

NON-VALUE ADDING ACTIVITIES IN SOUTH AFRICAN CONSTRUCTION: A RESEARCH AGENDA

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ABSTRACT: The construction industry's importance to nation building, economic empowerment, and contributions to global commerce cannot be over emphasised. However, poor productivity, accidents, rework, time and cost overruns, and client dissatisfaction have characterised the industry performance in a multi-dimensional way.

The central issue in this particular research is the seemingly inadequate achievement of optimum performance in the construction process, either with respect to value for money for the client and the entire construction supply chain or value in terms of the utility derived from built assets in spite of efforts by government and governmental bodies such as the Construction Industry Development Board (cidb) to increase industry performance.

Therefore, based upon an extensive review of related literature, the paper reports on effects and causes of non-value adding activities in the construction industry in general, and South African construction in particular.

The research findings indicate that activities that can be referred to as non-value activities are not only prevalent, but they can also be held responsible for performance related issues in terms of cost, time, quality and health and safety (H&S) in construction; and the exploration of pluralism in the research methodology may result in a robust model based upon the system dynamics approach. Therefore, the study suggests that there is major scope for value optimisation in the construction process especially in terms of availability and implementation of interventions, which have not only proven successful in other industries, but are also adaptable in the construction industry context.

Keywords: Construction, Non-value adding activities, Performance, South Africa

1. INTRODUCTION

In South Africa, the cidb Construction Industry Indicators (CII) measure the performance of the industry annually, focusing on clients, consultants, and contractors. The most recently released results indicate, *inter-alia* that [1]:

- Clients were neutral or dissatisfied with the performance of contractors on 18% of the projects surveyed in 2009;
- Around 12% of the projects surveyed had levels of defects that are regarded as inappropriate;
- Contractors were neutral or dissatisfied with the quality of tender documents and specifications obtained from clients on around 26% of the projects surveyed;
- Contractors were neutral or dissatisfied with the management of variation orders on 31% of the projects surveyed, and
- H&S on construction sites remains a concern.

In addition, scrutiny of the report revealed that clients were least satisfied with the performance of contractors in the residential building sector, followed by civil and special works; clients were neutral or dissatisfied with performance relative to construction schedule on 21% of

the projects; clients were neutral or dissatisfied with the quality of completed work on 19% of the projects in 2009; clients were neutral or dissatisfied with the resolution of defective work during the construction period on 23% of the projects surveyed; and while the overall results for client satisfaction are encouraging, the performance of the consultants and contractors on 20% to 30% of projects surveyed are distinctly below the performance of their peers [1]. Therefore, the results indicate that there is considerable scope for performance improvement in the industry especially in terms of cost, H&S, quality, and time.

However, while numerous reports and empirical findings have attributed the not so inspiring performance of the industry to the so called skills shortages [2, 3] emerging findings suggest that there is more to the challenges that must be surmounted in order to improve the industry performance. Though the research findings centred on issues surrounding variations in the industry, Ndihokubwayo and Haupt [4] and Nghona *et al.* [5] contend that activities categorised as non-value adding activities are having a detrimental effect on the industry. These non-value adding activities that are otherwise referred to as waste [6, 7,] or supportive / interactive activities [8] have been given prominence in construction management research endeavours that address

construction productivity issues in general, and lean construction at the annual conference of the International Group for Lean Construction (IGLC).

Han *et al.* [9] suggest that construction activities can be categorised into value adding activities (VAAs), value supporting activities (VSAs), and non-value adding activities (NVAAs). According to them, VAAs are operational efforts that realise project requirements defined in the contract data, VSAs are supportive efforts that do not directly add value, but support the realisation of VAAs, while NVAAs are wasted efforts that consume time and resources without directly or indirectly adding value to the project requirements. Accordingly, Koskela [10] contends that waste may be due to defects, overproduction, unnecessary processing, unnecessary material and people movement, waiting periods, inventories, and designs that do not meet the needs of the client; and Alarcon [6] gave examples of waste in construction projects, which include work not done, rework, unnecessary work, errors, stoppages, waste of materials, deterioration of materials, loss of labour, unnecessary material and people movement, excessive vigilance / supervision, additional space, delays in activities, extra processing, clarification, and abnormal wear and tear of equipment. Other documented NVAAs in construction include delays to schedule, repairs to finishes, repairs to foundation works, damaged materials on site, waiting for instructions, waiting for equipment repair, waiting for arrival of equipment, frequency of equipment breakdowns, material not meeting specifications, lack of supervision or poor quality of supervision, and loss of materials on site [11].

Obviously, regardless of the metrics / names used in the categorisation of NVAAs, empiricism has justified their existence in construction. For example, a case study presented by Arbulu *et al.* [12] reveal that in the supply chain of pipe support used in power plants in the USA, 96% of time expended is non-value added time. The study in which industry-wide practices with respect to the delivery of the pipe supports was clearly described, highlighted the significant opportunity that exist for the reduction of NVAAs in construction.

Incontrovertibly, given the uniqueness of individual construction project, it is inevitable that one or more of these wastes / non-value adding activities may occur with unpalatable consequences for project objectives. Therefore, in order to address these non-value adding activities in construction awareness relative to what they are, their causes and impacts, and possible mitigation remedies should be inculcated into the minds of construction stakeholders.

2.0 THE CAUSES OF NON-VALUE ADDING ACTIVITIES IN CONSTRUCTION

Han *et al.* [9] contend that errors and changes generally trigger NVAAs in the construction production system in the forms of interruption, productivity loss, and rework, which requires additional time and efforts (additional resources that were not originally planned for) in order to compensate for the lost time and effort. In a doctoral

dissertation that produced a model based on system dynamics for the measurement of NVAAs in the construction production system, Han *et al.* [9] suggest that though through a simulated model NVAAs can be identified and quantified, they can nonetheless be easily propagated into other related activities. Therefore, rework in the form of 'the rework cycle' that can occur either at the design stage or on construction sites seems to pervade the construction process regardless of project activities, types and / or location [13].

Further, Hwang *et al.* [14] discovered that on both owner and contractor reported projects on the database of the Construction Industry Institute (CII) in the USA, design error / omission appeared to be the root causes of rework among other sources that included owner change, design change, constructor error / omission, constructor change, vendor error / omission, vendor change, and transportation error. Another study that focused on the construction industry in Australia and Indonesia 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 to site, inappropriate construction method, poor design, poor quality of site documentation, slow drawing revisions and distributions, unclear site drawing, unclear specification, and weather conditions individually and collectively result in NVAAs in varying degrees [11].

In addition, the sources of NVAAs can be categorised in terms of people, professional management, design and documentation, material, site operations, and physical factors [15]. Sources of NVAAs associated with 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 particularly serious in South Africa; sources of NVAAs linked to professional management include poor planning and scheduling, poor information management, poor coordination within the construction supply chain, a slow decision-making process; sources 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; sources of NVAAs relative to material include non-conformance to quality standards, delay of material delivery, poor material handling, inappropriate use of material, and the sources of NVAAs linked to site operation include poor site layout, outdated equipment, shortage of equipment, inappropriate construction methods, and excessive reliance on overtime in order to execute work timely. To be succinct, origins of NVAA in construction in terms of material or time can be categorised with respect to design, procurement, material handling, site operation, and other construction related activities [16].

3.0 THE IMPACT OF NON-VALUE ADDING ACTIVITIES IN CONSTRUCTION

NVAAs in various forms have a detrimental effect on construction projects [11, 15]. Specifically, NVAAs in the

form of rework impact cost negatively [14], and impact construction productivity negatively [7, 9, 15, 17, 18]. In fact, Horman and Kenley [7] contend that as much as 49.6% of construction operative time may be devoted to NVAAs. Even overtime that seems to be the norm rather than the exception in the construction industry negatively impact productivity and may increase fatigue, incidents and accidents that eventually increase the cost and time spent on construction projects [18]. Notably, these NVAAs if left unchecked may have severe consequences for the competitiveness of organisations and by extension the productivity of the industry [15, 19].

Not surprisingly, within the South African construction industry context, NVAAs have been identified as one of the problems negatively impacting issues relative to variation. In a study that focused on two completed apartment complexes in Cape Town, South Africa, Ndiokubwayo and Haupt [4] determined that design changes, design errors, design omissions, and construction changes were the most frequently cited root causes of variation orders on the two projects. Furthermore, these variation orders resulted in completion delays that were approximately 33% for one project and 9% for the other project when compared with completion dates agreed upon at project inception. The variation orders also increased the project cost of the two complexes by an average of 6% when compared with budgeted project cost. Nghona *et al.* [5] also, *inter alia*, pointed out that inadequate scoping of work, unnecessary redesign of work, poor design management, and inadequate design briefs lead to NVAAs during the design stage of construction projects. These research findings are based on another study, which was quantitative in nature, conducted in Cape Town South Africa. The NVAAs that were identified during the design stage do not only consume resources in an attempt to remedy the situation, they also influence activities downstream of the construction supply chain [5].

4.0 THE NEED TO ADDRESS NON-VALUE ADDING ACTIVITIES IN CONSTRUCTION

The aforementioned causes of NVAAs may account for the reason why the optimisation of the construction process focuses on the elimination of non-value-added and unnecessary cost-added activities, which includes change orders for design errors; rework as a result of inappropriate planning and operation; misunderstanding within the construction supply chain; and the inevitable inefficiencies associated with the lack of skilled artisans [20]. As an illustration, the public sector that always procure 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, Samuel [21] examined six public sector projects that were not completed satisfactorily in South Africa, and discovered 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. While noting the poor project management competency among project

stakeholders, a situation analysis conducted relative to the identified failures suggest that NVAAs played a prominent role in terms of the problems recorded on the projects. Flyvbjerg *et al.*'s [22] contention that transport infrastructure projects do not perform as promised, as risk as well as uncertainties associated with cost of transport infrastructure projects are substantially high, may not be far from the truth given the mirage of problems plaguing projects in developing countries. While cost escalation is a pervasive phenomenon in transport infrastructure projects across project types, geographical location and historical period [22], it was discovered that cost escalation was strongly dependent on the length of the implementation phase of construction project delivery [23]. Specifically, Flyvbjerg *et al.*'s [22] findings, *inter alia*, indicate that nine out of ten transport projects fall victim to cost escalation; cost escalation has not decreased over the past seventy years, which suggest that no learning seems to have taken place; cost escalation appears to be a global phenomenon, and it appears to be more pronounced in developing nations than in North America and Europe. Though the work done by Bent 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 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.

Clearly, there is good reason to be concerned about sluggish planning and implementation of projects [23]. Delays occasioned through long project implementation phase can potentially damage project objectives especially in developing countries. Long *et al.* [24] suggest that failure to meet project objectives may stem from project delays, cost overruns, labour accidents, low quality, and even disputes between parties may occur [25]. During research conducted in Vietnam, a developing country in Asia, 62 construction related problems were investigated with the intent of categorising and identifying the most important problems militating against the achievement of project objectives [24].

Relying on statistical analysis that is rooted in factor analysis, the most important problems were categorised into incompetent designers and contractors, poor estimation and change management, social and technological issues, site related issues, and improper techniques and tools [24]. The problems that were under the purview of owners, consultants, and contractors that seem to occur with high frequency include inaccurate time estimating, slow site clearance, excessive change orders, severe overtime, bureaucracy, obsolete technology and equipment, improper planning and scheduling, poor site management, impractical design, and incompetent project team [24].

Even the developed countries have not fared significantly better than the developing countries in terms of cost escalation and its associated problems in construction. For example, the Boston Big Dig project that was estimated at \$2.6 billion at inception (1982)

experienced so many problems that in 2002 the estimated cost at completion had to be changed to \$14.6 billion [26]. In their research findings, Shane *et al.* [26] contend that delivery / procurement approach, project schedule changes, engineering and construction complexities, scope changes, scope creep, faulty execution are among cost escalation factors identified through a research conducted among public sector clients in the USA. These problems singularly or collectively result in NVAAs either in form of rework or other activities that consume resources and time without commensurate contributions towards the progress of work in the construction process.

To be succinct, the construction management literature is replenish with a plethora of problems associated with the construction process to the extent that failure to attempt redress through a multi-dimensional perspective may not augur well for the industry and academia. Therefore, the efforts of researchers, especially the lean construction researchers, must be commended in terms of performance improvement through the reduction and / or elimination of NVAAs. For example, Kraemer *et al.* [27] contend that from 1993 to 2001, approximately 48% of conference papers presented at the IGLC annual conferences addressed issues surrounding value adding and non-value adding activities in construction. However, while recognising the efforts of the lean construction researchers, it is nevertheless imperative to note that due to the nature and characteristics of NVAAs, their management in the construction process requires an holistic approach [9], which attempts to remedy problems by focusing on the whole rather than individual processes / organisations involved in project objective realisation [28].

In order to improve project performance therefore, learning must recognise past good performance, and improve upon it systematically and continuously [13]. In addition, management approaches relative to supply chain management (SCM) such as lean construction, TQM, and logistics management provides opportunities for reducing NVAAs in the construction process, while engendering cultures of continuous improvement at the same time. For example, Shakantu [29] contend that construction could benefit substantially from supply chain optimisation tools such as the concept of reverse logistics that have proved to be effective in improving transport utility in other industries such as manufacturing; Abdel-Razek *et al.* [17] suggest that lean construction is an effective tool for managing the construction process after they successfully applied lean construction principles to labour productivity measurement in 11 Egyptian construction projects; and lean principles can be applied in construction process reengineering in order to significantly improve the performance of the industry [8, 30].

However, in order to fully appreciate the effectiveness and efficiency of these processes that have proven their worth in the manufacturing environment, anecdotal evidence suggests that they must be modified and applied with caution, bearing in mind the uniqueness of the construction industry environment. Though acknowledging that improving the performance of supply chains is not an easy task due to complexities and the

fragmented nature of the industry, Arbulu *et al.* [12] nevertheless suggest that supply chain participants intending to reduce lead times through the elimination of NVAAs should consider selecting project partners early, share unambiguous information, and also endeavour to make use of integrated computer tools for optimum project performance.

The significance of the aforementioned is not only critical for construction industry performance, but also impacts the competitiveness of contractors / consultants alike in the global context, and South Africa in particular. A close look at CII indicators [1, 31] and industry reports [32, 33] suggest that indeed cost, H&S, productivity, quality, and time are challenges in South African construction. Specifically, the cidb [32, 33] have recognised the need to improve the status of project parameters such as H&S with the overall intent of improving the industry performance as a whole.

5.0 CONCLUSION

Since documented empirical studies suggest that NVAAs are the major reason behind schedule delays, cost overruns and other related problems in construction, to successfully execute construction projects requires efforts targeted at minimising the amount of NVAAs in construction [9]. In addition, given the importance of the detrimental effects of these activities in terms of project performance parameters of cost, time, quality and H&S, the construction industry has to take measurable steps to reduce, and if possible, eliminate non-value adding activities / or waste / or what other names is given to activities that is carried out during the strategic, tactical and operational phase of the construction process.

Therefore, it is not gainsaying that the identified constraints in this paper provides a platform for further empirical research in construction. In the South African construction context, the empirical research will attempt to find answers to questions such as:

- What construction related activities can be classified as non-value adding activities in South Africa?
- What are the causes of the identified non-value adding activities in South African construction?
- What are the consequences of non-value adding activities in South African construction?
- What impact do these non-value adding activities have on cost, H&S, time and quality in South Africa?
- What is the relative frequency of non-value adding activities in South African Construction?

Arguably, responses to these questions as well as other empirical findings generated through a mixed-mode quantitative research method during the empirical process may create awareness relative to NVAAs in construction, their sources, effects, and interventions applicable to the South African construction context. Though construction management research is seemingly rooted in quantitative research methodology, the operational steps relative to this study as indicated in Figure 1 propose a methodology that embraces concepts associated with pluralism in construction research [34]. Considerable effort and time shall be devoted to period of investigation so as to ensure

reliability and validity of the research primary data through mixed-mode quantitative methods [35]. Specifically, after the empirical investigations, the development and validation of model (s) shall adopt the system dynamic approach [36] so as to create robust solutions to identified problems.

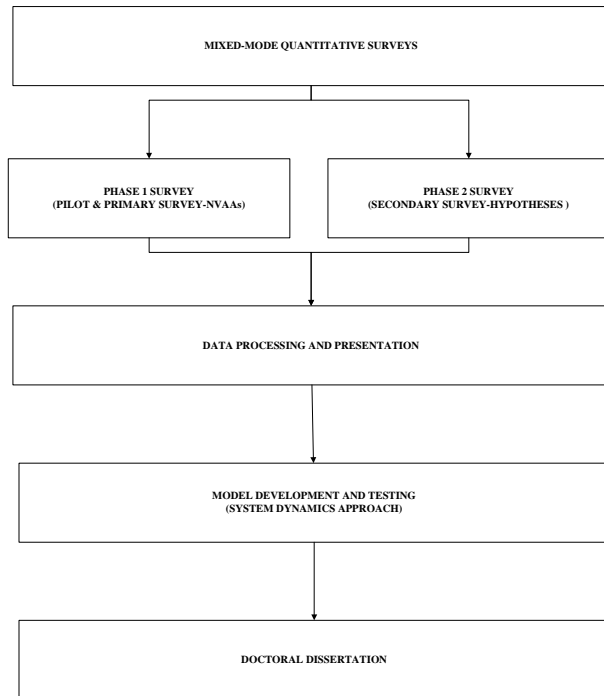


Figure 1 The research method operational steps

To sum up, it is instructive to note that while the short-term research project addresses NVAAs in South African construction, the long-term objective of the research agenda is to engender a culture of continuous improvement in construction through the agency of processes inherent in supply chain management (SCM). The initiative is underpinned by the assumption that improvement of the construction supply chain may not only reduce NVAAs, but may also increase efficiency in the construction process.

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