CLIENTS' PERCEPTIONS OF NON-VALUE ADDING ACTIVITIES IN SOUTH AFRICA

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ABSTRACT

Based upon documented non-value adding activities (NVAAs) in the literature, the study was undertaken in order to investigate NVAAs that are significant in the South African context. According to the research problem statement, the recurrent poor performance recorded in South African construction may be due to the prevalence of NVAAs.

Though the larger research embraced methodological pluralism, this particular paper reports on a quantitative survey conducted among South African public sector clients. The survey used NVAAs and their causes identified through the literature as the basis for the investigation.

The research findings suggest that NVAAs do not only pervade South African construction, but also marginalise the realisation of optimal project performance in terms of cost, environment, health and safety (H&S), quality, and time.

The implications are centred on the need to increase knowledge and awareness, and also reduce the frequency of occurrence of NVAAs in South Africa. Though only an aspect of the research is reported upon in this paper, the research equally entailed an empirical study conducted among consultants and contractors with a view of creating awareness throughout the entire industry.

However, future multi-case study research involving the most cited NVAAs will complement the long-term objective of the study.

KEYWORDS

Construction, Infrastructure, Non-value adding activities, Performance, South Africa

BACKGROUND

The South African public sector, which is undeniably the biggest procurer of construction services in order to fulfil electoral pledges and constitutional requirements, cannot be said to be fully satisfied with the performance of the industry. For example, an examination of six public sector projects that were not completed satisfactorily in South Africa revealed that inadequate tender rates, poor project cost, as well as scope, quality, time, and integration management related problems were the causes of failures linked with the projects (Samuel, 2008). While noting the poor project management competency among project stakeholders, a situation analysis conducted relative to the identified failures suggest that NVAAs played prominent

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roles in terms of the problems recorded on the projects. In fact cost escalation that is pervasive in transport infrastructure projects across project types, geographical location and historical period is reportedly strongly dependent on the length of the implementation phase of construction project delivery (Flyvbjerg *et al*., 2003).

Though Flyvbjerg and other researchers have attempted to address the cost escalation problems through the lens of policy-making and decision-making at project inception, anecdotal evidence and other research findings seems to suggest that activities both upstream and downstream of the construction supply chain influence the length of the implementation phase of project delivery, and contribute to the final cost of projects at their completion. For instance, empirical studies suggest that NVAAs are the major reason behind schedule delays, cost overruns, and poor construction productivity (Horman and Kenley, 2005; Han *et al*., 2007; Alwi *et al*., 2002). Even within South African construction, the prevalence of NVAAs is reported to be increasing the amount of variations / claims recorded in projects (Ndihokubwayo and Haupt, 2008). The need to address these NVAAs is imperative given that South African construction is currently contending with performance related issues relative to cost, H&S, quality, and time (cidb, 2009; 2010). Consequently, the primary objective of the research is underpinned by the need to investigate NVAAs that have seemingly engendered poor project performance in South African construction. Thus, the aim of this discourse is to present NVAAs, their causes, and effects in South African construction from the perspectives of public sector clients so as to provide insights into 'how matured South African construction is' in terms certain aspects of lean construction.

THE RESEARCH

Though, the larger research embraced methodological pluralism, since it entailed detailed investigations that involved clients, consultants, and contractors in the industry, this particular paper reports on a quantitative survey conducted with the use of self administered questionnaires among South African public sector clients. The survey used NVAAs and their causes identified through the literature as the basis for the investigation. With respect to NVAAs, their causes, their effects, and possible remedies, literature such as Koskela (1992), Alarcon (1997), Alwi *et al*. (2002a; 2002b), Han *et al*. (2007), Polat and Ballard (2004) provided the conceptual / theoretical basis for the investigation.

In 1992, Koskela suggested that NVAAs may be due to defects, overproduction, unnecessary processing, unnecessary material movement, unnecessary people movement, waiting periods, inventories, and designs that do not meet the needs of the client. And in 1997, Alarcon gave more examples of NVAAs that could manifest in construction projects. Such NVAAs include work not done, rework, unnecessary work, errors, stoppages, waste of materials, deterioration of materials, loss of labour, excessive supervision, additional space, and abnormal wear and tear of equipment. Other documented NVAAs in construction include delays to schedule, repairs to finishes, repairs to foundation works, damaged to material, frequency of equipment breakdowns, lack of supervision, and loss of material on site (Alwi *et al*., 2002a). These NVAAs are caused by a range of anomalies in construction. In a study that was undertaken in Australia and Indonesia, Alwi *et al*. (2002b) discovered that design changes, lack of trade's skill, slow decision-making, poor coordination between

project partners, poor planning and scheduling, delay in material delivery, poor construction methods, poor design, poor quality of site documentation, slow drawing revisions, unclear site design information, and weather conditions lead to NVAAs, albeit in varying degrees.

In brief, causes of NVAAs can be categorised either with respect to design, procurement, material handling, and site operation (Polat and Ballard, 2004) or with respect to people, professional management, design and documentation, material, site operations, and physical factors (Alwi *et al*., 2002b). According to Alwi *et al*. (2002b), causes of NVAAs relative to people include inadequate trades skills, poor distribution of labour, late supervision of work, shortage of skilled supervisors / foremen, inadequate subcontractor skills, and inexperienced inspectors that seems to be a source of concern in South African construction; causes of NVAAs associated with professional management include poor planning and scheduling, poor information management, poor coordination of construction, and slow decision-making processes; causes of NVAAs relative to design and documentation include poor quality site documentation, unclear specification, unclear site drawings, slow response to requests for information (RFI), design changes, and poor design; causes of NVAAs relative to material include non-conformance to quality standards, delay of material delivery, poor material handling, inappropriate use of material; and the causes of NVAAs associated with site operations include poor site layout, outdated equipment, shortage of equipment, inappropriate construction methods, and excessive reliance on overtime in order to execute work timely. In a nutshell, the cited research findings and others that address NVAAs have consistently amplified the fact that NVAAs, and their causes marginalises production in construction, and by implication engenders poor performance in construction.

Thus, eighty (80) variables that are related to NVAAs were derived from an extensive literature review. In particular, forty (40) variables are relative to NVAAs, while another 40 variables are relative to the causes of NVAAs. Further, the 40 variables relative to NVAAs that contribute to poor project performance were separated into five (5) classifications with eight (8) variables assigned to each category: NVAAs categories that occur due to rework, waiting periods, material, movement, and human resources. Similarly, the 40 variables relative to causes of NVAAs were separated into 5 classifications with 8 variables assigned to each category: causes of NVAAs categories that occur due to human resources, designers, information and documentation, material / equipment, and site operations. The survey questionnaire was designed by asking respondents to identify NVAAs that contribute to poor project performance, construction related activities that lead to NVAAs (causes of NVAAs), the issues that occurs as a result of NVAAs in construction, and the ratings of effects of NVAAs on project parameters. Specifically, respondents were able to identify NVAAs and their causes using 5 point likert-type scale: (1) Minor extent; (2) Near minor extent; (3) Some extent; (4) Near major extent; (5) Major extent. In order to record the effects on NVAAs in South African construction, respondents were able to express their perceptions using 5 point likert-type scale: (1) Never; (2) Rarely; (3) Sometimes; (4) Often; (5) Always.

Therefore, out of 122 public sector client organisations that were surveyed, 28 valid responses were received after the survey period of about 16 weeks in which 6 e-mail reminders were sent in order to improve the response rate. However, at the end

of the survey, the response rate equated to 23%. In addition, while 74.1% of the respondents have participated in transport infrastructure projects such as roads, ports or harbours, only 18.5% of the respondents have been part of a power project undertaking, either dam, gas, or coal. This demographic data suggests that all respondents are active in the South African civil engineering construction sector. Further, since this paper only presents findings that form part of a larger research project, the use of mean comparisons is considered appropriate for presenting the results at this stage.

THE RESULTS AND DISCUSSIONS

As indicated in cidb reports, the findings of this survey also indicates that in general the respondents can be deemed to rate the performance of project parameters of cost (MS = 3.12), health and safety (H&S) (MS = 3.00), quality (MS = 2.96), environment (MS = 2.88), and time (MS = 2.65) in South Africa to be below average as opposed to above average. The result is thus not at variance with previous research findings that have continued to call for an improvement in project performance in the sector (cidb, 2009; 2010). In addition, the respondents' perceptions relative to three NVAA related aspects of the South African construction industry in terms of percentage responses to a scale of 1 (limited); 2 (below average); 3 (average); 4 (above average) and 5 (extensive); suggest that respondents perceive their encounter with (MS = 3.33), and their knowledge (MS = 3.08) of NVAAs in the South African construction to be between below average to average / average. In addition, the frequency of occurrence of NVAAs in the South African construction can be deemed to be below average to average / average. These findings is thus a cause for concern as NVAAs are not only deemed to be wasted efforts that consume time and resources without directly or indirectly adding value to the project requirements, but most importantly NVAAs can also become compounded and even propagated into other related activities (Han *et al*., 2007). For example, Han *et al*. (2007) contend that errors and changes generally trigger NVAAs in the construction production system in the forms of interruption, productivity loss, and rework that requires additional time and effort so as to compensate for lost time and effort.

Table 1 indicates the respondents' perceptions of the extent to which NVAAs contribute to poor project performance in South African construction in terms of percentage responses to a scale of 1 (minor) to 5 (major). It is notable that twenty-six (65%) of the forty NVAAs that have been categorised based on their mode of occurrence (rework; waiting periods; material; movement; human resources) have MSs above the midpoint of 3.00, which suggests that the respondents deem them to contribute more of a major than a minor extent to poor project performance in South African construction. In the category of rework, the ranking in the table suggest that rework relative to design, structural works, foundation works, and finishing works, could contribute the most to poor project performance; while in the category of waiting period, waiting for materials, instruction / information, and critical tasks to be finished contributions to poor project performance can be considered significant. In the category of material, only non-conformance to specification that is ranked 1st can be considered significant, and in the category of movement, though poor coordination of resources and poor sequencing of tasks are ranked 1st and 2nd, none of the NVAAs

can be said to contribute majorly to poor performance based on the respondents' observation.

Table 1: Extent to which NVAAs contribute to poor project performance in South African construction

NVAA	Response (%)						MS	Rank
	Unsure	Minor……Major						
		1	2	3	4	5		
Rework relative to:								
Design	0.0	7.1	0.0	21.4	35.7	35.7	3.93	1
Structural works	3.6	3.6	7.1	35.7	21.4	28.6	3.67	2
Foundation works	3.6	3.6	25.0	17.9	17.9	32.1	3.52	3
Finishing works	0.0	10.7	14.3	21.4	25.0	28.6	3.46	4
Formwork	7.1	14.3	7.1	42.9	10.7	17.9	3.12	5
Mechanical works	10.7	7.1	28.6	25.0	17.9	10.7	2.96	6
Electrical works	10.7	14.3	25.0	17.9	21.4	10.7	2.88	7
Service-e.g plumbing works	3.6	10.7	28.6	35.7	7.1	14.3	2.85	8
Waiting periods to:								
Materials	0.0	0.0	21.4	21.4	25.0	32.1	3.68	1
Information	0.0	7.1	10.7	25.0	21.4	35.7	3.68	2
Critical tasks	0.0	7.1	10.7	21.4	32.1	28.6	3.64	3
Equipment availability	0.0	3.6	25.0	21.4	28.6	21.4	3.39	4
Labour availability	0.0	7.1	21.4	28.6	28.6	14.3	3.21	5
Specialist availability	0.0	10.7	17.9	35.7	17.9	17.9	3.14	6
Work platform availability	0.0	10.7	21.4	32.1	21.4	14.3	3.07	7
Inspections	0.0	10.7	25.0	32.1	17.9	14.3	3.00	8
Material:								
Deviation from specification	0.0	3.6	14.3	10.7	39.3	32.1	3.82	1
Defective materials on site	0.0	10.7	17.9	25.0	28.6	17.9	3.25	2
Deterioration of materials	0.0	10.7	25.0	39.3	17.9	7.1	2.86	3
Loss of materials on site	0.0	10.7	25.0	42.9	14.3	7.1	2.82	4
Unneeded material handling	7.1	14.3	21.4	35.7	10.7	10.7	2.81	5
Waste of raw materials on site	0.0	25.0	25.0	25.0	17.9	7.1	2.57	6
Excess materials on site	0.0	14.3	53.6	17.9	10.7	3.6	2.36	7
Excessive inspection	7.1	35.7	17.9	14.3	25.0	0.0	2.31	8
Movement:								
Poor coordination of resources	0.0	3.6	21.4	32.1	14.3	28.6	3.43	1
Poor sequencing of tasks	0.0	7.1	25.0	17.9	25.0	25.0	3.36	2
Unreliable equipment	0.0	10.7	21.4	28.6	21.4	17.9	3.14	3
Poor equipment movement	0.0	10.7	21.4	35.7	25.0	7.1	2.96	4
Poor ergonomics and injuries	3.6	21.4	17.9	17.9	25.0	14.3	2.93	5
Poor positioning of cranes	7.1	28.6	7.1	21.4	17.9	17.9	2.88	6
Poor vehicle / truck movement	0.0	17.9	21.4	28.6	28.6	3.6	2.79	7
Unneeded handling of tools	3.6	21.4	17.9	35.7	17.9	3.6	2.63	8
Human Resources:								
Inadequate supervision	0.0	0.0	7.1	17.9	35.7	39.3	4.07	1
Lack of required competencies	0.0	3.6	3.6	28.6	32.1	32.1	3.86	2
Human error / mistake	0.0	0.0	17.9	32.1	32.1	17.9	3.50	3
Strikes	0.0	10.7	21.4	10.7	21.4	35.7	3.50	4
Low employee morale	0.0	7.1	7.1	32.1	39.3	14.3	3.46	5
Idleness on site	0.0	10.7	21.4	35.7	14.3	17.9	3.07	6
Unnecessary work	0.0	10.7	25.0	25.0	28.6	10.7	3.04	7
Ignorance	0.0	7.1	32.1	25.0	25.0	10.7	3.00	8

However, in the category of human resources, the respondents are of the opinion that inadequate supervision, lack of required competencies, human error / mistake, and strike could contribute significantly to poor project performance in South Africa. This findings support recent South African publications that have continued to reiterate the detrimental effects that shortage of skills in terms of artisans and site management employees is having on the industry performance (cidb and CSIR, 2007; Lawless, 2007). The findings tabulated in Table 1 are thus significant for South African construction as NVAAs in various forms have a detrimental effect on construction productivity and organisational performance (Alwi *et al*., 2002a; 2002b). In addition, the findings in Table 1 reveal that unlike a study conducted by Alarcon in 1997 in which waste of materials, work not done, errors, and delay in activities constituted the most significant NVAAs that occurred in an industrial assembly project, this study suggests that NVAAs relative to inadequate supervision, design rework, lack of required competencies, non-conformance to specifications, waiting for materials, and waiting for information could be occurring significantly in South African construction.

Furthermore, Table 2 indicates the respondents' perceptions of the extent to which causes contribute to NVAAs in South African construction in terms of percentage responses to a scale of 1 (minor) to 5 (major). It is notable that thirty-six (90%) of these forty causes of NVAAs, which have been categorised in the groups of human resources, design related issues, information and documentation, material / equipment, and site operations, have MSs ≥ 3.00, which suggests that the respondents deem them to contribute more of a major than a minor extent to NVAAs in South African construction.

In the category of human resources, lack of appropriately skilled workers, lack of leadership abilities, poor decision-making abilities, and scarcity of workers are perceived by the respondents to be significant causes of NVAAs in South Africa; while in the category of designers, delay in design approval, poor interaction, repetitive revisions and changes, bureaucracy, and slow response to RFI are observed by respondents to be major causes of NVAAs.

In the category of information and documentation, the respondents sense that late dissemination of information, error in material specifications, incomplete designs, poor project execution plan, and unclear design could be contributing to the occurrence of NVAAs in South Africa. In the category of materials / equipment, the respondents are of the opinion that scarcity of materials and error in material specifications are the most important contributors in the group, and in the category of site operations, the respondents can be deemed to consider that poor planning of construction, poor construction methods, inadequate design information, external influence on operations, and accidents due to poor H&S are significant causes of NVAAs in South Africa.

These findings correspond to the findings of Alwi *et al*. (2002a) that suggested that design changes, lack of trades' skill, slowness in making decisions, poor planning and scheduling, and poor coordination among project participants are key waste causes in Indonesian construction projects. In addition, in a study that used similar causes of NVAAs classification indicated in Table 2, Alwi *et al*. (2002b) discovered that in Australian construction projects, the key causes of NVAAs are mostly design and documentation related.

Table 2: Extent to which causes contribute to NVAAs in South African construction

Cause	Response (%)						MS	Rank
	Unsure	Minor……Major						
		1	2	3	4	5		
Human Resources:								
Lack of skilled workers	0.0	0.0	11.1	18.5	25.9	44.4	4.04	1
Lack of leadership abilities	0.0	3.7	7.4	29.6	33.3	25.9	3.70	2
Poor decision-making abilities	0.0	0.0	14.3	32.1	25.0	28.6	3.68	3
Scarcity of workers	3.6	0.0	17.9	35.7	17.9	25.0	3.52	4
Lack of unity among workers	0.0	3.6	17.9	32.1	28.6	17.9	3.39	5
Poor team spirit (workers)	0.0	0.0	28.6	35.7	25.0	10.7	3.18	6
Low morale among workers	0.0	7.1	14.3	42.9	28.6	7.1	3.14	7
Lack of empowerment	0.0	3.6	28.6	39.3	21.4	7.1	3.00	8
Designer (Consultants):								
Delay in design approval	0.0	3.7	3.7	14.8	33.3	44.4	4.11	1
Poor interaction	0.0	3.7	14.8	14.8	33.3	33.3	3.78	2
Repetitive revisions / changes	0.0	3.7	18.5	11.1	29.6	37.0	3.78	3
Bureaucracy	0.0	7.1	7.1	28.6	28.6	28.6	3.64	4
Slow response to RFI	14.8	7.4	3.7	22.2	33.3	18.5	3.61	5
Over design	3.6	7.1	17.9	21.4	32.1	17.9	3.37	6
Design not requested by client	3.6	7.1	25.0	21.4	10.7	32.1	3.37	7
Excessive control & inspection	0.0	21.4	14.3	46.4	17.9	0.0	2.61	8
Information and documentation:								
Late circulation of information	0.0	3.6	3.6	17.9	50.0	25.0	3.89	1
Error in material specifications	0.0	7.1	7.1	14.3	39.3	32.1	3.82	2
Incomplete drawings / designs	0.0	7.1	7.1	17.9	39.3	28.6	3.75	3
Poor project execution plan	0.0	3.7	11.1	25.9	29.6	29.6	3.70	4
Unclear design / details	0.0	7.1	3.6	25.0	46.4	17.9	3.64	5
Poor document control system	0.0	7.1	7.1	39.3	35.7	10.7	3.36	6
Conflict in design documents	0.0	14.3	10.7	17.9	39.3	17.9	3.36	7
Design revisions	0.0	10.7	7.1	39.3	25.0	17.9	3.32	8
Materials / Equipment:								
Scarcity of materials	3.6	3.6	10.7	32.1	32.1	17.9	3.52	1
Error in material specifications	0.0	7.1	7.1	32.1	42.9	10.7	3.43	2
Scarcity of equipment	0.0	3.6	21.4	35.7	25.0	14.3	3.25	3
Over / Under ordering materials	0.0	3.6	25.0	28.6	32.1	10.7	3.21	4
Delays in material delivery	0.0	3.6	32.1	25.0	21.4	17.9	3.18	5
Inappropriate use of equipment	0.0	10.7	25.0	39.3	17.9	7.1	2.86	6
Poor waste management	0.0	14.3	28.6	35.7	17.9	3.6	2.68	7
Removal of unwanted material	0.0	17.9	28.6	42.9	7.1	3.6	2.50	8
Site operations:								
Poor planning of construction	0.0	0.0	17.9	17.9	28.6	35.7	3.82	1
Poor construction methods	0.0	3.6	10.7	39.3	17.9	28.6	3.57	2
Inadequate design information	0.0	7.1	10.7	28.6	25.0	28.6	3.57	3
Externalitieson operations	3.6	3.6	10.7	35.7	25.0	21.4	3.52	4
Accidents due to poor H&S	0.0	3.6	28.6	14.3	28.6	25.0	3.43	5
Inadequate materials control	0.0	3.6	10.7	35.7	46.4	3.6	3.36	6
Poor site layout	0.0	3.7	22.2	33.3	29.6	11.1	3.22	7
Inadequate staging areas	7.1	7.1	10.7	39.3	28.6	7.1	3.19	8

However, though Alwi *et al*. (2002b) contend that design changes were the only variable that both Indonesian and Australian projects agreed to be a significant

variable causing waste during the construction process, the results indicated in Table 2 suggest that delay in design approval and lack of appropriately skilled workers are the most significant causes of NVAAs in South Africa. In particular, of the seven NVAAs (waste) proposed by Koskela (1992), NVAAs relative to waiting periods, and human resources in the construction production process are perceived by the respondents to be significant in South Africa.

Table 3 indicates the respondents' perceptions of the frequency at which consequences of NVAAs occur in terms of percentage responses to a scale of 1 (never) to 5 (always), and a MS ranging between 1.00 and 5.00. It is notable that eleven of the fourteen consequences of NVAAs have MSs $\geq$ 3.00, which indicates that in general these consequences of NVAAs could occur in South Africa.

Table 3: Frequency at which the consequences of NVAAs occur in South African construction

Consequence	Response (%)						MS	Rank
	Unsure	Never …… Always						
		1	2	3	4	5		
Time overruns	3.6	0.0	3.6	17.9	42.9	32.1	4.07	1
Variations / Claims	0.0	0.0	14.3	28.6	35.7	21.4	3.64	2
Cost overruns	0.0	0.0	17.9	25.0	39.3	17.9	3.57	3
Client dissatisfaction	0.0	3.6	25.0	21.4	32.1	17.9	3.36	4
Non-conformances	0.0	0.0	25.0	28.6	42.9	3.6	3.25	5
Reduced productivity	0.0	3.6	17.9	35.7	35.7	7.1	3.25	6
Clash / Overlapping of activities	0.0	0.0	17.9	50.0	28.6	3.6	3.18	7
Interruptions / Disruptions to activity sequence	0.0	0.0	21.4	39.3	39.3	0.0	3.18	8
Additional resource allocation	0.0	3.6	17.9	42.9	32.1	3.6	3.14	9
Time-space conflict	14.3	3.6	7.1	57.1	17.9	0.0	3.04	10
Incidents and accidents	0.0	7.1	32.1	21.4	28.6	10.7	3.04	11
Overtime	3.6	3.6	35.7	21.4	32.1	3.6	2.96	12
Fatigue	7.1	7.1	21.4	35.7	25.0	3.6	2.96	13
Damage to the environment	0.0	7.1	46.4	28.6	10.7	7.1	2.64	14

In effect, these findings suggest that the consequences of NVAAs in South Africa should be addressed. In particular, the findings indicate that time overruns and other consequences are present in South African construction as corroborated by international construction management literatures (Flyvbjerg *et al*., 2003; Love *et al*., 2008), and previous South African literatures that suggest that indeed the achievement of project objectives related to cost, H&S, productivity, quality, and time are challenges in South African construction (cidb, 2009; 2010). Therefore, as suggest by Han *et al*. (2007) NVAAs must be identified and possibly quantified in order to forestall their propagation or rather ensure their removal in the construction process.

To be succinct, of the five NVAAs categories in South African construction, the respondents indicate that human resources related NVAAs may be contributing the most to poor project performance as suggested by the category's mean score (3.44). This category is followed by waiting periods related NVAAs at MS = 3.35; and rework related NVAAs with MS = 3.30. These findings imply that the surveyed public sector clients are of the opinion that NVAAs that occur due to human resources

related lapses could contribute significantly to poor project performance in South Africa. Similarly, of the five causes of NVAAs categories in South African construction, the respondents indicate that information and documentation related inadequacies may to a large extent result in NVAAs as the category MS is the highest (3.61) within the classification. Followed by information and documentation related causes of NVAAs is the designer category, which has its MS = 3.53. This is closely followed by human resources and site operations related causes of NVAAs that achieved the same MS (3.46).

Given the results presented in this paper, the respondents can be deemed to advocate 'lean' either directly, or indirectly. This is even more imperative as one of the survey's respondents rightly opined that "*non-value adding activities should be minimized to ensure project success in South African construction*." Adopting the paradigm of lean construction therefore constitute a radical change that engenders improvement efforts focused on construction productivity, cost, schedules, and a wide spectrum of NVAAs (Alarcon, 1997).

CONCLUSIONS

Though, the survey respondents' knowledge of, encounter with, and perceived frequency of NVAAs in the South African infrastructure construction sector may be deemed moderate or average, the mere acknowledgement of the existence of these NVAAs and their detrimental effects is a cause for concern. The existence of these NVAAs is a concern in the sense that they can be propagated into other activities, and thus become compounded as indicated by a quantitative simulation model proposed by Han *et al*. (2007).

Another issue of concern is that of time overruns, which in turn may be influenced by the impact of NVAAs on project time as indicated in the survey results, and other previous research findings documented in the construction management literature. Further, based on the perceptions of the survey respondents and previous authors, detrimental effects of notable NVAAs such as inadequate supervision, rework relative to design, and lack of required competencies should be addressed in order to ensure improved project performance in the industry.

In brief, it is herein suggested that the removal or reduction of notable causes of NVAAs such as delay in design approval and lack of appropriately skilled workers provides a platform for reducing the frequency of NVAAs in the construction process. As the research findings relied on a limited sample size and response rate, it can be argued that the paper presented insightful as opposed to definite information about NVAAs in South African construction. However, the variables / framework used in the research may nevertheless be able to create awareness with respect to project performance improvement so that NVAAs can be reduced in South Africa.

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