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Non-Value Adding Activities in South African Construction: A Research Agenda

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Abstract: ***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.***

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

I. 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, and
- H&S on construction sites remains a concern.

In addition, scrutiny of the report revealed that clients were neutral or dissatisfied with performance relative to construction schedule, quality of completed work, and resolution of defective work on some of the projects surveyed[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 (NVAAs) are having adetrimental effect on the industry. These NVAAs 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 in particular.

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 NVAAs 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,

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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 therefore, it is inevitable that one or more of these NVAAs occur with unpalatable consequences for project objectives. Therefore, in order to address NVAAs 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.

II. The Causes of NVAAs 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].

III. The Impact of NVAAs 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, Ndihokubwayo 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].

IV. Addressing NVAAs 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 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. For example, 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 faired 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.

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.

V. The Research Agenda

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 International Group for Lean Construction (IGLC) annual conferences addressed issues surrounding VAAs and NVAAs 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 a 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.

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 a range of NVAAs and project performance related questions that, inter-alia, include:

- 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, while the abovementioned questions forms part of other questions that will be asked in the course of the research enquiry, the research objectives shall significantly influence the questions to be asked in order to create awareness relative to NVAAs in South Africa. Specifically, the research will aim to identify NVAAs, their causes and impact in South African construction with a view to recommending mitigation strategies that may be deemed realistic in the South African context.

VI. The Research Methodology

Though construction management research is seemingly rooted in quantitative research methodology, the operational steps relative to the 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.

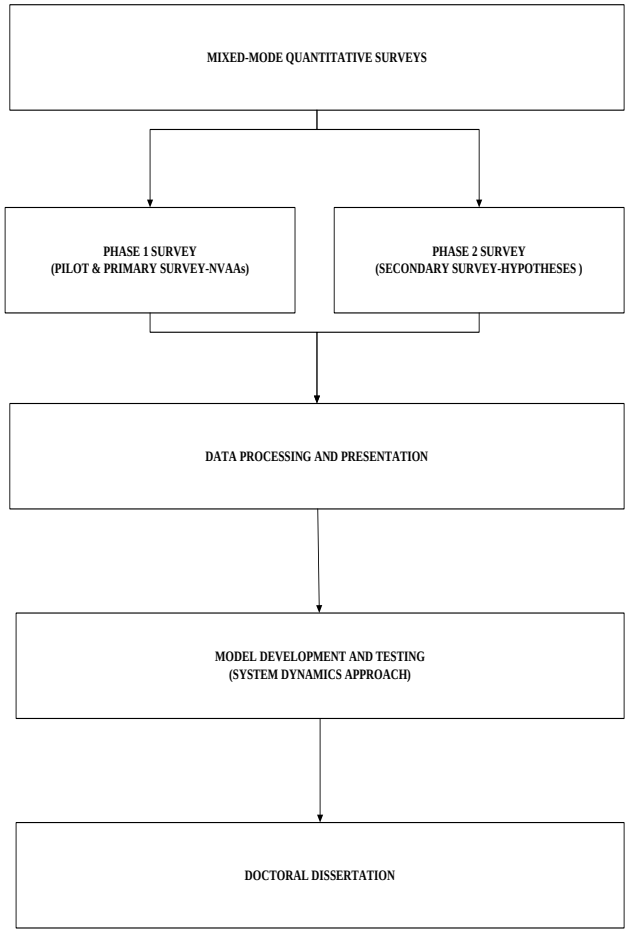

FIGURE I
THE RESEARCH METHOD OPERATIONAL STEPS

Given that the research findings reported upon in reviewed NVAAs and project performance related publications documented in previous sections were based on either quantitative or qualitative research methods, the choice of the method to be used for the investigation was influenced by the need to examine the 'as it is' situation in the South African construction context. This intent is based on the need to identify NVAAs that are significant in the South African construction context. It is notable that within South African construction, the study may be assumed to be a seminal investigation in terms of project performance related problems from the perspective of NVAAs. Therefore, the need for objectivity and rigour, which is associated with the quantitative method, is presumed to be necessary in order to provide a robust platform for future NVAAs related study, be it quantitative or qualitative, through the research findings.

In particular, approximately forty NVAAs and forty causes of NVAAs identified through the literature formed significant part of the instrument used for the phase 1 investigation (Figure 1), which formed part of a larger doctoral study in a South African university. Due to the fact that the overall objective of the research is thus underpinned by the need to examine the dynamics that have seemingly enshrine poor project performance in South African construction, the SD approach was proposed for the development of models. This assumption is anchored on the need for the research to build compelling explanations for how project performance differences arise, persist, and disappear over time in South African construction.

The phase 2 investigations that are based on postulated research hypotheses as well as other steps in Figure 1 are beyond the scope of this discourse. The importance of the research is reinforced by the recent CII report released by the cidb. Though overall performance results for the industry show an improvement over previous years, the 2010 survey findings nevertheless affirms the need to address performance gaps in the industry [37]. Notably, clients were neutral or dissatisfied with the performance of contractors on 15% of the projects surveyed in 2010, and H&S, quality and other performance issues remain a concern in South Africa.

VII. 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 NVAAs from activities that is carried out during the strategic, tactical and operational phase of the construction process.

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 project performance improvement in construction. The initiative is underpinned by the assumption that reduction of NVAAs may increase efficiency in construction.

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