Impact of Variation Orders on Construction Project Cost and Time

Ulunji Msiska and Nokulunga Mashwama
University of Johannesburg, Faculty of Engineering and the Built Environment
Department of Construction Management and Quantity Surveying
University of Johannesburg
South Africa
admin@umconsultants.co.za , schwalicious@gmail.com

Didibhuku Thwala
SARChI in Sustainable Construction Management and Leadership in the Built Environment
Faculty of Engineering and the Built Environment
University of Johannesburg
South Africa

Abstract

Variation orders are unwanted but inevitable reality of any construction project and affect project performance as they adversely affect productivity and project cost. Moreover, projects with many variation orders cause the contractor to achieve lower productivity levels than planned. Therefore, the study is based on the impact of variation orders which adversely impact project performance in terms of cost, time, quality degradation, health and safety issues and professional relations. Quantitative approach was adopted for this study. 159 Questionnaires were analysed after the data was collected online via a structured questionnaire. Factor analysis was conducted, correlation matrix, coefficients has been conducted to ensure visibility of co-efficients greater than 0.3 and Kaiser-Meyer-Oklim (KMO) and Bartletts were conducted. From the findings it transpired that additional payment for contractors; delayed schedule completion; increases in project cost; time overruns, logistics delays also cause disputes among the professional team were some of the impacts caused by variation orders just to mentioned a few. The more the number of variation orders, the more they are likely to affect the overall construction delivery cost. In fact, variation orders have both a direct and indirect effect on cost.

Keywords
Construction, Change orders, Impact, Performance, Kaiser-Meyer-Oklim.

1. Introduction
The construction industry is often affected by changes that are happening in the construction market and in turn affects the client's needs and requirements during construction. These changes include emerging technologies which have a tendency of contributing to the occurrence of change orders (Memon 2014). Variations are common in all construction projects type and are inevitable (Ibbs, et al. 2001). Most variations orders continue to pose a serious threat to the construction industry, since they contribute to time and cost overruns, therefore, affecting the contract price of the project. Hence variations may have a negative or positive impact on construction projects (Osman et al. 2009). In addition variations maybe caused by various sources such as: scarcity of resources, environment conditions, involvement of other parties and contractual relations. Furthermore, as a result of these sources the construction projects may face changes that could delay the project completion time (Clough and Sears 1994). Moreover, the impact of variation differs from one project to the other, but it is general accepted that variation can affect construction projects with unpalatable consequences in time and cost (Ibbs et al. 2001). There are two type of variations, which are beneficiary variation and detrimental variations. Beneficiary variations are those variations that bring good to the project such as help to improve quality, reduce cost, schedule, or degree of difficulty in the project. Detrimental variations are those that reduce owner value or have a negative impact on a project (Ibbs et al. 2001). The project team should be able to take advantage of beneficial variations when the opportunity arises(Arain and Low, 2005). Even if the project is planned well from the onset, it is likely that there will be changes to the scope of the

contract as work progresses (Oladapo 2007). Variation orders can be deleterious for any project, if not considered collectively by all participates (Arain and Low 2005). Hence, the need to investigate the impact of variation orders towards the construction cost and time in a project.

2. Literature Review

2.1 Cost overruns

Construction projects involve different phases of which two are particularly important for the paper, namely the pre-construction and construction phases (Alhilli and Rezoqi, 2021). Given that the construction phase typically consumes more resources than the pre-construction phase, attention to cost planning is focused on the construction phase. Clients desire to know in advance the total cost of their finished construction projects. Clients prefer final construction costs to equate to the originally forecast tender figure (Alhilli and Rezoqi 2021). Unfortunately, due to changes that might occur in the project, the budget somehow spirals out of control. However, all variation orders do not increase the costs of construction. Omissions in most cases reduce costs while additions increase costs (Ssegawa et al. 2002). Various studies have revealed that variation orders contribute to cost overruns. A study of the effects of variation orders on institutional building projects revealed that variation orders contributed substantially to project cost increase (Arain and Pheng 2005). The study conducted by Mohamed (2001), on twelve combined sewer overflow project revealed 7% increase due to variation orders contributed to costs increase by 7% of the original project costs (Mohamed, 2001). Arguably, the more the number of variation orders, the more they are likely to affect the overall construction delivery cost. In fact, variation orders have both a direct and indirect effect on cost.

Bower (2000) identified the following direct costs associated with variation orders: time and material charges related immediately affects the construction schedule and tasks; recalculation of network, increased time-related charges, and overheads; reworks and standing time; timing effects; inflation, change to cash flow and loss of earnings; and management time, head office and site charges. While the direct costs associated with variation order can be easily calculated, Bower (2000) argued that indirect costs are more difficult to quantify. Indirect costs are costs incurred because of variation orders, whether they are apparently linked to them or not. These include rework and making good on affected trades other than the actual variation order. It was revealed that the cost of rework caused by variation orders accounted for more than four-fifth of the total costs of rework (Love et al. 2019). Change in cash flow due to effect on inflation and financial charges; loss of productivity due to interruption where the gang has to familiarize with new working condition, tools and material; cost for redesign and administration of the variation order; and litigation-related costs in case disputes arise due to the variation order.

2.2 Time overruns

Clients require their construction projects to be completed within minimum time limits. It is anticipated that projects finished within the shortest possible time to achieve some monetary savings. Contractors are heavily penalized when they exceed the original project delivery date. The penalty imposed is meant to compensate damages suffered by the client owing to the prolonged delivery period. Several authors agree that variation orders are one of the reasons for project time overruns (Mohamed 2001). Koushki (2005) found that variation orders issued during various phases of construction projects negatively affected both the completion time and costs of projects (Koushki 2005). Hanna et al. (2002) found that as the number of variation orders increases, the more significant productivity losses become. Productivity is the amount of output over a unit of time. Therefore, loss in productivity implies loss of time and subsequent delays.

2.3 Professional relations

A construction project is not merely brick and mortar brought together. Rather, it creates professional relationships between parties to the contract. Each project successfully completed constitutes an added experience to participants and their reputation builds up. But disputes may arise between parties to the contract due to variation orders. Misunderstandings may arise when contractors are not satisfied with the determination of the valuation of variation orders by the client's consultant. Parties to a contract are left to argue over the cost, time effects due to compensation of a variation order (Bower, 2000). Possibly because contractors are not confident about the outcome of such negotiations, they usually request higher values for variation orders than the actual cost incurred. Bower (2000) opined that there will be tension between parties as the contractor continually pushes the client to settle claims for additional costs while invariably feeling that the reimbursement has been insufficient. This can be very damaging to the relationship between the representatives of all parties (Bower, 2000). Charoenngam et al. (2003) remarked that disputes between the client and the contractor can occur if variation orders are not managed carefully. Harbans (2003), further states that unless a mutual acceptable solution is agreed by the parties, valuation of variations in the form of variation orders will continue to remain at the forefront of disputes and claims making their way ultimately to arbitral tribunals or the corridors of justice. Khalifa and Mahamid (2019) found that a large proportion of current arbitrations were on claims for additional time and additional expenses. Ssegawa et al. (2002) reported that more than one-third of disputes pertained to how to determine losses that stem from variation orders. The excessive occurrence of variation orders due to design errors or omission may undermine the professionalism of the designer.

3. Methods

Quantitative approach was adopted for this study. The data was collected through primary and secondary sources, 159 structured questionnaires were received from the construction stakeholders which were then analysed. A five-point Likert scale was used to determine the impacts of variation orders on construction projects. The adopted scale was as follows: 1= To no extent, 2= Small extent, 3= Moderate extent, 4=Large extent, 5= Very large extent. The computation of the mean item score (MIS) was calculated from the total of all weighted responses and then relating it to the total responses on an aspect. After mathematical computations, the criteria were then ranked in descending order of their mean item score (from the highest to the lowest). The test of hypothesis was conducted through the factor analysis. These include the assessment of the suitability of data for analysis; Correlation matrix coefficients to ensure visibility of coefficients greater than 0.3, Kaiser-Meyer- Olkim (KMO) and Bartlett 's test was conducted. Kaiser's criterion used as it applies the eigenvalue rule to eliminate and extract factors. Any factor with eigenvalue which was less than one (1) was eliminated and greater than one (1) was retained.

4. Results and Discussion

Table 1 present the cost impact of variation orders on construction performance in South Africa. The factors were tested for validity and internal reliability. A five point Likert scale was used where: 1= To no extent, 2= Small extent, 3= Moderate extent, 4=Large extent, 5= Very large extent. Certain abbreviations and number of range were established to present results outcomes accordingly.

Table 1 below indicate the cost impact of variation orders on construction performance: unplanned site meetings was ranked first with (mean (M)=4.89; Standard deviation (SD)= 0.405; Cronbach alpha (α)= 0.95; Rank (R)=1); expenses of idle plant machines with (M=4.89;SD= 0.389; α= 0.956; R=1);labour expenses during the waiting time with (M=4.89; SD=0.415; α=0.956; R=1); litigation-related cost in case dispute arise due to variation order with (M=4.87; SD=0.417; α=0.958; R=2);head office and site charges with (M=4.86; SD=0.457; α= 0.956; R=2). Moreover, timing effect(can miss project delivery deadlines) was ranked number three with (M=4.86; SD=0.443;α= 0.958); followed by standing time costs with (M=4.84; SD=0.414; α=0.958; R=4); management time, increase with (M=4.84; SD=0.457; α=0.957; R=4). Cost of administration of the variation order with (M=4.84; SD=0.502; α=0.959; R=4); communication expenses with (M=4.84; SD=0.538; α=0.956; R=4); increased tie related charges with (M=4.82; SD=0.457; α=0.955; R=5); inflation costs with (M=4.82; SD=0.510; α=0.957; R=5); change in cash flow with (M=4.82; SD=0.534; α=0.958; R=5); overheads costs with (M=4.81; SD=0.466; α=0.956; R=6); cost for redesign with (M=4.80; SD=0.488; α=0.958; R=7). Lastly material charges to affected task and change to cashflow and loss of earnings were ranked eight with (M=4.79; SD=0.555; α=0.955; R=8) and (M=4.79; SD=0.620; α=0.958; R=8) respectively; travelling expenses with (M=4.77; SD=0.550; α=0.957; R=9); loss of productivity with (M=4.75; SD=0.613; α=0.956; R=10); rework time costs with (M=4.74; SD=0.611; α=0.957; R=11).

Table 1. cost impact of variation orders

		N	Mean	Std. Deviation	crobach's alpha	Rank
D16.11	Unplanned site meetings	159	4.89	0,405	0.957	1
D16.14	Expenses of idle plant machines	159	4.89	0,389	0.956	1
D16.15	labour expenses during the waiting time	159	4.89	0,415	0.956	1
D16.10	head office and site charges	159	4.86	0,457	0.956	2

D17.5	Litigation-related cost in case dispute arise due to variation order	159	4.87	0,417	0.958	2
D16.1	Timing effect(can miss project delivery dead-lines)	159	4.86	0,443	0.958	3
D16.3	standing time costs	159	4.84	0,414	0.958	4
D16.9	Management time, increase	159	4.84	0.457	0.957	4
D17.4	Cost of administration of the variation order	159	484	0.502	0.959	4
D16.13	communication expenses	159	4,84	0.538	0.956	4
D16.4	Increased tie related charges	159	4,82	0.457	0.955	5
D16.7	Inflation costs	159	4,82	0.510	0.957	5
D17.1	Change in cash flow	159	4,82	0.534	0.958	5
D16.5	overheads costs	159	4,81	0.466	0.956	6
D17.3	Cost for redesign	159	4,80	0.488	0.958	7
D16.6	material charges to affected task	159	4,79	0.555	0.955	8
D16.8	change to cash flow and loss of earnings	159	4,79	0.620	0.958	8
D16.12	Travelling expenses	159	4,77	0.550	0.957	9
D17.2	Loss of productivity	159	4,75	0.613	0.956	10
D16.2	Rework time costs	159	4,74	0.611	0.957	11

4.1 Exploratory Factor Analyses

Twenty cost impact of variation orders were subjected to exploratory factor analyses (EFA). Table.2 revealed the presence of correlation matrix of twenty variables. All twenty factors were less than one (<1) and were considered to be strong variables. Correlation co-efficient have been conducted to ensure visibility of co-efficient greater than 0.3 and there were quite a number of correlations greater than 0.3 tentatively suggests that the factor analysis was appropriate (Fabrigar et al. 1999).

Table 2. Cost impact of variation orders-correlation order

Correlation Matrix																					
		D16.1	D16.2	D16.3	D16.4	D16.5	D16.6	D16.7	D16.8	D16.9	D16.10	D16.11	D16.12	D16.13	D16.14	D16.15	D17.1	D17.2	D17.3	D17.4	D17.5
Correlation	D16.1	1,000	0,590	0,571	0,660	0,609	0,471	0,396	0,376	0,611	0,500	0,582	0,468	0,516	0,643	0,539	0,378	0,410	0,398	0,354	0,385
	D16.2	0,590	1,000	0,686	0,716	0,691	0,691	0,602	0,552	0,553	0,549	0,467	0,518	0,580	0,619	0,538	0,439	0,502	0,437	0,354	0,515
	D16.3	0,571	0,686	1,000	0,856	0,764	0,569	0,678	0,534	0,637	0,453	0,421	0,398	0,424	0,517	0,454	0,246	0,396	0,375	0,302	0,361
	D16.4	0,660	0,716	0,856	1,000	0,823	0,748	0,843	0,603	0,683	0,610	0,574	0,545	0,602	0,740	0,667	0,442	0,635	0,521	0,398	0,547
	D16.5	0,609	0,691	0,764	0,823	1,000	0,699	0,685	0,604	0,661	0,531	0,456	0,474	0,482	0,614	0,484	0,476	0,523	0,472	0,381	0,463
	D16.6	0,471	0,691	0,569	0,748	0,699	1,000	0,716	0,767	0,639	0,681	0,735	0,710	0,793	0,707	0,779	0,427	0,681	0,448	0,374	0,484
	D16.7	0,396	0,602	0,678	0,843	0,685	0,716	1,000	0,541	0,532	0,493	0,424	0,444	0,494	0,632	0,539	0,304	0,529	0,442	0,283	0,490
	D16.8	0,376	0,552	0,534	0,603	0,604	0,767	0,541	1,000	0,751	0,610	0,608	0,599	0,596	0,554	0,575	0,249	0,460	0,296	0,274	0,336
	D16.9	0,611	0,553	0,637	0,683	0,661	0,639	0,532	0,751	1,000	0,653	0,552	0,536	0,538	0,574	0,578	0,326	0,426	0,368	0,301	0,426
	D16.10	0,500	0,549	0,453	0,610	0,531	0,681	0,493	0,610	0,653	1,000	0,633	0,580	0,680	0,694	0,690	0,652	0,646	0,556	0,453	0,473
	D16.11	0,582	0,467	0,421	0,574	0,456	0,735	0,424	0,608	0,552	0,633	1,000	0,792	0,843	0,720	0,869	0,317	0,549	0,300	0,313	0,327
	D16.12	0,468	0,518	0,398	0,545	0,474	0,710	0,444	0,599	0,536	0,580	0,792	1,000	0,857	0,707	0,781	0,316	0,547	0,324	0,324	0,399
	D16.13	0,516	0,580	0,424	0,602	0,482	0,793	0,494	0,596	0,538	0,680	0,843	0,857	1,000	0,847	0,914	0,406	0,664	0,404	0,393	0,472
	D16.14	0,643	0,619	0,517	0,740	0,614	0,707	0,632	0,554	0,574	0,694	0,720	0,707	0,847	1,000	0,826	0,482	0,651	0,513	0,488	0,652
	D16.15	0,539	0,538	0,454	0,667	0,484	0,779	0,539	0,575	0,578	0,690	0,869	0,781	0,914	0,826	1,000	0,429	0,692	0,394	0,372	0,471
	D17.1	0,378	0,439	0,246	0,442	0,476	0,427	0,304	0,249	0,326	0,652	0,317	0,316	0,406	0,482	0,429	1,000	0,775	0,811	0,671	0,639
	D17.2	0,410	0,502	0,396	0,635	0,523	0,681	0,529	0,460	0,426	0,646	0,549	0,547	0,664	0,651	0,692	0,775	1,000	0,786	0,692	0,621
	D17.3	0,398	0,437	0,375	0,521	0,472	0,448	0,442	0,296	0,368	0,556	0,300	0,324	0,404	0,513	0,394	0,811	0,786	1,000	0,822	0,746
	D17.4	0,354	0,354	0,302	0,398	0,381	0,374	0,283	0,274	0,301	0,453	0,313	0,324	0,393	0,488	0,372	0,671	0,692	0,822	1,000	0,597
	D17.5	0,385	0,515	0,361	0,547	0,463	0,484	0,490	0,336	0,426	0,473	0,327	0,399	0,472	0,652	0,471	0,639	0,621	0,746	0,597	1,000

Table 3 below represents the Kaiser-Meyer-Olkin (KMO) with the value of 0.874, which was beyond the anticipated value of 0.6 (Kaiser, 1960), and the Bartlett's test of sphericity (Bartlett,1954) reached statistical significance of 0.000 ($p<0.05$), supporting the factorability of the correlation matrix with degree of freedom of 190.

Table 3. Cost impact of variation orders-KMO and Bartlett's test

KMO and Bartlett's Test		
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.874
Bartlett's Test of Sphericity	Approx. Chi-Square	3835.006
	df	190
	Sig.	0.000

Table 4 shows the anti- image matrix of correlation as a measure of sampling adequacy (MSA) which was beyond 0.5 as the indication of the factorability of the data set.

Table 4. Cost impact of variation orders-Anti image correlation

Anti-image Matrices																				
Anti-image Correlation																				
	D16.1	D16.2	D16.3	D16.4	D16.5	D16.6	D16.7	D16.8	D16.9	D16.10	D16.11	D16.12	D16.13	D16.14	D16.15	D17.1	D17.2	D17.3	D17.4	D17.5
D16.1	.828[a]	-0,348	0,144	-0,287	-0,071	0,051	0,322	0,324	-0,413	0,133	-0,383	0,046	0,097	-0,310	0,126	0,006	0,089	-0,206	0,054	0,257
D16.2	-0,348	.912[a]	-0,352	0,088	0,039	-0,255	-0,071	-0,130	0,187	-0,011	0,250	-0,050	-0,152	0,052	0,047	-0,217	0,091	0,155	-0,005	-0,198
D16.3	0,144	-0,352	.838[a]	-0,635	-0,293	0,289	0,107	-0,011	-0,087	-0,114	-0,087	0,122	-0,192	0,285	0,019	0,283	0,138	-0,127	-0,165	0,044
D16.4	-0,287	0,088	-0,635	.891[a]	-0,126	-0,091	-0,483	0,022	0,000	0,010	0,038	-0,062	0,246	-0,205	-0,187	-0,035	-0,277	0,063	0,141	-0,061
D16.5	-0,071	0,039	-0,293	-0,126	.881[a]	-0,404	0,025	-0,037	-0,192	0,323	0,052	-0,141	0,138	-0,311	0,223	-0,455	0,117	0,054	0,035	0,220
D16.6	0,051	-0,255	0,289	-0,091	-0,404	.882[a]	-0,334	-0,339	0,117	-0,195	-0,194	0,148	-0,366	0,417	-0,071	0,178	-0,160	0,081	-0,074	-0,189
D16.7	0,322	-0,071	0,107	-0,483	0,025	-0,334	.883[a]	0,112	-0,031	0,002	0,081	-0,050	0,193	-0,267	0,009	0,199	0,042	-0,270	0,184	0,103
D16.8	0,324	-0,130	-0,011	0,022	-0,037	-0,339	0,112	.883[a]	-0,530	-0,090	-0,224	-0,079	0,115	-0,178	0,217	0,156	-0,132	0,006	-0,020	0,089
D16.9	-0,413	0,187	-0,087	0,000	-0,192	0,117	-0,031	-0,530	.860[a]	-0,349	0,209	-0,059	-0,014	0,273	-0,257	0,120	0,103	0,035	-0,038	-0,284
D16.10	0,133	-0,011	-0,114	0,010	0,323	-0,195	0,002	-0,090	-0,349	.874[a]	-0,065	0,009	0,024	-0,336	0,012	-0,560	0,198	-0,150	0,140	0,374
D16.11	-0,383	0,250	-0,087	0,038	0,052	-0,194	0,081	-0,224	0,209	-0,065	.905[a]	-0,264	-0,027	0,054	-0,453	-0,009	0,144	-0,029	-0,042	0,071
D16.12	0,046	-0,050	0,122	-0,062	-0,141	0,148	-0,050	-0,079	-0,059	0,009	-0,264	.931[a]	-0,493	0,166	0,107	0,052	-0,005	0,048	-0,053	-0,109
D16.13	0,097	-0,152	-0,192	0,246	0,138	-0,366	0,193	0,115	-0,014	0,024	-0,027	-0,493	.871[a]	-0,549	-0,368	0,067	-0,116	-0,151	0,141	0,200
D16.14	-0,310	0,052	0,285	-0,205	-0,311	0,417	-0,267	-0,178	0,273	-0,336	0,054	0,166	-0,549	.837[a]	-0,139	0,169	0,071	0,212	-0,297	-0,503
D16.15	0,126	0,047	0,019	-0,187	0,223	-0,071	0,009	0,217	-0,257	0,012	-0,453	0,107	-0,368	-0,139	.911[a]	-0,095	-0,271	0,237	0,023	-0,044
D17.1	0,006	-0,217	0,283	-0,035	-0,455	0,178	0,199	0,156	0,120	-0,560	-0,009	0,052	0,067	0,169	-0,095	.810[a]	-0,393	-0,243	-0,005	-0,233
D17.2	0,089	0,091	0,138	-0,277	0,117	-0,160	0,042	-0,132	0,103	0,198	0,144	-0,005	-0,116	0,071	-0,271	-0,393	.913[a]	-0,324	-0,150	0,196
D17.3	-0,206	0,155	-0,127	0,063	0,054	0,081	-0,270	0,006	0,035	-0,150	-0,029	0,048	-0,151	0,212	0,237	-0,243	-0,324	.840[a]	-0,531	-0,471
D17.4	0,054	-0,005	-0,165	0,141	0,035	-0,074	0,184	-0,020	-0,038	0,140	-0,042	-0,053	0,141	-0,297	0,023	-0,005	-0,150	-0,531	.878[a]	0,139
D17.5	0,257	-0,198	0,044	-0,061	0,220	-0,189	0,103	0,089	-0,284	0,374	0,071	-0,109	0,200	-0,503	-0,044	-0,233	0,196	-0,471	0,139	.819[a]
a. Measures of Sampling Adequacy(MSA)																				

Table 5 shows the communalities of the variables after extraction and were above the acceptable 0.3 value (Field, 2000).

Table 5. Cost impact of variation orders-communalities

Communalities		
	Initial	Extraction
D16.1	0.748	0.460
D16.2	0.723	0.621
D16.3	0.859	0.789
D16.4	0.941	0.919
D16.5	0.832	0.782
D16.6	0.899	0.793
D16.7	0.826	0.624
D16.8	0.779	0.577
D16.9	0.87	0.610
D16.10	0.98	0.635
D16.11	0.55	0.823
D16.12	0.79	0.738
D16.13	0.38	0.933
D16.14	0.14	0.776
D16.15	0.19	0.888
D17.1	0.63	0.765
D17.2	0.873	0.800
D17.3	0.889	0.948
D17.4	0.737	0.649
D17.5	0..771	0.589
Extraction Method: Principal Axis Factoring.		

Table 6 shows the total variance explained of the cost impact of variation orders on construction performance and it revealed three components which had eigenvalue of above 1 namely: (11.587; 2.187 and 1.631). The components eigenvalues defined 57.933%; 10.937 and 8.154% for the variance which indicates 77.023% of the total variance before the rotation and 73.597% after the rotation. The Kaiser eigen value which is greater than 1 was retained for interpretation (Fabrigar, et al., 1999). The total of twenty variable were strengthen by a scree plot test (Pallant, 2013). The results indicated the variables which clearly defined the cost impact of variation orders on construction performance.

Table 6. Cost impact of variation orders- total variance explained

Total Variance Explained									
Factor	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	**11.587**	57.933	57.933	11.336	56.680	56.680	5.310	26.552	26.552
2	**2.187**	10.937	68.869	1.955	9.777	66.457	5.231	26.156	52.709
3	**1.631**	8.154	**77.023**	1.428	7.139	73.597	4.178	20.888	**73.597**
4	0.776	3.882	80.905						
5	0.727	3.633	84.538						
6	0.495	2.474	87.012						
7	0.466	2.331	89.343						
8	0437	2.185	91.528						
9	.,297	1.484	93.012						
10	.255	1.275	94.288						
11	0.239	1.197	95.484						
12	0.203	1.013	96.498						
13	0.174	0.871	97.368						
14	0145	0.723	98.091						
15	0.108	0.542	98.633						
16	0.086	0.428	99.061						
17	0.063	0.317	99.378						
18	0.050	0.252	99.630						
19	0.043	0.216	99.846						
20	0.031	0.154	100.000						
Extraction Method: Principal Axis Factoring.									

Table 7 indicates the factor loading of the cost impact of variation orders on construction performance. The total of twenty variables loaded on three components and the results were strengthened by a scree plot test below figure 1

(Pallant, 2013). The results indicated the variables which clearly defined the impact of variation order on construction performance.

Table 7. Cost impact of variation-Rotated factor matrix

Rotated Factor Matrix[a]			
	Factor		
	1	2	3
D16.13	**0892**	0.259	0.26.5
D16.11	**.853**	0.279	0.136
D16.15	**0.852**	0.303	0.266
D16.12	**0.793**	0.282	0.171
D16.14	**0.654**	0.440	0.394
D16.6	**0.644**	0.558	0.259
D16.10	**0.547**	0.377	0.440
D16.3	0.164	**0.863**	0.133
D16.4	0.340	**0.843**	0.304
D16.5	0.228	**0.803**	0.290
D16.7	0.280	**0.701**	0235
D16.2	0.334	**0.654**	0.285
D16.9	0.420	**0.637**	0.165
D16.8	0.518	**0.546**	0.100
D16.1	0.366	**0.516**	0.245
D17.3	0.101	0.250	**0.935**
D17.1	0.187	0.161	**0.839**
D17.4	0.168	0.149	**0.774**
D17.2	0.450	0.260	**0.728**
D17.5	0.228	0.316	**0.661**
Extraction Method: Principal Axis Factoring. Rotation Method: Varimax with Kaiser Normalization.[a]			
a. Rotation converged in 5 iterations.			

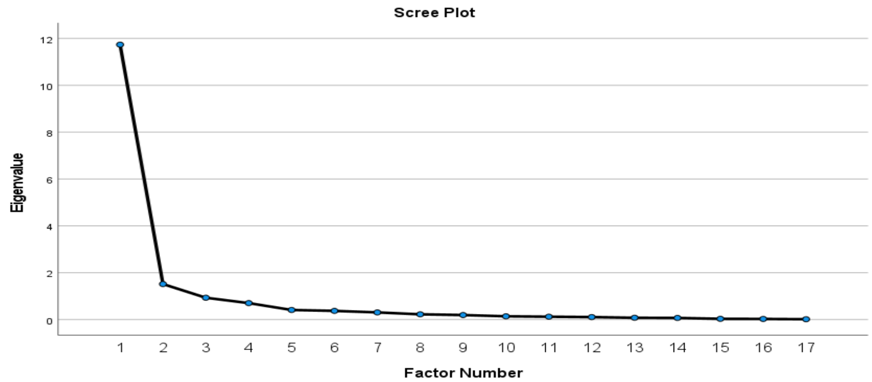

Figure 1. Scree plot for cost impact of variation orders

5. Naming of components of the cost impact of variation order on construction performance

5.1 Components 1: project cost

The factor 1 encountered 57.933% (Table 6) of the total variance of the cost impact of variation order on construction performance which was valid. Factor 1 suggested that variation orders has an impact on project cost toward construction performance. The following clearly suggest that variation orders have an impact on the cost of a project and this VO's may increase communication expenses; unplanned site meetings; labour during the waiting time; travelling expenses; expenses of idle plant machines; material charges to affected task; head office and site charges. Table 7 represent the following variables D16.13; D16.11; D16.15; D16.12; D16.14; D16.6; D16.10.

5.2 Components 2: Site cost

Table 6 represented component 2 which has been named site cost due to variation order and encountered 10.937% of the total variance which was valid. Factor 2 suggest that site cost include standing time costs; increased time related charges; overheads costs; inflation costs; rework time costs; management time increase; changes to cash flow and loss of earnings; timing effect (can miss project delivery deadlines). Site cost can cripple a project and make a huge loss when not managed very well. Factor 2 defined the following variables D16.3; D16.4; D16.5; D16.7; D16.2; D16.9; D16.8 and D16.1.

5.3 Component 3: Indirect cost impact on performance

Table 6 represented component 3 which encountered 8.154% of the total variance on the indirect cost impact on performance due to variation orders which was valid. Indirect cost impact drain the project slowly if not tackled as soon as possible. Factor 3 suggest that indirect cost caused by variation orders may include cost for redesign; change in cash flow; cost of administration of the variation order; loss of productivity; litigation-related cost in case dispute arise due to variation order. Factor 3 defined the following variables D17.3; D17.1; D17.4; D17.2; D17.5.

6. Conclusion

Vo's are a worldwide phenomenon, and the consequences include friction among clients, consultants, and contractors. Most variations orders have a negative impact on construction performance which creates a significant financial risk to clients. Also vo's may cause painful experiences if they are not accounted for and adjudicated properly by the client quantity surveyor, furthermore, if vo's are not properly managed may give rise to costly disputes between contractor and client. The findings above clearly shows that variation orders indeed have negative impact on the overall project cost, site cost and indirect cost. Therefore, vo's must be minimized to ensure a health, smooth operation of a project. Proper planning of project is highly recommended since frequent occurrence of vo's can affect the overall quality of works

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Biographies

Ulunji M Msiska is the managing member of UM Consultants, a multidisciplinary engineering consulting firm Mr. Ulunji Msiska holds Bachelor of Science degree in Architecture from University of Malawi, a Postgraduate Diploma in Project management from Regent Business School and has just completed the Masters of Business Adminstration from Regent Business School. He has been recognized as a professional architectural consultant with over 20 years of experience in working in both the public and private sectors.He is member of the South African Council for the Architectural Profession, A chartered member of the Royal Institute of British Architects, International associate of the American Institute of Architects, member of the South African Institute of Architects, member of the Gauteng Institute of Architects.

N**okulunga X Mashwama** is a Senior Lecturer in the Department of Construction Management and Quantity Survey at the University of Johannesburg. She earns PhD in quantity surveying and Masters in construction Management from the University of Johannesburg. She has published a number conference papers. She has worked for the industry for 9 years as quantity surveyor with Owen Thindwa and Associate Chartered Quantity Surveyors and Construction Companies as a site quantity surveyor.

Didibhuku Thwala is a Professor with the university of Johannesburg, and A-rated researcher. He has published a number of conference paper, journal and published book on Health and Safety. He has a PhD from the WITS university. He is an Editor in Chief of the Journal of Construction Project Management and Innovation (JCPMI). He is the head of SARChI chair in the built environment.