Journal of Construction Project management and Innovation

Volume 8 Supplement 1 June 2018 (Special Issue)

ISSN 2223-7852

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Aigbavboa, 2010, 2011), (Thwala et al., 2001)

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Aigbavboa CO (2010). Residential satisfaction in low-income housing: a South Africa perspective. Journal of Construction Project Management and Innovation. 1(2): 14 – 20.

Aigbavboa CO, Lesito K (2012). ICT benefit in South Africa Construction Journal of Construction Project Management and Innovation. 2(2): 75 – 81.

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Preface to the JCPMI special issue celebrating the 10th Anniversary of the cidb Postgraduate Conference series

The cidb postgraduate conference was initiated in 2003 to bring together academics, researchers, practitioners and students from the different construction industry disciplines to debate issues of interest. Since inception, the conference has provided a platform for active postgraduate researchers to exchange experiences and observations about the state of the industry and to also provide a knowledge base for the future development of the industry.

The focus of papers presented at the conference have covered areas of construction industry performance, such as health and safety and people in construction; competitiveness of the industry including the development of small and medium contractors; the industry's contribution to socio-economic development and its contribution to employment creation as well as long-term sustainability in the industry.

The cidb postgraduate conference has always focussed on supporting a research agenda that results in the development and transformation of the South African construction industry and the human capital of the industry. The cidb is pleased that from humble beginnings, the academic community for facilitating debate, partnerships and knowledge dissemination amongst students and academics across different institutions now recognises the conference as a significant event. It has also made significant contributions to knowledge creation on developmental issues in infrastructure development such as the debates on health and safety, the growth of the emerging sector, and impact of government procurement on contractor development, among others.

Significantly, the cidb postgraduate conference has contributed to the growth of academics. From the initial intention of providing a place for potential and up and coming researchers, the conference has grown to a space where professors who first participated in the conference as honours and masters students have been given a platform to develop to full professors. It is further encouraging seeing that these professors are using the same platform to support the growth and development of their students. This we hope will lead to the continued growth and prestige of the cidb postgraduate conference.

Further growth of the conference is shown by the expansion of its geographic and academic reach. From its humble beginnings as a local conference targeting students and researchers in South Africa, the conference has now grown a global footprint that attracts participants from across the world. It is our firm belief that the cidb Postgraduate Conference will continue to grow and attain the status of a fully international meeting.

Where to next?

As we reflect on the 10th conference, we need to re-focus our efforts on where we would like the emphasis of academic development and the trajectory of the industry as a whole to be in the next ten years. Some of the critical areas to consider as we plan for the next 10 years and beyond include an increased emphasis on human resources transformation, including the recruitment and retention of more blacks and female academics; the development of more structured partnerships between academic institutions and industry; the translation of research findings into practical solutions – with particular reference to factors that impact on small contractor development and sustainability. We need to develop learning material that can be used to train contractors to higher levels of competitiveness and sustainability. We also need to broaden the focus beyond contractors, and to include a more significant emphasis on the role of built environment professionals. Lastly, we need to improve the working conditions in the industry and increase overall health and safety performance as well as providing quality training that results in sustained career opportunities.

The cidb remains committed to increasing its support for the built environment research agenda through the re-introduction of the cidb Centres of Excellence to facilitate dedicated research studies and shorten time to graduation.

Lastly, as we celebrate the 10th occurrence of this prestigious conference, we wish to acknowledge the support that we have received from the academic community in continuing to deliver outstanding papers, as well as the heads of academic departments in the various universities who have partnered with us through the years to host the conference.

Editorial

Fidelis A Emuze, PhD, Pr.CM, MSAICE, GMICE
Professor in Built Environment
Faculty of Engineering and Information Technology
Central University of Technology, Free State
Bloemfontein, South Africa
Email: femuze@cut.ac.za
Website: www.fidelisemuze.com

The productivity, performance, and transformation of construction have been in the spotlight for decades. The spate of accidents, injuries, fatalities, project failures, and failed businesses necessitate a paradigm shift in both research and practice. This themed issue from the 10th edition of the Construction Industry Development Board (CIDB) Postgraduate Conference contributes to the debate.

In the first article of this publication, Monyane et al. (2018) tackle the prevalence of cost overruns in public sector projects. This study seeks to make sense of cost management practices to identify challenges hindering effectiveness. The cost overrun phenomenon was assessed using a phenomenological approach that entails purpose interview of professions in the Free State. Analysed documents and the textual data from the interviews reveal the profile of existing cost management practices on construction projects. The pattern of current practices indicates a need for a paradigm shift in the industry and academia. More important is the need to reverse the ongoing tradition of providing estimates for completed designs as opposed to designing to the allocated project amount.

When a project begins to encounter cost overrun, delayed payments is not far behind. Cumberlege et al. (2018) mapped out the characteristics of delayed payment. They showed the effects of late payments on the contracting business in construction. In particular, the article revealed that the cash flow of projects is affected as a result of late payments of completed works to contractors. The effect grows in severity and magnitude with smaller contractors that may face bankruptcy without emergency support. These consequences thus require contractors, clients (and their implementing agents) to comprehend what would happen to projects when payments are not forthcoming.

The next two articles in this publication tackle time, which is a concern alongside the cost of projects. Moghayedi and Windapo (2018) examined uncertain events encountered in highway projects in order to evaluate their impact on the construction time. The authors contend that uncertainties that influence highway project duration are distributed across economic, environmental, financial, legal, political, social and technical factors. This factor contains several uncertain events, which impact on construction time differently, through a combination of the unpredictable events of the individual construction activities. The authors conclude that highway projects do have construction time that that is affected by social and technical factors of uncertainties.

Still, on time performance parameter, Das and Emuze (2018) suggest that client-linked delays are frequent in Indian construction. The industry in India is not alone. Delays occur on most construction projects regardless of location. The contribution of the article by Das and Emuze (2018) is the use of system dynamics modelling to assess the influence of client-induced factors that cause delays in construction projects. The conceptual article proposed mechanisms that could resolve delay related matters. The interventions suggested apply to South Africa. These include timely decision-making, availability of the requisite information and effective communication. The authors also argued for enhanced availability of funds through adequate budgetary allocations.

A construction project is made up of several social networks, which could make or break a project. The article by Ayegba et al. (2018) brings out the importance of collaborative working and supply chain management in construction. The spectacular failure of the conventional procurement methods across the globe is responsible for the call for a shift towards collaboration and long-term relationships (CLR) contracts in construction. Ayegba et al. (2018) thus present a study that examined the dimensions of CLR in construction. The result indicates that top management commitment, willingness to learn and support project parties, mutual trust, complete integration of project team members, efficient and open communication are required for CLR to success. These suggestions are not new. The questions are how the

implementation aspect is unfolding in practice.

Leaving the construction phase of a project lifecycle beheld the final two articles of this publication focus on post construction and preconstruction phenomena. Musvoto and Mooya (2018) present a conceptual understanding of what constitutes affordable housing. The authors used critical realism and structure-agency theory to provide nuances around the characterisation of the affordable housing sector in South Africa. They argued that a conceptual framework that is guided by a critical realism and structure-agency theory will enable a better understanding of housing. The framework provides insight into the structural dynamics that shape the strategies, interests and decisions of stakeholders in the sector.

Green campus initiative (GCI) is the focus of the work of Mafongosi et al. (2018). In alignment with a range of sustainable development goals (SDGs) (such as goal 4, 9, 11), the reported study explored the success GCI in a particular South African university with specific reference to built assets. The research suggests that the GCI concept could make a significant contribution to the realisation of the SDGs if encountered barriers are robustly addressed.

Nyarirangwe and Babatunde (2018) addressed how to make a doctoral research scientifically rigorous using infrastructure projects a point of departure. The authors assessed the feasibility of proposed data-collection methods, sampling frame and data-analysis techniques. The article, which makes an interest read for all doctoral students, highlights the logistical challenges of a rigorous research exercise geared toward making a significant contributions to knowledge.

These articles in this publication represent the attempt of role players in the industry, be it academics or practitioners, to evolve a better route towards enhanced productivity, the performance of project parameters, and the transformation of the sector in general.

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AN IDENTIFICATION OF COST MANAGEMENT CHALLENGES IN PUBLIC SECTOR PROJECTS

TG MONYANE[1], FA EMUZE[2], and G CRAFFORD[3]

[1] Department of Built Environment, Central University of Technology, Free State, Bloemfontein, South Africa, Email: tmonyane@cut.ac.za

[2] Department of Built Environment, Central University of Technology, Free State, Bloemfontein, South Africa

[3] Department of Quantity Surveying, Nelson Mandela University, Port Elizabeth, South Africa

ABSTRACT

The prevalence of cost overruns in public sector projects is a call to all stakeholders to address cost management issues in the construction industry. This study seeks to make sense of these existing cost management practices. Such sense-making will enable an evaluation of the status quo, and it will identify challenges hindering effective cost management during project delivery. Adopting a qualitative case study research design, this study relies on data obtained from a purposively selected list of interviewees from a cluster of cases, i.e., recently completed public sector construction projects in the Free State. These interviews will be juxtaposed with evidence from project-related documents. Based on the data, the study will provide a profile of existing cost management frameworks applied to these projects. Encompassing various stages of the project delivery life cycle, this profile will enable an identification of the challenges in terms of cost management on these projects. It is expected that findings from this study will provide an outline of the failings of current cost management frameworks.

Keywords: construction, cost management, projects, public sector, South Africa

1. INTRODUCTION

The construction industry in South Africa has remained an essential role player in the country's gross domestic product. The contribution made by the industry amounted to 4.9% in 2014 (Nimbona and Agumba, 2014). The importance of the industry in contributing to job creation is highlighted by Mbatha and Mokhema (2014), where the industry became the highest hiring industry in the third quarter of 2014, with 99,000 jobs. The importance of performance improvement in the construction industry is underscored by the role the industry is playing in the economy. However, the industry is notorious for various forms of overruns recorded on projects (Ramabodu and Verster, 2010, 2013; Baloyi and Bekker, 2011; Monyane and Okumbe, 2012; Mukuka et al., 2014). Management of construction projects is evaluated through the lens of project management parameters. Cost management is a parameter with multiple pathways of monitoring and control. Consistent reports of cost overruns on projects is sufficient

reason to assess whether current cost management practices are successfully dealing with the challenges of modern construction.

As mentioned earlier, cost performance of projects in the industry is cause for concern. For the purposes of this article, cost management challenges manifest through "dissatisfactions" which are linked to either non-expenditure of the budget or over-expenditure of the budget. Challenges such as poor project estimating practices hamper the delivery of construction projects (Nimbona and Agumba, 2014). In a recent study to address global cost management issues, Smith (2014) mentioned several blowouts of cost budgets on major projects around the world, which amount to hundreds of millions and billions of dollars. The problem is exacerbated by the 2008 global financial crisis, which continues to have a significant impact on project financing around the world, as financiers tighten controls on lending and avoid lending to projects lacking sufficient risk control (Smith, 2014). Similarly, Ali and Kamaruzzaman (2010) stress the importance of controlling costs to improve project performance. Construction projects are unique, and they tend to assume greater complexity as they increase in size. In developing countries, cost management approaches to construction projects have proven to be less efficient when compared to time management approaches (Mohamad, 2003).

A construction project is an inter-organisational process, which requires the contribution of all stakeholders to achieve the goal of successfully completing the project within agreed-upon constraints. According to Namadi et al. (2017), the current project delivery system still treats design and cost as a separate and independent function carried out discretely. Similarly, the United Kingdom (UK) and South Africa have traditionally assigned cost management duties to the chief quantity surveyor (QS). Namadi et al. (2017) argue that this practice of assigning cost management mainly to the chief QS accounts for much of the cost overruns that are prevalent in the construction industry, due to its lacking a collaborative approach to costing.

In the South African context, numerous studies have established cost overruns as a common problem that requires appropriate interventions (Ramabodu and Verster, 2010, 2013; Baloyi and Bekker, 2011; Monyane and Okumbe, 2012; Mukuka et al., 2014). In response to the call for interventions, this study was commissioned. The research that is reported in this article forms an integral part of the broader lean-led study. The failings of current practice could provide opportunities for the introduction of lean-based solutions. The article thus presents a profile of existing cost management practices in public sector-driven projects. Incorporating various stages of the project delivery life cycle, this profile enables an understanding of the cost management challenges on the identified projects.

2. LITERATURE REVIEW

2.1 Challenges of current cost management practices

Some studies have highlighted the problems of cost management performance of the industry. For instance, Ndihokubwayo and Haupt (2009) identified waste arising from variation orders on projects in the South African construction industry. The study also found that excessive occurrence of variation orders results in unnecessary costs to the project. The study concluded that clients regard variation orders as linked to additional scope approvals. Changes in scope are indicative of haste in project planning.

Similarly, Ramabodu and Verster (2010) established that cost overruns are a problem in the Free State province of South Africa. They identified critical factors contributing

to cost overruns, by ranking them in order of importance. Furthermore, the latter study concluded that an essential consideration for minimisation of cost overruns was removal of the human element.

The traditional practice of delivering public sector projects is to assign all professionals to handle the predesigned tasks in a fragmented manner. However, the research conducted by Mukuka et al. (2014) revealed that the traditional way of improving cost performance is not providing value in the construction industry. Akinyede and Fapohunda (2014) confirmed that the cost increases that occur daily on-site are due to valuable construction resources demanded for production.

2.1.1 Outcomes of traditional cost management approaches

Hanid et al. (2011) identified seven key issues in cost management. They described the problems as shortcomings of cost management practice. The issues were first identified through the literature, and they were then validated through exploratory interviews. The seven critical issues and/or shortcomings were the following:

- Failure to forecast;
- Failure to support improvement opportunities;
- Costs are considered as resulting from action;
- Relative neglect of value consideration;
- Poor support for inter-organisational cost management;
- Negative influence on behaviour; and
- Constraints created by budgeting.

The severity of ineffective and poor cost management in public sector projects in South Africa is illustrated in Figure 1. Figure 1 indicates that cost performance amounts to only 60%, instead of the desired 95% (Samuel, 2008).

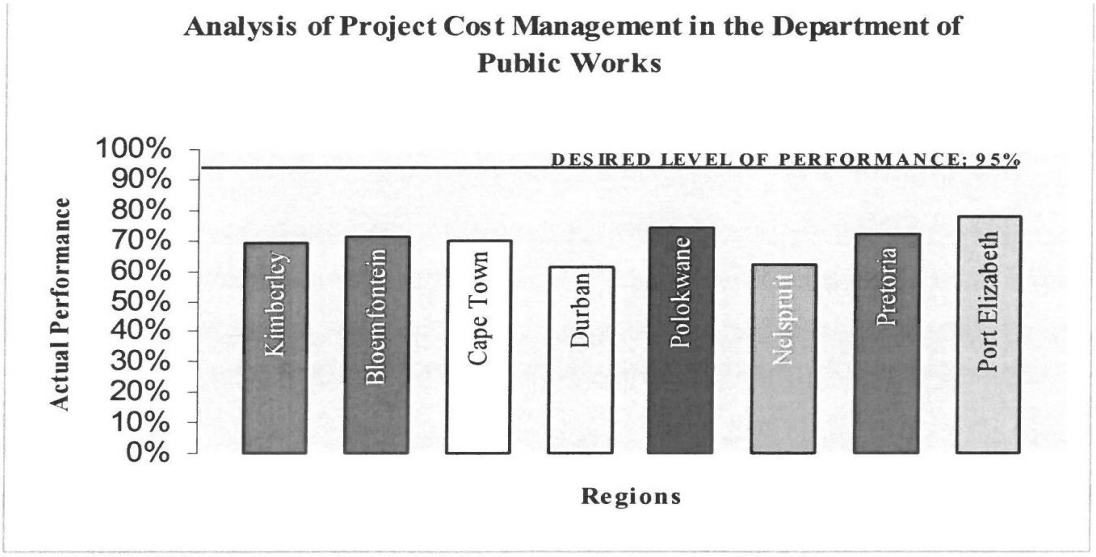

Figure 1: An analysis of project cost management

(Adapted from Lesele, 2006, cited in Samuel, 2008)

Figure 1 shows that public sector projects were still performing poorly in terms of cost management. Bowen and Edwards (1985) asserted that a paradigm shift was imminent, where we must move from a deterministic stance, where cost models and price forecasts

are based on a "single figure", to a scenario that is more representative of reality, where price variability is explicitly considered. It is now 33 years later, it appears that this paradigm shift is yet to occur, as underwhelming project cost performance figures are on the increase, particularly in South Africa, hence this study.

2.1.2 Effective cost management and the quantity surveyor

Poor cost performance emanating from construction project delivery is not just a local dilemma but a global phenomenon affecting owners' budgets, affordability of end users, and competency levels of project teams (Obi et al., 2015; Memon et al., 2014; Smith, 2014; Mbachu and Nkado, 2004). The quantity surveying (QS) fraternity has traditionally conducted cost management functions in South Africa (and in many other Commonwealth countries). The QS profession evolved in the 17th century. The Royal Institute of Chartered Surveyors (RICS) established it as a practice in 1864 (Seeley and Winfield, 1999, cited in Ashworth et al., 2014). The contribution of QSes has traditionally been to offer cost advice, assist with alternative design solutions, and provide cost estimates of preliminary designs and procurement, using elemental cost planning and checking (Kirkham, 2007, cited in Namadi et al., 2017). Ashworth et al. (2014) list the duties of QSes as encompassing post-contract cost management tasks, such as interim valuations, change control, and assessing variations in the final account.

Quantity surveyors employ traditional cost planning. A study by Zimina et al. (2012) views traditional cost planning as ineffective and inadequate for effective cost management that produces value for money. The authors express their view as a challenge, since the initial decision-making is dependent solely on the architect, rather than on collaborative decision-making from all the project participants. Thus, it is assumed that the reduced cost performance observed in public sector projects could be because of a lack of adequate techniques employed.

3. RESEARCH METHOD

The study adopted a qualitative research design. Case study research is commonly used when researchers want to understand a current phenomenon within a particular context, and when they have little control over events. The choice of descriptive case studies was motivated by the expectation that it could produce context-specific insights (Yin, 2014). Furthermore, case studies have a reputation for promoting in-depth investigation of a phenomenon within its natural context. The use of multiple cases also encourages and sustains enhanced replication across cases. Use of multiple sources of evidence ensures construct validity (Yin, 2014). Use of multiple cases to test a range of cross-case propositions enhances the external validity and the replicability, in terms of both literal and theoretical replications. The study purposefully selected four cases from the Department of Public Works. The projects were constructed in the last 10 years. Document analysis was conducted to analyse the textual data. The document analysis data was supplemented with semi-structured interview data collected from project actors in the selected cases.

Organisational consent was sought from the Department of Public Works head office in Pretoria, through a letter to the Director-General. The interviewee sample consisted of a select group of experts who were part of the case study projects sampled for evaluation. In all, 15 interviewees were recruited. Six interviewees each were drawn from the construction project management, architecture, civil engineering, electrical engineering, mechanical engineering and quantity surveying cohorts, respectively. Sampling was guided by project cases, which prevented bias from the authors. Interview sessions lasted an average of 25 minutes each. Semi-structured questions were asked in

the interview format. Semi-structured interviews were chosen because of the use of similar questions, instead of identical questions, as would be the case if structured interviews were espoused (Denscombe, 2010). Interviewees were requested to discuss their roles in various stages of the life cycle of construction projects. The interview sessions were recorded and transcribed with the permission of the interviewees. To make sense of the data, the transcripts emanating from the transcription were read more than once by the researchers, independently of each other. Predetermined themes were aligned to the research objective and questions. Pre-set themes evolved from the coded data.

4. FINDINGS AND DISCUSSION

Table 1 illustrates two case projects in extreme positions regarding poor cost performance, as advocated by Samuel (2008). However, Table 2 demonstrates a different picture, of two other project cases showing better cost performance from the public sector client. The reason for the difference was because the client demanded value engineering exercises to improve the outcome. Secondly, project performance was measured after completion, without really looking at the cause and effect of different reasons for the result. Table 1 shows the two projects that indicated poor cost performance. Table 2 shows the two projects that indicated good cost performance compared to the projects shown in Table 1.

Table 1: Project 1 and Project 2

PROJECT 1 INFORMATION		PROJECT 2 INFORMATION	
Department	Department of Health	Department	Department of Education
Project name	Extension to Boitumelong Hospital	Project name	New Primary School
Town	Kroonstad	Town	Bothaville
Date of site handover	28 July 2011	Date of site handover	2 October 2013
Actual start date	21 November 2011	Actual start date	2 October 2013
Completion date	November 2014	Completion date	29 May 2015
Actual completion date	April 2015	Actual completion date	29 May 2015
Contract amount	R138,263,009.29	Contract amount	R28,152,536.86
Final amount	R170,339,718.37	Final amount	R32,758,734.81
Overrun amount	R32,076,709.05	Overrun amount	R4,606,197.95

Table 2: Project 3 and Project 4

PROJECT 3 INFORMATION		PROJECT 4 INFORMATION	
Department	Department of Health	Department	Department of Education
Project name	New Mantsopa Hospital	Project name	New Special School
Town	Ladybrand	Town	Kroonstad
Date of site handover	12 August 2010	Date of site handover	2 March 2016
Actual start date	12 August 2010	Actual start date	2 October 2017
Completion date	12 January 2013	Completion date	2 October 2017
Actual completion date	12 January 2013	Actual completion date	2 October 2017
Contract amount	R264,662,777.29	Contract amount	R39,400,000.00
Final amount	R264,662,777.29	Final amount	R38,977,652.13
Overrun amount	R0.00	Overrun amount	- R422,347.87

4.1 Observed cost management practice from project participants

Figure 2 is a profile of the current mode of project delivery and cost management processes carried out on public sector projects. The profile is derived from semi-structured interviews conducted in the case studies. It is worth noting that the method of delivering public sector projects can be classified as a traditional design by employers, according to the Integrated Development Management System toolkit used by the National Treasury. It must be noted that school projects utilised the design-build model of project delivery, because designs are standard, and there is no need for new drawings. However, despite the difference in project delivery method, recorded cost performance experienced by both the design-build projects was poor, and another project performed exceptionally well. Figure 2 is a profile for stages 1 to 6 of the professional consultant service agreement (PROCSA) signed between the client and each professional team. The stages detail what service is expected of every professional appointed, as well as the anticipated outcomes in each stage to enable an opportunity for fee claim after each stage is completed. Consultants carry out tasks related to the project at each stage, and after each phase is completed, a fee claim can be submitted for payment to the professional. These are stages that are critical in identifying cost management approaches employed by professionals, as well as various tasks that are carried out to highlight opportunities for lean thinking strategies to improve the status quo of how professionals deliver projects to the client to the intended outcome of the project's parameters. Each stage represents the activities carried out related to each project executed by these professionals.

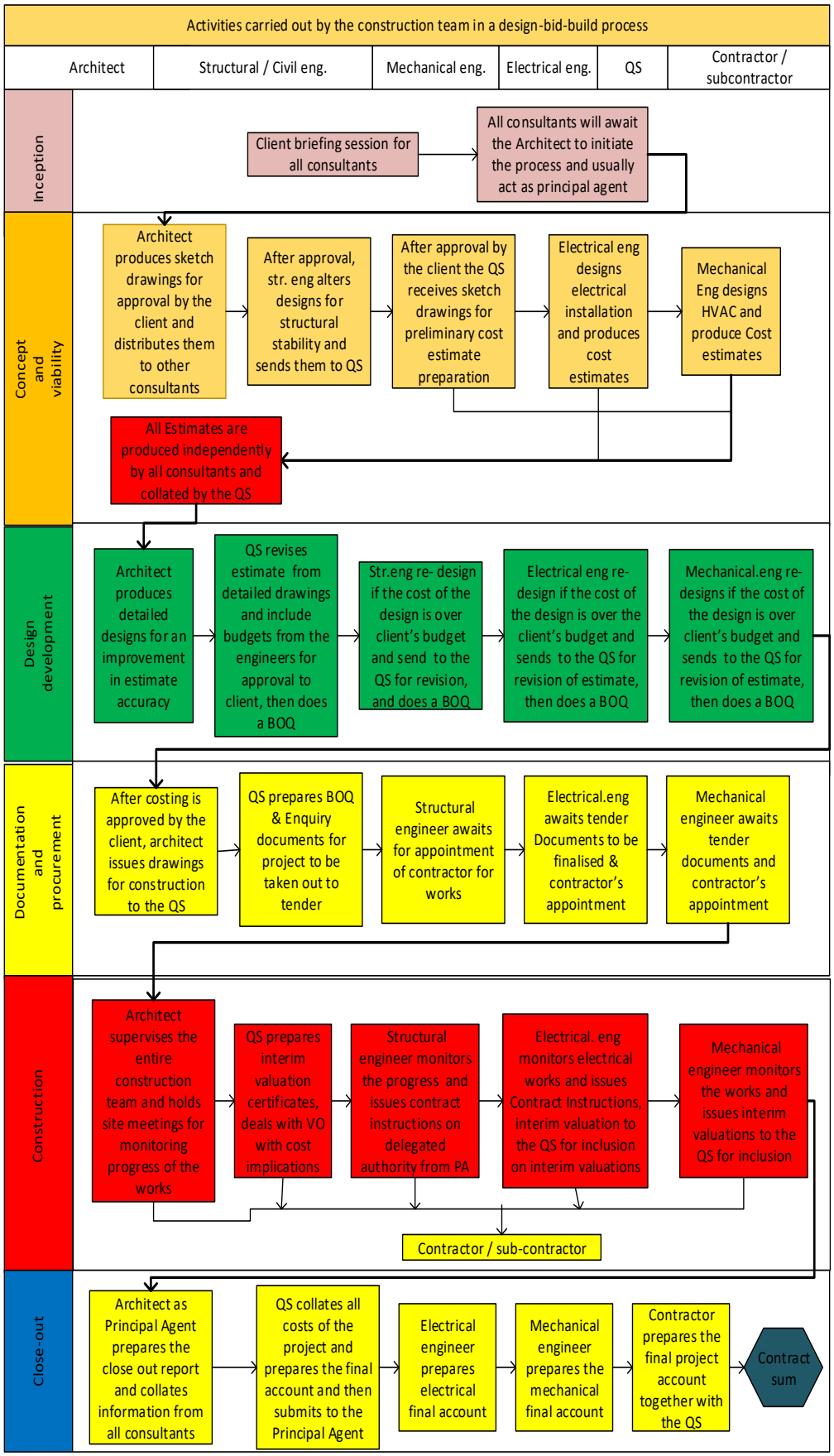

Figure 2: Observed activities from project participants

PROJECT 1		Cost management process on Design-bid-build projects		PROJECT 3
Cost element		Responsibility.	Cost element	Responsibilty.
Inception	Number of meetings held - 2	Client	Number of meetings held - 3	Client
Concept and viability	Period for sketches – 3 weeks Period for QS estimate -2 weeks Period for electrical designs - 2 weeks, Period for mechanical designs 2 weeks. Number of meetings – 2 for approval	Architect as principal agent (PA)	Period for sketches – 5 weeks, Period for QS estimate - 4 weeks Period for Electrical designs - 2 weeks Period for Mechanical designs - 2 weeks Number of meetings for approval - 5	PA
Design development	Detailed drawings and specifications – 2 weeks BOQ production – 3 weeks Electrical costing – 2 weeks Electrical BOQ – 1 week Mechanical costing – 2 weeks Mechanical BOQ – 1 week Number of meetings – 2 for approval	PA	Detailed drawings and specifications – 6 weeks BOQ production – 4 weeks Electrical costing – 4 weeks Electrical BOQ - 2 weeks Mechanical costing – 4 weeks Mechanical BOQ – 2 weeks Number of Meetings – 5 for approval	PA
Documentation & procurement	Collating all BOQs – 2 weeks Tender document – 2 weeks Compiling and printing and binding tender – 1 week Meetings for approval – 1 week Advertising of tender - 8 weeks Adjudication of tender - 8 weeks Appointment of contractor – 2 weeks	QS & PA.	Collating all BOQs – 2 weeks Tender document – 2 weeks Compiling and printing and binding one tender doc – 1 week Meetings for approval – 3 week Advertising of tender - 8 weeks Adjudication of tender – 6 weeks Appointment of contractor – 2 weeks	QS & PA & Client departments
Construction	Site handover – 3 weeks Start date – contractually Revision of drawings – 5 revisions Number of RFIs from contractor – 12 Project delay – 5 months Delays with Contractor payment – Yes, 3 months Scope creep – Yes, with cost Time overruns - Yes Cost overruns - Yes Number of site meetings - 54	Client & PA.	Site handover – 1 week Start date – contractually Revision of drawings – No revisions Number of RFIs from contractor – None Project delay – none Delays with contractor payment – Yes, 1 month Scope creep – none Time overruns - No Cost overruns - No Number of site meetings - 19	QS & PA & Client departments
Close -out	Agreement of final account – 4 months, Close out report – 2 weeks	QS, mechanical, electrical engineers. & PA.	Agreement of final account – 4 months, Close out report – 2 weeks	QS, mechanical, electrical engineers. & PA.

Figure 3: Cost management process from project participants

5. DISCUSSION

Figure 3 above presents what the respondents revealed transpired in projects 1 and 3 only. The study analyses only project 1 and project 3 of the four project cases, as these are preliminary findings of an ongoing study. The study exposed the inefficiencies of the existing cost management processes in selected cases in Figure 2 and Figure 3. From the foregoing, it can be seen that costing is still carried out independently by the design team early on in the project. The current practice encourages the so-called "silo mentality"; this indicates failure to support improvement opportunities and inability to forecast (Hanid et al., 2011). Figure 3 shows that the pre-contract planning in project 1 was done quicker than that in project 3, which led to a large number of variations during construction, hence the poor cost and time performance. From the findings of Hanid et

al. (2011), this is confirmed as relative neglect of value consideration. Project 3 in figure 3 indicates successful cost performance due to better planning and a high number of approval meetings observed from clients for design and costing, unlike project 1. Respondents also revealed that project 1 had less commitment from the side of the client, hence major changes came later. Hanid et al. (2011) demonstrate in their findings a negative influence on behaviour.

However, project 3 recorded better project performance concerning time and cost. Project 1 shows quicker pre-contract planning. It is worth noting that in the case studies, the QS is still the custodian of the costing process. Again, findings of Hanid et al. (2011) show failure to support inter-organisational cost management, inability to sustain improvement opportunities, and constraints created by budgeting. The only exception is the mechanical and electrical subsections of a project, which are handled by their respective engineers for costing. Again, this creates a silo mentality, where collaboration for cost management is still fragmented. The PROCSA stages of construction are mostly followed, instead of a rationale for professionals to claim for fees, which is why the stages of the latter were followed in the projects. The relationship of different organisations and individuals involved in projects impacts on the delivery of construction projects for the public sector.

6. CONCLUSION

The study first showed a profile of the activities carried out by the professional team and interaction with the client during planning and execution of public projects, using the PROCSA document, which is a service level agreement in the South African construction industry. The study then demonstrated how respondents went about the process of cost management in the two project cases from the selected four projects. Figure 3 demonstrates the inefficiencies of the existing cost management processes, by comparing two of the projects taken from Table 1 and Table 2.

From the evidence of the case studies, it can be concluded that spending sufficient time on planning for the project does not necessarily equate with a favourable outcome expected concerning project parameters. However, the cases also reveal that there is an opportunity to spend just the right amount of time but use it efficiently and collaboratively to achieve the intended outcome for the client.

7. ACKNOWLEDGEMENT

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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CONTRACTORS' PERCEPTIONS OF LATE PAYMENTS

R CUMBERLEGE[1], B BOTHA[2], M BENTLEY[3]

[1,3] Department of Quantity Surveying, Nelson Mandela University, Email: roy.cumberlege@mandela.ac.za

[2] Department of Construction Management, Nelson Mandela University

ABSTRACT

The purpose of this article is to identify the effects of late payments on contractors, and to implement procedures which will ultimately eliminate payment delays in future. The article also highlights the importance of understanding the mechanisms and the workings of various contract agreements, in order for the contractor to be aware of their rights and responsibilities in terms of the contract, as well as what legal steps could be taken should a client be in default regarding payment. A quantitative research method was used. A structured questionnaire was administered to contractors who are members of the Master Builders Association (MBA), Eastern Cape Province. The findings revealed that contractors' cash flow is greatly affected as a result of late payments. Smaller contractors even face bankruptcy. Contractors are also forced to suspend work on-site due to late payments; this extends the contract period, and, as a result, the contractor's expenses increase. It is also suggested that payment legislation should be introduced in order to reduce the number of late payments made by clients to contractors. The research is limited to contractors who are registered members of the Master Builders Association (MBA), Eastern Cape Province. An understanding of the effects of late payments will assist contractors in the smooth running of a construction project financially. Contractors will also benefit from being knowledgeable in terms of contractual agreements in the event of a delay in payment from the client. Contractors will furthermore be able to identify the effects of late payments, and will be able to plan accordingly.

Keywords: cash flow, delays, effects, late payment, payment

1. INTRODUCTION

Payment has been a source of grief for contractors for generations, whether it is delays in payment or no payment whatsoever, and it is likely to be for generations to come if no adequate legislation is put in place (Gow, 2006). There are two parts to the problem. Firstly, the client fails to pay the contractor on time, or they do not pay at all. Secondly, the contractor is consequently not in a position to pay subcontractors, due to a lack of cash flow. The focus will be on clients failing to pay the contractor, and the implications as a result, as well as contractors' opinions of how to improve the current payment situation.

A common characteristic of construction projects is that they are dynamic and they have a high level of uncertainty (Al-Kharashi and Skitmore, 2009). When payments are

delayed, the contractor's cash flow suffers greatly, and it becomes difficult to remain competitive in the industry.

Payment problems arise from an imbalance of commercial power between the client and a contractor (Gow, 2006). The construction industry plays a vital role in any country's development process (Fikri Hasmori et al., 2012). Efficient and timely payment is a main factor in the success of a project. The problem at hand affects most countries and industries. Due to the long duration of construction projects, a large amount of money is required, and the need for prompt payment in construction industries is intensified. This research determines the effects of late payments on contractors registered at the Master Builders Association (MBA) in the Eastern Cape, especially the impact on the contractor's cash flow.

2. A REVIEW OF RELATED LITERATURE

2.1 Causes and effects

The main cause of late payment in South Africa is the client, according to Van der Merwe et al. (2011). According to Van der Merwe et al. (2011), the effects of late payments are that they create cash flow problems and financial hardships and put a lot of unnecessary stress on the contractor.

2.2 Forms of contract for construction work

The issue of late payments has been seen as a major worldwide crisis, as the impact is negative in all construction sectors and related economies. To a certain extent, it is still currently a worldwide crisis, with the exception of a few countries that are implementing new legislation (cidb, 2010). The cidb has endorsed forms of contract for construction and building work, which provide legal remedies to enforce payment; forms of contract are the Joint Building Contracts Committee Principal Building Agreement (JBCC PBA), the General Conditions of Contract for Construction Works (GCC), the New Engineering Contract (NEC), and the Conditions of Contract for Construction for Building and Engineering Works Designed by the Employer (FIDIC Red). The most commonly used contracts in South Africa are the JBCC PBA and the GCC. South Africa does not have construction-specific legislation to address the need for prompt payment of building and civil engineering contractors and consultants (cidb, 2014).

The contractor is entitled to default interest on late payments, as all cidb-endorsed contract documents make provision for the payment of interest. The rate is dependent on the contract used. When work is partially complete, the contractor's claim for interim payment of the partially completed work could be met with a counterclaim from the client based on *exceptio non adimpleti contractus*, which is the exception of a non-performed contract; a contractor cannot abandon site if the client fails to pay for partially completed work (cidb, 2014). All four of the cidb-endorsed contracts contain provisions for suspension of work and/or cancellation of the contract when the client does not pay interim payment certificates. The contractor needs to take some aspects into consideration before leaving site or terminating the contract. In order to enforce the termination clause, the conditions for its implementation need to be stringently complied with. If the contractor is required to give the client notice of their intention to terminate the contract, the notice must be given as an express extrajudicial announcement, where such notice cannot be implied or given by notice of motion. If there is no contractual termination clause, a contractor will not be able to terminate a contract if a client does not make an interim payment (cidb, 2013).

Other remedies available in order to enforce payment are that the client provides evidence of the funds needed to pay for a specific project, a contractor's lien, a provisional sentence, a summary judgement, or to make an arbitration award an order of the court. The FIDIC Red provides for evidence to be provided by the client to the contractor, whereby, among other things, the client proves that there are sufficient funds available to pay the contract price. According to the Department of Public Works (2015), "[t]he Employer shall submit, within 28 days after receiving any request from the Contractor, reasonable evidence that financial arrangements have been made and are being maintained which will enable the client to pay the Contract Price (as estimated at that time). If the client intends to make any material change to his financial arrangements, the client shall give notice to the Contractor with detailed particulars". The mechanism for the provision of evidence is not a remedy, but it does help minimise the possible risks related to the capability of the client to pay for work. Similar provisions are not found in the JBCC PBA, the NEC3 ECC and the GCC documents.

2.3 Contractor's lien

A contractor's lien entitles the holder to the right to retain possession of property until the defaulter has paid the money due. The lien is designed to support the contractor's claim for payment (cidb, 2014). A provisional sentence is an extraordinary procedure; it is available to a creditor who has liquid documentary proof of a claim against a debtor. This provides a quick provisional judgement without the expense and delay which an ordinary trial action would involve. A summary judgement enables a creditor with a clear case to obtain swift enforcement of his claim against a defendant who has no real defence to the claim (cidb, 2014). A common practice in South Africa is to make an arbitration award an order of the court. An award that has been made an order of the court can be enforced in the same way as any judgement or order to the same effect. After an award has been made an order of the court, the party enforcing its rights can issue a summons of execution, to be executed by the Sheriff of the Court. Restricted availability of funds occurs in not only the public sector, but the private sector as well; again, this is due to slack financial management and budgeting problems, which are the cause of late payments (Che Munaaim, 2006). The predicted outcome is to create a process which will ensure cash flow, establish payment provisions, and introduce adjudication as a compulsory first step for the resolution of disputes in both the public and private sectors. The proposed regulations avoid withholding of payments without going through a clear procedure. Contractors will have a statutory right to suspend work, charge interest on late payments and introduce a compulsory form of statutory adjudication to resolve disputes (Hattingh and Massey, 2015).

3. RESEARCH METHODOLOGY

3.1 Methodology

In this study, a quantitative approach was used for obtaining and analysing data. The aim of the research was to identify the effects that late payments have on contractors, the contractor's cash flow, and suspension of work on-site.

3.2 Questionnaire design

A questionnaire was formulated, which was distributed to contractors in the province of the Eastern Cape. The questionnaire was designed to be brief, concise, and straightforward, so as to encourage a high response rate from potential respondents. The questionnaire was pre-tested by five contractors, to ensure that it was understandable to

the respondents. The results of the pre-tested questionnaires are included in the overall analysis of the survey. The questionnaire consisted of four main sections.

Section A consisted of questions related to the respondent's demographic background regarding organisational and personal data. Section B related to the contractor's knowledge and views based on past experience, section C solicited the contractor's opinions on cash flow problems caused by late payments, and section D pertained to the effects of late payment on suspension of work. A five-point Likert scale was used in the questionnaire to determine the extent to which the respondents agreed or disagreed with the questions posed.

3.3 Sample size and response rate

The sample for the study consisted of 150 registered contractors, all members of the Master Builders Association (MBA) in the Eastern Cape. The online questionnaire was emailed to all the contractors. Forty-two completed questionnaires were returned, which represents a response rate of 28%.

4. FINDINGS

4.1 Demographics

It is notable that 80% of the respondents had more than 10 years of experience in the construction industry, while 60% of the respondents had more than 15 years' experience. These are positive indicators. All the respondents were males.

A further positive observation is that 92% of the respondents had a qualification higher than a matric certificate. This indicates that the respondents were all educated and knowledgeable.

4.2 Contractors' experiences related to late payments

As is evident from Table 1, the respondents indicated that provision is needed for a mechanism that will ensure that a client cannot withhold payment from the contractor unless effective notice has been given by the client of their intention to withhold such payment. Litigation is seen negatively, as it is a time-consuming and costly exercise, where the outcome could also take some time to be reached. It should be compulsory for the client to place at least two months' turnover on deposit in a joint account or an account administered by the principal agent, as the contractor is exposed to approximately two months' further work on-site due to all the legal notice periods. The respondents furthermore indicated by means of an open-question response that consultants, such as the quantity surveyor, should play a more permanent role in the payment process, advising the client on the legal and contractual consequences of non-payment. Another open-question response indicated that contractors feel they have a right to the "pay-when-paid" clause, as the risk needs to be evenly distributed.

Table 1 indicates the contractors' opinions regarding various late payment or non-payment issues.

Table 1: Contractors' opinions

Aspect	Strongly Disagree		Neutral	Agree	Strongly agree	Unsure	Mean score (MS)
			(%)				
	1	2	3	4	5		
Litigation takes a long time, and the results may often come too late to prevent financial harm to the company	0	8.3	0	16.7	75	0	4.58
Due to the high cost of litigation, a successful result may often be a 'paper victory' (a worthless judgement)	0	25	0	58.3	16.7	0	3.67
Once a company has instituted litigation against a party, chances are limited that the company will get further work from that party in future	0	0	8.3	75	16.7	0	4.08
Statutory prompt payment provisions will eliminate late payment practices in the South African construction industry	0	16.7	8.3	66.7	8.3	0	3.67
Provision of escrow accounts, or similar trust accounts, to the benefit of the contractor and for retention money retained from the contractor is needed	0	25	8.33	50	8.33	8.33	3.45
Provision is needed for a mechanism that will ensure that a client cannot withhold payment from the contractor unless they have given effective notice of their intention to withhold such payment	0	8.3	0	66.7	25	0	4.08

4.3 Contractors experience cash flow problems during the construction stage

Table 2 indicates that the respondents all agreed or strongly agreed (MS=4.83) that when interim payments are paid late, this affects the contractor's cash flow. Ninety-five percent of the respondents agreed or strongly agreed that cash flow problems are experienced during the construction stage of a project. Contractors are often unable to pay their subcontractors, labourers, and suppliers, due to their restricted cash flow. The delay in payment makes subcontractors reluctant to work with contractors known for paying late, which tends to inflate prices. Table 2 also shows that respondents are of the opinion that the ability to tender on future projects is consequently impacted.

Table 2: Contractors' opinions

Aspect	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Unsure	Mean score (MS)
	(%)						
	1	2	3	4	5		
Late payments are normally a result of a default caused by the client/employer	0	5	0	35	60	0	4.50
Cash flow is affected by late payments	0	0	8	0	92	0	4.83
Cash flow problems are experienced during the construction stage	0	5	0	25	70	0	4.60
When interim payments are paid late, this affects cash flow	0	0	0	17	83	0	4.83
Cash flow has a negative impact on the success of a company	0	0	8	8	84	0	4.75
Late payments by clients lead to bad working relationships	0	0	0	75	25	25	4.25
Late payments result in the contractor not being able to pay subcontractors, suppliers, and labourers	0	0	8	59	33	0	4.25
Cash flow problems lead to bankruptcy or liquidation	0	10	50	35	5	0	3.35
Subcontractors, suppliers, and labourers are reluctant to work with contractors known for paying late	0	8	0	75	17	0	4.00
Subcontractors, suppliers, and labourers inflate their prices in anticipation of late payments	0	0	25	67	8	0	3.83
The ability to tender on future projects is impacted by cash flow problems	0	0	0	75	17	8	4.18

4.4 Suspension of work

Table 3 shows that the majority (83%) of contractors were of the opinion that late payments result in suspension of work on-site. Table 3 further indicates that 92% of the respondents agreed or strongly agreed that suspension of work forces the client to pay. All the respondents agreed or strongly agreed that the contractor's expenses and construction costs increase as a result of a delay in payment.

5. CONCLUSION

The research investigates the effects of late payment or non-payment on the contractor. Procedures need to be implemented which reduce payment delays in South Africa. Contractors should be knowledgeable in terms of various contractual agreements, and they should be aware of their rights in the event of a delay in payment. The objective of the research was to find a solution, which will, in turn, create a better working environment, by eliminating late payments. Cash flow is affected due to late payment;

late payment also results in suspension of work on-site. The literature review stated the importance of various laws which could reduce the number of late or delayed payments within the construction industry. The results supported the literature regarding late payments to contractors being a re-occurring phenomenon and contractors failing to pay labourers, subcontractors, and suppliers due to the negative effect that late payments have on their cash flow. Suspension of work, in turn, results in a longer construction period, which increases the contractor's expenses. Other countries, such as Australia and the United Kingdom, have made progress regarding late payment and non-payment within the construction industry, which shows that it is possible for South Africa to do the same. The Department of Public Works Government Gazette released in May 2015 shows progress in the right direction for South Africa as a country.

Table 3: The effects of late payments on suspension of work

Aspect	Strongly disagree	Disagree	Neutral	Agree	Strongly agree	Unsure	Mean score (MS)
	(%)						
	1	2	3	4	5		
Late payments result in suspension of work on-site	0	17	0	83	0	0	3.67
Late payments which cause suspension of work are not always the fault of the client	0	17	8	8	67	0	3.67
Suspension of work forces the client to pay	0	0	8	84	8	0	4.00
Construction costs increase as a result of a delay in payment	0	0	0	83	17	0	4.17
The contractor's expenses increase	0	0	0	67	33	0	4.33

6. RECOMMENDATIONS AND FURTHER RESEARCH

The following are recommendations emanating from this study:

- A commission should be established to investigate errant payments; and
- Prompt payment legislation is required in South Africa.

Further research should be conducted on the reasons why clients are delaying payment, as well as the consultant's roles in the payment process. The payment systems used by government departments which also negatively affect the contractor should also be investigated.

7. ACKNOWLEDGEMENT

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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IDENTIFICATION OF THE UNCERTAIN EVENTS IMPACTING ON CONSTRUCTION TIME OF SOUTH AFRICAN HIGHWAY PROJECTS

Alireza MOGHAYEDI[1], and Abimbola WINDAPO[2]

[1] Department of Construction Economics and Management, University of Cape Town, South Africa, Email: MGHALI001@myuct.ac.za

[2] Department of Construction Economics and Management, University of Cape Town, South Africa, Email: Abimbola.Windapo@uct.ac.za

ABSTRACT

This article examines the uncertain events encountered in the construction process of highway projects in South Africa, so as to evaluate their impact on the construction time of such projects. The rationale for this examination stems from the view held by scholars that highways are complex projects initiated in dynamic environments, which are often beset by different uncertainties and a lack of appropriate evaluation of the uncertain events that occur during the construction process. The research made use of a review of existing literature in the area of uncertainty management and modelling in infrastructure projects, to guide the direction of the study, brainstorming, and interviews conducted with highway experts to identify the factors of uncertainty that impact construction time on infrastructure projects. A simple uncertainty matrix for South African highway projects was developed using a quantitative model and descriptive statistics. It emerged from the study that the uncertain events that affect the construction time of highway projects are distributed across economic, environmental, financial, legal, political, social and technical factors. Also, it was found that each factor contains several uncertain events, which impact on construction time differently, through a combination of the uncertain events of the individual construction activities. Based on the findings, it can be concluded that construction time on South African highway projects is significantly related to the social and technical factors of uncertainties. The matrix developed will be useful in modelling uncertainty of the cost and time of individual construction activities in highway projects.

Keywords: construction time, highway projects, South Africa, uncertainty

1. INTRODUCTION

Highway construction projects are subject to risks and uncertainties (Moret and Einstein, 2016). There are various risks and uncertainties existing in highway construction projects that affect construction performance differently. Risks have different probabilities of occurrence that impact project performance (Walker et al., 2003), causing schedule delays or cost overruns (Moghayedi, 2016; Chapman, 2006; Wang and Chou, 2003; Zayed and Halpin, 2004). The number and the importance of such events depend on the size and the complexity of the construction project (Zavadskas et al., 2010). Highway projects are one of the most dynamic, challenging,

and complex construction projects, because they are exposed to different risks (Mills, 2001). According to Flyvbjerg (2007), there is more uncertainty in highway projects than there is in other construction projects, because of the unique features of such projects, including complexity in the long duration of the construction, the dynamic nature of the process, the repetitive linear nature of such projects, and the mobile nature of the construction sites. Uncertainty affecting construction projects has long been recognised by researchers as a major obstacle to achieving the objectives of the project, and as a cause of low levels of productivity (Antunes and Gonzalez, 2015; Bloom, 2014; Childerhouse and Towill, 2004; Moret and Einstein, 2016).

Uncertainty means an unknown phenomenon (Walker et al., 2003). It is associated with the location, it is project-specific, and it has no root causes that can be generalised (Ramanathan et al., 2012). Therefore, there is an obvious need to effectively anticipate, identify and classify the uncertain events on different locations and projects to assess their influence on the objectives of construction projects. Uncertainty assessment involves identifying, evaluating and modelling various uncertain events in the construction process of highway projects, and developing a model for quantifying the impact of different events on the objectives of the project.

The magnitude of the influence of uncertainty can be assessed by two parameters, namely probability of occurrence, and severity of the event (Gadd et al., 2003; ISO, 2009; Project Management Institute, 2013). Quantification of these factors with classical methods, such as probability analysis and influence diagrams, is very difficult (Zeng et al., 2005). Efficient applications and quantification techniques are difficult and complex, and, furthermore, exact data are required (Winch, 2010). Unfortunately, such data either do not exist at all or are hard to obtain. Furthermore, most of the classical mathematical assessment methods, such as differential equations, are not able to examine the relationship between input variables and an output variable, and they are not well suited for uncertain problems (Youssef, 2004). Stepwise regression analysis (SRA), on the other hand, is used in modelling to examine the strength and the direction of the relationship between each dependent variable and an independent variable, and the results indicate whether this relationship is statistically valid. Also, SRA is able to estimate the value of dependent variable when the independent variables are known.

Therefore, this current research examines the uncertain events in the construction of highway projects in South Africa, and whether there are key events that have a significant impact on the completion time of such projects, with the aim of developing SRA models to assess the impact of uncertainty on the completion time of highway construction projects.

2. LITERATURE REVIEW

The effect of uncertain events on the objectives of infrastructure projects has been identified in several works of literature (Anderson et al., 2007; Antunes and Gonzalez, 2015; Barker and Haimes, 2009; Moret and Einstein, 2016; Renuka et al., 2014). Occurrence of uncertain events in highway construction projects is greater than in other construction projects, due to the unique features of such projects, including complexity, the long duration of the construction, the dynamic nature of the process, the repetitive linear nature of such projects, and the mobile nature of the construction sites (Flyvbjerg, 2007). Due to the peculiar nature of uncertainty, there is a need to identify and classify the uncertain events and their factors, using the breakdown structure and the risk and uncertainty management process to assess their impact.

One of the most comprehensive studies in the field of uncertainty factors identification was conducted by Aziz and Abdel-Hakam (2016). They explored 293 disruptive events as delay causes of road construction projects in Egypt under 15 major groups. Another noteworthy study was conducted by Odediran and Windapo (2017). They identified 81 risks in African construction markets under five major factors, namely political, social, economic/financial, procurement, and design and construction. Similarly, Assaf and Al-Hejji (2006) evaluated 73 uncertain events that cause delays in different types of large construction projects in Saudi Arabia under the following factors: project, owner, contractor, design, materials, equipment, labour, and external.

After an extensive review of literature in the field of risk and uncertainty in construction projects, the seven uncertainty-related factors most common to researchers in the field were identified. They are presented in Table 1.

Table 1: Proposed uncertainty factors

Factor	Description	Sources
Economic	Issues or concerns associated with the macroeconomic impact of the community and the region in which the construction project is to be located	Banaitiene and Banaitis, 2012; Dey, 2001; Iyer and Jha, 2005; Kuo and Lu, 2013; Saqib et al., 2008; Tah and Carr, 2000; Wang and Yuan, 2011; Zavadskas et al., 2010
Environmental	Issues associated with the environmental problems, concerns and activities confronting the project	Banaitiene and Banaitis, 2012; Ehsan et al., 2010; Iyer and Jha, 2005; Saqib et al., 2008; Tah and Carr, 2000; Wang and Yuan, 2011
Financial	Issues or concerns associated with the financing of the project. Several researchers emphasise financial uncertainties as one of the important factors affecting infrastructure project outcomes	Banaitiene & Banaitis, 2012; Bunni, 2003; Dey, 2001; Ehsan, Mirza, Alam, & Ishaque, 2010; Fang, Marle, Zio, & Bocquet, 2012; Saqib, Farooqui, & Lodi, 2008; Shen, Wu, & Ng, 2001; Taghipour, Seraj, Hassani, & Kheirabadi, 2015; Tah & Carr, 2000; Zayed, Amer, & Pan, 2008
Legal	Issues or concerns associated with the significant legal consequences that flow from legal actions attributable to the project	Bunni, 2003; Shen et al., 2001; Zou et al., 2007
Political	Issues or concerns associated with the local, regional and national political and regulatory situation confronting the project. Various researchers identify political uncertainty as a major factor affecting the	Baloi and Price, 2003; Banaitiene and Banaitis, 2012; Dey, 2001; Ehsan et al., 2010; Iyer and Jha, 2005; Saqib et al., 2008; Taghipour et al., 2015;

	performance of infrastructure projects.	Tah and Carr, 2000; Zavadskas et al., 2010; Zayed et al., 2008
Social	Issues or concerns associated with the social and cultural impacts of the community and the region in which the construction project is to be located	Kuo and Lu, 2013; Saqib et al., 2008; Wang and Yuan, 2011; Zavadskas et al., 2010
Technical	Issues or concerns associated with the technology used in the project by different stakeholders during construction	Banaitiene and Banaitis, 2012; Bunni, 2003; Dey, 2001; Dikmen et al., 2007; Ehsan et al., 2010; Fang et al., 2012; Mahendra et al., 2013; Nieto-Morote and Ruz-Vila, 2011; Saqib et al., 2008; Shen et al., 2001; Tah and Carr, 2000; Wang and Yuan, 2011; Zavadskas et al., 2010; Zayed et al., 2008

Through a review of the literature, a list of uncertain events that impact on the completion time of construction projects was compiled. These events were analysed and ranked according to the number of times cited. The top 20 uncertain events cited in the literature which were adapted to the current study are listed in Table 2.

Table 2: Top 20 uncertain events cited in the literature

Event	Factor	Adam et al. (2017)	Odediran and Windapo (2017)	Santoso and Soeng (2016)	Aziz and Abdel-Hakam (2016)	Taghipour et al. (2015)	Marzouk and El-Rasas (2014)	Mahendra et al. (2013)	Banaitiene and Banaitis (2012)	Fang et al. (2012)	Kuo and Lu (2013)	Nieto-Morote and Ruz-Vila (2011)	Ehsan et al. (2010)	Zayed et al. (2008)	Saqib et al. (2008)	Zou et al. (2007)	Assaf and Al-Hejji (2006)	Dey (2001)	Total
Weather	Environ-mental	✓		✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	16
Availability of materials	Technical	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	15
Inaccurate management or supervision	Technical		✓	✓	✓	✓	✓	✓		✓	✓		✓	✓	✓	✓	✓	✓	14
Availability of skilled labour	Technical	✓	✓	✓	✓	✓	✓		✓	✓		✓	✓		✓	✓	✓	✓	14

Health & safety	Technical	✓	✓	✓	✓	✓	✓	✓	✓			✓	✓		✓	✓	✓		13
Materials delivery	Technical			✓	✓	✓	✓		✓	✓	✓	✓	✓		✓	✓	✓	✓	12
Construction methods	Technical	✓		✓	✓	✓	✓		✓	✓	✓		✓	✓	✓		✓		12
Availability of equipment	Technical		✓	✓	✓		✓		✓	✓		✓	✓		✓	✓	✓	✓	12
Cash flow difficulties (contractor finance)	Financial	✓	✓	✓	✓		✓	✓	✓		✓	✓		✓	✓		✓		12
Design, drawings, specifications, and samples	Technical		✓	✓	✓	✓	✓		✓	✓			✓		✓	✓	✓		11
Incompetent contractor/ subcontractor	Technical			✓	✓	✓	✓		✓	✓			✓		✓	✓	✓		10
Low level of productivity	Technical			✓	✓	✓	✓		✓	✓			✓		✓	✓	✓		10
Payment delays	Financial	✓	✓		✓		✓	✓	✓		✓	✓		✓			✓		10
Planning and scheduling of project by contractor	Technical		✓		✓	✓	✓		✓	✓			✓		✓	✓	✓		10
Difficulty of schedule	Technical				✓	✓	✓		✓	✓			✓		✓	✓	✓		9
Lack of capital by owner	Financial	✓	✓		✓		✓	✓			✓	✓		✓			✓		9
Change order (change in the scope of the project)	Technical		✓		✓	✓			✓	✓			✓		✓	✓		✓	9
Legal/ industrial disputes between various parties in the construction project	Legal	✓			✓		✓	✓			✓		✓		✓		✓		8
Communi-cation/ coordination between construction parties	Technical				✓	✓			✓	✓			✓		✓	✓		✓	8
Fluctuation of prices of	Economic	✓	✓		✓			✓			✓	✓		✓			✓		8

materials and/or equipment

It can be seen from Table 2 that the most cited uncertain events are technical-related. To verify the existence of these uncertain events in highway construction projects in South Africa, the research conducted further investigations. The methods used are presented in the following section.

3. RESEARCH METHODOLOGY

The study made use of a sequential mixed-methods research approach in identifying the uncertain events and their main factors and assessing the impact of uncertainties on the completion time of highway construction projects in South Africa. Brainstorming sessions were held with six highway experts who have more than 25 years of experience in South African highway construction projects. The highway expert panel reviewed and modified the uncertain events identified in the literature to appropriately reflect the events occurring on South African highway construction projects. The expert panel also grouped these events into seven uncertainty factors, as seen in Table 1.

A survey questionnaire was designed on a five-point linguistic Likert-scale form to assess the impact size of confirmed uncertain events in highway construction projects in South Africa. The questionnaire was administered to 32 highway project managers with a minimum of 20 years of experience in the South African construction industry, to rate the probability of occurrence and the severity of each uncertainty on the completion time of a highway project.

4. DATA ANALYSIS

To evaluate the effect of uncertainties on construction time of highway projects using collected data on the probability of occurrence and the severity of uncertainties from the six highway experts, the ISO (International Standards Organization) 31000 impact matrix was utilised (ISO, 2009). The ISO (2009) defined the impact size of an event as a function of the probability of occurrence and the severity of that event should it occur.

Table 3 shows the probability of occurrence and the severity as two input variables, and relevant impact size as the output variable.

Table 3: Impact size matrix

		Severity				
		Insignificant (1)	Minor (3)	Moderate (5)	Major (7)	Catastrophic (9)
Probability of occurrence	Rare (.1)	Minimal	Minimal	Low	Low	Moderate
	Unlikely (.3)	Minimal	Low	Moderate	Moderate	High
	Possible (.5)	Low	Moderate	Moderate	High	High
	Likely (.7)	Low	Moderate	High	High	Extreme
	Almost certain (.9)	Moderate	High	High	Extreme	Extreme

4.1 Developing a stepwise regression model

The main objective of this study is to quantitatively analyse and assess the impact of uncertainties on completion time of highway construction projects, through numerical analysis of the uncertainty variables. Stepwise regression analysis (SRA) is an extension of multiple regression analysis. The SRA model is a mathematical model used in estimating the relationship between a dependent variable and independent variables, with a strong mathematical background. SRA models have been used extensively in different areas of construction management, particularly assessing risk and uncertainty, assessing the critical factors affecting cost performance of Ethiopian public construction projects (Sinesilassie et al., 2018), modelling the construction risk ratings and estimating contingencies in highway projects (Diab et al., 2017), identifying the success factors for public-private partnership projects in Korea (Yun et al., 2015), evaluating project risks in Iran (Ebrat and Ghodsi, 2014), evaluating the risk factors leading to cost overruns in highway construction projects in Australia (Creedy et al., 2010), analysing the risk perception of build-operate-transfer road project participants in India (Thomas et al., 2003), developing models to forecast the actual construction cost and time (Skitmore and Ng, 2003), and designing a multivariate analysis to build project success factors in Hong Kong (Chan et al., 2001).

The impact size of uncertain events as the dependent variable is a function of two independent variables (probability of occurrence, and severity) of relative uncertainty (ISO, 2009), as shown in Equation 1.

$$Uncertainty\ impact_i = a_i p + b_i s + r_i \qquad \text{(Equation 1)}$$

Where r_i is a constant value. a_i and b_i represent regression coefficients of the independent variables.

Because each input variable can have a low correlation with the output variable, the SRA model was used in this study. Table 4 presents the values of the correlation coefficients.

Table 4: Correlation coefficients among the input and output variables

	Probability	Severity	Impact
Probability	1		
Severity	0	1	
Impact	0.685061	0.685061	1

Table 4 shows the low correlation between the independent variables and the dependent variable.

The general SRA model for impact size, based on the impact size matrix in Table 3, has been developed to predict the impact size of each uncertainty on cost and time of highway construction projects. The SRA model test details are shown in Table 5.

Table 5: Regression test details

Regression statistics	
Multiple R	0.968822
R-squared	0.93861607
Adjusted R-squared	0.93303571
Standard error	0.31622777

	Coefficient	Standard error	*t*-statistic	P-value
Intercept	0.18	0.170294	1.056996	0.301982
Probability	2.9	0.223607	12.96919	8.82E-12
Severity	0.29	0.022361	12.96919	8.82E-12

Table 5 reveals that the correlation value (R-Squared) of the model is close to 1, and the P-value is very low (<0.05). The very low P-value indicates the statistically significant relationship of each independent variable to the dependent variable of the model, and the closeness of the R-value to 1 verifies the close fit of the estimated output model to real data. The developed stepwise regression analysis model for general uncertainty impact size is outlined in Equation 2.

$$Uncertainty\ impact = 2.9 \times p + 0.29 \times s + 0.18 \qquad \text{(Equation 2)}$$

Similar steps were repeated to develop the SRA models for each uncertainty impact on construction time of highway projects. To assess the optimum impact size of each uncertainty, the optimum values of two independent variables (probability of occurrence, and severity of event) are identified using sensitivity analysis, and are inserted to develop the SRA models. For instance, the maximum probability of occurrence (0.6625) and severity (5) value of event weather were inserted to develop the SRA model (Y = 0.2915 + 2.9728p + 0.27905s), and the estimated impact size of this uncertainty (3.66) on the completion time of highway construction projects. The

impact sizes of all identified uncertainties on the completion time of highway construction projects were estimated and ranked. Table 6 presents the top 20 events with significant impact size on construction time of highway projects, from a ranking perspective.

Table 6: Top 20 uncertain events with significant impact size on construction time of highway projects

Code	Event	Probability of occurrence	Severity of event	Impact size	Rank
TG11	Latent ground conditions	0.84375	8.3125	4.94	1
TCS6	Inaccurate time and cost estimation	0.79375	8.3125	4.78	2
TG5	Inadequate planning and scheduling of project by contractor	0.8125	7.6875	4.72	3
SO4	Rehabilitation of affected people	0.78125	7.8125	4.66	4
PL3	Human-made disaster (war, protest, strike, etc.)	0.8125	7.4375	4.66	5
SO5	Disease (HIV, Ebola, etc.)	0.70625	6.8125	4.19	6
TG9	Change order by owner (scopes and specifications)	0.73125	6.4375	4.16	7
TG4	Difficulty of schedule	0.55625	7.75	4.00	8
TCR5	Rework due to contractor errors	0.64375	5.5625	3.84	9
EN2	Natural disasters (earthquake, floods, hurricane, etc.)	0.4125	7.9375	3.81	10
SO3	Social and cultural impacts	0.76875	4.375	3.81	11
TT1	Obsolete technology	0.58125	6.1875	3.78	12
LE9	Problem in dispute settlement due to law	0.625	5.6875	3.78	13
TCR4	Management or supervision of project by contractor	0.66875	5.5	3.78	14
TL1	Low level of productivity	0.725	4.625	3.75	15
TM2	Materials delivery	0.56875	6.1875	3.75	16
TCS4	Design, drawings, specifications, and samples	0.675	5.1875	3.75	17
PL1	Political situation	0.64375	5.6875	3.72	18
TCS3	Frequent design changes	0.60625	5.8125	3.72	19
TM3	Bad quality of materials	0.61875	5.5	3.72	20

It can be seen from Table 6 that the top three uncertain events, based on estimated impact on completion time of highway construction projects, from a ranking perspective, are latent ground conditions (4.94), inaccurate time and cost estimation (4.78), and inadequate planning and scheduling (4.72). Likewise, latent ground

conditions and inaccurate time and cost estimation are two uncertain events with catastrophic consequences.

To evaluate the SRA models' performance, the root-mean-square error (RMSE), the mean absolute percentage error (MAPE), and the R-squared of 76 developed assessment models were calculated. The results for the top 20 events in South Africa are presented in Table 5.

Table 5: Performance evaluation of the SRA models for the top 20 events

Code	Model	P-value	R-squared	RMSE	MAPE
TG11	Y = 2.9897 + 1.604p + 0.071255s	2.21e-10	0.784	0.244	0.0638
TCS6	Y = 1.3931 + 1.9967p + 0.21694s	1.01e-07	0.671	0.249	0.0481
TG5	Y = 0.89851 + 2.3235p + 0.25137s	3.56e-08	0.694	0.261	0.0533
SO4	Y = 0.5412 + 2.6448p + 0.26225s	7.5e-09	0.725	0.262	0.0537
PL3	Y = 0.80427 + 2.7748p + 0.21478s	3.7e-09	0.738	0.255	0.0518
SO5	Y = 0.064987 + 2.9907p + 0.29509s	2.85e-12	0.84	0.245	0.0521
TG9	Y = 0.88561 + 2.6217p + 0.21025s	2.1e-08	0.705	0.252	0.0556
TG4	Y = 0.88358 + 2.4275p + 0.22789s	2.21e-08	0.703	0.248	0.0557
TCR5	Y = 0.97812 + 2.1685p + 0.26421s	1.05e-06	0.613	0.237	0.0553
EN2	Y = 1.2336 + 2.0528p + 0.21823s	6.52e-07	0.626	0.251	0.0621
SO3	Y = 1.4539 + 1.8779p + 0.20912s	1.74e-07	0.658	0.24	0.0571
TT1	Y = 0.68305 + 2.7031p + 0.24679s	3.56e-09	0.739	0.259	0.0664
LE9	Y = 0.52521 + 2.481p + 0.29985s	1.55e-07	0.661	0.253	0.0628
TCR4	Y = 1.2381 + 2.0753p + 0.21005s	1.52e-07	0.661	0.253	0.0632
TL1	Y = 0.75 + 2.3438p + 0.28125s	2.25e-08	0.703	0.286	0.0729
TM2	Y = 0.98332 + 2.0923p + 0.25482s	6.62e-08	0.68	0.257	0.0660

TCS4	Y = 0.92489 + 2.6345p + 0.20179s	3.96e-08	0.691	0.253	0.0635
PL1	Y = 0.80167 + 2.2434p + 0.25897s	1.08e-08	0.718	0.251	0.0618
TCS3	Y = 0.92834 + 2.1309p + 0.25781s	2.62e-08	0.7	0.259	0.0669
TM3	Y = 0.24167 + 3.1541p + 0.27735s	1.54e-10	0.789	0.248	0.0620

The small value of errors (RMSE and MAPE) and P-values ($p<.01$) proved the reliability and statistical significance of all the developed models. However, the fit of the estimated values to real data varies from 0.442 to 0.954. Fifty-two of the developed models have a strong fit ($r>0.7$), 22 models have a moderate fit ($.5<r<.7$), and two of the models have a low fit to the real data (Moore and Kirkland, 2007).

Furthermore, the estimated impact size of uncertain events was classified into five groups, namely extreme, high, moderate, low, and minimal (see Table 7).

Table 7: Impact size groups

Group	Impact size	Events
Extreme	$I \geq 4$	Latent ground conditions; inaccurate time and cost estimation; inadequate planning and scheduling of project by contractor; rehabilitation of affected people; human-made disaster; disease; change order by owner; difficulty of schedule
High	$3 \leq I < 4$	Rework due to contractor errors; natural disasters; social and cultural impacts; obsolete technology; problem in dispute settlement due to law; management or supervision of project by contractor; low level of productivity; materials delivery; design, drawings, specifications, and samples; political situation; frequent design changes; bad quality of materials; security; new technology adoption; corruption; remote location cost; availability of skilled workers; availability of materials; change order; delays in decision-making; weather; right of way acquisition; payment delays; fluctuation of prices of materials and/or equipment; health & safety; financing by contractor, cultural heritage issues; inaccurate investigation of construction site; monopoly of material and/or equipment suppliers; low efficiency of equipment; unreliable supplier of material; lack of technical staff; mistakes in design and/or specifications; encroachment problems; lack of capital by owner; poor quality of workmanship; planning and scheduling of project by contractor; frequent change of subcontractors; contract failure – new contract establishment cost; terrain or topographical; construction methods; lack of technical staff; ineffective delay penalties; poor communication/coordination between construction parties

Moderate	2≤I<3	Absenteeism of labour; incompetent contractor/subcontractor; legal/industrial disputes between various parties in the construction project; changes in government regulations and laws; inadequate monitoring and supervision; poor financial control; type of contract; availability of equipment; deficient documentation; contractual claim; late delivery of equipment; personal conflicts among labour; lack of experience in the line of work; lack of experience in design and supervision; fluctuation in foreign exchange rate; high cost of materials and/or equipment; high tender price; changing of bankers' policy for loans; high cost of labour; saturated market; difficulties in importing equipment and materials
Low	1≤I<2	Slow mobilisation of equipment; tax and/or legal fees; size of contract
Minimal	1<I	NONE

Key: I = impact size

Table 7 groups the uncertain events identified in South African highway projects, based on their estimated impact on the completion time of projects.

5. DISCUSSION OF FINDINGS

The current study modelled the existing uncertain events in South African highway construction projects using stepwise regression analysis (SRA) to assess their impact on the completion time of such projects. Impact assessment of uncertain events is essential to prevent delays on the project before signs of delay begin to appear.

Comparison of the top 20 uncertain events from the literature review (see Table 2) with the 20 events with the highest estimated impact in South Africa (see Table 3) revealed that only seven events from this list are common with the top 20 cited events (inadequate planning and scheduling of project by contractor (3rd), change order by owner (7th), difficulty of schedule (8th), management or supervision of project by contractor (14th), low level of productivity (15th), materials delivery (16th), and design, drawings, specifications, and samples (17th)). The other 13 most-cited events are found to impact the construction time of highway projects differently (availability of skilled workers (25th), availability of materials (26th), weather (29th), payment delays (31st), fluctuation of prices of materials and/or equipment (32nd), health & safety (33rd), financing by contractor (34th), lack of capital by owner (43rd), construction methods (49th), poor communication/coordination between construction parties (52nd), incompetent contractor/subcontractor (54th), legal/industrial disputes between various parties in the construction project (55th), and availability of equipment (60th)).

The study found that more than 70% of identified events impact on the completion time of highway construction projects. The results presented in Table 7 revealed that eight uncertain events (10.5%) have an extreme impact on completion time of highway projects, 44 events (57.9%) have a high impact, 21 events (27.6%) have a moderate impact, and three events (4%) have a low impact on construction time of highway projects. This is evidence of the fact that the completion time of highway construction projects in South Africa is very sensitive to uncertain events. These results are consistent with those of previous studies. For instance, Adam et al. (2017), Assaf and Al-Hejji (2006), Aziz and Abdel-Hakam (2016), Baloi and Price (2003), Fang et al. (2012), Taghipour et al. (2015), Zayed et al. (2008), and Zou et al. (2007) also found

that latent ground conditions was a key uncertain event impacting the construction time of projects.

Also, the SRA model results indicate that inaccurate time and cost estimation, inadequate planning and scheduling, changes to specifications, and difficulty of schedule are the other four technical uncertain events that extremely affect completion time of construction projects. These technical events were also identified in previous studies (Assaf and Al-Hejji, 2006; Aziz and Abdel-Hakam, 2016; Bunni, 2003; Ehsan et al., 2010; Gosling et al., 2012; Huang et al., 2002; Mahendra et al., 2013; Marzouk and El-Rasas, 2014; Saqib et al., 2008; Zou et al., 2007). Human-made disaster and disease emerged from the study as two political and social uncertain events with extreme impact on construction projects in South Africa, which is consistent with the findings of studies conducted by Aziz and Abdel-Hakam (2016), Marzouk and El-Rasas (2014), and Odediran and Windapo (2017) in South Africa and Egypt.

6. CONCLUSION

The current study adds to existing knowledge of construction management by including an extensive literature review in the field of uncertainty in construction projects, it established the uncertain events and uncertainty factors through brainstorming by a highway expert panel, and it verified the probability of occurrence and severity of 20 events through gathering data from highway construction experts. A significant number of the uncertainties were related to social and political factors. Therefore, it is recommended that the companies pursuing highway construction in African countries should seriously consider the social and political risks, along with the technical events, when involved in this market. The study also developed stepwise regression analysis models to assess the impact of each event on the completion time of highway construction projects, and it classified these events into five groups, based on their estimated impact.

This study is relevant to both practitioners and researchers. It provides practitioners with a simple and straightforward tool to assess and prioritise the impact of uncertain events on highway construction projects, and it provides researchers with a qualitative and quantitative methodology and a mathematical model for use in evaluating the effect of uncertain events on highway construction projects in South Africa. The SRA was used in assessing the impact of uncertain events on highway construction completion time, due to the fact that the model has a strong mathematical background and has been employed in assessing risk and uncertainty in the field of construction management. The study found the SRA model to be a reliable and statistically significant method for assessing uncertainty on construction projects. However, the accuracy of the estimated impact of some of the models is low. Therefore, to accurately estimate the impact of these events, the study recommends using a systematic fuzzy inference system, such as an adaptive neuro-fuzzy inference system (ANFIS).

The detailed analysis and estimated outputs from this research should be used as a platform and a benchmark for future studies in highway construction in South Africa. This platform should be utilised for estimating the duration of highway construction projects accurately, by assessing the uncertain events that impact on the completion time of each construction activity.

7. ACKNOWLEDGEMENTS

Funding from the National Research Foundation (NRF) towards this research is hereby acknowledged. Opinions expressed, and conclusions arrived at, are those of the authors, and are not necessarily to be attributed to the NRF.

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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RESOLVING CLIENT-LINKED DELAYS IN CONSTRUCTION PROJECTS IN INDIA

Dillip DAS[1] and Fidelis EMUZE[2]

[1] Department of Civil Engineering, Central University of Technology, Free State, South Africa, Tel.: +27 51 507 3647, Email: ddas@cut.ac.za

[2] Department of Built Environment, Central University of Technology, Free State, South Africa

ABSTRACT

Client-linked delays are prevalent in construction projects in India. Using the survey research method and the principles of system dynamics modelling, this study examined the influence of various client-induced factors that cause delays in construction projects, and the mechanisms that have been developed to resolve the challenge of delays in construction projects in the Indian context. The findings suggest that delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, and delays in furnishing and delivering the site to the contractor by the owner are the major client/owner-related factors which cause delays. The mechanisms developed suggest that timely decision-making, reinforced by availability of the requisite information and effective communication, together with availability of funds and an adequate budget allocation, can ensure timely progress of payment, which essentially should be able to reduce construction delays.

Keywords: client, communication, construction, funds, system dynamics modelling

1. INTRODUCTION

The construction industry is a significant contributor to the Indian economy. It is estimated that it has accounted for about 6% to 9% of the gross domestic product (GDP) of the country in the last five years. The sector is also generating substantial employment consistently, and it is predicted that employment will grow at a rate of about 8% to 9% per year, which is expected to add about 2.5 million jobs per year. However, despite this economic potential, the construction industry is faced with the challenges of low productivity, and time and cost overruns, which range from 20–25% in building projects to 50% in other sectors, such as the power, petroleum and railway sectors (Ernst & Young, 2011; Gupta et al., 2009). More notably, delays are a major cause of concern in the majority of construction projects in India.

A number of investigations have been conducted to explore the intrinsic factors and the causes of delays; these investigations are reported in the mainstream project

management and construction management research literature (Assaf and Al-Hejji, 2006; Aiyetan and Das, 2016; Das, 2015; Doloi, Sawhney, Iyer and Rentala, 2012; Iyer and Jha, 2005). Evidence from various investigations suggests that availability of qualified professionals, quality performance, time, and cost are major challenges faced by the construction industry. Time overruns are the most significant factor that results in cost escalation. Such challenges have been cited by various stakeholders, namely clients, contractors, consultants, and designers, etc. However, client/owner-related factors are argued to be major concerns of delays, in addition to other factors linked to the contractor, the design, the equipment, project management, etc. The literature also suggests that although the client-linked causes and factors of delays have been identified, it is contended that most studies have failed to examine how the identified causes work together in a mechanism and influence the occurrence of delays (Doloi, Sawhney, Iyer and Rentala, 2012).

It is therefore argued that area-specific identification of the causes and factors of delays without an understanding of the collective influence of delays on schedule performance does not provide a convincing argument for preventing delays in the context of Indian construction projects (Doloi, Sawhney, Iyer and Rentala, 2012). This is because an understanding of the mechanisms that cause delays, and causal relationships, is pivotal to quantify schedule performance under various scenarios and to develop policy interventions to reduce delays and improve schedule performance. So, the main concern remains with the lack of understanding of the causal relationships between the factors and the mechanisms, and not foreseeing unwarranted events that cause delays. In the Indian context, it is also observed that investigations on causes of delays because of client or owner attributes are limited. Moreover, there has scarcely been any significant research conducted on the interlinkage of the various client-linked factors, which develop mechanisms that engender delays in construction. In other words, investigations relating to development of policy/strategic interventions or mechanisms based on the causal relationships between the client-induced factors, to resolve the challenge of delays in construction projects in India, are observed to be scarce.

Therefore, the objectives of the article are to examine the influence of various client-related factors causing delays in construction projects in the Indian context, and to develop mechanisms based on the causal feedback relationships between the various client-related factors influencing delays in construction projects, which could assist project stakeholders to identify the activities and events, understand the interlinkage between the variables that cause delays, and make appropriate policy interventions to resolve the challenge of delays in construction projects.

The investigation was conducted using survey research methodology and the system dynamics (SD) modelling approach. The findings suggest that delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, and delays in furnishing and delivering the site to the contractor by the owner are the major client/owner-related factors which cause delays. These variables are interlinked with

each other and function in causal feedback mechanisms, creating a chain of actions, which influence the occurrence of delays. Remedial mechanisms involving timely decision-making, reinforced by availability of the requisite information and effective communication, together with availability of funds and an adequate budget allocation, can ensure timely progress of payment, which essentially can reduce construction delays in construction projects in India.

2. LITERATURE REVIEW

Delays in construction can be defined as the time overruns either beyond the contract date specified in a contract or beyond the date that the parties agreed upon for delivery of a project. Generally, it is the additional days of work for completion of a project/activity or as a delayed start of an activity (Assaf and Al-Hejji, 2006; Stumpf, 2000). Since the construction process is subject to many variables and unpredictable factors, delays are found to be inevitable, and they become an integral part of the project's construction life. Even with the availability of advanced technology, and understanding of project management techniques, construction projects continue to suffer delays (Stumpf, 2000). The sources of delays are varied, and they include the performance and involvement of stakeholders, resource availability, environmental conditions, and contractual relationships, among others (Alaghbari et al., 2007; Odeh and Battaineh, 2002). Scholars such as Al-Barak (1993), Al-Momani (2000), Chan and Kumaraswamy (1997), Kaming et al. (1997), Kumaraswamy and Chan (1998), and Noulmanee et al. (1999) have studied the causes of delays in different projects, and they have found that causes of delays vary with context and project environment. Some of the most important factors responsible for time overruns and delays are design changes, poor labour productivity, inadequate planning, and resource shortages (Al-Momani, 2000; Kaming et al., 1997; Kumaraswamy and Chan, 1998). Lack of organisational support, poor health and safety, rework, extra work, external factors such as unavailability of utilities, government law and regulations, etc. also cannot be underestimated (Aiyetan and Das, 2015; Iyer et al., 2008). However, scholars have also established that client-related factors contribute significantly to project delays. For instance, Chan and Kumaraswamy (1997) found that slow decision-making by clients and client-initiated variations are the major causes of delays.

Although from the literature published over the past few decades, it is observed that there is a high degree of similarity in the delay factors across many projects, the factors associated with the construction industry in India do not necessarily follow the same pattern (Ernst & Young, 2011). In the Indian context, although some scholars have established that inadequate design and planning, coupled with scope creep, regulatory hurdles, and contractor- and consultant-related factors, are the primary reasons for time overruns in Indian construction projects, the role of owners in causing delays is considerable (Aswathi and Thomas, 2013; Doloi, Sawhney, Iyer and Rentala, 2012; KPMG and PMI, 2012; Ndekugri et al., 2007; Singh, 2010). Factors such as delays in progress of payment by the owner, delays in furnishing and delivering the site to the contractor by the owner, change orders by the owner during construction, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, poor communication and coordination by the owner and other parties, slowness in decision-making by the owner,

unavailability of incentives for the contractor to finish ahead of schedule, and suspension of work by the owner also cause delays (Assaf and Al-Hejji, 2006; Desai and Bhatt, 2013; Doloi, Sawhne and Iyer, 2012).

However, it is seen that although many of the factors are interlinked and have cause-and-effect relationships (Assaf and Al-Hejji, 2006; Chan and Kumaraswamy, 1997; Das, 2015; Das and Emuze, 2017; Odeh and Battaineh, 2002; Frimpong et al., 2003; Manavazhi and Adhikari, 2002; Sambasivan and Soon, 2007), explicit studies relating to causal feedback relationships and their influence on construction delays are found to be limited. So, the importance of early identification of construction delays and development of a causal interlinkage between the factors, to engender delay-reducing remedies, has been stressed (Alaghbari et al., 2007; Sweis et al., 2008).

3. RESEARCH METHODOLOGY

The survey research method was employed to collect primary data from the various stakeholders in construction projects in Odisha state of India. The survey was conducted using a pretested questionnaire. The questionnaire was developed by incorporating most of the key factors under the client attributes causing delays, as observed from various sources (Aswathi and Thomas, 2013; Desai and Bhatt, 2013; Doloi, Sawhney, Iyer and Rentala, 2012; Odeh and Battaineh, 2002; Lo et al., 2006; Satyanarayana and Iyer, 1996; Semple et al., 1994), and testing and fine-tuning them through a pilot survey in the study area.

A total of 120 questionnaires were administered to various professionals and stakeholders, who were selected from 28 large and medium construction projects in Odisha state of India through a random selection process. Table 1 presents the profile of projects and respondents used for the survey. The various construction projects from which respondents were selected for the survey include building (39.2%), road (21.4%), bridge (14.28%), railway (7.14%), power plant (7.14%) and industrial complex (10.71%) projects. The respondents include project managers (16.67%), architects (10.78%), engineers and designers (13.73%), skilled technicians (8.82%), consultants (11.76%), estimators (quantity surveyors) (10.78%), contractors (12.75%), and clients/owners (12.75%), who were surveyed through the semi-structured interview method. From the survey, of the 120 questionnaires administered, 102 responses were returned, which equates to a response rate of 85%.

Table 1: Profile of respondents

Project characteristics			Characteristics of respondents			
Type of project	**Number**	**Percent**	**Respondents**	**Number**	**Percent**	**Average industry experience (range in years)**
Buildings	11	39.28	Owners/clients	13	12.75	14–22
Roads	6	21.42	Project managers	17	16.67	8–15
Bridges	4	14.29	Consultants	12	11.76	7–18
Railways	2	7.15	Architects	11	10.78	6–15
Power plants	2	7.15	Engineers	14	13.73	13–20
Industrial complexes	3	10.71	Contractors	13	12.75	12–21
Total	28	100.00	Estimators	11	10.78	5–14
			Skilled technicians	9	8.82	4–16
			Total	102	100	8.6–17.6

The respondents were asked to assess the perceived influence of the measured attributes in the form of an affirmative question, by selecting one of the projects in which they had participated. A five-point Likert scale (1 = not influential, 2 = less influential, 3 = somewhat influential, 4 = significantly influential, and 5 = most influential) was adopted to guide the participants to provide their objective responses for various degrees of influence of client-related factors on construction delays (Doloi, Sawhney, Iyer and Rentala, 2012; Gravetter and Wallnau, 2009).

A quantitative descriptive statistics analysis and a Cronbach's alpha test of the data collected were conducted to observe the reliability of the data. A Likert scale was employed to measure the relative influence of the variables in terms of a delay index (DI) (as obtained from the surveyed data) causing delays. The delay index is the mean score achieved from the responses of the respondents. Conceptual models using SD modelling principles (Forrester, 1968; Sterman, 2000), based on the systems thinking process (Von Bertalanffy, 1974), were then developed. The construction project was considered as the system, or the environment, while developing the model. The influential variables, their positive and negative influences on the related variables, and the causal relationships between them were used to develop the conceptual SD models. The causal relationships between the variables within and across the major parameters were developed based on the evidence observed from the literature, as well

as discussions conducted with and the experiences of the professionals surveyed. The causal relationships were developed using a systematic process. First, the variables of information, decisions, actions, and environment (system) were identified (Olaya, 2012). Second, the variables were connected with simple one-way causality, in terms of one-way linkages of information, decisions, and actions impacting on the environment with their influence (i.e., information assisting in making decisions (policy interventions), decisions leading to appropriate actions, and actions influencing the environment (the system)) (El Halabi et al., 2012; Olaya, 2012; Vennix, 1996). Third, once the one-way causalities were established, the feedback relationships were checked and established. Fourth, the constructed causal feedback relationships were then discussed with the professionals and experts in the field to check the validity of the causal diagrams, and relevant modifications with respect to the names of the variables, their polarity, and causal relationships, as need be, were made. Finally, modifications and amendments to the causal relationships and conceptual models and validation were made to develop the final causal feedback relationships and conceptual model. The valid causal feedback diagrams (causal loop diagrams) were then employed to develop the conceptual SD models.

4. RESULTS, CONCEPTUAL SD MODELS, AND MECHANISMS

4.1 Major client-related factors causing construction delays

Table 2 presents the client-related factors and their level of influence on construction delays. The high Cronbach's α value (0.93) shows the reliability and acceptability of the data. It is observed that the standard deviations (SDs) are also within an acceptable range, which shows that there was low variation in the responses of the respondents. So, the results are considered as acceptable and can be used for further analysis. From Table 2 it is evident that delays in progress of payment by the owner (DI=4.35), slowness in decision-making by the owner (DI=4.20), change orders by the owner during construction (DI=4.10), poor communication and coordination by the owner and other parties (DI=4.05), lateness in revising and approving the design documents by the owner (DI=3.95), delays in approving the shop drawings and sample materials by the owner (DI=3.85), and delays in furnishing and delivering the site to the contractor by the owner (DI=3.65) are the major client/owner-related factors which cause delays. Factors such as suspension of work by the owner (DI=3.20) and unavailability of incentives from the client to the contractor to finish ahead of schedule (DI=2.85) have less impact on delays in construction.

Table 2: Significance of attributes and factors influencing delays in construction

Group/ attribute	Factor	Delay index (DI) (Likert-scale mean score)	SD	Cronbach's α	Rank in the group	General rank across the groups
Client/ owner	Delays in progress of payment by the owner	4.35	0.34	0.93	1	1
	Delays in furnishing and delivering the site to the contractor by the owner	3.65	0.27		7	13
	Change orders by the owner during construction	4.10	0.32		3	5
	Lateness in revising and approving the design documents by the owner	3.95	0.33		5	7
	Delays in approving the shop drawings and sample materials by the owner	3.85	0.38		6	9
	Poor communication and coordination by the owner and other parties	4.05	0.35		4	6
	Slowness in decision-making by the owner	4.20	0.32		2	3
	Unavailability of incentives from the client to the contractor to finish ahead of schedule	2.85	0.26		9	21
	Suspension of work by the owner	3.20	0.22		8	19

4.2 Conceptual models, understanding of the causal feedback relationships responsible for client-induced delays, and possible mechanisms to reduce delays

Considering the influence of the factors as discussed above, conceptual SD models have been developed to understand the dynamic causal feedback relationships between the factors which cause delays, and to develop possible mechanisms that can assist in developing policy interventions to reduce or eliminate delays in construction. In the model, the causal feedback relationships (loops) which essentially balance or disrupt

the system (construction projects), and consequently promote delays, are identified by balancing loops (Bs). By contrast, the causal feedback loops which reinforce smooth functioning of the system, and consequently assist in reducing or eliminating delays, are identified by reinforced loops (Rs). The causal feedback relationships between the influential factors and the conceptual SD model are presented in Table 3 and Figure 1, respectively.

4.2.1 Causal feedback relationships, and the conceptual SD model

As mentioned in section 4.1, and as seen from Table 2, delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, and delays in approving the shop drawings and sample materials by the client are the major client/owner-related factors which cause delays, although other factors contribute to a lesser extent. It is observed that there exist cause-and-effect relationships between these factors, and that they work through a causal feedback mechanism (see Table 3). Figure 1 depicts the conceptual SD model based on such causal feedback relationships. As shown in Figure 1, slowness in decision-making leads to delays in progress of payment, which cause delays and disrupt the system, through balancing loop B1. Also, poor communication leads to slowness in decision-making, and vice versa, through balancing causal feedback sub-loop B1A. So, sub-loop B1A aggravates the actions of balancing loop B1. Besides, factors such as change orders during construction, delays in approving the shop drawings and sample materials, late approval of revision of design, and delays in furnishing the site delivery by the client are influenced by slowness in decision-making, and vice versa. By contrast, effective communication between stakeholders (which can be enhanced by coordination between them) will assist in decision-making, which will facilitate timely payment, and consequently will assist in reducing construction delays from the client's side. However, to achieve this, measures such as coordination between stakeholders, which will lead to effective communication, availability of the requisite information, to aid timely decision-making, and availability of funds and an adequate budget allocation, which will allow for timely payment, are necessary.

Thus, the feedback mechanism involving effective communication, timely decision-making, and timely payment will promote a reduction in delays, through reinforcing loop R1. As a result, the disrupting effects of feedback mechanisms B1 and B1A are balanced, or negated, by feedback mechanism R1. So, the causal feedback relationships between communication, decision-making, progress of payment, and construction delays are the dynamic hypotheses, which influence delays, and they need to be attended to, so as to develop remedial mechanisms to alleviate the problem.

Table 3: Cause-and-effect relationships between client-related factors

Cause	Effect	+/–	Sources
Slowness in decision-making by the owner	Delays in progress of payment by the owner	+	Aibinu and Odeyinka (2006); Al-Kharashi and Skitmore (2009); Odeh and Battaineh (2002); Semple et al. (1994)
Delays in progress of payment by the owner	Delays in construction	+	
Poor communication and coordination by the owner and other parties	Slowness in decision-making	+	Ahsan and Gunawan (2010); Aibinu and Odeyinka (2006); Assaf et al. (1995); Abd El-Razek et al. (2008); Lo et al. (2006); Semple et al. (1994)
Delays in furnishing and delivering the site to the contractor by the owner	Slowness in decision-making	+	Aibinu and Odeyinka (2006); Al-Kharashi and Skitmore (2009); Odeh and Battaineh (2002); Faridi and El-Sayegh (2006); Semple et al. (1994)
Change orders by the owner during construction	Slowness in decision-making	+	
Lateness in revising and approving the design documents by the owner	Slowness in decision-making	+	
Delays in approving the shop drawings and sample materials by the owner	Slowness in decision-making	+	
Unavailability of incentives for the contractor to finish ahead of schedule	Delays in progress of payment by the owner	+	Aibinu and Odeyinka (2006); Al-Kharashi and Skitmore (2009); Odeh and Battaineh (2002); Semple et al. (1994)
Coordination between stakeholders	Effective communication	+	Ernst & Young (2011); KPMG and PMI (2012)
Availability of the requisite information	Timely decision-making	+	
Availability of funds and an adequate budget allocation for the project	Timely progress of payment	+	
Effective communication	Timely decision-making	+	
Timely progress of payment	Delays in construction	–	

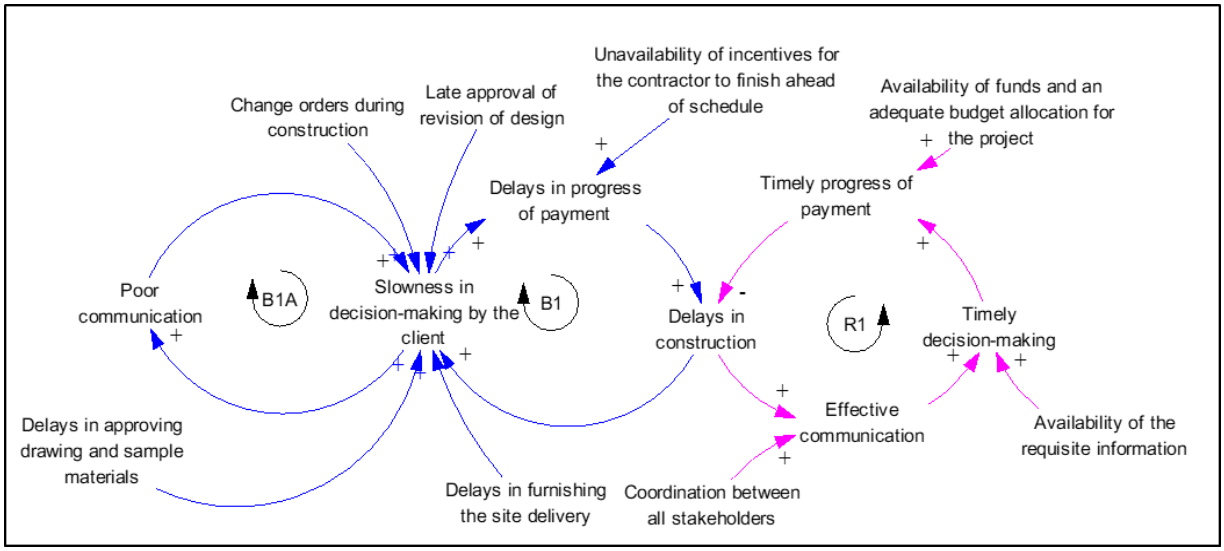

Figure 1: An SD model based on causal feedback relationships between the client/owner-related factors causing delays

4.3 Validation of the causal relationships

Validation of the causal relationships and SD models is crucial before using them for deriving mechanisms for policy/strategic interventions. So, the causal relationships and SD models were discussed with a different set of professionals and experts to those from the construction industry who were consulted during the survey, so as to validate the causal relationships used in the models (as mentioned in the methodology section). Based on the suggestions and judgements of the experts, the constructed causal relationships were adjusted, and the models were refined, so as to represent real scenarios in the construction project environment. Besides this, the validity of the causal relationships was also tested qualitatively, through test structure verification (where the cause-and-effect relationships were verified).

4.4 Mechanisms for policy interventions

Figure 2 depicts the causal feedback mechanisms derived from the dynamic hypotheses that are obtained from the SD models, based on which policy interventions can be derived. It shows how construction delays are influenced by various client-related factors. First, they are influenced by slowness in decision-making by the client, which is caused by several factors, such as poor communication, change orders during construction, delays in approving the shop drawings and sample materials, lateness in approving the revised design, and delays in furnishing the site delivery. Second, they are influenced by delays in progress of payment, which are essentially caused by slowness in decision-making. These variables are found to be connected in a chain of actions. However, timely decision-making, which is one of the most significant

variables, can be reinforced by availability of the requisite information and effective communication. Timely decision-making, together with availability of funds and an adequate budget allocation, will ensure timely progress of payment, which essentially should be able to reduce construction delays.

The mechanisms as depicted in Figure 2 also indicate that all the factors are linked to each other through a chain of actions activated by causal relationships, and they influence each other through appropriate feedback mechanisms. Figure 2 also clearly shows how the factors influence each other, and how the mechanisms work. So, the mechanisms provide the scope to diagnose the challenges at various stages of the construction work, on which timely and appropriate interventions can be taken to address the problem, which will assist in reducing delays in construction projects.

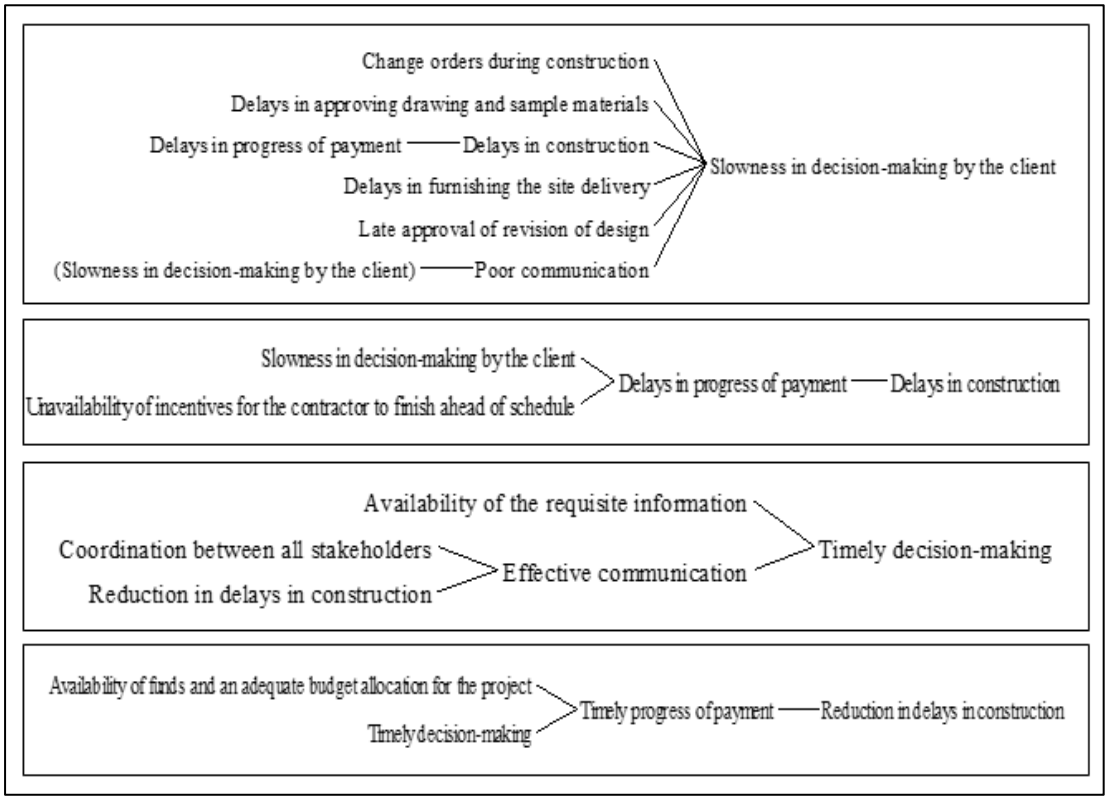

Figure 2: Mechanisms to understand client-related construction delays, and ways to reduce them

5. CONCLUSION

Delays in construction projects are a menace, particularly in India. They lead to appreciable overruns in both cost and time. Although there are plenty of studies that have been conducted to investigate the causes of construction delays, which vary depending on the context, there are several causes that are observed to be common in most of the projects. However, there is a paucity of literature available on the

mechanisms which could aid in developing policy interventions to reduce or eliminate construction delays. This gap in the research has warranted this investigation.

The investigation examined the various client-induced factors that influence the occurrence of project delays in construction, and it developed mechanisms based on the causal feedback relationships between the various client-related factors influencing delays in construction projects. To realise the objectives of the investigation, the survey research method was used, followed by development of a conceptual SD model. Before the conceptual SD model was developed, an evaluation was conducted based on a delay index developed with the exploratory survey data obtained from construction projects in India. It was revealed that delays in progress of payment by the owner, slowness in decision-making by the owner, change orders by the owner during construction, poor communication and coordination by the owner and other parties, lateness in revising and approving the design documents by the owner, delays in approving the shop drawings and sample materials by the owner, and delays in furnishing and delivering the site to the contractor by the owner are the major client/owner-related factors which cause delays. The mechanisms from the SD model indicate that delays are influenced by slowness in decision-making by the client, which is caused by poor communication, change orders during construction, delays in approving the shop drawings and sample materials, lateness in approving the revised design, and delays in furnishing the site delivery. Furthermore, delays in progress of payment, which essentially cause delays in construction, are engendered by slowness in decision-making. However, timely decision-making, reinforced by availability of the requisite information and effective communication, together with availability of funds and an adequate budget allocation, can ensure timely progress of payment, which essentially should be able to reduce construction delays.

The major contribution of the article is that it explicitly shows the causal feedback relationships between the client-induced variables causing construction delays, and it shows the mechanisms on which they work, in a chain of actions, reference to which is scarce in the existing body of literature. The article also goes beyond identification of the causes of delays and their level of influence, offering ways to develop mechanisms for diagnosing the problems at different stages of construction work, and to develop policy interventions to take remedial measures. It also offers a methodological avenue to analyse construction delays by using SD principles.

The article has its limitations, however. The obvious limitations are that the modelling was done conceptually, although the basic premise behind it was to see the challenge of delays in a more critical way. However, there is a need for the quantitative modelling to examine the extent to which construction delays can be reduced or eliminated under different scenarios of strategic/policy interventions, based on the dynamic hypotheses derived from the conceptual model, in which there is scope for further research.

6. ACKNOWLEDGEMENT

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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COLLABORATION AND LONG-TERM RELATIONSHIPS IN CONSTRUCTION

Calistus AYEGBA[1], Xebiso B KAMUDYARIWA[2], and David ROOT[3]

[1] School of Construction Economics and Management, University of the Witwatersrand, PO Box 2050, Johannesburg, South Africa, Email: Calistus.Ayegba1@students.wits.ac.za

[2] School of Construction Economics and Management, University of the Witwatersrand, PO Box 2050, Johannesburg, South Africa

[3] School of Construction Economics and Management, University of the Witwatersrand, PO Box 2050, Johannesburg, South Africa

ABSTRACT

There is increasingly a shift away from traditional contracting practices to collaboration and long-term relationships (CLR) contracts in the construction industry. The purpose of this article is to examine dimensions of CLR practices from a construction perspective. The research methodology employed is based on desk research. This involves the collection of secondary data on CLR practices. NVivo Pro 2011 software was used to aid analysis of the multiple articles. The findings indicate that top management commitment, a willingness to learn from and to support the parties, mutual trust, complete integration of project team members, and efficient and open communication are some of the requirements for CLR. The procurement strategies that internalise CLR practices in construction are reported to be framework contracts, partnership, and alliance contracting. However, these approaches are shown to be appropriate for specific kinds of clients, suppliers and projects. Consequently, the selection of parties to go into these procurement strategies for CLR becomes critical to achieve the benefits that CLR has been shown to deliver. This will ensure that scarce resources are only dedicated to relationships and processes that will genuinely benefit and support CLR. The knowledge and understanding generated by the study will be useful in encouraging construction stakeholders to appreciate the need for CLR practices and to embrace CLR approaches.

Keywords: alliancing, collaboration, framework contracts, long-term relationships, partnership

1. INTRODUCTION

The interest in collaboration and long-term relationships (CLR) arrangements has been one of the concerns of the construction industry in recent years. This may be attributed to the industry's response to the failings of traditional contracting practices, as a result of their characteristics, which are shown in Table 1. Thus, a shift away from traditional contracting practices to CLR contracts is advocated for the construction industry. The dominant references for this change are Latham's (1994) *Constructing the team* and Egan's (1998) *Rethinking construction* industry reports. These reports suggest a change in culture and a move towards teamwork, collaboration, and supply chain management of projects. As a result, there has been growing adoption of strategies that create an opportunity for CLR in construction. Hence, several studies exist on CLR arrangements by researchers in construction and project management studies. Some of these studies have used the compound

term “long-term collaborative relationships” to imply CLR (e.g., Donohoe and Coggins, 2016; Kumar et al., 2016; Wang et al., 2016; Chang et al., 2015; Challender et al., 2014; Meng, 2013; Ylitalo et al., 2005).

CLR practices are increasingly being adopted in the construction industry globally, owing to their success in the manufacturing and service sectors, where the strategies are seen as a vehicle to maximise value, levels of quality, and service delivery (Khalfan et al., 2014; Meng, 2013; Frödell, 2011; Naoum, 2003; Saad et al., 2002). The approach has been shown to be mutually beneficial to both clients and contractors when adopted for project delivery. However, some clients do not see it as a promising strategy, particularly during economic meltdown and recessions (Donohoe and Coggins, 2016; Challender et al., 2014; Meng, 2013). Sanchez (2012) and Saad et al. (2002) reported that CLR approaches require a longer time, more effort, resources, and commitment to develop. Also, due to power dynamics resulting from the dominance of some clients in the approach, some contractors do not embrace the approach in contract relationships (Rinkus et al., 2016; Chicksand, 2015). Furthermore, issues around contractors becoming complacent, and the inability to prosecute rights under such contracts, have been raised (Palaneeswaran et al., 2003; Black et al., 2000). These issues suggest a limited understanding of the concept of CLR practices, and a tendency to view such strategies through the lens of traditional procurement practices. This article will therefore strive to create a better understanding of the issue, by examining the requirements and practices of CLR in construction, as well as the strategies that harness CLR in the construction industry, and it will suggest that a reconceptualisation is required to rebase the premise of these strategies.

Table 1: Characteristics of traditional contracting practices

Author(s) & year	Paper title	Source	Characteristics
Akintan and Morledge, 2013	Improving the collaboration between main contractors and subcontractors within traditional construction procurement	*Journal of Construction Engineering*	Main contractors and subcontractors pursue their self-interests Mostly preferred by once-off clients Engender adversarial attitudes Prone to conflicts and disputes A lack of focus on customers’ requirements, and failure to satisfy clients’ needs Delivery processes are still mostly disconnected Contract terms are often very strictly and litigiously applied
Challender et al., 2013	Collaborative procurement: An exploration of practice and trust in times of austerity	ARCOM conference proceedings	Short-term contracts A constant quest for the lowest initial bid price Open and competitive traditional bidding
Challender et al., 2014	Partnering in practice: An analysis of collaboration and trust	*Proceedings of the Institution of Civil Engineers - Management, Procurement and*	Competitive procurement methods, based on lowest cost Risk-averse work practices They are limiting the scope for knowledge sharing across projects

		Law	They are hampering familiarisation of project teams and learning from experiences. They are reducing innovation and investment within the sector
Rowlinson and Cheung, 2004	A review of the concepts and definitions of the various forms of relational contracting	International Symposium of CIB	Adversarial in nature Contractors are selected mainly by lowest price Superintendents see their role as gatekeepers, safeguarding the client's interests
Khalfan et al., 2014	Building trust in construction projects	*Supply Chain Management: An International Journal*	Rigid flow of communication Adversarial approach to construction projects
Lloyd-walker et al., 2014	Enabling construction innovation: The role of a no-blame culture as a collaboration behavioral driver in project alliances	*Construction Management and Economics*	Tend to be risk-averse Characterised by blame and litigation Designers have the most power and influence Require each participant to look after the interests of their own organisation Involve pursuing a 'claims mentality'
Palaneeswaran et al., 2003	Curing congenital construction industry disorders through relationally integrated supply chains	*Building and Environment*	Transactional contracting approach Fragmented and disjointed transactions and processes Short-term visions Adversarial relationships Unhealthy competition Purely price-based selections Incomplete contracts Numerous change orders and claims Improper risk-shedding tactics Disputes and breaches of contract, leading to litigation Client acts as 'watchdog', with control measures (such as warning letters and penalties)
Spekman, 1988	Strategic supplier selection: Understanding long-term buyer relationships	*Business Horizons*	Clients rely on a large number of suppliers to gain price concessions Clients assume an arm's-length posture Use of only short-term contracts
Suprapto et al., 2015	Sorting out the essence of owner-contractor collaboration in capital project delivery	*International Journal of Project Management*	Confrontational interactions between owner and contractor Too much emphasis on formal mechanisms (i.e., contracts, tools, and techniques)

2. METHODOLOGY

The research methodology employed to address the aim of the study is based on desk research of publications on CLR. First, to gather relevant publications to obtain data for the study, a bibliographic survey was conducted via Scopus, using the string of words "collaboration and long-term relationships". The Scopus database was chosen because it is the largest abstract and citation database of peer-reviewed literature, consisting of scientific journals, books, and conference proceedings across various disciplines. Searching within the titles, keywords and abstracts in the Scopus database yielded a total of 749 document results on this topic from 69 countries since 1970 across several subject areas, with most of the documents (up to 90%) being published after the year 2000. However, papers which are not strongly related to the field of interest of this study and construction, such as publications on medical and natural sciences subjects, were excluded in the search. Also, on downloading some documents, other articles closely related to the topic articles were identified by the search engine and were also downloaded for the study. The final number of articles reviewed in the study was 96.

The collected articles were then imported into the NVivo Pro 2011 software, to quickly identify prominent words and phrases, as well as key concepts, across the multiple articles. In the NVivo software, the word frequency query was carried out using the 50 most frequent display words, with stemmed word settings, and then the word cloud tab was used to identify the keywords from all the text. This enables exploration of trends and ideas that are prevalent in the articles, and identification of what authors are frequently writing about on collaboration and long-term relationships. The result indicated several themes in the research area (collaboration and long-term relationships). However, the theme of interest in this study is the requirements and practices/process of CLR. So, from the several themes on the word cloud, a text search query was carried out on the themes of requirements and practices. This was followed by clicking the reference tab, upon which a list of articles with a bit of context appears. Nodes were created for these themes, and significant reports from each author were coded and saved into the nodes. (A node is a bucket in which related materials are gathered into one place, so that one can easily look for emerging patterns or ideas.) Nodes were also created for other relevant aspects of the study, namely framework contracts, partnership, and alliance contracting, which were indicated from the analysis as the practices that internalise collaboration and long-term relationships in construction. Within the nodes, other sub-nodes that were established in the study were definitions and descriptions of key concepts, benefits, requirements, and challenges. All relevant text was coded into the nodes and sub-nodes, and aspects that are of interest and are essential to the study were then integrated into the study.

3. COLLABORATION

Collaboration is defined as a mutually beneficial and well-defined relationship between two or more organisations working together to achieve common goals (Mattessich and Monsey, 1992). Wilkinson (2005) defines collaboration as a creative process undertaken by two or more interested organisations, sharing their collective skills, expertise, understanding and knowledge in an atmosphere of openness, honesty, trust, and mutual respect, to jointly deliver the best solution that meets their common goal. According to Saunders et al. (2012), collaboration means building a democratic approach to communication and decision-making when constructing, planning, taking and evaluating each action research stage or cycle. Some of the motivation for collaboration is that collaboration enables access to more resources through sharing with other parties; it allows access to new technology domains and knowledge transfer for business enhancements. (Ylitalo et al., 2005). Gadde and Snehota

(2000) suggest that collaboration is a function of the volume of business for the buying organisation. As it is a more appropriate relationship to adopt when a supplier relationship represents a major volume of business for the buyer, and, conversely, when the transaction size or volume of business is low, an arm's-length relationship may be suitable (Gadde and Snehota, 2000).

The factors that encourage collaboration between two or more organisations when working together are indicated to include top management commitment, and mutual and shared understanding about the goals of cooperation. Other factors are a willingness to learn from and to support the partner, mutual trust, complete integration, effective communication, risk and reward sharing, and a clear definition of responsibilities (Cha and Kim, 2018; Meng, 2013; Anbanandam et al., 2011; Ylitalo et al., 2005). Collaboration is found to be a suitable means of nurturing relationships among contracting parties, achieving better project performance and greater end user satisfaction (Ning et al. 2013).

Collaboration has been indicated to have the benefit of maximising efficiency, improving profitability, reducing waste, contributing to more valuable relationships, and enabling benchmarking of current levels of practice against best-in-class performers (Cha and Kim, 2018; Shepherd and Günter, 2006; Greenbaum, 2004). It creates a free and open environment, where the aim is to learn from each other and employees can air their views without hesitation, and it gives access to unique capabilities and resources to all involved (Soosay et al., 2008; Squire et al., 2006). These benefits may not be available in the traditional practices of arm's-length relationships, where parties act in self-interest, without any special obligation to the other party. Mattessich and Monsey (1992) submit that with collaboration, individual expenses can be reduced in planning, research, training, and other development activities in the early stages of a new initiative. Also, they suggest that through collaboration, overhead expenses are shared, and duplication of costs and effort is avoided. Glover (2008) submits that such an arrangement is designed to encourage a certain degree of sharing of information; therefore, it is necessary for parties to be open and honest with each other in such relationships. Thus, a collaborative working arrangement is seen as key to improved efficiency and enhanced innovation in construction (Kadefors et al., 2007). Li, L. et al. (2012) argue that with a collaborative working arrangement, there is a higher chance of buyers achieving greater success with suppliers, and it should be the right strategy for major contracts if an element of challenge, competition and value is retained in such a relationship. Collaborative working arrangements are also reported to reduce project costs and secure operational efficiencies (Tennant and Fernie, 2010). This is because of the opportunity to share costs collaboratively.

However, Lawson et al. (2006) suggest that although collaboration improves performance, it costs money in terms of coordination, communication, adaptation, and commitment to achieve it. This may hinder its adoption in times of austerity. Also, the pursuit of self-interest and the element of power dynamics in situations where clients engage for collaboration while retaining authority and responsibility makes collaborative working impossible to achieve (Akintan and Morledge, 2013; Sanchez, 2012). Therefore, clients must genuinely open up a conversation and empower people to collaborate with one another, while retaining the direction and greater effort is required in negotiating the interests of various stakeholders in collaboration (Sanchez, 2012). Nevertheless, even though the collaborative arrangement is not without risks, the gain is argued to exceed the potential risks (Spekman, 1988).

4. LONG-TERM RELATIONSHIPS

A long-term relationship, also referred to as a "strategic relationship", is a relationship that requires long-term commitment, upon which a series of projects can be delivered over a specified number of years (Filippetti and D'Ippolito, 2017; Jones and Kaluarachchi, 2007). Such relationships allow for firms to internalise the value of knowledge generated across organisational boundaries over time (Filippetti and D'Ippolito, 2017). This contrasts with the traditional practices of short-termism and discrete contracts, where new supply chain arrangements must be established for every project. Long-term relationships are suggested to be suitable for projects involving repeat clients, where the continuity of work from the client stabilises the relationship, where suppliers supply scarce or high-value products and where the complexity of the supply market is high, and where the product is of great importance to the client (Meng, 2013; Spekman et al., 1998; Kraljic, 1983).

Several previous studies report benefits associated with long-term relationships. For example, Cadden et al. (2015) submit that parties in a long-term relationship can review the credibility of one another, reward truth-telling, and penalise for breaches or defaults. Thus, long-term relationship provides the right incentive for truthful information sharing. Other studies indicate the benefits of long-term relationships to include the following: they offer stable business relationships, resulting from continuity of work; they allow for aligning specific objectives between parties, they enable the development of a particular way of working that adds value to production, and they create an atmosphere of trust and commitment. Others benefits are: they ensure the provision of technological and managerial assistance and exchange of information during the product development and production stages (Filippetti and D'Ippolito, 2017; Meng, 2013). Also, long-term relationships increase the level of cooperation in terms of coordination, participation, and joint problem solving (Mohr and Spekman, 1994).

Different industries have adopted the long-term relationship approach in delivering projects. Fujimoto (1999) asserted that in the automotive industry some clients prefer to deal with suppliers on a long-term basis. Khalfan et al. (2014) suggested that the approach can be used for providing projects such as school buildings, social housing stock, maintenance and improvement projects in the UK. Meng (2013) reported a wider acceptance of the approach in the UK for school building projects, as 33.3% of school building projects were said to have adopted the long-term relationship approach. However, they reported that the short-term, project-specific approach as practised in traditional contracting is initially employed when dealing with a contractor for the first time, so as to establish suitability for a long-term relationship. A similar practice was reported in a study on "innovative construction procurement" at the University of the Witwatersrand (Laryea and Watermeyer, 2014). This could be an expensive and high-risk selection mechanism to practise, but it indicates that good performance from the first work by a supplier provides the foundation for going into a long-term relationship. Ellram and Martha (1990) argued that paying more attention to a supplier's development potential and future plans is an essential consideration for a long-term relationship. Nevertheless, trust and openness between clients and suppliers that enable mutual learning and competency development are the significant factors that have a positive effect on the long-term orientation of the relationship (Filippetti and D'Ippolito, 2017; Bäck and Kohtamäki, 2015; Anbanandam et al., 2011; Ylitalo et al., 2005).

5. COLLABORATION AND LONG-TERM RELATIONSHIPS REQUIREMENTS AND PRACTICES IN THE CONSTRUCTION INDUSTRY

Table 2: Requirements for collaboration and long-term relationships

Author(s) & year	CLR Requirements	
Sanchez, 2012	• Having shared goals • Being involved in the process	• Having open lines of communication • Directed engagement
Saad et al., 2002	• Ability to create, manage and reshape relation-ships • Continuous learning	• Commitment from top management
Babaeian Jelodar et al., 2016	• Trust • Commitment • Teamwork • Open communication • Common goals between partners • Fair balance of risks and rewards	• Consistent objectives • Mutual trust • Clear understanding of roles and responsibilities • Clear contract • Clear decision-making mechanism
Chang et al., 2015	• Social exchange behaviour • Detailed information • Respect between parties	• Flexibility • Mutuality • Solidarity
Ylitalo et al., 2005	• Open-ness • High level of trust	
Meng, 2013	• Continuity of work • Long-term programme	
Mattessich and Monsey, 1992	• Legislation and funding to promote collaboration • Educating potential collaborators • Required resources of its members • Ability to take risks	• Being knowledgeable • Previous experience • Participatory policy development style
Frödell, 2011	• Willing-ness and capability for collaboration • Aligned core values • Parties to be approach-able, honest, and responsive • Total cost focus	• Know-ledge, along with delivery precision • Trust • Long-term orientation
Suprapto et al., 2015	• Commitment • Cooperation • Connectedness of owner and contractor striving for a common goal • Team-work	• Relational attitudes • Capability • Team integration
Challender et al., 2014	• Trust • Change in mind-set • Commitment of participants	• Greater coordination • Sufficient time to nurture relation-ship • Long-term vision
Kadefors et al., 2007	• Trust • Commitment	• Team-work
Wang et al., 2016	• Mutual trust • Commitment	• Solidarity between the buyer and the supplier

Table 2: Collaboration and long-term relationships practices

Author(s) & year	Practices
Sanchez, 2012	Interactive meetings to talk about, review, and revise norms, and to help each other learn to respect and abide by the norms Practise respect, equality, direct and intentional communication and feedback, and transparency Employees are made responsible for the good of the organisation The organisation must be respectful of individual needs and diversity Subsidiary corporations must act with the good of the entire organisation in mind Empowering subsidiary corporations to make decisions in their own best interests Involving those affected by a decision or change. Involving the subsidiary corporations in planning, problem solving, and decision-making. Based in part on the importance people place on belonging to part of a larger community Each subsidiary sees itself as part of the larger organisation. This sense of organisation-as-community engenders a desire for shared success and unity. Sincerely soliciting feedback Participants express a genuine sense of pride and joy about opportunities to help one another
Saad et al., 2002	Involve some stages, including the need to innovate, knowledge awareness, evaluation of alternative innovations, planning, and implementation Top management commitment Agreeing on mutual objectives Making decisions openly, and resolving problems in a way that was jointly agreed upon at the beginning of the project Aiming to achieve measurable improvements in performance, through incentives Promoting collaboration through leadership, facilitation, training, and incentives Replace short-term contractually driven project-by-project adversarial relationships with long-term, multiple-project relationships based on trust and cooperation Restructuring and integration of project processes and supply networks, with fewer strategic supplier partners
Black et al., 2000	Frequent communication, both formally and informally Cooperative attitudes Trust between the parties A win-win approach to negotiation Open sharing of information Multidisciplinary involvement Both the buyer and the supplier are highly dependent on each other
Lavikka et al., 2015	Co-located working

Author(s) & year	Practices
	Collaborative decision-making in inter-organisational meetings
	A liaison role
	Shared project goals
Frödell, 2011	The importance of sticking to the agreements, even if the supplier's competitors are dropping their prices
	Give the service suppliers the right prerequisites when they are involved in a project, because they base their pricing on them
	For the supplier to be able to plan and forecast, the contractor needs to invite the supplier earlier in the design phase of the project, and they must also strive to keep to the predetermined schedule, since suppliers use it to plan their work
	Core values: personnel are approachable, honest, and responsive
	Treating suppliers fairly, to avoid suppliers getting tired of clients and clients getting a bad reputation
Palaneeswaran et al., 2003	Certain approaches introduce some incentives (e.g., awards, bonuses) as motivators for good performance
	Each alliance partner has a higher 'stake' in the project, which leads to stronger commitment and closer bonds
	Checks are installed to avoid abuse and misuse of such relationships. This may be done through contractual safeguards, which need not be dismantled in the 'binding forces'.
Lloyd-walker et al., 2014	Inclusive decision-making
	Members jointly work to deliver project outcomes
	Joint member sharing of all project risks, in a no-disputes and no-blame environment, where unanimous decision-making takes place
	Provide no formal process for legal action, except in the case of wilful default
	Signatories work together in good faith, acting with integrity and making best-for-project decisions
	The incentivisation contract ensures that the financial reward and penalty provisions drive motivation
	Pool their insurances by negotiating an alliance insurance agreement, rather than separate insurance requirements, thereby reinforcing unity of purpose
	The terms of contract (TOC) established early in the alliance selection phase of the project represents fair and reasonable expected end costs
	The details of budgets and all design and delivery assumptions are openly and transparently discussed for full understanding during initial post-alliance TOC agreement workshops
	Innovation mainly achieves potential gain sharing from the incentivisation contract leg, and so this arrangement encourages and facilitates innovation
	Encourage a trade-off of the normal rights to sue parties that do not perform to expectation, such that they may inhibit parties achieving their key performance indicators (KPIs).
	Consensus behaviours turn power and communication imbalances to symmetrical input mechanisms, which allow consensus about a solution to emerge

Author(s) & year	Practices
	Cost control is monitored through adherence to KPIs and an open-book approach to probity and auditing
	A no-blame culture develops from these features
	The transparency and open-book approach lowers fears that any party can 'cheat' the system
	Mutual dependency binds participants closely together, because the incentive contract rewards project performance, not individual party performance
	All strive for best-for-project decisions, with an understanding that this involves trying new approaches and recalibrating efforts pragmatically when a better understanding of the context requires plans to be changed
Anbanandam et al., 2011	Top management commitment
	Information sharing
	Trust among supply chain partners
	Long-term involvement
	Risk and reward sharing
Cadden et al., 2015	Espousing characteristics of trust, cooperation, and information sharing
	Working closely together through cross-functional teams and joint away days, both at operational level and strategic management level, from creation of the relationship
	Behavioural change about how firms deal with each other in respect of pricing strategies and service level agreements is vital
Suprapto et al., 2015	Joint working
	Open and effective communication
	Clear and fair risk allocation
	Regular performance measurement
	A no-blame culture
	Quality defects can be reduced through effective problem-solving mechanisms
Spekman, 1988	Balanced power-sharing relationship
	A mutual commitment to the future
	A balanced power relationship is essential for the process
	Mutual trust nurtures commitment
	Open communication
	Both the buyer and the seller must invest in the relationship
	They represent a complex web of the less tangible issues of trust, openness, and commitment

The requirements for CLR, as well as the CLR practices, as found from the desk research conducted, are shown in Table 2 and Table 3, respectively. As is evident from these tables, CLR requirements and practices are indicated to focus on creating an enabling environment that optimises the ability of project team members to work together efficiently and collaboratively. Thus, building long-term business relationships through which a series of projects can be delivered successfully without litigation is vital. This is a fundamentally different situation from what is sought in the traditional contracting practice of one-tender-

per-project approach, where the client enters into a contractual agreement and assembles a separate supply chain for each project, with short-term relationships, and a consequent concentration of knowledge within the design team only (Ruparathna and Hewage, 2015; Watermeyer, 2012; Sinclair, 2011). Such practice is said to often result in significant opportunities for claims and inappropriate risk avoidance, and, consequently, adversarial relationships and litigation processes (Ruparathna and Hewage, 2015; Watermeyer, 2012; Sinclair, 2011).

The contracting strategies reported to internalise and provide the opportunity for collaboration and long-term relationships in construction are partnership, alliance contracting, and framework contracts (Babaeian Jelodar et al., 2016; Suprapto et al., 2015; Lloyd-walker et al., 2014; Challender et al., 2014; Mouzas and Blois, 2013; Watermeyer, 2013; Cheung, 2011; Palaneeswaran et al., 2003). These strategies are further discussed below.

5.1 Partnership

A partnership is one of the construction procurement strategies that harness collaboration and long-term relationships practices. Gale (2013) argues that the earliest form of collaboration is through partnering arrangements between parties, and several studies have described long-term relationships as the basis of partnership (Meng, 2013; Ambrose et al., 2010; Naoum, 2003). Nevertheless, partnership can also be for a short-term relationship, when it is based on a single project (Gadde and Dubois, 2010). Lambert et al. (1996) defined partnership as a "tailored business relationship based upon mutual trust, openness, shared risk, and shared rewards that yield a competitive advantage, resulting in business performance greater than would be achieved by the firms individually". The UK's National Economic Development Council (1991) defined partnership as a long-term commitment between two or more specific organisations for achieving specific business objectives, by maximising the effectiveness of each participant's resources. The Associated General Contractors of America (1991) described partnership as a way of achieving an optimum relationship between a client and a contractor. However, Cheung et al. (2003) described partnership as not a contract but an attempt to establish non-adversarial working relationships among project participants, through mutual commitment and open communication.

Several benefits of partnership are indicated in the literature. Gadde and Dubois (2010) reported the potential benefits of partnership to include increased productivity, reduced costs, reduced project times, improved quality, improved client satisfaction, and greater stability. In a study examining the potential of partnering principles for subcontractor selection and improvements in overall project outcomes, by interviewing 20 successful and unsuccessful subcontractors, Kumaraswamy and Matthews (2000) revealed that the partnership approach produces at least a 10% cost reduction in the tender price, and an increase in the cost, time and quality performances in the project. Similarly, Bennett and Jayes (1998) examined the financial benefits of partnership, and they submitted that the partnership approach can achieve savings of up to about 10% of total costs. Other benefits of the partnership approach include improved relationships among contracting parties, cost effectiveness, work efficiency, opportunities for innovation, equitable risk sharing, and less confrontation (Cheung et al., 2003; Naoum, 2003; Black et al., 2000). However, the Royal Institution of Chartered Surveyors (2005) argues that the focus of most partnership studies on success rather than failure presents an unbalanced view and a biased impression in terms of the contribution that partnering and collaborative procurement have had within the construction industry, and that these studies have therefore raised questions around reliability. Also, Morgan (2009) reported that partnering projects are often open to abuse, owing to the scale of

the commercial interests involved, such that clients may be paying far too much for their products. Cheung et al. (2003) indicate that the non-compromising tendering process, poor perceptions of the partnering process, a lack of knowledge and skills to adopt partnering, and non-commitment of partnership parties in construction undermine the benefits partnership has been shown to deliver.

The requirements essential for successful partnerships reported in the literature are commitment, trust, preparation, understanding, equity, development of mutual goals, inclusion of appropriate parties, continuous joint evaluation, use of project partnering tools and procedures, empowerment of stakeholders, evaluation methodology, and willingness to accept mistakes (Ng et al., 2002). Other requirements are mutual objectives, effective communication, continuous improvement, equality, win-win profit sharing, management commitment, a clear understanding of roles, consistency of objectives, and flexibility to change (Babaeian Jelodar et al., 2016; Chicksand, 2015; Black et al., 2000).

5.2 Alliancing

Alliancing, partnership, and framework contracts are the procurement strategies that incorporate collaboration and long-term relationships in construction. Although the term "alliancing" is often used interchangeably with the term "partnership" (Ingirige and Sexton, 2006), it refers to any arrangement in which the contractual arrangements are designed to stimulate trust by aligning commercial objectives (Broome, 2002). In the business literature, the term "alliancing" is used to refer to an arrangement between two or more suppliers (not involving buyers or clients) joining together to market, manufactures, distribute and sell their product (Broome, 2002). The important difference between alliancing and partnership is that parties share gains and losses in alliancing, while in partnerships, parties may individually gain and suffer losses (Challender et al., 2014). Thus, alliancing reflects a joint rather than a shared commitment between partners, where partner selection is based on performance, rather than only price (Raisbeck et al., 2010).

Alliancing is argued to have the potential benefit of providing an environment that maximises collaboration through joint decision-making, by employing a best-for-project and a no-blame philosophy (Lloyd-walker et al., 2014).

Although factors that contribute to collaborative working, such as trust, mutual understanding, respect, communication, problem-solution mechanisms, sharing of the risks and benefits, and having a win-win philosophy, are attributed to promoting alliancing among parties, a 'no-blame culture' is indicated to be the key requirement for the success of alliance contracting (Lloyd-walker et al., 2014).

5.3 Framework contracts

A framework contract, which may also be referred to as a "framework agreement", or an "umbrella agreement" (Mouzas and Furmston, 2008), is an agreement which is reached between two parties to cover a long-term collaborative arrangement, particularly where clients have a long-term programme of work in mind and are looking to set up a process to govern the series project or supply packages that may be necessary during the term of the framework (Glover, 2008). Mouzas and Blois (2013) describe a framework contract as a manifestation of agreements that define the fundamental principles upon which companies wish to work together. Framework contracts provide an "umbrella" contract, upon which projects are procured on a call-off basis, as opposed to traditional discrete-contract practice (Lam and Gale, 2015). Watermeyer (2012) remarked that framework contracts enable clients

to procure goods, services, and construction works on an instructed (call-off) basis over a term, without any commitment to the quantum of work instructed, and in the absence of a detailed scope of work.

Long-term relationships are submitted as the theoretical basis for the adoption of framework contracts by clients, as opposed to the arrangements in discrete contracts (Gale, 2013). This is due to the tenure period in framework contracts, which provides the opportunity for parties to the project to work together for the period of the framework agreement. Tennant and Fernie (2010) indicated the period of framework contracts to be four years, with an additional two years, subject to exceptional circumstances. The ISO (2010) specified a tenure period of three years for a framework agreement, after which unsuccessful contractors must wait for the next opportunity to present themselves for selection. It has been argued that the long period of relationship in framework contracts makes selection of the right contractor vital to ensure that continuous improvement is achieved within the period.

In describing a framework contract, some authors have associated the approach with other construction procurement strategies. For example, Gale (2013) opined that the framework contract approach might have evolved from partnering arrangements. Tennant and Fernie (2010) noted that the approach is in many ways analogous to partnering. However, Tennant and Fernie (2012) describe it as a descendant of the design-and-build procurement route. This may stem from the characteristics of the approach in providing the opportunity for integration of design and construction, through early contractor involvement at the pre-construction stage of projects, which has been one of the advantages of the design-and-build system.

Framework contracts provide the advantage of suppliers reserving capacities for their clients, making supplies cheaper and quicker, as markup is fixed for the period of the contract (Balcik and Ak, 2014). The approach is also indicated as a tool for improving performance, quality, and long-term relationships (Lam and Gale, 2015; Lacoste, 2014; Mouzas and Blois, 2013). In other words, the framework contract is used to describe an arrangement in which streams of projects can be obtained, without the need for a new tendering procedure, under certain agreed-upon conditions. The Joint Contracts Tribunal and Glover (2008) described it to be suitable when clients have a long-term programme of work in mind.

Framework contracts are apparently not intended for individual (once-off) projects and short-term relationships. The approach is best suited for long-term relationships and repeat clients. It may involve several contractors being selected for contracts over an extended period. However, to allow for price competition within a framework agreement, the minimum number of contractors to contract with when it involves more than one contractor is suggested to be three, and there is no maximum number of contractors to contract with (Mills & Reeve, 2015). However, in practice, it will be difficult to deal with a large number of contractors, due to the need to approach each of the contractors for a call-off (Mills & Reeve, 2015). Nevertheless, if framework contracts are not properly implemented, it can result in corruption, increases in costs, and exclusions (National Treasury, 2016).

6. CONCLUSION

This article creates a better understanding of CLR, by examining the requirements and the practices of CLR in construction, as well as the strategies that internalise CLR practices in the construction industry, based on desk research. In the literature review conducted, CLR was indicated to deliver several benefits to all parties involved. These benefits may not be achievable in the traditional practices of short-termism and arm's-length relationships. The literature review found that the requirements for collaboration are top management

commitment, a spirit of teamwork, flexibility, solidarity, continuity of work, litigation avoidance, shared understanding about the goals of collaboration, a clear definition of responsibilities, a willingness to learn from and to support the parties, mutual trust, complete integration of project team members, efficient and open communication, and fair risk and reward sharing. The practices that promote CLR are good performance from the first engagement, potential for development by parties, future plans of parties, so as to guarantee continuity, interactive and scheduled meetings, mutual respect, a no-blame culture, mutual trust, and all parties taking responsibility for the good of the organisation. Other practices that promote CLR include a balanced power relationship, parties being approachable, honest, and responsive, inclusive decision-making and involvement, having a sense of belonging to the larger organisation, a win-win approach to negotiation, replacing short-term contractually driven project-by-project adversarial relationships with long-term, multiple-project relationships, and openness between parties.

These requirements are different from what obtains in traditional contracting practices, as the traditional approach requires more directive functions, separation of design activities from construction, and a consequent concentration of knowledge within the design team only, with arm's-length relationships. With once-off project practices, relationships are short-term in traditional approaches, and the values of long-term relationships are thus not accessed. The study found that the procurement strategies adopted in the construction industry that internalise collaboration and long-term relationships practices are framework contracts, partnership, and alliance contracting.

Consequently, the selection of parties to go into these procurement strategies for CLR becomes critical to achieve the benefits which collaboration and long-term relationships has been shown to deliver, especially as most practitioners on both the contractor and the client sides have been trained in and are accustomed to traditional contracting practices. Parties will need to assimilate the requirements and practices that support and promote CLR, to ensure that scarce resources are only dedicated to relationships and processes that will genuinely benefit and support CLR.

7. ACKNOWLEDGEMENT

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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ADDRESSING CHALLENGES IN THE SOUTH AFRICAN AFFORDABLE HOUSING MARKET: A CRITICAL REALIST PERSPECTIVE

Elizabeth Mirika MUSVOTO[1], and Manya Mainza MOOYA[2]

[1] Department of Construction Economics and Management, University of Cape Town, South Africa, Email: lizmusvoto@gmail.com

[2] Department of Construction Economics and Management, University of Cape Town, South Africa, Email: manya.mooya@uct.ac.za

ABSTRACT

Since the advent of democracy, South African policymakers and researchers have been focusing on housing solutions. The South African affordable housing market has been battling with undesirable outcomes in terms of location, density, integration, and affordability. Housing is a complex multidimensional phenomenon that has been analysed from various perspectives. Various scholars have adopted either mainstream or institutional approaches in trying to explain housing outcomes, through examining the effects of regulations on housing provision. Oftentimes, such analysis has reached unfavourable conclusions on the actual causes of the outcomes in the housing market. The purpose of the article is to present a philosophical, theoretical and conceptual understanding of the study of affordable housing, which is critical in identifying variables for creating interventions to address challenges in the affordable housing market. This article employs a literature-based analysis of the theories and ontological approaches to housing development, key concepts of critical realism, and the relationship to structure-agency theory. Structure-agency theory is then applied to the South African affordable housing market. The challenges experienced by the South African affordable housing market are the same as those in both the developed and the developing world. The current view of the South African affordable housing market is not adequate to address the prevailing challenges. It is argued that a conceptual framework that is guided by a critical realist perspective and structure-agency theory will enable a better understanding of an interdisciplinary study such as that of housing. Such a framework provides insight into the structural dynamics that shape the roles, strategies, interests and decisions of various role players within a particular setting, leading to various outcomes. While this article draws on a critical realist perspective, it provides a platform to identify interventions in the affordable housing market that could influence policy formulation and implementation, and consequently, outcomes. The interventions identified will be limited to specific geographical locations, since there are various social and political factors at play; hence, the interventions cannot be generalised. The interventions identified in the affordable housing market through a critical realist perspective will inform policy implementation on how to provide integrated affordable housing in appropriate locations and at appropriate densities.

Keywords: affordable housing, critical realism, interventions, structure-agency theory

1. INTRODUCTION

This article focuses on the methodological approach which provides insight into the structural dynamics that shape the roles, strategies, interests and decisions of role players in an interdisciplinary study such as that of housing. The South African affordable housing market has been battling with undesirable outcomes. The growing concern is the pace, scale, location, density, integration and affordability associated with the affordable housing market, despite there being a myriad of housing and planning policies aimed at addressing these challenges. The Department of Human Settlements defines the affordable housing market in South Africa as represented by those households falling within the R3,501 and R15,000 monthly income groups. This is the property segment valued at less than R500,000 (Rust, 2010). Households in this segment earn too much to qualify for a fully subsidised Breaking New Ground (BNG) house and too little to access a conventional mortgage loan. This category is known as the "gap market". According to Rust (2010), the gap market is an important emerging sector in the South African property market, with the most people and the most properties, both for rental and for sale.

In the South African context, the problem is not only the failed efforts by both the government and the private sector to provide housing for the gap market, but the unavailability of well-located land and bulk infrastructure, and deficiencies in the housing delivery process (Financial and Fiscal Commission (FFC), 2013), which are all key to housing development, in a country battling with the spatial legacy of apartheid. According to Tissington (2011), the affordable housing market is still characterised by unavailability and high costs of housing units. The FFC (2013) concurs that the key challenges in the supply side of the affordable housing market include insufficient delivery to scale, the lack of sustainability, an increase in the gap market, the lack of well-located land, attributed to the lack of assembling of public land for affordable housing by local authorities, and bulk infrastructure and housing delivery deficiencies. The main challenge for affordable housing is a shortage of well-located land for housing development (Rust, 2010; FFC, 2013; Tissington, 2010), despite 70,000 hectares of state-owned land having been identified for housing developments, but none of this land has been made available for this purpose (FFC, 2013). This is exacerbated by poor land assembly mechanisms and greater affordability of land at the urban periphery, as opposed to expensive land in more central areas, coupled with insufficient subsidy amounts to build at higher densities, to offset the higher land costs (Venter et al., 2004). A lack of well-located land leads to development of settlements on the periphery of towns, far away from amenities, thereby intensifying urban sprawl and increasing the daily transport costs of the poor (Newton and Schuermans, 2013; Seekings, 2000).

Furthermore, findings from an analysis prepared for one of South Africa's largest affordable housing investment funds suggest that it took almost double the time allowed for in regulations for a housing project to proceed from inception to bond application. The township application process, including survey and approval of the general plan, conclusion of services agreement, and council consideration, took 157 months, thus 69 months longer than the 88 months set out in guideline documents (FFC, 2014). As this cannot be generalised for all developments, the crux of the matter is that it takes a long time for a housing project to pass through inception to completion, thus increasing the cost of delivery, reducing the profit margins of developers, and reducing the affordability of the houses, thus shrinking the pool/scale of affordable housing. It can be concluded that the pace, scale and cost of delivery of affordable housing can be attributed to the execution of regulatory mechanisms in the local authorities.

Furthermore, the high cost of labour and building materials is also a contributing factor to the lack of housing delivery in the affordable housing market.

The challenges associated with the South African affordable housing market are highlighted above, and the challenges are the same as those experienced in both the developing and the developed world. This article argues for a critical realist perspective in addressing the challenges faced in the South African housing sector. This article is structured as follows: a critical analysis of the ontological perspectives in housing research will be discussed in section 2, with theories of housing development being explained in section 3. Section 4 argues for a conceptual framework that is guided by a critical realist perspective and structure-agency theory in addressing the challenges in the South African affordable housing market. This is followed by a conclusion in section 5.

2. ONTOLOGICAL PERSPECTIVES IN HOUSING RESEARCH

Housing is a complex multidimensional phenomenon, which has been analysed from various perspectives. Various scholars have adopted mainstream neoclassical approaches, institutional approaches, or both, employing either qualitative or quantitative analysis in trying to explain housing outcomes, through examining the effects of regulations on housing provision. The varying methodologies are influenced by the ontological and epistemological views of the researchers, as described by Fleetwood (2005): "the way we think the world is (ontology) influences: what we think can be known about it (epistemology); how we think it can be investigated (methodology and research techniques); the kinds of theories we think can be constructed about it; and the political and policy stances we are prepared to take".

The powerful rhetoric of international literature has associated the outcomes in the housing market with the effects of the planning system. At the methodological level, the mainstream approaches have adopted neoclassical econometric modelling as the main approach, which tends to neglect the social interactions in housing provision, while the institutional approaches have adopted institutionalism, which is concerned with the social, political and economic factors influencing the housing development processes. From an epistemological point of view, an institutional approach in housing studies recognises that the habits or behaviours of market actors shape housing market outcomes (Ball, 1998), while the mainstream econometric modelling approach neglects institutions, and the positivist-deductive approach employs assumptions in achieving its conclusions (Hamzah, 2013).

The ontological stance of positivists is that an apprehensible reality is assumed to exist, driven by immutable natural laws and mechanisms (Guba and Lincoln, 1994). This is because in this paradigm, human behaviour is believed to be subject to operation of the laws of cause and effect, and the process of hypothesis testing can be used to develop laws that can predict patterns between concrete events. Its epistemological argument is that the social world exists externally of the researcher, and that its properties can be measured directly through observation (Gray, 2004). In this regard, positivists strive to find patterns of observable behaviour, towards development of predictive theories (Lawson, 2003).

Of the studies that have sought to adopt the positivist approach on the relationship between planning and the housing market, Cheshire and Sheppard (1989), Bramley (1993), and Bramley and Watkins (1996) have provided quantitative answers on the impact of planning on the housing market. For example, using a time series economic model, Bramley (1993) examined the effects of planning controls over a period of time.

Using the model to simulate the effects of land use changes over time, he provided quantitative answers on the outcomes in the housing market when planning controls are relaxed. World Bank housing researchers such as Brueckner (2006) have modelled the effects of government interventions such as urban growth boundaries, floor-area ratio (FAR) restrictions, cost-increasing regulations, bureaucratic control of development decisions, and radically based land use interventions, such as apartheid in South Africa, on housing, and they have observed an increase in prices and densities.

According to Lawson (2003), this application of positivism shows the objectivity of positivists, but also their over-reliance on empirical data. However, the complexity of the housing market means that the positivists' experimental view is not helpful, as it only exists in terms of actual, observed and measurable events. It is the subject of long-standing debate whether it is appropriate to apply positivism as a natural science approach to the social sciences. Criticism of positivism has triggered alternative perspectives in the social sciences, such as interpretivism. Even though it has not been adopted in any known studies on the relations between planning and the housing market, interpretivists provide an anti-naturalist, subject-oriented perspective, as opposed to the deductive, predictive, observable, measurable and quantifiable perspective of positivists.

The interpretivists' paradigm maintains that reality is defined by meanings given by inhabitants, and that meanings are thus defined by social actors. Their ontological perspective is that reality is multiple and subjective, and that the behaviour of social actors is influenced by the unobservable meanings. Much criticism has been levelled against interpretivists. However, in relation to the planning system and the housing market, it should be noted that there exist complex underlying relationships between various actors operating within a certain structure (such as rules and policy frameworks). As such, these criticisms are on the level of consciousness held by actors, the implicitness of the researcher's own critique, the disregard for institutional structures and material resources, the limits placed on causality, unintended consequences of actions, and existence of structures of conflict and social change (Sayer, 2000). It is therefore important to acknowledge the importance of these interactions in bringing about certain outcomes in the housing market.

From the preceding discussion of positivism and interpretivism, it can be discerned that the critical realists' ontological and epistemological views lie in between these two perspectives. As Lawson (2003) asserts, "critical realism does not seek to strive for experimental conditions of closure, which ignore the open, contingent-laden context of reality, to produce regular outcomes and make law-like generalisations; it also rejects strongly the socially constructed world of multiple realities, which is sceptical of any kind of knowledge claims or scientific progress (Sayer, 2000)".

Critical realists believe that knowledge (epistemology) is different from being or existence (ontology). This implies that there is a reality somewhere that exists separately from human thought. As espoused by Bhaskar (1978), natural and social phenomena do not exhaust the category of what really exists in the world. He distinguishes between the domains of the empirical, the critical, and the real. In Bhaskar's opinion, the three domains are independent of each other. The domain of the empirical is made up of human sensory experiences and perceptions, while the critical refers to the events occurring in the world, and the real consists of those mechanisms and structures that have causal powers and whose generative capacity creates the order we see in the world (Bhaskar, 1978). The real is not the same as the empirical. The empirical provides an

avenue to access the real, but only when the former is guided by theory (Olsen, 2009). According to Warner (1993), for the realist, the goal of science is the theoretical identification of things and their causal powers. Realists argue for a more structured ontology, with overlapping domains of experience, events, and necessary and contingent relations. Causal mechanisms may or may not be observable; they have emergent powers, and they generate tendencies for certain events to occur (Lawson, 2003).

Easton (2010) asserts that events or outcomes are what critical realists investigate, that is, the external and visible behaviours of people, systems, and things as they occur, or as they have happened. Thus, in order to understand the social world, it is important to understand the structures that created the events. Sayer (1992) confirms that "to ask for the cause of something is to ask what makes it happen, what produces, generates, creates or determines it, or more loosely, what enables or leads to it". Realists argue that structure exists, and realists' presuppositions tend to support the use of structural variables as either independent or dependent variables in regression (Olsen, 2009). Furthermore, agency and structure are central to their social ontology. They argue that agency and structure are internally related: the one is what it is, and can exist, only by virtue of the other.

Based on the above discussion, it is argued that critical realism is the appropriate approach for analysing the challenges in the affordable housing market, because it acknowledges and promotes an understanding of the influence of specific ideas and practices around housing provision, and, importantly, it recognises the existence of emergent real relations that may have generated these ideologies and practices. As such, critical realism provides a more fruitful basis for theoretical explanations of the housing development and structure-agency theory offers that theoretical undertaking.

3. THEORIES OF THE HOUSING DEVELOPMENT PROCESS

There are various models of the development process which could be used to provide a basic framework for analysis of the housing market. The development process unpacks the activities that transform a property from one state to another. The focus of this section is on understanding the development process through the lenses of different models as they conceptualise such a process and the interests of different actors. Healey (1991) categorised land development models as follows.

3.1 Equilibrium models

Equilibrium models are best explained from the neoclassical perspective, which focuses on supply and demand of commodities (Healey, 1991). Healey (1991) asserts that the development process is viewed as relatively unproblematic, since transactions and investments are activated by market signals. In this model, actors with greater understanding of signals and those least impeded by market constraints will successfully complete their projects. However, Healey (1991) argues that this model is only applicable where there are active property markets dominated by large developers.

3.2 Event-sequence models

Event-sequence models unpack the complex development process into its constituent events, to recognise the different social relations which might surround each event, and to appreciate the time scale of development projects. However, Healey (1991) argues that event-sequence models focus on potential blockages to development activity but do not specify actors and interests. Furthermore, they do not explain the dynamics of the development process in terms of nature and time.

3.3 Agency models

Agency models bridge the gap left by event-sequence models. They focus on the actors and the roles they play, and the interests which guide their strategies (Healey, 1991). They highlight the way agents focus on various sets of activities in the development process, thereby analytically separating the agents and the roles they play. These models incorporate the element of time in the development process. However, Healey (1991) argues that these models tend to be too descriptive and to lack critical appraisal. They also fail to consider other forces that might drive the development process.

3.4 Structure models

Structure models attempt to explain the land development process by focusing on the way markets are structured through power relations of capital, labour, and landowner (Healey, 1991). These models offer ways of linking events and agency behaviour to the dynamic modes of production and regulation of different economies, even though their analytical concern has been with capitalist societies.

Healey (1991) acknowledges that structure models offer ways of linking events and agency behaviour to the dynamics of the modes of production and regulation of different economies, and they focus their attention on the way the relations of property development are structured by the broader dimensions of capital, labour landowner, and state-market relations. The main weakness of structure models is that they barely penetrate into the detail of the events of the development process and the nexus of agency relationships surrounding each development. This background fundamentally influenced the approach Healey offered in analysing the property development process.

3.5 Healey's structure-agency theory

Healey and Barrett (1990), Healey (1991), and Healey (1992) called for an approach that generalises the nexus of roles and relationships in the property development process. Healey (1991) asserts that a theoretical model of the property development process is needed, which would enable the detail of agency relationships in the negotiation of development projects to be captured, while at the same time allowing generalisation about how these relationships might vary under different conditions. She further argues that an institutional approach is necessary, because of the complexity of development processes, and the need to avoid missing out on key links in understanding how and why a particular project took place.

Healey and Barrett (1990) are of the view that it is important to understand the relationship between agency and structure. Agency is depicted by the strategies, interests and actions of the various agents involved in the development process, while structure is the organisation of both economic and political activity, and of values about land, property, buildings, and environments which frame or structure agents' decision-making. Furthermore, it is vital to establish the link between structure and agency empirically, through relating the construction of roles and the strategies and interests of agencies to the material resources, institutional rules and organising ideas which agents acknowledge implicitly and explicitly in what they do.

The relationship between agency and structure plays an important role in the property development process. Structure is defined in terms of the framework within which individual agents make their choices; it may be seen to inhere in the various resources to which agents may have access, the rules which they consider govern their behaviour, and the ideas which they draw on in developing their strategies (Healey and Barrett, 1990). Healey (1992) further elaborates that structures are said to be the material

resources (land, land rights, labour, finance, information, and expertise), institutional rules (planning regulations and requirements governing the location of developments, parking, densities, and heights of developments), and organising ideas which agencies acknowledge. Ideas influence the dynamics of resource use and rule formulation, because they inform the interests and strategies of actors as they define projects, consider relationships, and develop and interpret rules. These ideas carry assumptions about various developmental aspects, which have an influence on how agents perceive their interests and devise strategies.

Healey and Barrett (1990) define agency in terms of the way individual agents develop and pursue strategies. This can be interpreted as the way various role players in the development process perform their roles. Agents that are involved in the development process vary and can include landowners, investors, developers, consultants, politicians, and community groups. The act of agency is shaped by the structure (institutional rules of the game, material resources, and ideas), thereby determining the outcome of a certain development, that is, understanding the behaviour of developers in choosing to invest in affordable housing.

From the discussion above, it can be discerned that the property development process involves a number of role players, including private consultants, landowners, government departments, developers, and financial institutions, amongst others. These role players deal with various factors, such as economic considerations and political, social and government policies and regulations, in their operations and interactions. The way they perceive these institutions shapes the property development process in terms of what can be developed where, when, how, and for whom. Therefore, it can be argued that clear articulation of roles, perceptions, and behaviour of various role players in the property development process, clear identification of the stages that shape the development process, and an understanding of the interactions amongst the role players and various institutions gives a more accurate account of the property development process.

4. CONCEPTUALISING THE SOUTH AFRICAN AFFORDABLE HOUSING MARKET

This research advocates for the methodological point of departure for analysing the South African affordable housing market to be based on structure-agency theory and informed by critical realism. Critical realists acknowledge that structure exists, and structure and agency are central to their social ontology. The central principle of critical realists is to investigate events or outcomes, that is, the external and visible behaviours of people, systems, and things as they occur, or as they have happened (Easton, 2010). Structure-agency theory offers a platform to investigate the resulting patterns of interactions, and the outcome of the process. As such, this approach offers an alternative view to an understanding of the complex, multifaceted, and structured nature of affordable housing.

According to Sayer (2000), identifying causal mechanisms and how they work, and discovering how they have been activated, and under what conditions, creates explanations. Healey (1992) argues that structure-agency theory is necessary, because of the complexity of development processes, and the need to avoid missing out on the key links in understanding how and why a particular project took place.

Housing development is shaped by actors through their response to a given structure, and their views, goals and subsequent actions. One of the key issues of this study is with the structures, or institutions, in housing development that impact on the behaviour of

actors. The importance of structures/institutions has been elaborated elsewhere (Ball, 1994; Healey, 1992; Alexander, 2001; Buitelaar, 2004; Guy and Henneberry, 2000). Institutions are defined by North (1990) as "humanly devised constraints that shape human action". According to Shepsle (2014), an institution specifies the players whose behaviour is bound by its rules, the action the players must, may, must not, or may not take, the information conditions under which they make choices, their timing and the impact of exogenous events, and the outcomes that are a consequence of these choices and events. From the various definitions and perspectives of institutions highlighted above, three main characteristics are of interest to this study. Firstly, it is the ability of institutions to provide rules, norms, and regulations to agents. Secondly, it is their ability to influence the interactions of various agents. Finally, institutions provide certainty in the operations of agents, and they allow for analysis of outcomes that have resulted from the operations of the agents.

The housing sector as a segment of the property market is guided by a multitude of rules and norms that emanate from the planning system and the property market. The planning system and the property market have rules that enable or constrain the actor's behaviour and actions. The planning system has a pertinent role, not only in affecting supply and demand, but also in shaping the context for relations within the process of property development. The challenges in the affordable housing market can be addressed by opening the development process and identifying the key actors and the relationships, rules, resources and ideas that influence their decisions, and the roles, strategies and interests that shape their actions, leading to certain outcomes. Figure 1 below represents an application of structure-agency theory to the affordable housing development process, identifying the key actors, institutions, actions and outcomes. This approach will give a different view in addressing the challenges in the affordable housing market.

The affordable housing market is characterised by agents, which are the main actors, structure, which are the rules, resources and ideas, and agency, which is shaped by the interests, roles and strategies of the agents. Structure enables or constrains the act of agency in the affordable housing market. The outcomes in the affordable housing market are a function of structure. The interaction of actors within a certain structure brings about the outcomes in the affordable housing market in terms of location, density, integration, and affordability. In order to address the challenges in the affordable housing market, interventions should be targeted at specific variables that can be identified through the conceptual framework depicted in Figure 1 below. For example, a change in rules (the planning system) can have an enabling or a constraining effect on the density, location or affordability of affordable housing.

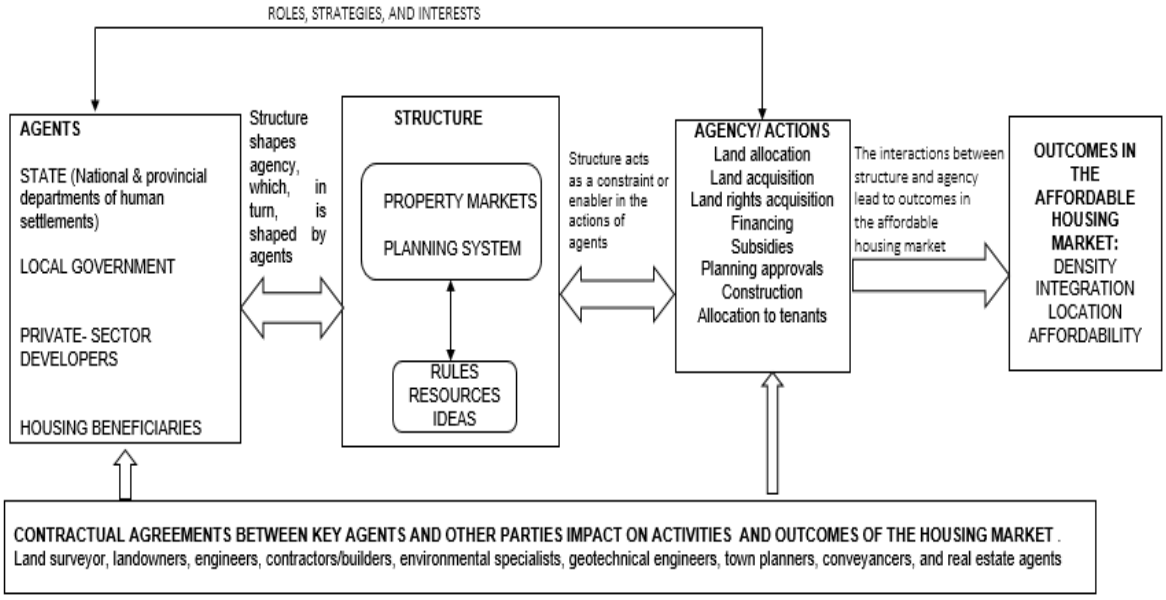

Figure 1: Application of structure-agency theory to affordable housing development

5. CONCLUSION

This research does not offer solutions to the challenges in the affordable housing market; it advocates a change in view and methodological approaches in addressing these challenges. The unfavourable outcomes in the South African affordable housing market are both a cause and a consequence of the deficient policy framework. While policymakers and researchers have been focusing on providing housing solutions in terms of location, density, integration, and affordability, the interventions have had a narrow focus on supply and demand, focusing mainly on funding and subsidies. To address these challenges, there is a need to identify variables through the proposed conceptual framework, and to derive targeted interventions. This article argues for a context-specific conceptual framework that is guided by critical realism and structure-agency theory. The interventions identified through application of this framework will have policy implications in the provision of integrated, well-located affordable housing.

6. ACKNOWLEDGEMENT

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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EXPLORING STAKEHOLDERS' PERCEPTIONS OF THE GREEN CAMPUS INITIATIVE IN SOUTH AFRICAN HIGHER EDUCATION INSTITUTIONS

Katleho Nolwandle MAFONGOSI[1], Bankole Osita AWUZIE[2], and Alfred Atsango TALUKHABA[3]

[1] Department of Building Sciences, Tshwane University of Technology, South Africa, Email: katlehonolwandlem@gmail.com

[2] Department of the Built Environment, Central University of Technology, South Africa

[3] Department of Building Sciences, Tshwane University of Technology, South Africa,

ABSTRACT

Although mixed performances have been documented in attempts by South African higher education institutions (HEIs) to integrate the ethos of sustainable development (SD) into their core activities, neglect of such integration in the management of built assets and spaces on their campuses has been observed. This prompted the introduction of the Green Campus Initiative (GCI) in South Africa in 2012, among other things. However, implementation performance of the GCI seems to be under-reported, hence the need for this study. The study explored the level of awareness, as well as the perceptions of stakeholders, of the success or otherwise of the GCI in their respective institutions. Adopting a case study research design, this study relied on semi-structured interviews. Interviewees were recruited through purposive snowballing at a selected HEI, which served as a case study. Data that accrued from these sources was analysed using the thematic analysis technique. The preliminary findings revealed a considerable level of awareness among the interviewed stakeholders. The interviewees also agreed regarding the potential of the concept to make a significant contribution to resolving the environmental challenges bedevilling the South African context. Impediments hindering successful implementation of the initiative were also identified. Findings from this study will contribute to a wider research project seeking to optimise GCI implementation performance in South African HEIs.

Keywords: campus, Green Campus Initiative, higher education institutions, sustainable development, thematic analysis

1. INTRODUCTION

Sustainability and sustainable development (SD) remain pivotal concepts, which need to be addressed. Abubakar et al. (2016) have stated that over the past two decades, South African higher education institutions (HEIs) and other HEIs across the globe have joined their counterparts in promoting the concept of sustainability initiatives, also known as "the Green Campus Initiative (GCI)".

It must be taken into consideration that HEIs are known to be a microcosm of societies, or "small cities" (Alshuwaikhat and Abubakar, 2008). This means that HEIs are not only responsible for offering qualifications and conducting research, they are the key stakeholders in promoting and sustaining transformation within societies (Soni et al., 2015). Thus, it behoves HEIs to serve as champions for the sustainable development aspirations of societies. Accordingly, they are expected to provide exemplary leadership in this endeavour, through adoption and implementation of various facets of sustainable development in their core and non-core activities. The GCI happens to be one of the initiatives launched to achieve this objective.

The GCI is a broad concept, which consists of education, research, administration, and campus operations (Aleixo et al., 2018). A green campus consists of features such as energy management, water management, landscape management, biodiversity management, waste management, building management, purchasing, and food services. The focus of the study is limited to implementation of the GCI during the development and management of built assets in South African HEIs.

Although there have been many studies conducted on the state of implementation of the GCI globally, no studies are known to the authors concerning the state of GCI implementation within South African HEIs since the concept was launched in 2012. This lack of studies on the phenomenon is cause for concern among scholars, administrators, and policymakers working in the HEI space in South Africa. This study emanates from this observation and seeks to explore the level of awareness, as well as stakeholders' perceptions, of the GCI in South African HEIs.

This article is structured according to the following sections: a review of the literature, a justification of the research methodology, presentation and discussion of the findings, and a conclusion.

2. LITERATURE REVIEW

2.1 Sustainability and sustainable development in higher education institutions

According to Aleixo et al. (2018), sustainability is now a well-known concept. However, the terms "sustainability" and "sustainable development (SD)" remain ambiguous, as they will have different meanings for different people (Owens and Legere, 2015). Despite the existence of diverse views concerning what sustainability means, the definition provided by the World Commission on Environment and Development (WCED) appears to be widely accepted. According to the WCED (1987:46), sustainability is "the ability to meet the needs of the present while living within the carrying capacity of supporting ecosystems and without compromising the ability of the future generations to meet their own needs".

In a recent study conducted by Aleixo et al. (2018), most respondents (35%) associated sustainability with the "preservation and conservation of resources for future generations", while 30% of the respondents associated the concept with the three pillars of sustainability, namely the social, environmental and economic pillars. Other respondents associated the concept of sustainability with either one or two dimensions of sustainability. This shows that there is no generally accepted meaning for the concept.

Research has shown that HEIs are key stakeholders in driving society's quest for sustainable development (Baker-Shelley et al., 2017). This can be achieved through proper education, research, and involvement of all stakeholders (Dumitriu, 2017).

Educating HEI stakeholders about SD is important, as it will assist in developing their skills and broadening their knowledge regarding SD (Sanusi and Khelghat-Doost, 2008). This has led to the evolution of the sustainable university concept.

A sustainable university, according to Velazquez et al. (2006:812), is defined as "a higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or a global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfil its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles". A sustainable campus, or a green campus, must be able to reflect these features across four main components, as shown in Figure 1.

Figure 1: The main components of a sustainable campus (Adapted from Arroyo, 2017)

2.2 The Green Campus Initiative

Humblet et al. (2010:4) define a green campus as "a higher education community that is improving energy efficiency, conserving resources and enhancing environmental quality by educating for sustainability and creating healthy living and learning environments". The definition of a sustainable university (Velazquez et al., 2006) and the definition of a green campus (Humblet et al., 2010) are similar, as they both have a connection to what sustainability connotes. It should be noted that the main aims of the GCI in HEIs is to reduce the negative impacts that the biophysical environment is encountering due to the high levels of energy and water consumption and the utilisation of dangerous materials, through the design and construction of energy-efficient buildings (Alshuwaikhat and Abubakar, 2008).

According to Filho (2011), the aims of the GCI can only be achieved once the perceptions of stakeholders are understood. Katiliūtė et al. (2017) stated that the GCI cannot be achieved without the participation of stakeholders. Arroyo (2017) observed that HEIs consist of several stakeholders, as listed in Table 1. Each of the stakeholders listed in Table 1 has a fundamental role to play in the achievement of a green campus.

Table 1: Green campus stakeholders

External stakeholders	Internal stakeholders
Community/donors	Sustainability officer
NGOs	Faculty
University bodies	Staff
Companies	Research centres
Other universities	Administration
HE associations	Students
Alumni	
Government	

Source: Arroyo (2017)

2.3 Implementation of the GCI in South African HEIs

The GCI was launched in South Africa in 2012 by the Minister of Higher Education and Training, Mr Blade Nzimande. The purpose behind the launch was to make HEIs aware of the negative environmental impacts that are caused by their daily operations. In addition, the initiative sought to provide students with the necessary skills and knowledge to address and overcome sustainability issues, not only on their campuses, but also in their communities. However, six years after the launch of the initiative in South Africa, achievement of campus sustainability remains a critical subject that seems to be overlooked.

Many HEIs are struggling to fully implement the GCI, due to impediments that they are experiencing (Rwelamila and Purushottam, 2015). According to research that has been conducted, a common impediment that is experienced is the lack of financial resources (Arroyo, 2017). Katiliūtė et al. (2017) report that having a limited budget may result in HEIs not being able to fully commit to GCI projects, as some of these projects require a lot of money for them to be successful. Lack of awareness and knowledge regarding the GCI is also one of the impediments that have led to unwillingness among HEI stakeholders to support the sustainable transformation of their institutions (Katiliūtė et al., 2017).

Besides these, Velazquez et al. (2005) identified 18 impediments to GCI implementation, while Sharp (2002) identified mechanisms that can lead to successful achievement of the GCI (see Table 2).

Table 2: Impediments to GCI implementation, and mechanisms for successful GCI implementation

Impediments to GCI implementation	Mechanisms for successful GCI implementation
Lack of awareness, interest and involvement	Securing support from the management of the HEI
Not having a functional organisational structure	Having effective coordination
Lack of funding	Maximising face-to-face communication

Lack of support from the HEI administrators	Building formal and informal support
Lack of time	Seeking partnership from students and external stakeholders (through also involving the community)
Lack of data access	
Lack of training	Launching initiatives that attract most of the attention and support from stakeholders
Lack of opportune communication and information	
Resistance to change	Removing risk and generating organisational support for the running of projects
A profit mentality	
Lack of rigorous regulations	Having continuity of the launched initiatives
Lack of interdisciplinary research	
Lack of performance indicators	Having the right management framework
Lack of policies to promote sustainability on campus	Willingness to support low-risk innovation and to mentor staff
Lack of standard definitions of concepts	Continuously improving the learning curriculum regarding the GCI
Technical problems	Sharing its learning experiences
Designated workplace	
The "machismo"	

Sources: Velazquez et al. (2005), Sharp (2002)

The absence of any study that has comprehensively sought to identify these factors within South African HEIs, through eliciting stakeholders' perceptions, has led to this study.

3. RESEARCH METHODOLOGY

3.1 Research method and design

This research study adopted a case study research design. The adopted research design was chosen as it allows the phenomenon to be viewed in more detail, namely exploring the perceptions of stakeholders in South African HEIs (Denscombe, 2007). The research study utilised multiple data-collection methods for the selected case study. Interviews were deployed to elicit data.

3.2 Case study selection

HEIs in South Africa were selected as probable case studies within which the viewpoints of relevant stakeholders would be elicited. Selection of the HEIs was based on their publicly available position regarding adoption of the GCI as part of their developmental programmes, as well as their intention to achieve the status of a sustainable university.

3.3 Sampling technique

A non-probability sampling technique was used, namely the purposive snowballing technique. This technique was chosen to give the researcher the opportunity to apply personal discretion in the selection of interviewees, based on their ability to provide

relevant answers to the interview questions posed (Saunders et al., 2009). The snowballing sampling technique made it possible for the interviewer to be referred to other stakeholders who could be able to answer questions regarding the phenomenon of the GCI. As such, the interviewed participants were selected based on their involvement in the GCI in the HEIs during the development and management of built assets and those who utilise the built assets.

Although efforts are still ongoing to conduct interviews with interviewees from the cases selected, this study reports on the interviews carried out within one particular case study. It was expected that the interviews would be conducted across four HEIs in South Africa. Unfortunately, due to certain constraints, only five internal stakeholders and one external stakeholder were interviewed in one particular HEI (see Table 3). The interviews were contacted telephonically, and the six interviewees that were interviewed are the ones that confirmed their availability. Data collection is still ongoing.

The interviewees are shown in Table 3.

Table 3: List of interviewees

No.	Interviewee code	External stakeholder	Internal stakeholder
1	FM1		Facilities management
2	FM2		Facilities management
3	F1		Faculty
4	F2		Faculty
5	S		Student
6	CS	Consultant	

Source: Authors (2018)

3.4 Data-collection technique

Data was collected through semi-structured interviews. The interviewees were assured that the interviews would remain confidential, and that their identities would be kept anonymous. Each interview lasted an average of 25 minutes. Notes were taken during the interviews, as the participants did not want to be recorded, because they wanted to protect the identity of their HEI. Three of the interviews were conducted in person, and the remaining three were conducted telephonically.

The interview questions were categorised in such a way that it would make it possible to determine and understand the following:

- the participants' level of knowledge, awareness and acceptance of the GCI concept;
- the degree of participants' participation in the initiative;
- the participants' perceptions of the significance of the GCI; and
- identification of impediments to GCI implementation.

After the interviews were conducted, the author relied on the notes taken during the interview sessions for data analysis.

3.5 Data-analysis technique

The collected data was analysed using the thematic analysis technique. Pre-set themes were adapted from the subcategories, namely

• the participants' level of knowledge, awareness and acceptance of the GCI concept;

• the degree of participants' participation in the initiative;

• the participants' perceptions of the significance of the GCI; and

• identification of impediments to GCI implementation.

The interviewer made sense of the pattern of narratives observed in the transcripts. Fragments of the narratives which are aligned with the pre-set themes were identified. The collection and analysis of data is still ongoing. As a result, only the preliminary findings will be discussed in the following section.

4. PRELIMINARY FINDINGS

The preliminary findings are presented below.

4.1 Level of knowledge, awareness and acceptance of the GCI concept

The interviewees were asked what they understand by the term "sustainability" and the concept of the GCI. Based on the responses received, they associated the term and the concept with the reduction of negative environmental effects resulting from campus operations.

F2 related the GCI concept to the three pillars of sustainability. F2 said that "GCI can be related to the three pillars of sustainability, which are social (which is the people who are involved the GCI, for example, student, faculty, administration and facilities management), environment (which is how the campus is being treated, for example, are people littering on campus, what kind of buildings are being constructed), and economic (how the GCI is being promoted relating to finances)".

Although, CS was not very familiar with the concept of the GCI, she stated that "[i]t has to do with creating an environment that is eco-friendly on campuses, developing campuses to become less inclined to harm the natural environment".

Once the interviewer gave a clear explanation of the concept of the GCI, the interviewees became aware of how broad the concept is. They were also able to align it with some of the "environmental" projects that are ongoing at their HEI. This made it clear to the interviewer that the absence of a standard definition of the concept (Velasquez et al., 2005) might be one of the reasons for the failure of the initiative to be introduced and implemented in South African HEIs.

4.2 Participation in the initiative, and perceptions of its significance

When asked about the effectiveness of the initiative and whether the participants had participated in any of the activities, the responses received were that the GCI in HEIs in South Africa might not be as effective as the GCI in HEIs in other countries (such as the United States of America), due to certain impediments that they are facing. Additionally, the interviewees alluded to the salient nature of the initiative.

F2 noted that it is important to have the GCI implemented, especially with the climate change and drought that South Africa is facing, and the important role was related that the HEIs play in educating about and achieving green, or sustainable, environments.

According to CS, "[s]ustainable buildings are important for HEIs. Natural resources can be depleted if people do not start such initiatives and create some awareness around the need to conserve resources. I think this initiative is also important when we consider the fact that encouraging a healthier environment will make for better space for the students that occupy it". S agreed that implementation of the initiative would not only be beneficial to the environment, but would make the campus environment a conducive one to study in.

4.3 Identification of impediments to GCI implementation

According to Velazquez et al. (2005), there are countless impediments that are affecting successful implementation of the GCI globally. According to the interviewees, the main impediments that they noted were lack of awareness and a lack of financial resources. Lack of financial resources was identified as a barrier, since GCI projects cost a lot of money, and when these projects do not have enough support and/or acceptable project proposals, they easily forfeit funding from sponsors. All the interviewees noted that the lack of awareness of the initiative resulted in the insignificant level of support received from the management of the HEIs, as well as poor student involvement in the initiative.

According to FM1, the GCI is not as effective as it should be. FM1 stated that "[r]easons for this are because greening a campus costs a lot of money, and, for example, if we are unable to get funding, it is impossible to carry on with the greening plans that we have to the buildings".

Among the 18 impediments that were identified by Velazquez et al. (2005), lack of awareness, interest, involvement, support from the HEIs' administrators, and funding are the impediments that lead to unsuccessful implementation of the GCI. This shows some consistency between the findings of both studies, despite the dissimilarities in the geographical contexts of the HEIs.

4.4 Suggestions for improved GCI implementation performance

The interviewees concluded that for HEIs in South Africa to achieve an acceptable level of greening, or sustainability, in their campuses, it was important to have more visible and audible campaigns, i.e. effective communication. Also, they stressed the need for faculty and staff to attend workshops, to make it possible for them to transfer the knowledge and skills obtained to the staff and students, as well as to the host community.

FM1 said that "[i]t will also be nice if we could be taken to workshops, in order for us to have a wider understanding of what the green campus is about. I believe that this will assist us in coming up with other better ideas in greening campus buildings".

Sharp (2002) concluded that one of the key mechanisms to achieving successful GCI implementation is to have continuity in improving the learning curriculum regarding the initiative. The interviewees added that raising awareness of the initiative, through conducting greening programmes and having small activities, would be of benefit for future greening activities.

5. CONCLUSION

This exploratory study set out to explore the level of awareness, as well as the perceptions of stakeholders, of the GCI in South African HEIs. It is one of the first studies to be conducted that has sought to gain an understanding of the perceptions of various stakeholders within the community of South African HEIs.

Adopting a qualitative multi-method case study, this study commenced by conducting interviews, to gain insight from the stakeholders. However, the study has two limitations: firstly, the data cannot be generalised to the pre-selected South African HEIs, and, secondly, documents were not reviewed, as no formal permission was given by the HEIs. Data emanating from the qualitative sources was thematically analysed based on the pre-set categories.

The preliminary findings highlight the participants' level of knowledge, awareness and acceptance of the GCI concept, the degree of participants' participation in the initiative, the participants' perceptions of the significance of the GCI, and identification of impediments to GCI implementation.

This study is still ongoing. It is expected that once the data collection and analysis has been completed, the findings will be used to assist in identifying the factors that influence implementation of the GCI, and the factors that contribute to the achievement of the GCI in South African HEIs.

6. ACKNOWLEDGEMENT

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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COMPETENCES FOR MANAGING MEGA INFRASTRUCTURE PROJECTS: A PILOT STUDY

Maxwell NYARIRANGWE[1], and Oluwayomi K BABATUNDE[2]

[1] School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa, Email: 1304390@students.wits.ac.za

[2] School of Construction Economics and Management, University of the Witwatersrand, Johannesburg, South Africa

ABSTRACT

Mega infrastructure projects have been conceptualised as complex adaptive systems characterised by emergence, co-evolution, and self-organisation. These projects have been found to consistently underperform technically, financially, socially, and environmentally, due to gaps in traditional project management practices regarding complexity management. Consequently, project management teams have been compelled to utilise unique processes and complexity management competences. This article is a pilot study of an ongoing PhD research programme. It aims to assess the appropriateness and feasibility of the proposed data-collection methods, sampling frame and data-analysis techniques. It also aims to establish potential logistical challenges and, consequently, to review the methods and processes of the main survey. Semi-structured interviews were used to collect data from five subject experts working on a bus rapid transit project in Polokwane. The results were analysed using content analysis. The findings of the study assisted in highlighting some of the potential logistical challenges which could have been encountered during the main research interviews. The results were also used to assess the appropriateness of the proposed research approach, the sampling frame and size, and the data-collection tool. Overall, the lessons drawn from the findings of the study will be used to review the proposed methods and processes prior to commencement of the main research. Despite the important insights drawn from this study, the data collected will not be used in the main study, but will only be used to improve the associated methods and processes.

Keywords: mega infrastructure projects, complexity, competences, pilot study

1. INTRODUCTION

This article uses insights which were drawn from a previous publication (Nyarirangwe and Babatunde, 2016), which focused on presenting the findings from a detailed review of existing literature on megaproject complexity and the required management and leadership competences, as part of a PhD research proposal. The findings from that publication, and the valuable insights which were obtained, have since been used to refine and update the key constructs and to design the proposed methodology in the PhD research proposal. Consequently, this study is a subsequent step in the research process. It focuses on piloting the proposed methodology and processes, before

commencing the main research. The article begins with a brief review of relevant literature on mega project complexity, the required management competences, and the importance of conducting pilot studies in guiding the main research. This is followed by a brief description of the methodology that was used, and key findings that emanated from the study.

2. LITERATURE REVIEW

This section of the article provides a summary of the findings from an integrated review of existing literature on mega project complexity, the required management processes and competences, and pilot studies. In addition to explaining these constructs, the importance of conducting pilot studies, and the role of such studies in informing and guiding the main research, is clarified.

2.1 Mega infrastructure projects

Mega infrastructure projects as a developing phenomenon have been found to be largely elusive (Brookes and Locatelli, 2015). Consequently, some authors have attempted to define them broadly according to the perspectives of investment, operations, and the economy, respectively (Flyvbjerg, 2014; Brookes and Locatelli, 2015; Mišić and Radujković, 2015). According to the investment perspective, mega infrastructure projects have been delineated in terms of budget size, technological components, and levels of innovation involved (Flyvbjerg, 2014). The operations perspective has been construed to cover aspects such as the implementation time frames and socio-economic and environmental impacts, among other things (Brookes and Locatelli, 2015). Lastly, the economic perspective has been found to focus on the contextual issues which impinge on the project (Locatelli et al., 2014).

Haidar and Ellis (2010) distinguished mega infrastructure projects from other projects, using size and degree of complexity involved. While metrics such as budget and schedule thresholds have been advanced as important features that distinguish mega infrastructure projects from other conventional projects (OMEGA Centre, 2012), they have been found to be largely arbitrary, and hence, not universally applicable across different settings (Brookes and Locatelli, 2015). Consequently, contextual elements, such as the size of the host country's gross domestic product (GDP), have been advanced as important attributes of the definition of mega infrastructure projects (Flyvbjerg, 2014).

Mega infrastructure projects have also been found to have certain characteristics that distinguish them from other conventional projects (Dimitriou et al., 2013). Some of the commonly cited characteristics include long implementation periods, multiple and diverse stakeholders, novel technology, and high social and political significance, among other things (Johnson and Mulder, 2016). The interaction among these different attributes has been suggested as one of the key sources of mega infrastructure project complexity (OMEGA Centre, 2012). Consequently, complexity has been advanced as the single most important impactful characteristic of mega infrastructure project performance (OMEGA Centre, 2012).

2.2 Mega infrastructure project complexity

Complexity theory (CT) in general and complex adaptive system (CAS) theory in particular have been used to provide the necessary theoretical framework for analysing mega infrastructure project complexity dimensions, levels and attributes (Curlee and Gordon, 2011; Wood and Gidado, 2008). The ability of the CT and the CAS theories to explain non-linear relationships and interactions has been underscored in investigating

how mega infrastructure project systems adapt to their environments, as well as the resultant emergent properties that emanate from interactions among the components of the systems (Aydinoglu, 2011; Schalcher, 2015).

CAS theory has been found to be applicable at construction industry, project and site levels (Schalcher, 2015). On the one hand, the construction industry has been construed as a complex phenomenon, within which firms operate as autonomous agents that are loosely governed by voluntary institutional structures, rules and standards (Bertelsen, 2014). On the other hand, construction projects have been conceptualised as non-linear and complex phenomena, which demand much more agile processes than those espoused under the traditional project management philosophy (Wood and Gidado, 2008). Lastly, construction sites have been emphasised as complex environments for cooperation and social interaction, which are characterised by multiple layers of formal and informal human relationships (Schalcher, 2015). Consequently, the CT and the CAS theories have been advanced as suitable lenses to illuminate the non-linearity associated with mega infrastructure project systems (The Standish Group, 2012).

2.3 Processes and competences for managing complexity

The failure of infrastructure projects across the globe has been attributed to some of the gaps in traditional project management approaches, tools and processes (Johnson and Mulder, 2016). By using the Pareto principle, 80% of mega infrastructure project failure has been attributed to human factors, in general, and project management-related processes, in particular (Shenhar, 2011). Consequently, from a complexity perspective, it has been postulated that mega infrastructure projects demand unique approaches and delivery models (Johnson and Mulder, 2016). In Nyarirangwe and Babatunde (2016), it was proposed that the success of mega infrastructure project delivery can be enhanced through unique balancing of administrative, enabling and adaptive leadership models, in line with the levels of complexity involved. This balancing process was construed under the complexity-leadership alignment model (Nyarirangwe and Babatunde, 2016). Levels of complexity have also been associated with the size of the project, and this has been presented using the size-complexity matrix, which has been presented as a framework for determining the required delivery competences and processes (The Standish Group, 2012).

Additionally, it has been postulated that competences and processes required to deliver mega infrastructure projects should be distinguished from those commonly found in traditional project management literature (Australian Constructors Association, 2015). It has been distilled that such competences and processes should be flexible and emergent in nature, in order to deal with the unique characteristics of complex adaptive systems (Johnson and Mulder, 2016). Confirming this assertion, Flyvbjerg (2014) equated the competences and processes required to deliver mega infrastructure projects to the need for a jumbo jet pilot's licence. Accordingly, delivering mega infrastructure projects using traditional management competences and processes has been equated to attempting to fly a jumbo jet using a motor vehicle driver's licence, and hence the widely reported failures (Flyvbjerg, 2014). The competences and processes required to deliver mega infrastructure projects, which were drawn from the reviewed literature, are summarised in Table 1.

Table 1: Competences and processes for managing megaprojects as CAS theory

COMPLEXITY MANAGEMENT	
MANAGEMENT PROCESSES	MANAGEMENT COMPETENCES
Processes that emphasise leadership approaches more than techniques for maintaining control and power	The ability to create an engaging ecosystem for stakeholder engagement, adaptive concept scoping, and human engineering
Processes that promote positive behaviour and success, e.g. unique incentives and inhibitions	Creating an enabling environment for innovation, through space for creativity, engagement, debate, and co-creation
Processes that emphasise assessment of the value of outcomes, rather than efficiency optimisation	Architecting complex change, through diffused leadership and agile project processes, among other things
Processes that leverage and encourage adaptive and learning attributes, rather than enforcing of optimisation-focused systems, contracts and processes	Building a performance culture, by, for example, structuring of contracts around shared accountability, mutual achievement, and collaborative partnerships
Processes that emphasise incentives and encourage personal commitment, such as transparent organisational practices, policies and outcomes	Aligning business models, through deliberate migration from strict compliance with contracts towards using human collaboration
Models that shift decision-making from centralised command and control to points of interface in the mega infrastructure project structure	Changing leaders, through distributed leadership models, which shift the focus from managing complicated technological projects to leading complex social interactions
Organisational structure and processes which are flexible enough to adapt as more knowledge is gained in the system	Learning agility, through moving away from risk-averse governance frameworks and methodologies to embedded learning models

2.4 Pilot studies

Pilot studies have been defined in different ways by different authors (Dikko, 2016; Marinas et al., 2014). However, what has commonly been found across different studies has been the fact that pilot studies constitute small-scale investigations designed to test the feasibility of the methods and procedures to be used in large-scale research projects, among other things (Arain et al., 2010; Vogel and Draper-Rodi, 2017).

2.4.1 Reasons for conducting pilot studies

The utility of pilot studies has been underscored for both quantitative and qualitative research (Dikko, 2016; Hazzi and Maldaon, 2015). In both research approaches, pilot studies have been found to be used to assess the feasibility and adequacy of proposed research instruments, to illuminate unforeseen problems regarding the proposed data-collection strategies and methods, and to answer methodological questions, among other things (Thabane et al., 2010). The rationale behind conducting pilot studies has

been conceptualised according to process, resources, management and scientific perspectives, respectively (Hazzi and Maldaon, 2015; Thabane et al., 2010). In terms of process, pilot studies have been used to assess the feasibility of the steps that need to take place as part of the main study (Hazzi and Maldaon, 2015; Nunes et al., 2010). According to the resources perspective, pilot studies have been used to assess the time and budget problems that can occur during the main study (Marinas et al., 2014). The management perspective of pilot studies has been construed as addressing the potential human and data-optimisation problems which could be encountered during the main study (Nunes et al., 2010). Lastly, the scientific perspective has been found to be applicable mainly in medical research in terms of aspects such as assessment of treatment safety and determination of dose levels, among other things (Hertzog, 2008).

Some of the key questions a pilot study can assist in addressing include whether the proposed methods are appropriate, whether they should be adjusted or changed, and whether the questions will be well understood or whether they should be reformulated (Marinas et al., 2014; Nunes et al., 2010). Pilot studies have also been found to assist in checking the terminology used in the data-collection tool, as well as refining the research plans (Hazzi and Maldaon, 2015). It has also been advanced that pilot studies assist in revealing potential logistical challenges, and consequently improving the quality and efficiency of the main study (Nunes et al., 2010). Additionally, it has been suggested that well-conducted pilot studies can assist in designing a clear roadmap, by refining the data-collection and analytical procedures, which increases the likelihood of getting clearer findings in the main study (Hazzi and Maldaon, 2015). Consequently, pilot studies have been strongly recommended as a way of timeously identifying and correcting possible errors and avoiding potentially disastrous consequences before resources have been committed in the main study (Nunes et al., 2010).

Some of the gaps associated with pilot studies have been found to include the limited information they generate, which constrains their ability to guarantee the success of the main study (Nunes et al., 2010). Additionally, it has been suggested that many pilot studies remain unpublished, due to factors such as incorrect reporting of results, with too much emphasis on analysing statistical significance, poorly designed objectives, and the absence of analytical plans and success criteria, among other things (Thabane et al., 2010). Consequently, researchers have been compelled to use pilot studies mainly to establish the feasibility of the main research, as opposed to using them for hypothesis testing or sample size calculations (Hazzi and Maldaon, 2015).

2.4.2 Sample size for pilot studies

Generally speaking, it has been observed that there is limited published guidance regarding the recommended sample size for pilot studies (Vogel and Draper-Rodi, 2017). Consequently, some researchers have opined that even though all studies should have a sample size justification, pilot studies do not require a sample size calculation (Thabane et al., 2011). Some authors, however, have suggested that 10% to 20% of the sample size of the main study is generally sufficient for an associated pilot study (Hertzog, 2008), while specifically for a PhD research pilot study, four to five interviews has been considered as acceptable (Hazzi and Maldaon, 2015; Hertzog, 2008).

Other authors have proposed that regardless of the sample size used, the sampling frame for a pilot study should be representative of the target study population and should apply similar inclusion and exclusion criteria to those of the main study (Thabane et al., 2010). Additionally, it has been suggested that if there is a compelling need to pool the pilot

and the main study, caution must be exercised to ensure that the key features of the main study are preserved in the pilot study (Sorzano et al., 2017). Consequently, it has been recommended that any such pooling should be planned beforehand, and that it should be described clearly in the protocol, together with the statistical consequences and the remedial measures to be used to avoid or minimise the potential bias that may occur due to multiple testing issues (Sorzano et al., 2017; Thabane et al., 2011).

2.4.3 Interpreting pilot study results

In order to derive optimum benefit from pilot studies, it has been suggested that the analysis and reporting of pilot study results should highlight the key challenges that might affect the feasibility of the main study, and that it should recommend suitable remedial or mitigation measures for the main study (Arain et al., 2010). Consequently, the outcomes of a pilot study have been construed as recommendations to either stop the main study if it is not feasible, continue the main study, with modifications, continue the main study, without modifications, but with close monitoring, or continue the main study, with neither modifications nor close monitoring (Thabane et al., 2011).

3. RESEARCH METHODOLOGY

This study used a qualitative approach, which has been proposed in the PhD proposal. The choice of this research approach was informed by the epistemological and ontological aspects, as articulated by Creswell (2003) and Hall (2013). These two authors advanced that the epistemological and ontological questions constrain a study's methodological questions, as well as the investigator's choice of research approach (Creswell, 2003; Hall, 2013). Consequently, the study's research approach focuses on establishing the informants' perceptions regarding mega infrastructure project complexity and the required management processes and competences.

In the main research, the sampling frame firstly consisted of mega projects drawn from the list of strategic infrastructure projects (SIPs). A sample size of six projects covering the transport, water, gas and electrical sectors was selected. Secondly, the main study sampling frame also consisted of institutions mandated by the Presidential Infrastructure Coordinating Committee (PICC) to implement these projects, and senior managers responsible for delivering the projects. Only those institutions responsible for delivering the six selected projects were earmarked for data collection in the main study, with special focus on senior managers from clients, consultants and contractors involved. Selection of these three project stakeholders in the main study was guided by Winch's stakeholder mapping framework (Winch, 2004). Literature on mega infrastructure projects where this framework has been used has suggested the need to focus on internal stakeholders, rather than external stakeholders, due to the diversity of interests associated with the latter (Brookes and Locatelli, 2015).

This pilot study used a similar approach in defining the same sampling frame and the associated inclusion and exclusion criteria as proposed in the main study. Consequently, this pilot study is based on a mega project drawn from the list of strategic infrastructure projects (SIPs). In a similar approach to the main study, this pilot study also focused on internal project stakeholders, who consisted of senior professionals currently working on a bus rapid transit (BRT) project in Polokwane. These professionals were considered to exhibit the same traits as those targeted in the main research. The decision regarding the sample size was based on insights drawn from the literature, where it has been recommended that the sample size of a pilot study should be equivalent to between 10% and 20% of the sample size to be used in the main study (Hazzi and Maldaon, 2015). The proposed sample for the main study consists of a minimum of 42 senior managers

drawn from internal stakeholder institutions responsible for delivering the selected megaprojects. Consequently, a minimum sample of four interviews was required to satisfy the sample size guidelines given by Hazzi and Maldaon (2015). In this pilot study, a total of five senior professionals involved in delivering the Polokwane BRT project were interviewed. This is equivalent to about 11.9% of the sample size for the main study.

In terms of data collection, a semi-structured interview guide with the same questions as those in the main research was used in this study to collect data from five subject experts currently working on a bus rapid transit (BRT) project in Polokwane. The semi-structured interview guide consisted of six broad questions, which were designed based on insights drawn from existing literature on mega infrastructure project complexity and the required management processes and competences. The interview questions were designed to enable the interviewees to use their personal experiences on the project in discussing the different complexity attributes and management processes and competences, which were discussed in the preceding sections. Each of the questions was also designed to align with the objectives of the main research. In order to ensure that all the elements under each construct were adequately covered, each of the main questions was complemented by a set of probing sub-questions.

The data-collection process was guided by recommendations from the reviewed literature regarding the expected focus of pilot studies, as discussed in the preceding sections. It was recommended that no statistical analysis or hypothesis testing be conducted in pilot studies, due to the small sample sizes involved. Instead, it was suggested that the analysis processes should focus on assessing the feasibility of the proposed data-collection methods, the research protocol, and the sampling frame, and that potential logistical challenges that could be experienced in the main study should be established.

In order to assess the clarity of the different questions and the terminology used, content analysis was done of the responses. This assisted in assessing whether there are specific terminologies used in different disciplines, and the extent to which the respondents were familiar with the industry jargon used in the interview schedule. Consequently, the analysis process in this study focused on establishing these elements, with the aim of using the findings to refine the research methodology, tools and processes, before commencement of data collection for the main study. Due to the sample size used in this study, this process will be undertaken manually and will be limited to situations where marked variations would have been established. The different aspects of the findings from this study are explored in the following sections.

4. FINDINGS AND DISCUSSION

The study findings focused on the appropriateness of the proposed research approach, the sampling frame and size, the proposed data-collection methods, and the face reliability and validity of the interview guide. It has been proposed that face reliability and validity assessments be limited to establishing whether the questions have no errors and are clear enough to ensure that they generate appropriate responses required to address the questions and objectives of the research (Lancaster, 2015).

4.1 Appropriateness of the proposed research approach

To establish the appropriateness of the proposed research approach, the interviewees were required to use their personal experiences on the project in discussing the different elements under study. For instance, based on their current experience on the BRT

project, the interviewees were requested to explain their perceptions regarding the flexibility of the project management processes, the ease of change management procedures, the diffusion of leadership processes, the extent of decentralisation and mutual ownership of decisions, and successes and failures in dealing with emergent complexity aspects. These elements have been found to be largely experiential in nature, and hence best explored using a qualitative approach. Consequently, this approach enabled the interviewees to provide a narrative of their personal experiences with the different competences and processes when delivering mega infrastructure projects. This is in line with the approach used in other studies, where similar constructs have been found to be best explored using a qualitative rather than a quantitative approach (Brookes and Locatelli, 2015; OMEGA Centre, 2012).

4.2 Suitability of the sampling frame and size

The suitability of the sampling frame was assessed based on the extent of compliance with the inclusion and exclusion rules defined in the main study, which were outlined in the preceding sections. The selected project falls under the strategic infrastructure projects category number 7 (SIP 7) and qualified as a megaproject, based on the size of the budget and the number and the diversity of stakeholders involved, among other things. The selected interviewees qualified as consisting of senior project managers, as required in the main study. All the five interviewees involved held at least a degree qualification in either the built environment and/or project management. Their average project management experience ranged from five to over 20 years. With respect to their involvement on the project under study, their experience ranged from 18 months to four years. These attributes were considered sufficient to qualify the interviewees as experienced enough to both understand and articulate the subject matter and elements addressed in the interview. Consequently, the sampling frame was considered suitable, and it will be maintained for the main study.

The sample size was guided by recommendations from the literature, where it has been suggested that pilot study samples should be between 10% and 20% of the size of the sample of the main study (Hertzog, 2008; Lancaster, 2015). Consequently, the five semi-structured interviews which were used in this study complied with this suggested guideline. Some authors have proposed that four to five interviews constitutes a generally acceptable sample size for PhD research pilot studies (Hazzi and Maldaon, 2015; Hertzog, 2008; Lancaster, 2015). Based on these guidelines, this pilot study suggests that the main study's proposed sample size of 42 interviews should be maintained.

4.3 Appropriateness of the data-collection methods and instrument

This study used the same protocol and set of open-ended questions as proposed in the main study's interview schedule. However, an analysis of the responses obtained revealed some of the potential pitfalls associated with the diversity of responses obtained from the open-ended questions. While different responses had been expected from those to the open-ended questions, the range of response diversity revealed some potential analytical challenges. To a certain extent this diversity of responses has been attributed to the tenure of the interviewees on the project, and consequently their level of awareness and understanding of applied processes and competence levels among the project teams. For instance, variations were found among responses to questions that focused on the existence and application of management processes on the project. These variations were particularly found in responses provided by professionals who have

been working on the project for about 18 months, as compared to those who have been on the project for over four years.

In order to minimise the range of response diversity, insights were drawn from similar studies, where semi-structured group interviews were used instead of individual interviews (Brookes and Locatelli, 2015). These group interviews have been upheld for enabling the experts to share their experiences, and consequently co-create meaning regarding the different elements of the study constructs (Colucci, 2007; Kinchin et al., 2006). Other studies have also complemented the group interviews with integrative engagement tools, such as decision matrices or cognitive maps (Mojtahed et al., 2014). Consequently, this study underscored the importance of utilising similar complementary methods in the main research, in order to manage the diversity of responses, and also to utilise the collective experience of expert groups.

The research instrument was also evaluated against the planned duration. On average, each of the interviews was found to have exceeded the planned one-hour duration by between 10 and 20 minutes. This was attributed to two main reasons. Firstly, the interview guide consisted of main questions and pre-planned probes. The latter were carefully designed to ensure that none of the elements of the main study's constructs were inadequately addressed. However, the pilot interviews resulted in additional probing questions, which had to be asked to follow up on issues that emanated from the open-endedness of the interview questions. The net effect was an increase in the number of questions, which consequently compromised the interview duration.

Secondly, the interview protocol had been designed to distinguish questions in line with the different study objectives. Consequently, a number of questions were repeated under the categories of management processes and management competences, respectively. For instance, questions about the flexibility of project management procedures, decentralisation of decision-making, change management processes, and contract management had been asked twice, under the category of management processes, and under the category of management competences. This resulted in response redundancy. In order to address this ambiguity and redundancy, this pilot study underscored the need for reviewing the interview protocol, by merging some of the questions, based on the subject matter under investigation, instead of focusing on the research objectives. This study also proposed the need to keep the number of pre-planned probing questions to a minimum, in order to allow room for additional follow-up probes within the planned time constraints.

The semi-structured interview schedule was also assessed in terms of the clarity of the research questions. The assessment mainly focused on establishing the extent to which the interviewees struggled to understand the subject matter and the terminology used in each of the questions. Indicators such as the number of times interviewees sought clarity on the subject matter and the terminology, as well as the precision of answers, enabled the different questions used to assess the extent to which the interview questions were easily understood. During the pilot interview it was found that none of the participants struggled with either the subject matter or the terminology used in the different questions.

In terms of the terminology used, a short glossary covering key terminology used, including terminology related to complexity, competences, project management processes, and governance procedures, was provided and explained beforehand to guide the interviewees. By the time the interviews commenced, these terms were well understood. All the interviewees were also familiar with project management and

governance processes, as well as the main guides provided by institutions, such as the South African Council for Project and Construction Management Professionals (SACPCMP), the Project Management Institute (PMI), and the Engineering Council of South Africa (ECSA). Minor variations in the responses were largely attributed to the different backgrounds and experiences of the interviewees. For instance, while some interviewees referred to the governing document for the project as a "project charter", others referred to it as an "inception report". Similarly, some respondents used the term "workstreams", while others used the term "functional lines", when referring to the specialist segments of the project structure. Consequently, these terms are used interchangeably in this study. The outcomes of the pilot study resulted in some important decisions that will be used in reviewing the semi-structured interview guide and the data-collection processes before commencement of the main research. These different aspects are summarised in Table 2 below.

Table 2: Findings, and required reviews for the main study

ELEMENT	KEY FINDINGS	REQUIRED ACTIONS
Logistical aspects	Interview exceeds planned duration	Combine questions, and sequence them based on subject matter
Proposed research approach	A qualitative approach was upheld	Maintain the research approach
Proposed sampling frame	The sampling frame was upheld	Maintain the sampling frame
Data-collection instrument	The diversity of responses is too high, and it must be controlled to avoid data-analysis challenges	Use group interviews instead of individual interviews. Complement with interactive methods, such as decision matrices or cognitive maps.
Proposed sample size	4–5 interviews, or 10% to 20% of the main study sample size, is adequate	Maintain the sample size (a minimum of five experts in each of the proposed group interview sessions)
Clarity of questions	Questions were easy to understand, and terminology used was well understood	Maintain the terminology used, but complement it with a short glossary of terms
Instrument validity and reliability	Only face validity and reliability were assessed. Further assessments are needed to improve the validity and reliability.	The instrument will be assessed by at least two research experts before the main study commences

5. CONCLUSION

The findings from the pilot study provided some important lessons, which need to be incorporated in reviewing the proposed methods, tools and processes before undertaking the main research. The review process will assist in addressing potential pitfalls and logistical challenges in undertaking the main research. In addition to reviewing the interview schedule, questions and protocol, the data-collection instrument

will be presented to at least three subject experts, for further face validation and reliability assessments, prior to commencement of the main study. Additionally, the Cronbach's alpha will be determined to further assess the internal validity of the interview questions. The researcher will also explore the possibility of complementing the semi-structured group interviews with interactive methods, such as decision matrices or cognitive maps, so as to co-create meaning and manage the diversity of responses. Given the sample size used in undertaking this study, and the required reviews to the research methods, tools and processes, the resultant data will not be used in the main study. Only new data collected using the revised tool will be used to test the main study's proposition and to address the research questions.

6. ACKNOWLEDGEMENT

This article was language-edited by a freelance language editor, Anthony Sparg. He has edited several academic journal articles in the field of construction management. He has an MA *cum laude* in African Languages (isiXhosa), an MA *cum laude* in Linguistics, and a Higher Diploma in Education.

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