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VARIATION ORDERS ON CONSTRUCTION PROJECTS: VALUE ADDING OR WASTE?

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ABSTRACT

Purpose – This paper establishes the nature and impact of variation orders on the overall project performance in order to take proactive measures to reduce them.

Methodology/Scope – Literature was reviewed on waste associated with variation orders, their origin agents and adverse impact. Quantitative and qualitative methods were adopted consisting of closed-ended and open-ended questions respectively and case studies on construction projects. Case studies consisted of the scrutiny of site instructions in order to discover those that contributed to waste.

Findings – Generally it was found that a clause permitting variation orders was an essential feature of any construction project. The client was found to be the most predominant origin agent of variation orders as a result of unclear briefing and changing requirements. *Inter alia*, problems encountered when dealing with variation orders included time and cost determination which often could be sources of disputes between the contractual parties. The scrutiny of site instructions revealed apparent associated waste especially those involving alterations to completed work by having complete designs before work commenced on site variation orders could be reduced.

Research limitations - The analysis of site instructions was done on a limited number of construction projects under construction.

Practical implications - The study stimulates the debate over building activities that give rise to non value-adding costs or waste due to the occurrence of variation orders.

Value - The findings of the study will increase the awareness of the impact of variation orders on overall construction project performance and will enable the development of proactive measures to reduce them.

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1. INTRODUCTION

The desire to reduce non value-adding activities on construction projects emanated from the recognition of the need to reduce waste and the resultant optimization of the use of resources. Waste has been part of estimating conventions for a very long time. However, the scientific study of waste started in the United Kingdom in 1963 during investigations into a new form of tender documentation (Skoyles and Skoyles, 1987). This study revealed a considerable disparity between the norm used by contractors and the actual waste that occurs on site. Subsequently, many research studies have been carried out to analyse waste, its origin, causes and negative effects on projects.

The Swedish government investigated major problems in the construction sector such as high costs, general quality-related problems, general problems and reduction of costs for producing new buildings; however, these investigations did not consider the need to identify non value-adding activities and their associated costs (Saukkoriipi and Josephson, 2003). Consequently, a ground-breaking investigation was initiated into the existence of non value-adding activities in all phases of the construction process. Studies have been done on aspects such as caused by the piece-rate[3] (Saukkoriipi, 2004), non value-adding activities arising from defects and inspections, non-productive use of resources, injuries and other ill-health problems and municipality systems and structures (Saukkoriipi, 2005), non value-adding costs arising from traditional competitive tendering (Hassel *et al.*, 2005) and non value-adding costs hidden in taxes (Saukkoriipi and Josephson, 2005). However, to date, few studies have been carried out to investigate non value-adding activities associated with the changes or variations during the construction stage. While academic and practitioners concur that variation orders are common in the construction industry their potential effect on project performance has been overlooked. Arguably, variation orders may be seen as counter to the principle of waste reduction. The more variation orders on a project, the greater the likelihood that they become time consuming and costly elements in construction projects (Mohamed, 2001).

While existing infrastructure and buildings are upgraded the backlog in housing and infrastructure delivery, the deficit of skills, the high construction delivery costs and quality standards related problems are current challenges faced by the construction industry. There is growing concern about rising construction delivery costs. The study reported in this paper aims to uncover waste within various activities/practice in construction projects especially those associated with variation orders and the impact of variation orders on the overall project performance. The study had the following objectives, namely (1) to investigate the prevalence of variation orders on construction projects; (2) to determine whether the activities associated with variation orders may be regarded as waste; (3) to identify the predominant origin agent as well the causes of variation orders; and (4) to establish the nature and extent of the impact of variation orders on overall project performance.

[3] "piece-rate" refers to a kind of incentive pay consisting of a fixed wage and a bonus negotiated between the employer and employees on specific tasks before commencement of works on site.

2. PREVALENCE OF VARIATION ORDERS ON CONSTRUCTION PROJECTS

Various authors intimate that variation orders are common to all types of projects (Thomas, Horman, De Souza, and Zavřski, 2002; Oladapo, 2007). Ssegawa, Mfolwe, Makuke, and Kutua (2002) asserted that the presence of variation clauses in contracts amounts to admitting that no project can be completed without changes. Even if carefully planned, it is likely that there will be changes to the scope of the contract as the work progresses (Harbans, 2003). Hanna, Calmic, Peterson and Nordheim (2002) indicated that variations occur given the uniqueness of each project and the limited resources, time and money available for planning. Construction contracts must make provisions for possible variations given the nature of building construction (Finsen, 2005; Wainwright and Wood, 1983) because construction projects involve complex operations which cannot be accurately determined in advance. A degree of change should be expected as it is difficult for clients to visualize the end product they procure (Love, 2002). Unforeseen conditions[4] may arise which require measures that have not been provided for in the contract (Finsen, 2005). Arguably, variation orders cannot be avoided completely (Mohamed, 2001). Ssegawa *et al.* (2002) added that it is hardly possible to complete a construction project without changes to the plans or the construction process itself due to the complexity of construction activities. Variation orders occur due to a number of reasons ranging from finance, design, aesthetic, geological, weather conditions to feasibility of construction, statutory changes, product improvement, discrepancies between contract documents (Hanna *et al.*, 2002; Ssegawa *et al.*, 2002; Harbans, 2003; Uyun, 2007). Further, the human behaviour of parties to the contract cannot be predicted. Variation orders may arise from changes in the minds of parties involved in the contract. Variation orders may be initiated either by clients or by contractors (Harbans, 2003). A study that focused on the points of view of developers of potential causes of variation orders suggested four main root agents of variation orders (Arain and Pheng, 2006). These agents included clients, consultants, contractors and unspecified “others”.

3. WASTE ASSOCIATED WITH VARIATION ORDERS

The nature of variation orders can be determined by referring to both the reasons for their occurrence and subsequent effects. Arain and Pheng (2005) distinguished two types of variation orders, namely beneficial and detrimental variation orders. A beneficial variation order is one issued to improve the quality standard, reduce cost, schedule, or degree of difficulty in a project (Arain and Pheng, 2005). A beneficial variation order eliminates unnecessary costs from a project; and as a result, it optimizes the client's benefits against the resource input by eliminating unnecessary costs. However, it should be noted that regardless of how beneficial a variation order might be non value-adding costs are likely to accrue as a result. A detrimental variation order is one that negatively impacts the client's value or project performance (Arain and Pheng, 2005). Arguably, a detrimental variation order compromises the client's value system.

[4] Such as adverse ground conditions affecting foundations, which become apparent only during excavation.

While most construction industry stakeholders are arguably interested in the reduction of overall production costs, they are not always aware of the extent of non-value adding activities on construction projects (Saukkoriipi, 2005). Consequently, there is a lack of knowledge about non value-adding costs associated with variation orders. The realistic quantification of such costs is problematic due to lack of appropriate techniques for their measurement. In common practice, non value-adding costs arising from variation orders that are typically transferred to the client are underestimated. For example, one may be able to calculate the costs of aborted works, but non value-adding costs arising from non-productive time, redesign and overheads are not attributed to such an activity. Very often these costs are unknowingly transferred under the account of contingencies.

4. IMPACT OF VARIATION ORDERS ON PROJECT PERFORMANCE

Given a well-structured schedule of works, maximum project performance would be achieved if the work invariably flows smoothly within time limits and anticipated budget constraints. However, it is rare that projects perform precisely in line with their original schedule due to reasons such as, for example, business condition changes, delivery slips, and corrections to design (Al-Hakim, 2005). 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 increases in construction project costs (Arain and Pheng, 2005). Several authors agree that variation orders present as one of the reasons for project time overruns (Chan and Yeong, 1995; Mohamed, 2001). It was 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. If variation orders are frequent, they may potentially affect the quality of works. Patrick and Toler (n.d.[5]) indicated that contracts with a significant degree of risk for unknown variables such for example lump sum, contractors may cut corners on quality and quantity to maximize profits. Quality of works may be compromised as contractor may try to compensate for the losses as they are not optimistic at about cost recovery. Moreover; variation order occurrence can lead to revision of health and safety considerations. The OHS[6] (2003) clause 5.3 (e) stipulates that where changes are brought about, sufficient health and safety information and appropriate resources are made available to the contractor to execute the work safely. This is because change in construction methods, materials and equipment may require additional health and safety measures (Arain and Pheng, 2005). Furthermore, Charoenngam, Coquinco, and Hadikusumo (2003) remarked that disputes between the client and the contractor can occur if variation orders are not managed carefully. Harbans (2003) warned that unless a mutually 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. Finsen (2005) found that a large

5 No date retrieved July 17, 2008, from http://www.tolerlaw.com/files/Contract%20Negotiations%20(FINAL).pdf

6 South African Minister of Labour under section 43 of the Occupational Health and Safety Act No 85 of 1993, Construction Regulation formulated after consultation with the Advisory Council for Occupational Health and Safety.

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.

5. METHODOLOGY

Literature relevant to the research topic was extensively reviewed to explore, *inter alia*, the prevalence of variation orders, non value-adding activities associated with variation orders and their adverse impact on project performance. The study was confined to the Cape Peninsula geographical area where a number of construction stakeholders were contacted. This physical limitation was informed by the exploratory nature, budgetary limitations and time frames of the study. A purposive sampling approach was adopted. This approach involved the handpicking of supposedly typical or interesting cases (Blaxter, Hughes and Tight, 2001). It is a useful technique to obtain information from a sample of a larger population that one considers to be knowledgeable about the subject matter (Walliman, 2005). All participants in the study were registered members of the MBA[7]. Out of 112 registered quantity surveying practices, 547 architectural firms and 103 general contractors, 30 companies in total were selected. These companies were selected using criteria that included whether their contact details were available in the Professions and Projects Register and had responded to the initial telephonic enquiry requesting them to participate in the survey. The design of the research instrument was informed by the review of the literature. Closed-ended questions were included intentionally to restrict responses to a selection of limited responses. While recognizing the limitations of this type of question, they were necessary in order to obtain responses to specific variables that were being examined. A 5-point Likert scale was typically used. This particular scale is the most common scale for obtaining the opinions of respondents and can be used to produce hierarchies of preferences which can then be compared (Haupt, 2001). The semantic differential rating scale was used where rating positions are about equidistantly spaced which scale is a prerequisite for an accurate measurement. These questions were accompanied by a limited number of open-ended questions that allowed respondents to freely express themselves relative to various issues. Consequently, a richer variety and depth of information was obtained which aided in reducing the possibility of investigator bias (Kumar, 2005).

A snowball sampling method was used to select projects that constituted case studies. The snowball sampling technique used in this research study consisted of building up a sample through informants (Blaxter *et. Al.* 2001) given that participant companies had to designate on which construction sites the investigation could be conducted.

The preparatory work for the analysis of open-ended questions was done using the Microsoft Excel feature of Microsoft Office. The analysis involved the grouping of similar opinions which were subsequently quantified. Closed-ended questions were encoded using SPSS (Statistical Package for Social Scientists). The reliability of scaled responses was tested using Cronbach's alpha coefficient of reliability for scaled questions. Pallant (2005) suggested that Cronbach's alpha coefficient of scale should ideally be greater than 0.7. Pallant (2005)

7 The Master Builders and Allied Trade's Association known as MBA is an association for employers in the building industry founded in1891 in South Africa. Its members are builders, building contractors and building merchants or manufacturers of building products.

further indicated that it was common to find low Cronbach's alpha coefficients such as, for example, 0.5 for scales with fewer than ten items. For this study, it was decided that Cronbach's alpha coefficient of reliability would be 0.5 for questions that had less than 10 items. Site instructions[8] were audited in terms of their impact that included addition, omissions and substitutions and overall impact on cost and time. Waste associated with variation orders was uncovered by identifying those that involved demolition and or abortion of work that had already been started.

6. FINDINGS AND DISCUSSIONS

6.1. Research Participation

A sample size of 30 companies operating in Western Cape metropolitan was targeted with an expectation of obtaining an equal representation in a stratified sample of contracting, cost consultant and architectural companies. Companies were asked to distribute as many as possible copies of the questionnaire to appropriate employees. Most companies only returned one completed questionnaire. Out of 30 targeted construction organizations, 23 (77%) completed and returned questionnaires submitted to them. They included contractors (44%), architects (4%), cost consultants (31%), project management (4%), clients (4%) and developers (13%) (Take in Figure 1).

There was a low response rate to questionnaires sent by post especially from architectural companies. The respondents were quantity surveyors, lecturers, directors, site managers, clerks of works and architects. The experience of respondents in the construction industry ranged from two years and one month to 40 years. The median length of experience in construction was 10 years. While respondents had been in their present companies for a period ranging from 1 month to 26 years, the median length of time that they had worked there was 4 years. Their experience in their present positions ranged from one month to 25 years. The median experience in their current positions was 3 years. All respondents had been involved in administration of variation orders. The Cronbach's alpha coefficient of reliability was 0.6; which is greater than the anticipated one of 0.5 suggesting that the responses were reliable.

6.2. Awareness of the Outcome of Variation Orders

Table 1. Impact of variation orders

Instruction	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean
A clause permitting variation orders is an essential feature of any construction contract	23	0.0	4.3	4.3	34.8	56.5	4.4

8 Variation orders have been loosely understood as site or Architect's instructions. Clause 17 of the Joint Building Contracts Committee (JBCC, 2005) refers to contract instructions

Instruction	N	1 (%)	2 (%)	3 (%)	4 (%)	5 (%)	Mean
A variation order clause is provided because construction projects involve complex operations which can not be accurately determined in advance	23	4.3	4.3	4.3	39.1	47.8	4.3
All clients are fully aware that there could be unnecessary costs that accrue due to a variation order	23	0.0	17.4	21.7	43.5	17.4	3.6
The existence of a variation order clause is an aspect that tends to encourage clients/consultants to change their minds during the course of a contract	23	0.0	31.8	13.6	27.3	27.3	3.5
Most variation orders can be avoided	23	0.0	30.4	17.4	34.8	17.4	3.4
The excessive occurrence of variation orders increases the possibility of unethical practices	23	13.0	26.1	26.1	30.4	4.3	2.9

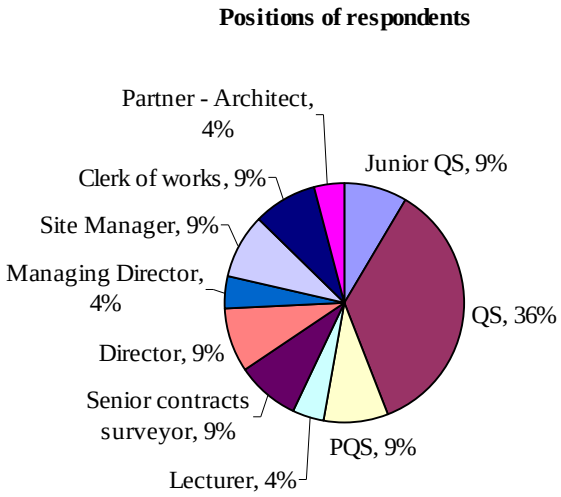

Figure 1. Position of respondents.

Variation orders are expected to occur on construction projects. A 5 point Likert scale determined to what extent respondents agreed with given statements, namely Strongly disagree = 1; Disagree = 2; Neutral = 3; Agree = 4; and Strongly agree = 5. The findings are presented in Table 1. Most respondents (91.3%) agreed that a clause permitting variation orders was an essential feature of any construction contract. More than a half (51.9%) of respondents reported that most variation orders could be avoided. Almost all respondents (86.9%) acknowledged that complex operations led to variation orders. More than half of respondents

(54.6%) admitted that the existence of a variation clause was an aspect that encouraged clients and/or consultants to change their minds during the course of a project. Almost two-thirds of respondents (60.9%) reported that clients were fully aware that unnecessary costs accrued on variation orders. Several respondents (39.1%) disagreed that excessive occurrence of variation orders could potentially increase unethical practices; others (26.1%) remained neutral while more than a third of respondents (34.7%) reported that excessive variation orders yielded unethical practices.

6.3. Frequency of Involvement of Origin Agents

The frequency of the involvement of four origin agents of variation orders, namely clients, consultants, contractors and unspecified "others" were investigated. The following ranking order was used, namely 1st (most frequent involvement) = 1; 2nd = 2; 3rd = 3; 4th (least frequent involvement) = 4. As shown in Table 2, the client was the origin agent most frequently involved with a mean score of 1.6, followed by consultant with a mean score of 1.7. Respondents were asked to clarify their ranking orders and their responses are set out in Tables 3 and 4.

Table 2. Ranking of origin agents of variation orders

Origin agent	N	Mean scores	Std. deviation	Ranking
Client	21	1.6	0.8	1
Consultant	20	1.7	0.8	2
Contractor	20	3.1	0.8	3
Others	19	3.5	0.6	4

From Table 3, it is evident that clients (49%) and consultants (47%) were the most frequently involved origin-agents in the generation of variation orders. Requirement changes (18%) by the client, lack of detailed drawings (18%) by the designer, provision of an unclear brief (14%) by the client and the consultant's role/responsibility as intermediate agent between the parties to the contract (10%) were reported as the dominant motivations for their choice of the most frequently involved origin agents.

Table 3. Origin agents most frequently generating variation orders

Origin agent	Reasons	Percentage	Clarifications
Client	Change of mind	18%	Clients change their mind or requirements
	Unclear brief	14%	Clients do not clearly state what they need then request for changes during the construction stage. Client clip is inevitable in the current market conditions
	Client satisfaction	10%	Clients pursue to achieve their dream as they wish. Since the projects ultimately belongs to them, even when they do not

Origin agent	Reasons	Percentage	Clarifications
			know what they wants, they are always right
	Budget constraints	7%	Budget constraints or the clients seek to make some savings
	Total	49%	
Consultant	Completeness of contract documents	18%	Variation orders originate from a consultant due to design changes or lack of detailed drawings
	Role/responsibilities into the contract	10%	Since the consultants act as an intermediate between the client and the contractor, they may initiate changes to suite the requirements of one of the parties
	Corrections	7%	A consultant usually issues instructions to correct a poor design
	Lack of understanding	4%	The lack of understanding of the requirements of the client by the consultant leads to variation orders
	Communication	4%	Lack of communication and coordination between the consultant team may lead to variation orders
	Unforeseen	4%	A consultant initiates a variation order due to unforeseen details at tender phase
	Total	47%	
Contractor	Forecast	4%	The contractor may be aware of the potential change and requests for instruction.

From Table 4, it is evident that contractors (73%) and unspecified others (18%) were the origin agents that were least involved in generating variation orders. The dominant reasons reported were that the contractor had no influence on the design (55%) and unforeseen circumstances (18%) such as, for example, extreme weather conditions.

6.4. Problems Encountered When Negotiating Variation Orders

There are problems encountered when administering variation orders. These problems were categorized as shown in Table 5. Respondents reported that they mostly encountered problems associated with the determination of the costs involved (32%). There was disagreement between the contractor and the consultant with regard to the amount being claimed, revised rates and additional preliminaries. There was also disagreement with determining the impact of a variation order on the works schedule and subsequent time extension (24%). The reluctant nature of the client, lengthy approval process, lack of coherent practice process, impediment in decision making were among the cited problems.

Table 4. Origin agents least frequently generating variation orders

Origin agent	Reasons	Percentage	Clarifications
Contractor	Procurement approach	55%	Contractor hardly contributes to variation orders as they carries out works according to the design and has no influence on design changes
	Construction methods	9%	Request by the contractor for alternative material/method for construction
	Remedial works	9%	Variation orders issued for corrective or remedial works following a faulty of the contractor
	Total	73%	
Others	Unforeseen	18%	Unforeseen problems such as for example revision for completion date due to excessive adverse weather conditions and strikes
Client	Responsibility	9%	Clients are not designers

Table 5. Problems encountered with when negotiating variation orders

Problem	Percentage	Explanation
Cost determination	32%	There are always difficulties to determine the involved costs, a disagreement between the contractor and the consultant with regard to the claimed amount, revised rates and additional preliminary and generals
Time determination	24%	There are difficulties and disagreement to ascertain the impact of a variation on the schedule of works and subsequent required time for extension
Reluctant nature of the client	8%	The client is reluctant to accept the order because in most cases variation orders involve additional budget and the client does not want to compensate related expenses
Lengthy approval process	8%	Contractors experience difficulties because works are delayed before the client accepts the variation order It takes long for a variation order to be approved by the whole team of relevant consultants
Difficulties to satisfy the contractor	6%	Contractors are rarely satisfied with allocated amount by the consultant as they feel this amount is not enough; consequently they bring in other issues not related to the variation order since they knows the claimed amount will not be certified in full
Lack of coherent practice process	6%	Different opinions and judgments or lack of understanding of the process
Impediment in decision making	6%	The client does not take timeous decisions for fear of repercussions especially in public sector works
Length of period payment	2%	Late payment or no payment at all to the contractor. The contractor get rarely in full the claimed amount

Problem	Percentage	Explanation
Accountability in covering cost	2%	There is a problem to know who covers the costs of a variation order
Logistic constraints	2%	Problems related to the availability of plant, experienced labour, quality and workmanship
Weather	2%	The occurrence of a variation order leads the project to facing constraints related to weather conditions
Disputes	2%	A variation order may be source of conflicts and disputes between parties to the contract

6.5. Outcome of Variation Orders on Project Performance

The frequency of outcomes of variation orders with regards to project performance were ranked using a 5 point Likert scale where Never = 1; Seldom = 2; Sometimes = 3; Often = 4; and Always = 5. From Table 6, it is evident from the ranking of the means of responses that time and cost overruns equally dominate with mean scores of 4.0. Disputes between parties to the contract followed with a mean score of 3.7 and then additional specialist equipment and personnel with a mean score of 3.4.

Table 6. Outcomes of variation orders

Impact	N	Mean	Std. dev	Rank
Time overrun	23	4.0	0.5	1
Cost overrun	23	4.0	0.5	1
Disputes between parties to the contract	23	3.7	0.7	3
Additional specialist equipment/personnel	23	3.4	0.5	4
Complaints of one or more of the parties to the contact	23	3.2	1.0	5
Quality standards enhanced	23	3.1	0.7	6
Professional reputation of one or more parties adversely affected	23	3.1	0.9	7
Additional health and safety equipment/measure	22	2.8	0.7	8
Degradation of quality standards	23	2.7	0.8	9
Optimum cost reduction	22	2.6	0.9	10
Degradation of heath and safety	23	2.4	0.6	11
Time reduction	23	2.3	0.7	12

6.6 Analysis of Site Instructions

6.6.1. Project Particulars

In practice, variation orders have been loosely understood as site/contract or architect's instructions. Site instructions issued on 3 construction projects including the refurbishment of two shopping complexes and a new residential flat were analysed. As the data was obtained from different contactors, it was realized that there was no standard method of recording site instructions. The summary of records is set in Table 7.

Table 7 Project particulars

Description	Project I	Project II	Project III
Scope of the project	Refurbishment and extension	New	Refurbishment and extension
Purpose of the development	Shopping premises and residential flats	Residential flat	Shopping centre
Tender sum	ZAR 258 million	ZAR 105 million	ZAR 109 million
Anticipated final contract sum	ZAR 280 million	ZAR 111 million	ZAR 102 million
Impact of variation orders on final contract sum	Escalated	Escalated	Escalated
Claimed amount of variations	ZAR 776,874	ZAR 1,437,744	Not available
Certified amount of variations	ZAR 276,418 (35%)	ZAR 796,205 (55%)	Not available
Original contract duration	25 months	24 months	12 months
Final/projected contract duration	25 months	33 months	12 months
Impact of variation orders on project duration	No impact	Escalated	No impact
Progress of works	70%	98%	100%
Methods used for valuation of variation orders	(1) Bill rates (2) Day works (3) Negotiated rates (4) Quotations	(1) Bill rates	(1) Bill rates (2) Day works (3) Negotiated rates (4) Quotations
Type of contract	Fluctuating	Fixed	Fixed
Existence of items falling under provisional (Yes/No)	Yes	Yes	Yes
Procurement method	Fast track	Traditional	Fast track
Completeness of contract documents at time of tender	Incomplete	Incomplete	Incomplete
Occurrence of site instruction	370 no	102 no	188 no

Project I consisted of the demolition of part of an existing six storey structure and construction of an eight storey reinforced concrete structure. This project was 70% complete and a total number of 370 site instructions had already been issued when the data was collected. It was believed site instructions had impacted the project duration while cost was not affected. From the total amount of ZAR 776,874 claimed by the contractor, only 35% (ZAR 276,418) had been certified.

Project II was an apartment block consisting of 6 levels with a basement and lower basement level for parking and storage. This project was almost complete (98%) and a total number of 102 site instructions had already been issued when the data was collected. It was believed site instructions impacted both project duration and cost increases. From the total amount of ZAR 1, 437,744 claimed by the contractor, only 55% (ZAR 796, 205) had been certified.

Project III consisted of the refurbishment of a shopping centre and construction of a two deck parking space. This project was 100% complete and a total number of 188 site instructions had been issued during the contract duration and had resulted in the final contract sum changing. Site instructions had no impact on the project duration. On this project, the reduction from the original tender sum of ZAR 109 million to the final ZAR 102 million resulted from savings provisional sums for various items of work not being executed. For example a new lift, chiller plant and standby station were not erected. It was decided to keep the old ones since they were still in good condition.

6.6.2. Work Implication of Site Instructions

From Table 8, 71% of site instructions for combined projects resulted in additional works and 10% in substitution work. The predominance of additional works could be predictable as a result of the incompleteness of the contract document, the provision of provisional sums and the scope of works. Project II experienced 36% site instructions leading to substitutions mainly due to excessively revised designs. Project III was a shopping centre whereby each completed portion was immediately handed over to the shop tenants. As result, more than a quarter (27%) of site instructions was snag or 'make good' lists issued at various interim handovers of various sections of works. The analysis of these site instructions revealed problems related to quality workmanship.

Table 8. Work implication of site instruction

	Project I		Project II		Project III		Summary	
	No	%	No	%	No	%	No	%
Additions	285	77	64	64	120	63	469	71
Substitutions	32	9	36	36	9	5	77	12
Omissions	3	1	0	0	2	1	5	1
On hold	1	0	0	0	0	0	1	0
Proceed	5	1	0	0	3	2	8	1
Snag	3	1	2	2	51	27	56	8
Unsure	41	11	0	0	3	3	44	7
Total	370	100	102	102	188	100	660	100

6.6.3. Cost Implication of Site Instructions

As shown in Table 9, it was found that 80% of site instructions involved cost adjustment while 12% did not.

Table 9. Cost implication of site instructions

	Project I		Project II		Project III		Summary	
	No	%	No	%	No	%	No	%
Cost implication	300	81	98	96	132	70	530	80
No cost implication	28	8	2	2	47	25	77	12
Unsure	42	11	2	2	9	5	53	8
Total	370	100	102	102	188	100	660	100

6.6.4. Nature of Site Instructions/Variation Orders

Table 10. Nature of variation orders

	Project I		Project II		Project III		Summary	
	No	%	No	%	No	%	No	%
Beneficial	338	91	102	100	187	99	627	95
Detrimental	0	0	0	0	0	0	0	0
Unsure	32	9	0	0	1	1	33	5
Total	370	100	102	102	188	100	660	100

Table 10 records the nature of site instructions. It was reported that most (95%) site instructions were beneficial. A beneficial variation is issued to add value to the product while the detrimental site instruction leads value degradation. Apparently, there were no variation orders issued that negatively affected the quality of the end product.

6.6.5. Waste Associated with Site Instructions

Despite the non-occurrence of detrimental variation orders, waste accrued as a result of site instructions. From Table 11, it is evident that 14% of the site instructions had waste associated with them. Activities that constituted waste included, for example, demolitions of portions of works already erected in order to correct errors.

Table 11. Waste Associated With Variation Orders

	Project I		Project II		Project III		Summary	
	No	%	No	%	No	%	No	%
Yes	18	5	31	30	40	21	89	14
No	314	85	71	70	146	78	531	80
Unsure	38	10	0	0	2	1	40	6
Total	370	100	102	102	188	100	660	100

6.7. Discussion

The findings of the questionnaire survey and the analysis of site instructions established that the most frequent impact of variation orders was additional works. Both the incomplete and inadequate scoping of works by the client during briefing and incomplete design by the consultant were reported to be primary reasons behind additional works. As clients sought to minimise project delivery periods, they shortened the pre-tender period and expected the construction work to start on site as early as possible. Clients preferred works to start on site and initiated changes as work progressed. On the other hand, consultants hardly objected to the demands of clients. They allowed embarking on construction stage while the design was incomplete. This was observed in fast track projects and refurbishment works where additional requirements would be often realised when works were in progress.

It is common in fast track and refurbishment contracts to tender with incomplete contract documents. Provisional sums were allowed to cover items for which the accurate quantities could not be determined at time of tender. The presence of provisional sums items and the incompleteness of contract documents created uncertainty of the scope of contract. Uncertainty was a clear indication of the likelihood of the occurrence of variation orders. Though work substitutions had less frequent work impact, waste occurred on these projects. Waste arose from alterations to portions of works that had already been completed.

The client and the consultant were found to be the most frequent originating agents of variation orders. This was the result of failure to produce detailed drawings by the consultant together with change of mind by clients resulted in variation orders. Impliedly, the occurrence of variation orders was a consequence of the behaviour of the client and the consultant during the pre-tender stage. Moreover, this could have been the reason to find that the contractor had least influence on variation orders during the construction stage. However, it is argued that

variation orders originating from the consultant included those originating from the client. In fact, since the change of plans or scope was the most predominant cause of variation orders originating from the client these encompass most of the changes originating from the consultant.

Experience and lack of experience were opposite causes generating variation orders but both originated from the contractor. On the one hand, the contractor with experience could propose replacement of materials or construction procedures. Such a variation order would enhance the value of the project. On the other hand, the lack of experience of the contractor had the potential to increase the number of variation orders on a project. The variation orders resultantly occurring adversely affected the value of the project. The fact that respondents suggested the reduction of the occurrence of variation orders could be admittance by the construction industry that excessive variation orders had some adverse impact on the project. Respondents suggested that adequate time should be spent on design and accurate information should be disseminated between parties to the contract.

Despite provision being made in contract conditions, variation orders resulted in problematic situations. Time and cost overruns and disputes between parties to the contracts were the most predominant adverse impacts of variation orders on project performance. Although there were several options to evaluate the cost of variation orders, a lack of common understanding was found between parties to the contract and could be the source of disputes between them. The discrepancies between the claimed and certified amounts suggest the need for improvements relative to variation order administration.

7. CONCLUSION

The study found that consultants accepted time frames proposed by clients instead of proposing realistic timeframes to complete the design. As a result they embarked on tendering whether the design was completed or not because they knew other required changes would be permissible under the conditions of contract. It was therefore concluded that the client was the most predominant origin agent of variation orders. Most variation orders added value to the project. However, waste was still a consequence of them. It was found that variation orders were not realistically priced resulting in increased construction costs. Time and cost overruns and disputes had major impacts on project performance. There were no standard methods for recording and administering variation orders. While respondents suggested that variation orders should be kept to minimum, they acknowledged that clients had the right to initiate changes provided they were contractually permissible and were prepared to pay the associated costs.

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