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The Impact of Variation Orders on Construction Projects

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ABSTRACT:

One of the biggest issues that all parties involved in construction projects must deal with is variation orders (VOs). An earlier exploratory survey with certain Nigerian construction managers found that VOs were seen as the primary reason for contract values to climb by more than 25%, for projects to take longer to complete and to be of worse quality and productivity. The findings of a research evaluating the effect of VOs on construction projects in Zamfara State, Nigeria, are presented in this article. To begin with, a rigorous and detailed assessment of the literature was done to determine the most important effects of VOs on construction projects. In-depth data on 10 construction projects completed in Nigeria State from 2007 to 2015 was obtained. The VOs seen and captured during the execution of these initiatives were enumerated, and their causes were noted. It was discovered that Vos caused project durations to rise by (22–200) %. On the other hand, cost study revealed that VOs increased costs by (2.67-42.86) %. This was followed by a questionnaire survey to enable evaluating VOs effects on a larger sample in order to confirm the early findings. The poll was conducted among a stratified sample of 23 project owners, 53 contractors, 47 civil engineering consultants, and 7 seasoned project managers. The significance index was then calculated to examine the responses. The Spearman's Correlation Coefficient components demonstrated a significant link (0.952-0.978) when assessed from the perspectives of the various involved parties, showing well-matched viewpoints about the effects of VOs. All of the mentioned VOs' effects on construction projects in Nigeria are confirmed by the derived Relative Importance Index (RII) values of (0.92-0.73). Respondents concurred that the order of the strength of impacts of (VOs) on building projects in Nigeria is as follows: "Decrease in workers' productivity," "Increase in projects cost," "Completion schedule delay," "Disputes between owners and contractor," "Decrease in quality of work," "Increase in overhead expenses," "Increase in the duration of individual activities," "Demolition and rework," and "Delay in payments," "Hold of work in other areas," and "Additional

Keywords: Projects Evaluation, Nigeria, Building Projects, Contractors, Impact, Variation Orders

1. Introduction

It is anticipated that the execution of construction projects would provide the industry more momentum. In order to minimize the negative effects of variation orders on the project's output, it is crucial to guarantee that these projects are completed smoothly and without any serious issues. A variation order is a formal directive given to the contractor by the Owner after the contract has been signed, enabling a modification to the work or an adjustment to the contract's price or timeline. The contract price and/or timetable will often alter as a result of changes to the drawings and contract documentation. Changes often provide issues for all parties engaged in the construction project process, and VOs enhance the likelihood of contractual conflicts. As a result, they may play a significant role in project failure. According to preliminary research undertaken with several Nigerian construction managers, VOs are mostly to blame for the status of Nigeria's building projects' increased contract value, lengthened timeline, and decline in quality and productivity.

This study aims to determine how VOs affect construction project performance in Zamfara State, Nigeria.

The following are the most significant causes of VOs in Nigerian construction projects: Instability of pricing and fluctuating currency rates, New Regulations, For a building project in Nigeria, there is no construction handbook or method available. Design flaws and omissions, two elements that rate equally owner fails to make choices or review documents at the appropriate time, and Owner's demands during the design stage are not clearly defined or variable, owner's financial difficulties, two criteria that are ranked in the same order. Contractor financial issues, a lack of coordination between consultants, contractors, and subcontractors, and (10) a failure to employ value engineering at the design stage to identify the best options are all factors. and contractors and subcontractors and (10) Non-use value engineering in design stage to find the best alternatives.

2. Literature Review

The origins and causes of VOs have mostly been the subject of prior research. Variation at different phases is often to blame for construction delays, cost overruns, and quality issues. The performance of a project as a whole is impacted by VOs. This is due to variations' potential to significantly alter the contract's term, its overall direct and indirect costs, or both. These VOs included changes to the quality, quantity, and timeline of the job as well as

additions, omissions, and substitutions. Project objectives and the scope of the job are seen as changing whenever they are added, subtracted, or otherwise altered.

According to, VOs had an effect on how well the project performed overall, with time and cost overruns and contract disputes having the most negative effect. Variability hinders project performance, as stated in, and came to the conclusion that it has a negative impact on project costs and productivity.

To determine the effects of variants and the connections between variations and their effects, several research have been conducted. The varied effects of VOs, according to this group of writers, were as follows:

1. Falling Productivity

Worker productivity is adversely affected by VOs, particularly repeated changes. As a result, labor costs rise along with the overall project cost. This effect is not seen in nations where labor is inexpensive. However, this decline in productivity can need additional days or weeks of costly labor.

2. Scheduled completion delays

Time extensions are often caused by variation. In other situations, the owner could desire to pay the contractor for speeding up the project to adhere to the original timeline. In either scenario, more time equals more money. Completion delays may be quite expensive. Imagine a facility that costs millions to delay by weeks or even days, like a refinery or a large commercial complex. Before requesting a time extension, the person signing the modification order should be aware of the expense of the delay.

3. Conflict between the Contractor and the Owner

One of the most frequent causes of claims and disputes is VOs. The contract specifies all other tasks, but since modifications need review, estimate, and negotiation, the relationship between the parties might become tense. If these differences are not resolved amicably via direct talks and arbitration, they head to court, where legal processes might put the whole project on hold.

4. Declines in Quality Occasionally variance results in a worse caliber of craftsmanship.

Changes may cause a mismatch with other things or areas as they modify the original plan in certain items or areas, which might lower the caliber of the job as a whole. As was already said, it is anticipated that the crew's poor morale after several changes will have an impact on how well they perform.

5. Project Cost Increases Variation instructions clearly have this effect.

The literature research included statistics on typical project cost increases brought on by modification orders.

6. More Cash for the Contractor

No matter how much has been mentioned about the drawbacks of VOs, the contractor often earns more money by carrying out more scope. The truth of this statement relies on how well-informed contractors and owners are about the immediate and long-term effects of modifications, as well as how ready they are to include this reality into change order price.

7. Tool and Material Delay

VOs cause issues with the supplies and equipment needed to complete a task. Think about, for instance, a request to have a building's doors changed after the vendor received a request for doors. The seller may not have the new style of doors in stock, and ordering or fabricating them could take longer. As a result, supplies take longer to arrive, delaying the completion of future tasks. For instance, when a certain construction technique has altered and calls for a bigger crane that is not easily accessible, the tools are delayed. Such a delay may cost a lot of money.

8. Work is paused

Work on other projects may be delayed if a given work package is changed. When actions are interrelated, this occurs. This may result in the crew of a certain vessel being frozen in place or its itinerary being altered. Rapid and efficient change order processes are essential for reducing this impact.

9. ***A rise in overhead costs***

Before they even start, VOs often involve procedural steps, paperwork, and reviews. They can demand that money that might otherwise be utilized for other purposes be put on hold. Due to their difficulty in defining and separating from other accounts, these small costs are often not paid to the change order account. Typically, the fee is added to the contractor's overhead account.

10. Payment delays

If the contractor is owed payment based on the fulfillment of a certain milestone, there is a chance that payment may be delayed as a consequence of a change that delays the attainment of that milestone.

Demolition and renovation 11.

Quite sometimes, changes that take place after a project is built necessitate demolishing some of the work and starting again. On the project time curve, this is the worst period to consider adjustments since their cost is the largest.

3. Research Methodology

Purposive sampling was used because of the kind of information that needed to be gathered from the important parties for the research. The research employed a mix of qualitative and quantitative methodologies.

3.1 Examined Cases

Ten construction projects that were completed between the years of 2007 and 2015 were analyzed in-depth, and thorough data was gathered (contract papers, monthly reports, and weekly reports). Face-to-face interviews with project participants were then conducted in order to ascertain how (VOs) affected the overall success of the research initiatives.

3.2 Industry Survey

The questionnaire was created with the study's goals in mind and was intended to provide information on the research topics. The questionnaire was created after much research and brainstorming. To examine the necessary questions and convey them in a straightforward manner, talks with industry professionals and case study analysis were undertaken. The questions were carefully worded in a way that the responders could understand. An Arabic version of the survey was created since it was anticipated that many respondents would not be native English readers or speakers. The Arabic version also made an attempt to deliver information in a straightforward and understandable manner.

3.2.1. Questionnaire Contents

Two components made up the questionnaire: The first portion of the questionnaire included "instructions" for respondents that defined the study's major terminology and told them how to fill out the questionnaire. Additionally, it included basic information on the respondents, including contact information, firm size, kind, and details about the industry, including experience and rate of change. The potential "impact of VOs on the project performance" was covered in the second part. The literature research was used to create a list of potential consequences. In section 2, an overview of these impacts is given. The responses in this area were graded on a 5-point scale, with VERY OFTEN (marked as 5) and NEVER (marked as 1) being the highest.

3.2.2 Population and Sample

Three limitations were placed on the process of choosing respondents: (1) to include consultants and contractors; (2) to confine the option to construction projects (administrative, commercial, residential, and hospital); and (3) to include the Nigerian State. According to the Contractors Union and the Council of Organizations of Consultants in Nigeria, the researchers' target demographics included owners, contractors, consultants, and project managers.

Based on statistical principles, the size of the sample from each population needed for this sort of exploratory study was established. The sample size for this study was established using the formulas given in [13, 14]: n0 (P*q)/V2 (1) nn0 /[1(n0 / N)] (2) Where:

N: The population size, n: The sample size, n0: Initial estimation of sample size, P: The percentage of the characteristic being assessed in the target population, q: Complement of 'p' or 1-p, V: The maximum standard error permitted.

Respondents were divided into four main categories, including owners, consultants, contractors, and project managers. Table 1 below, which displays the response rate, reveals the results from the four groups. Only 130 (72.2%) of the 180 intended replies completed the questionnaire and sent it back. 53 contractors, 47 consultants, 23 owners, and 7 project managers were among the 130 people who got questionnaires.

Table 1 shows the distribution and response rate for the survey.

Participant category	Questionnaires sent (Sample size)	Response	Response rate (%)
Contractors	70	53	75.71
Consultants	60	47	78.33
Owners	35	23	65.71
Project managers	15	7	46.67
Total	180	130	72.2

3.2.3 Pilot Study

A pilot research might assist in improving data collecting strategies with regard to both the data's substance and the method to be used [14]. Therefore, testing a questionnaire on a small, representative sample confirms its validity [15]. In this instance, a judging sample of 18 respondents was selected with a good representation of respondents' characteristics for the questionnaire's first testing. Contractors, consultants, owners, and project managers who were approached in person were given questionnaires. However, only 14 legitimate responses—or 77.7% of the total—were received from respondents, which

was deemed sufficient for validation. Minor adjustments were made to the questionnaire's structure, style, questions, and general substance in response to the input. Prior to the major survey, the questionnaire was improved upon via this procedure, which also served to verify it.

3.4 Data Analysis

The Statistical Package for Social Sciences (SPSS) version 21.0 was used to analyze the data. The reliability test, frequencies and impact analysis, Relative Importance Index, Spearman's ranking correlation coefficient, and descriptive statistics were used in the study of the data.

3.4.1. Trustworthiness

A research instrument's reliability is defined as a measurement of how consistently it produces findings or data after several trials. Random mistakes have an impact on research reliability. Reliability declines as random error rises. Provided the following generally recognized guideline for defining internal consistency using Cronbach's alpha:

Table 2. Cronbach's consistency alpha,

Cronbach's Coefficient Alpha	Internal Consistency Remarks
$\alpha \geq 0.9$	Excellent
$0.7 \leq \alpha < 0.9$	Good
$0.6 \leq \alpha < 0.7$	Acceptable
$0.5 \leq \alpha < 0.6$	Poor
$\alpha < 0.5$	Unacceptable

3.4.2. Relative Importance Index

The Relative Importance index (RII) for each impact was calculated according to equation (3) [1], [3], [17]

$$RII = (5\ 5\ 4\ 4\ 3\ 3\ 2\ 2x \square x \square \square x\ x \square x1)/(5*N) \quad (3)$$

Where:

X_i: the number of respondents who selected the option of impact; N: the total number of respondents.

3.4.3. Rank-Correlation Spearman's coefficient

The research includes a rating of the variables according to the strength of their influence. The variations in ranking between two sets of respondents scoring for different characteristics, such as owners vs consultants, owners against contractors, and consultants versus contractors, are measured using the Spearman (rho) rank correlation coefficient.

3.4.4. Correlation Coefficient (R^2)

Correlation coefficient (sometimes called the regression coefficient) is the act of the linear correlation between two variables x and y, between +1 and -1 for sale inclusive. $R^2 = 1$ indicates a perfect linear correlation and linear regression perfect, $R^2 = 0$ is no correlation and R= -1 total negative correlation. Table 3 states the accuracy of the correlation coefficient in measures by determination R^2. [18]

Table 3. Measure of correlation accuracy by R^2

R^2 Values	Accuracy
<0.25	Not good
0.25-0.55	Relatively good
0.56-0.75	Good
>0.75	Very good

4. Analysis and Discussion of the Results

4.1 Analysis of the Cases Examined

The findings verified a connection between the existence of VOs and project time overrun, as illustrated in figures 1 through 3. It has been noted that VOs have caused projects' durations to expand by (22–200%), which is worrying. On the other hand, cost study revealed that Vos caused a rise of (2.67-42.86) %.

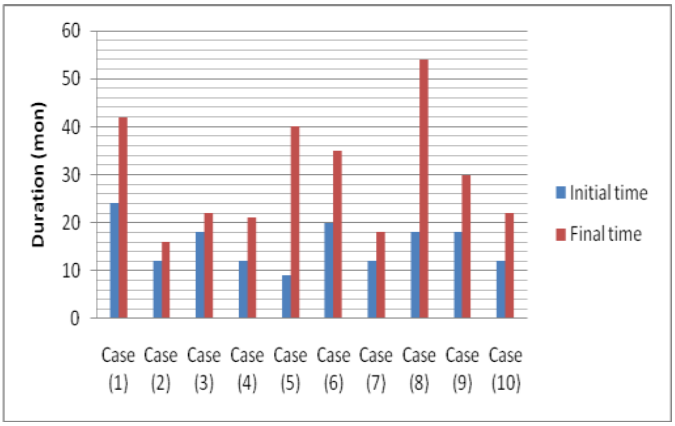

Figure 1. Comparison of the initial and final Time for Studied projects

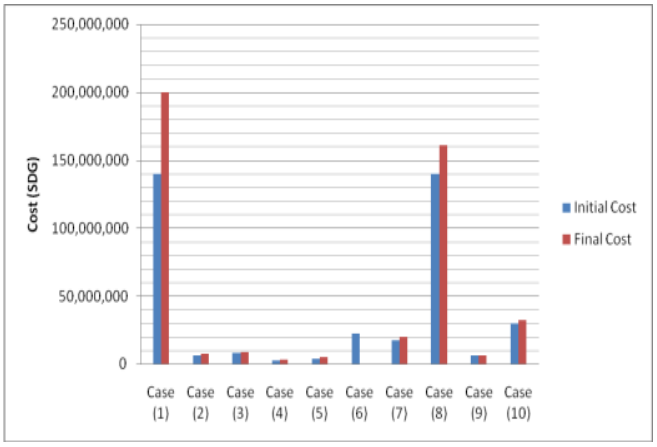

Figure 2. Comparison of the initial and final Cost for Studied projects

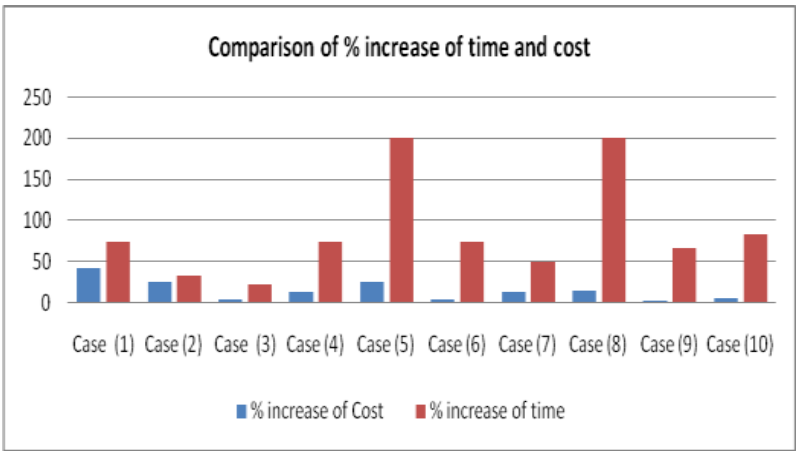

Figure 3. Comparison of the% increase in cost and time

4.2. Industry Survey

4.2.1. Reliability's Outcome

A reliability test was conducted to see whether the questionnaire could provide results that were comparable if respondents used it again. SPSS was used to run the test. The calculated result of the questionnaire's Cronbach's alpha coefficient was 0.857. This result shows that the scale formed from the survey items has a good level of internal consistency and dependability. Demonstrating that the participants in the construction sector are in agreement and that the survey instrument employed was good, reliable, and acceptable.

(4.2.2) Sample Configuration

Participants were distributed as shown in Figure 4, with 5.4% of respondents being project managers, 40.8% being contractors, 17.7% being owners, and 36.2% being consultants.

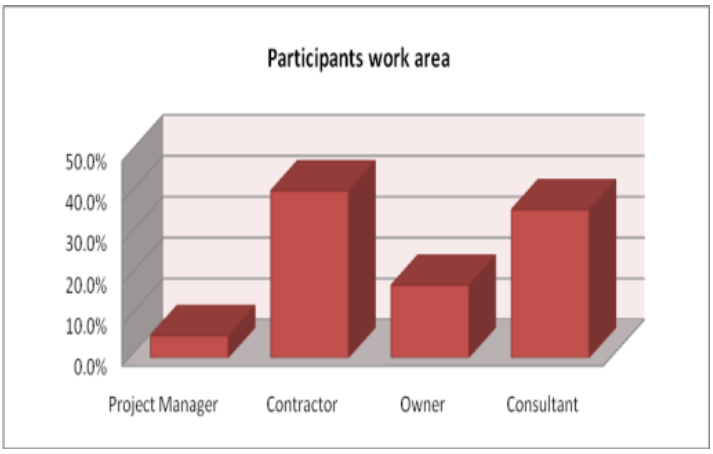

Figure 4. ***Participants work area***

According to the findings about their field of employment, 27.7% identify as working for public sector organizations, while 72.3% work for private sector organizations, as shown in Figure 5.

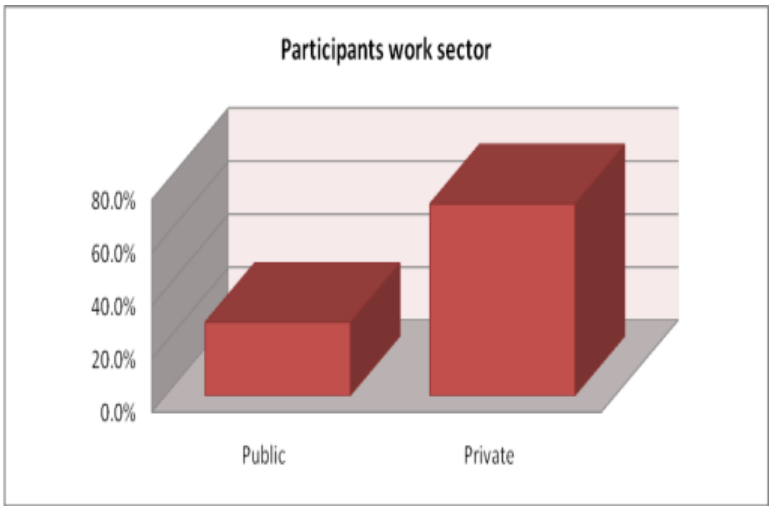

Figure 5. Participants work sector

When asked to specify their specialization, 79.2% of the respondents were civil engineers while 20.8% were architects (refer to Figure 6).

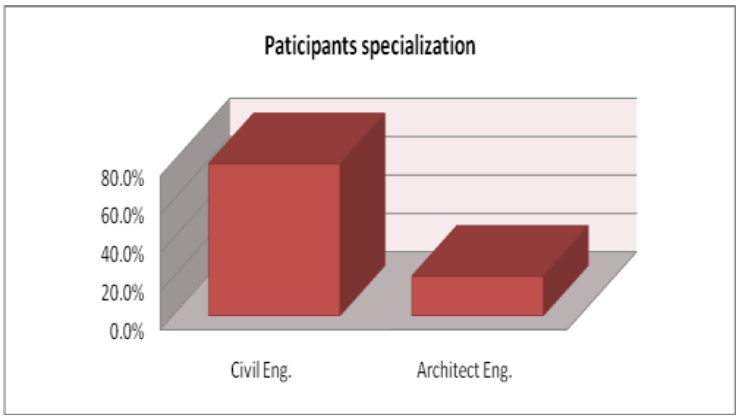

Figure 6. Participant's specialization

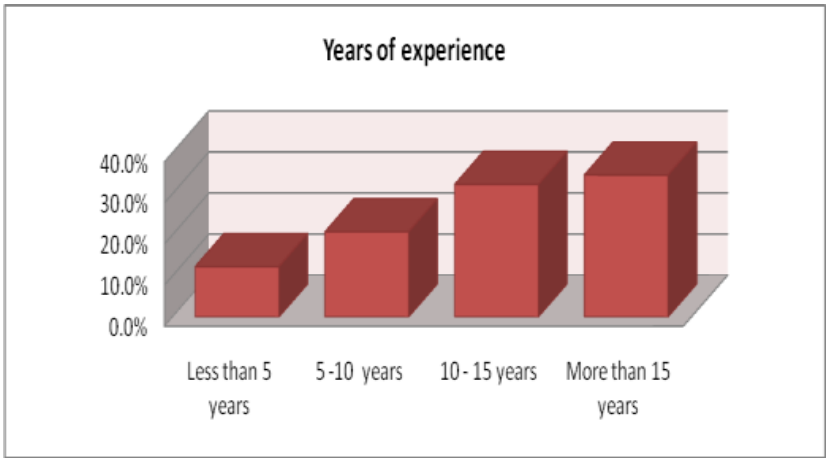

Figure 7. Participant's experience

In order to assess the respondents' experience, it was shown that 12.3% had worked in the sector for less than five years, 20.8% for five to ten years, 32.3% for ten to fifteen years, and 34.6% for more than fifteen years. This demonstrates that two out of three individuals had worked for at least ten years, which suggests they have the necessary expertise to provide reasonable consent. (Use Figure 7, please.

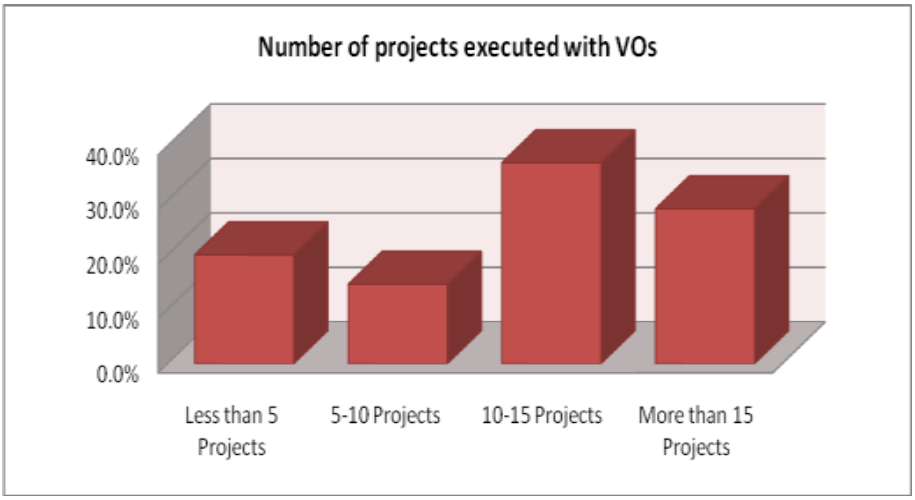

Figure 8 shows how many projects were completed using VOs.

Respondents were asked to specify the number of projects conducted with VOs and were given 4 alternatives from which to offer their comments in order to determine the frequency of occurrence of VOs in construction projects in the Nigeria specify. The findings demonstrated that VOs are observed in all completed projects; 20% of respondents confirmed that VOs occurred in less than five projects, 14.6% in those between five and ten, 36.9% in those between ten and fifteen, and 28.5% in those with more than fifteen. This supports the finding that 65.4% of respondents, or about two thirds, acknowledged having at least 10 projects using VOs.

4.2.3. VO Impact Occurrence and RII

Because there are a number of reasons that might contribute to VOs, each of which could have a different degree of influence, respondents were asked to evaluate the likelihood that each of the 11 potential impact types on project performance will occur. Table 4 and Figures 9 and 10 illustrate the findings as they were attained.

- The majority of respondents believe this to be the impact that occurs the most frequently during project execution, according to 68.5% of respondents, 23.1% frequently, 8.4% occasionally, 0% seldomly, and 0% never. The RII for this result is 0.92.
- Increases in individual activity duration are mentioned by 52.3% of respondents as occurring very frequently, 25.4% as occurring frequently, 10.0% as occurring occasionally, 10.0% as occurring infrequently, and 2.3% as occurring never. The RII of 0.83 highlights the fact that the majority of respondents view this as a result of VOs during project execution.

Delay in completion schedule) happens very often, 13.1% often, 6.9% occasionally, 5.4% infrequently, and 2.3% never, according to 72.3% of respondents. The RII value of 0.90 indicates that the majority of respondents believe this effect occurs often throughout project execution. According to 57.7% of respondents, payment delays happen often, followed by 13.8% more frequently, 10.8% sometimes, 10.0% seldom, and 7.7% never. The RII of 0.81 indicates that the majority of respondents believe payment delays happen frequently throughout project execution. Demolition and re-work occur extremely often, 11.6% regularly, 12.3% sometimes, 11.5% seldomly, and 4.6% never, according to 60.0% of respondents; the RII is 0.82, which indicates that the majority of respondents believe this effect happens frequently throughout project execution. According to 74.6% of respondents, a decrease in worker productivity happens often, followed by 14.6% more frequently, 8.5% less frequently, 2.3% less frequently, and 0% never. The RII value of 0.92 demonstrates that the majority of respondents believe this effect occurs frequently throughout project execution. With a RII of 0.85, 63.1% of respondents agreed that an increase in overhead costs happens often, followed by 16.2% more frequently, 5.4% sometimes, 11.5% less frequently, and 3.8% never. This finding shows that the majority of respondents believe this effect will occur frequently throughout project execution. Decrease in job quality happens very often, 13.8% often, 5.4% occasionally, 4.6% infrequently, and 6.2% never, according to 70.0% of respondents; the RII value of 0.87 demonstrates that the majority of respondents believe this effect will occur often throughout project execution. According to 70.0% of respondents, disputes between owners and contractors happen often, 11.6% frequently, 9.2% sometimes, 9.2% rarely, and 0% never. The RII score of 0.88 shows that the majority of respondents believe this effect occurs frequently throughout project execution. 52.3% of respondents said that Hold on work in other areas happens very often, followed by 11.6% frequently, 14.6% sometimes, 9.2% seldom, and 12.3% never. The RII for this data is 0.76, indicating that the majority of respondents believe this effect occurs frequently throughout project execution. The RII is 0.73, indicating that 50.8% of respondents agreed that Additional money for contractor happens very often, 10.0% regularly, 10.0% sometimes, 13.1% seldom, and 16.2% never. This finding shows that the majority of respondents believe this effect occurs frequently throughout project execution.

Table 4 shows the frequency and relative relevance of the influence of VOs on the execution of the projects.

Impact No	Very Often	Often	Sometimes	Seldom	Never	RII
Impact 1	68.50 %	23.10 %	8.40 %	0.00 %	0.00 %	0.92
Impact 2	52.30 %	25.40 %	10.00 %	10.00 %	2.30 %	0.83
Impact 3	72.30 %	13.10 %	6.90 %	5.40 %	2.30 %	0.90
Impact 4	57.70 %	13.80 %	10.80 %	10.00 %	7.70 %	0.81
Impact 5	60.00 %	11.60 %	12.30 %	11.50 %	4.60 %	0.82
Impact 6	74.60 %	14.60 %	8.50 %	2.30 %	0.00 %	0.92
Impact 7	63.10 %	16.20 %	5.40 %	11.50 %	3.80 %	0.85
Impact 8	70.00 %	13.80 %	5.40 %	4.60 %	6.20 %	0.87
Impact 9	70.00 %	11.60 %	9.20 %	9.20 %	0.00 %	0.88
Impact 10	52.30 %	11.60 %	14.60 %	9.20 %	12.30 %	0.76
Impact 11	50.80 %	10.00 %	10.00 %	13.10 %	16.20 %	0.73

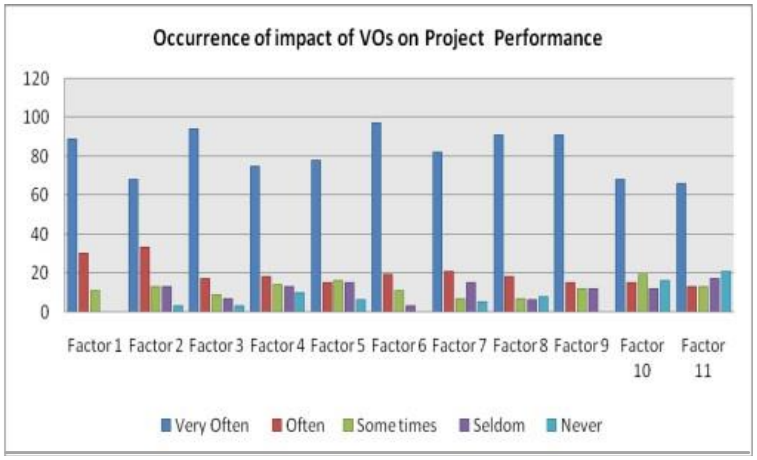

Figure 9. Occurrence of impact of VOs on project performance

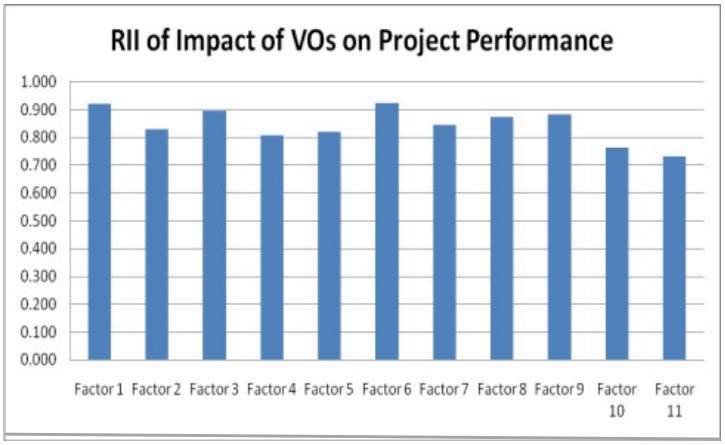

Figure 10. RII of impact of VOs on project performance

Upon checking the same result from the perspective of the participating consultants, (60%) confirmed that all 11 outlined effects on project performance take place very often in the pattern presented in figure 11.

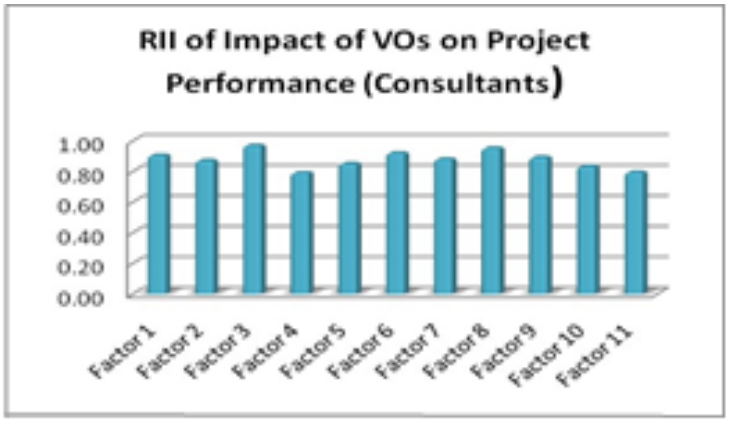

Figure 11. Occurrence of impact of VOs on project performance (Consultants)

The results shown in figure 12 for participating consultants portray the relative importance index when the 11 possible impact effects of VOs on project performance were considered. It was evident that as the highest ranked was Delay in completion schedule (RII=0.97) while the lowest was Delay in payments scoring (RII= 0.79).

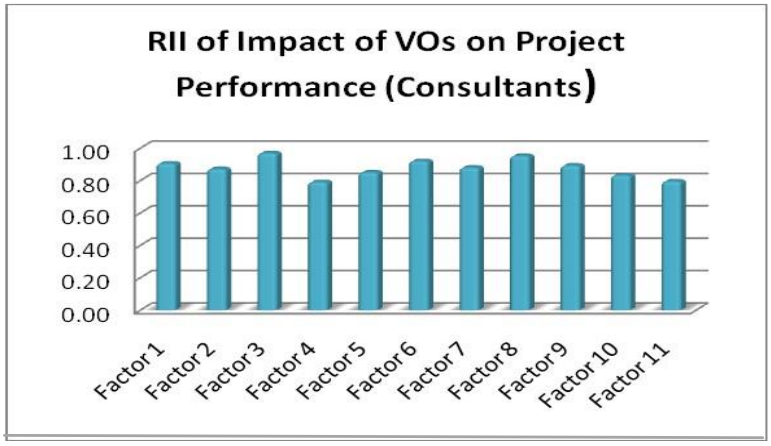

Figure 12. RIIof impact of VOs on project performance (Consultants)

Upon checking the same result from the perspective of contractors participants, (40%) confirmed that all 11 impact effect on project performance occur very often. Refer to figure 13.

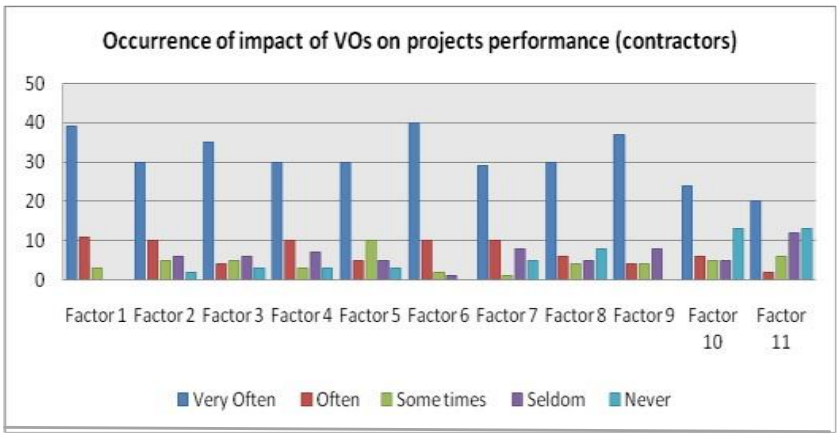

Figure 13. Occurrence of impact of VOs on project performance (Contractors)

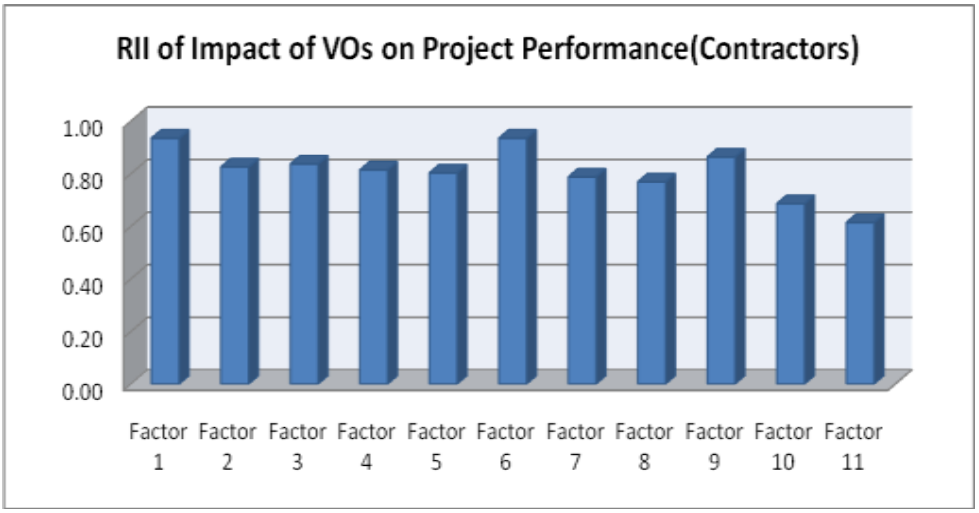

Figure 14. RII of impact of VOs on project performance (Contractors)

The results of relative importance index of impact of VOs on projects performance from the contractors' view have indicated 0.94 for Increase the cost of the projects and Decrease in productivity of workers a varied until to 0.62 for Additional money for contractor (refer to figure 14).

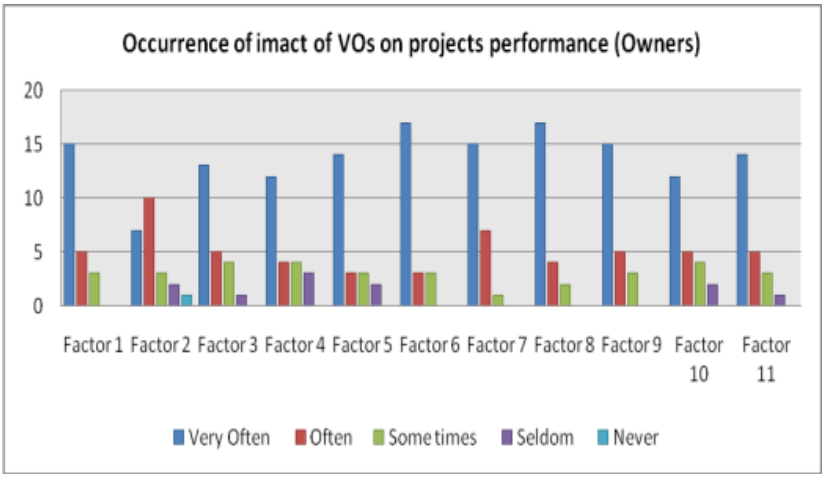

Figure 15. Occurrence of impact of VOs on project performance (Owners)

At least (35%) of owners indicated that all 11 impact effects on project performance occur very often after looking at the same outcome from the perspectives of the various participants (see figure 15).

The findings also revealed that, from the viewpoint of the participating owners, the relative crucial index of the influence of VOs on project performance was 0.93 for a decrease in work quality and as low as 0.77 for an increase in the time of individual operations.

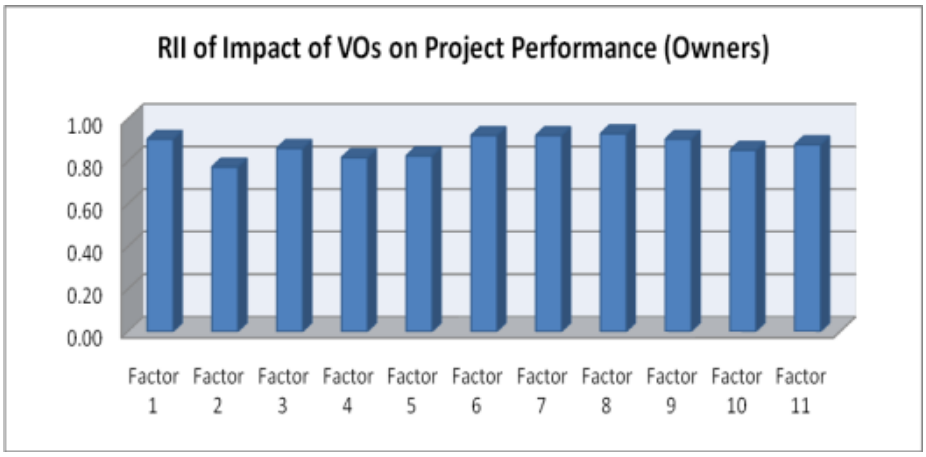

Figure 16. RIIof impact of VOs on project performance (Owners)

Checking the same result from the perspective of projects managers revealed that (42%) confirmed that all 11 impact effects on project performance occur very often, see in figure 17.

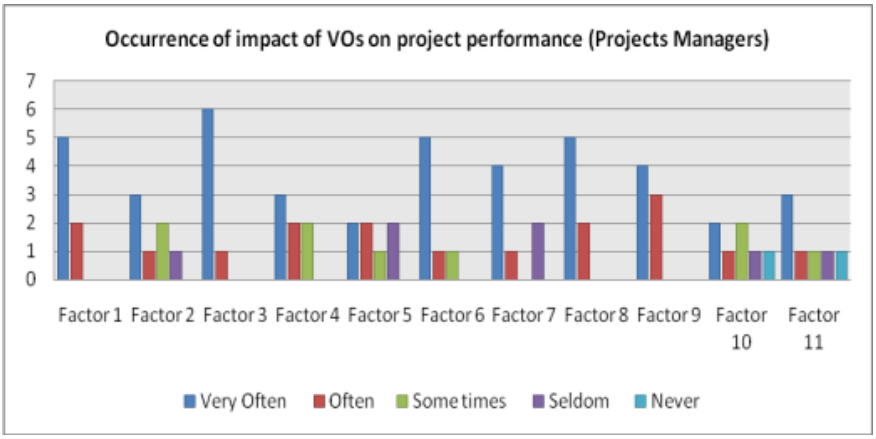

Figure 17. Occurrence of impact of VOs on project performance (Project Managers)

The results in figure 18 show that the relative importance index for the impact of VOs on projects performance was 4.86 for Delay in completion schedule and was 3.29 for Hold on work in other areas.

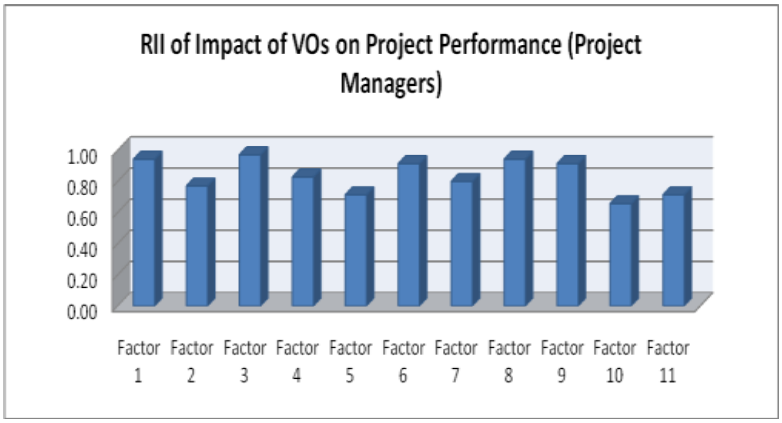

Figure 18. RII of impact of VOs on project performance (Project Managers)

4.2.4. Ranking of VOs' Effects on Project Results

The findings from figure 19 show that the order of the influence (consequences) of VOs on project performance, as seen by all participants, is as follows: (1) A decrease in worker productivity, (2) An increase in project costs, (3) A delay in the completion schedule, (4) Conflicts between owners and contractor, (5) Poorer job quality, (6) Higher overhead costs, (7) Lengthier individual tasks, (8) Demolition and rework, and (9) Delayed payments Hold off on other areas of work, and give the contractor more money.

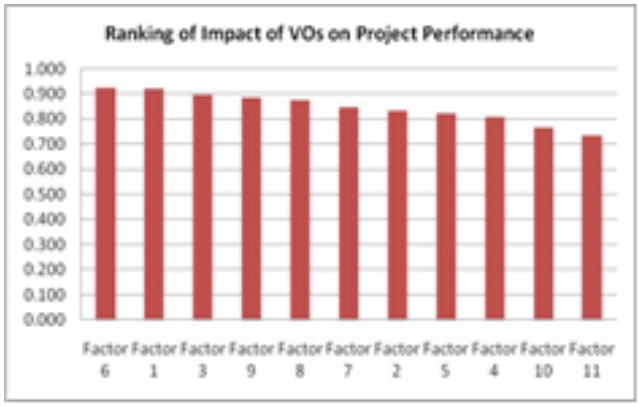

Figure 19. Ranking of impact of VOs on project performance

The rankings of the eleven VOs' impacts on project performance, in accordance with the consultants' opinions, are as follows: (1) A delay in the completion date, (2) A decline in the caliber of the work, (3) A decrease in worker productivity, (4) An increase in the cost of the projects, (5) A dispute between the owners and the contractor, (6) An increase in overhead costs, (7) An increase in the length of individual activities, (8) Demolition and re-work, (9) A delay in other areas of work, (10) A delay in other areas of work, (11) A delay in payments.

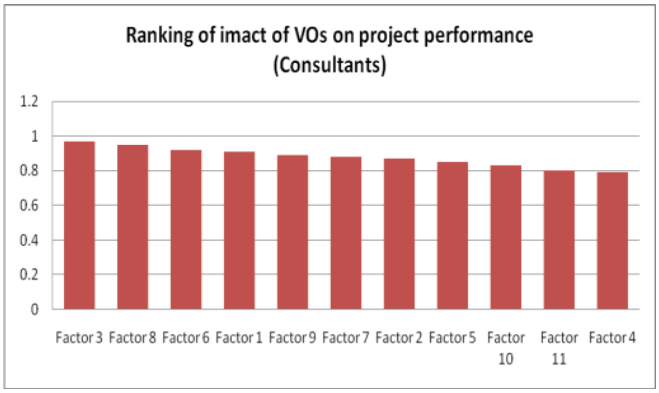

Figure 20. Ranking of impact of VOs on project performance (Consultants)

The eleven VOs that have the greatest influence on project performance, in order of the contractors' opinions, are as follows: (1) Increasing the cost of the projects and decreasing worker productivity, (2) Conflicts between owners and the contractor, (3) Delaying the completion schedule, (4) Extending

the length of individual tasks, (5) Postponing payments, (7) Demolition and re-work, (8) Increasing overhead costs, (9) Decreasing the quality of the work, (10) Delaying work in other areas, (11) Giving the contractor more money

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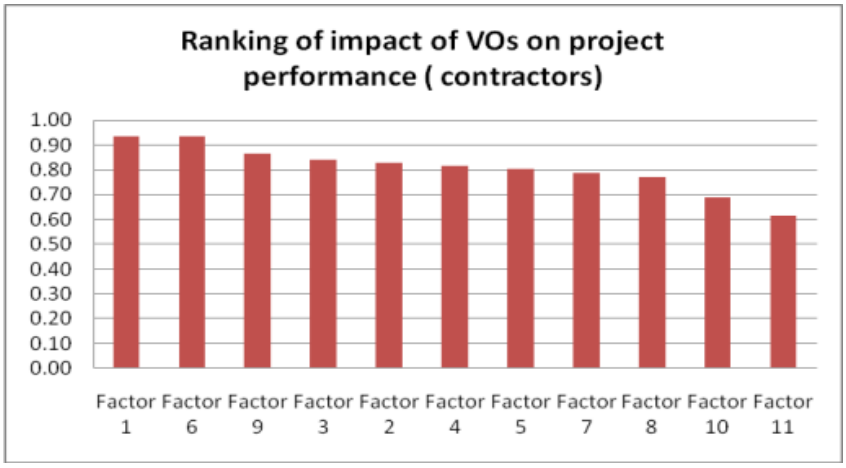

Figure 21. Ranking of impact of VOs on project performance (Contractors)

The findings of figure 22 indicated, in the opinion of the owners, that the eleven VOs' influence on project performance is ranked as follows: (1) Work quality decline, with two effects on the same rank (2) Lower worker productivity and higher overhead costs have a similar-ranking influence. (4) Make projects more expensive and cause disputes between owners and contractors, (6) More money for the contractor, (7) A delay in the completion date; (8) a halt to work in other areas; (9) demolition and rework; (10) a holdup in payments; and (11) an extension of the time spent on particular tasks.

Figure 22. Ranking of impact of VOs on project performance (Owners)

The eleven VOs that have the greatest influence on project performance, in order, are, in the opinion of the project managers, as follows: (1) A schedule slip, with two effects of equal rank (2) Increasing project costs and lowering job quality have the same rank-order effects. (4) Workers' decreased productivity and disputes between contractors and owners, (6) Payment delays; (7) an increase in overhead costs; (8) Lengthening of individual actions, influence on two ranks at once (9) Additional funds for the contractor, demolition, and rework (11) Be patient; work on other.

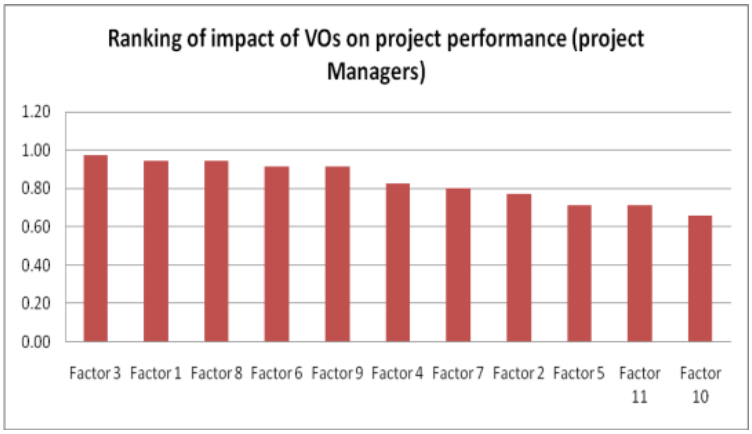

Figure 23. Ranking of impact of VOs on project performance (Project Managers)

4.2.5. Rank-Correlation Spearman's coefficient between the various responder groups, a correlation test (Spearman's Correlation Coefficient) was run. Table 5's correlation coefficient demonstrates that all groups have a very significant link with one another. This suggests that the majority of respondents have the same opinion on how VOs affect project performance.

5. Conclusions

The findings demonstrated a connection between the prevalence of VOs and time overruns in projects. It has been noted that VOs have caused projects' durations to expand by (22–200%), which is worrying. On the other hand, cost analysis revealed a (2.67-42.86)% increase as a result of VOs. The following eleven extremely important variables have the greatest effects on project performance: (1) Lower worker productivity; (2) Higher project costs; (3) Delayed completion schedule; (4) Disputes between owners and contractor; (5) Lower quality of work; (6) Higher overhead costs; (7) Longer duration of individual activities; (8) Demolition and rework; and (9) Delayed payments. (10) Continue your other fields of employment. (11) The degree to which VOs have an influence on construction projects in the Khartoum state is reflected in additional funding for the contractor. The spearmen's Correlation factors had a good link (0.952- 0.978) when assessed from the perspectives of the several involved parties, demonstrating well-matched viewpoints regarding the ranking of variables producing VOs.

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