	.748
2	Drawings detailed or not	.677
3	Inaccurate material estimating	.691
4	Congested site presenting site planning and logistic challenge	.735
5	Constraint from neighborhood characteristic-traffic congestion	.725
6	Topographical, logistic issues	.561
Group 2		
1	Funding problem	.793
2	Financial condition of the owner	.880
3	Cash flow of the contractor	.780
4	Innovative project with no precedents	.532
Group 3		
1	Errors or omissions in design drawings	.844
2	Inclement weather conditions	.545
3	Additional work to be executed at day work	.686
Group 4		
1	Length of time allowed for proper risk analysis at the onset and for quality execution of the job	.797
2	Choice of procurement system impacting workflow integration & relationship in the development process	.823
3	Choice of tendering and contract strategy impacting on risks and risk allowances	.619
4	Extent of fulfillment of contractual obligations	.562
Group 5		
1	Quality of design information/ documentation/communication	.679
2	Unforeseeable underground	.746

4.1 Discussion

As observed form the Table -4.4, the first group of designer related drivers, all six identified drivers have high loading on the group which gives a causative implication association to causing cost variation, literature suggests similar trend of the drivers of cots variation, recording relative index as of 68.51, and medium impact rating of 3.27 and 3.36 to some of the drivers. So, the findings of this paper with regard to the drivers in this group coincide with the reviewed literature.

Further drivers causing cost variation in various elements of the building group, four drivers of financial condition of the owner, funding problem, cash flow of the contractor and Innovative project with no known precedents to follow have high loading of the group factor. This particular group drivers is actually a gap that the research is ought to bring out to the attention of the stakeholders in the construction industry in Tanzania and the confirmed items have shown a causative implication association to cost variation of building construction projects to the group factor. In this group of drivers of cost variation, the literature indicates that there is 20% causation and 40% causation for drivers of cash flow of contractors and financial condition of the owner, unlike high loadings in these findings. The reason for the difference, is open to debate and further investigation. It could be difference in time that the studies have been done in the sense of time value of money, record keeping of construction financial data, audit scrutiny and improvements in the procurement system of a country in question, likewise geographical location where the studies have been done. On the other hand, other drivers seem to agree with the literature as they both have displayed high values of causative association to causing cost variation.

Furthermore in the third group of drivers causing variation at different stages of the building group there are drivers such as errors or omissions in design drawings has shown by the results to have strong loading hence strong causative association in the group to causing cost variation, whereas other identified and confirmed has medium loading to the group factor in casing cost variation of building construction projects. These findings show that the leading cause of cost variation at different stages of building construction is errors or omissions in design drawings. Other factors under this category include additional work to be executed at day work, and inclement weather conditions. With the exception of the driver 'additional work to be executed at day work', which deviates from the literature reviewed where it showed low mean rating of causative association to cost variation of cMRi 2.17, the rest of the drivers in the group finding are in agreement with literature findings to have high loading on causing cost variation of building construction projects

Moreover the findings in group four of general drivers causing cost variation indicate that the choice of procurement system impacting on workflow integration, and relationship in the development process are the leading causes of cost variation. On the other hand, other drivers such as length of time allowed for proper risk analysis at the onset and for quality execution of the job, choice of tendering and contract strategy impacting on risks and risk allowances, and extent of fulfillment of contractual obligations range from high to medium loading in causative association to the group factor that generally cause cost variation in building construction projects. In this group of drivers, all findings do agree with the literature by having a causative association with cost variation of building construction projects of between high and very high impact (2.6 - 4.10 cMRi)

In light of group five, only two were identified and confirmed as drivers causing cost variation in this group. Drivers such as unforeseeable underground and Quality of design information, documentation & communication have loading of medium to high on causative implication to the group. However this appears to be slightly on the lower side compared to those found in the literature which recorded a very high impact of 4.36 and 4.63 out of 5 respectively.

5.0 CONCLUSION

From the findings of the study, it is concluded that; five groups of drivers have been identified through factor analysis to have a causative association with cost variation of building construction projects in Tanzania. The identified groups drivers include are:

Group 1 consisting of designer related drivers which cause cost variation. The driver were wrong method of estimation; drawings; inaccurate material estimation; congested/restricted site presenting site planning and logistic challenges; constraints from neighborhood characteristics, such as traffic congestions; and topographical features-logistic issues. The first four drivers have a high loading in the group contributing to cost variation. This conforms to the traditional duties of the project designer, which includes taking into account his skills in designing and estimating the site and the neighboring environment. If these are not taken into consideration, they are likely to constraint the construction process, render the design impractical, delay the construction process and consequently cause costs to vary.

Group 2 of drivers associated with various elements of the building which are prone cost variation. These included funding problems such financial condition of the owner, cash flow on the part of the contractor; and innovative project with no known precedents to follow. Of these factors, financial condition of the owner records the highest loading of .880 compared to its accompanying drivers. Other drivers such as building elements of substructure, frame, finishes, decorations, service installation and external works are interdependent in their construction process. For example, a frame cannot start unless a substructure is finished. Likewise, finishes cannot take place prior to erecting the frame and so are decorations. Therefore, if the owner is financially constrained, the subsequent elements are likely to be delayed. If the delay is to occur, it will associate time value for money with issues such as inflation and increase in material prices. Likewise, technology and some types of materials may be obsolete. The opposite is also true, that if the client is finically stable, they may be tempted to speed up the construction works to early completion. Also, they are likely to cause a variation in the cost in terms of increasing the day works and overheads, procuring large quantity of material and increased labor force, which may cause management issue and hence have an implication to vary the costs.

Group 3 consists of drivers known to cause cost variation at different stages of the building construction, errors or omissions in design drawings, inclement weather conditions, and additional work to be executed at day work. Of all these factors, inclement weather has the lowest loading compared to the other two which have substantial high loading. It should be known that in a typical traditional set up, the stages are feasibility study, design stage, construction stage, and commissioning of the works. In any of these stages, an alteration of any sort, scheduled, formal or set up, will have a subsequent effect on the cost of the building project in question.

Group 4 consists of such drivers as length of time allowed for proper risk analysis at the onset and for quality execution of the job, choice of procurement system impacting on workflow integration and relationship in the development process, choice of tendering and contract strategy impacting on risks and risk allowances, and extent of fulfillment of the contractual obligations. The first driver on the list has the least loading compared to others. In this instance, procurement regulations such as lowest bidder being awarded a tender may have an effect on cost in the sense that contractors may deliberately lower their submission to secure work and eventually the contract price may go up. Likewise stiff competition of contractors in securing work may unnecessarily raise the contract value as opposed to what could have actually been.

Group 5 encompasses human actions and external drivers which cause cost variation in building construction projects. These include factors such as quality of design information, documentation and communication, and unforeseeable underground conditions. Of the factors, unenforceable ground conditions records the highest loading. This is not surprising as it is just like when the water table is high as contrasted by the test results, or if the soil type which may necessitate a change in the type of foundation my undoubtedly cause a variation the cost.

It follows therefore that all the group drivers identified are useful and have shown a causative association within the group they belong to. They all cause variation in the cost of the building construction projects in Tanzania.

Conclusively the first four drives in group one have high loading to forming group factor to contributing to cost variation. Further group two financial condition of the owner has the highest loading of .88 comparatively within the group contributing to variation. On the other hand inclement weather had lower loading contributing to variation than its other group drivers. Likewise unforeseeable ground condition recorded high loading in the group. The five groups henceforth have drivers that are significant and are confirmed to have a causative association to cost variation of building construction projects in Tanzania. Therefore, all the group drivers identified are useful and have shown a causative association within the group they belong to cause variation in the cost of the building construction projects in Tanzania.

6.0 RECOMMENDATION

It is recommended that drivers which were identified to have a causative association to cost variation of building construction projects, with medium to high loading in group of drivers (1 to 5) be on the watch out by project practitioners in all stages of construction. The recommended drivers are as follows:

Wrong method of estimation; drawings (whether detailed or not); inaccurate material estimation; congested/restricted site presenting site planning and logistic challenges; and constraints from neighborhood characteristics - traffic congestions.

Further, funding problem, issues such as financial condition of the owner; and cash flow on the part of the contractor. Likewise, errors or omissions in design drawings and additional work to be executed at day work.

Furthermore, length of time allowed for proper risk analysis at the onset and for quality execution of the job; choice of procurement system impacting on workflow integration; and relationship in the development process, quality of design information; documentation and communication; and unforeseeable underground conditions.

Therefore despite the variation on loading between high, medium and low, principally all the confirmed drivers in the groups are proven useful explaining the causative relationship of the drivers to cost variation and they should call for attention of construction practitioners on all stages of construction to plan and better manage cost and eventually curb cost variation as it is never welcomed by the project parties.

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