Construction quality process implementation as a source of competitive advantage in small and medium-sized construction projects

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Abstract

It is generally accepted that construction quality process implementation improves construction project performance through the systematic application of quality practices. It is equally established that current quality management systems, particularly compliance management, are essential for Small and medium-enterprises (SMEs) seeking effective completion of road-building infrastructure. Despite the opportunities offered by these quality practices, there are potential pitfalls. As low-cost economies proliferate, South African construction SMEs are under increasing pressure to be more flexible and innovative. The study examines the factors affecting the quality of work produced by construction SMEs through a regulatory road building procedure, namely design, construction, and execution. A questionnaire survey was conducted among 165 SME contractors, designers, and their experience was recorded of construction quality standards and performance improvement on completed work in the public sector in South Africa. A combination of descriptive and inferential statistics was used to analyse the data. The empirical findings established that five construction quality process factors affect the quality of road infrastructure projects undertaken by construction SMEs. These factors comprise construction process and design; construction quality management at the site level; the development and implementation of quality procedures and requirements; quality benchmarking issues; continuous improvement and communication. This study is of value to designers/consultants and managers in the construction SME sector as it helps to establish the factors affecting the quality of road infrastructure projects. Managers in analogous environments may also use the results of this study as a benchmark for competitive advantage. The results also provide a guideline for the successful construction quality implementation in small and medium-sized construction projects.

Keywords: Construction quality; Continuous improvement; Design; Performance; Quality management.

1. Introduction

The construction sector in Southern Africa itself is challenging because there are various multidimensional liabilities and operational procedures (Windapo & Cattell, 2013; George, 2016). Statistics South Africa (2017) reported that 30.1% to 39.4% inefficiency, poor rural road building and lack of construction process planning amongst SMEs contractors. Furthermore, poor road infrastructure and standards, design and construction deficiencies cause considerable contractors problems (Tshivhase & Worku, 2012; Oke, Aigbavboa & Mokashoa, 2017). One of the most daunting challenges

hampering development, particularly in evolving rural areas, is one of the widely debated issues related to the poor project implementation and lack of quality of work produced by construction SMEs (Statistics South Africa, 2017).

In South Africa, up to 80 per cent of the road infrastructure is older than its original design life (Statistics South Africa, 2001-2006). Additionally, there is a lack of life cycle costing, inadequate construction design, inefficiencies in material use, poor budgeting, labour shortages and construction difficulties (Tshivhase & Worku, 2012). Reasons for such poor rural road building construction sites include schedule overruns;

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degradation, and loss of trust (Mahmood et al., 2010). Moreover, such a poor construction quality rate indicates a failure to apply a quality cost model and underutilisation of quality management techniques and tools (Marthur et al., 2013). Previous studies on construction SMEs in South Africa have considered either lack of clarity over the relative roles, responsibilities, and accountabilities of different road agencies that undermine an assessment of institutional sustainability (Haupt & Whiteman, 2004; Mofokeng & Thwala, 2012; Tshele & Agumba, 2014). Improving the construction application process, competence and value of quality systems have become an on-going concern of governments and the international development community (Rumane, 2011). Hall and Sandelands (2009) recognise that improving the construction process and design of rural roads, including technical standards provided through endorsed development assistance, requires the existence of a quality system that meets international standards and that operates as envisioned.

The South African local government is obliged to provide roads to the local communities they serve (Nyakala, Pretorius & Vermeulen, 2019). Van Wyk (2003) postulates that adequate roads contribute to economic growth, redistribution and development of an adequate roads network infrastructure. According to Statistics South Africa (2017), the enhancement of rural road networks contributes to improving the socio-economic conditions of communities and supports the materialisation of active co-ordinating constructions through government to promote success in road service delivery. According to Aigbavboa and Thwala (2014), SME road contractors must use recognised quality management techniques to enable communities to have quality road networks and access to public services such as educational institutions, health facilities, and labour movement between workplaces). The success of construction SMEs is dependent on the cost-effective deployment of their limited resources of material, technologies, human resources and project management techniques (Nel & Pretorius, 2014).

It has been widely argued that construction quality techniques apply to technical factors, but it is mainly associated with organisational-oriented factors like policies, procedures, and the working environment (Van Wyk, 2003). Construction SMEs include several technically inexperienced contractors with little knowledge of construction quality management and procedures (Statistics South Africa, 2017). Construction SMEs are essential to the South African economy's development and growth and intimately related to job creation, economic empowerment, and employment within underprivileged communities (Aigbavboa & Thwala, 2014; Tshele & Agumba, 2014). Construction SMEs are operating in a competitive business environment where construction quality through good regulatory and road-building procedural infrastructure from other countries is not uncommon (Van Wyk, 2003).

The poor quality of rural road infrastructure imposes an enormous cost on South Africa. The construction 'bombardments' undertaken by the Department of Employment and Labour (DoE&L) established significant non-compliance to road infrastructure legislation, injuries, accidents (DoE&L, 2019). Aside from the increasing fatalities, injuries, and medical costs associated with accidents, the economic costs are immense and include lost time, rework, disruption, productivity loss, and loss of skills to the economy (cidb, 2004).

The problems and challenges faced in the South African construction industry on rural road infrastructure by construction SMEs need to be addressed. There is limited research on the rural road infrastructure and standards, design and construction process (Statistics South Africa, 2017). The study was undertaken on the premise that local roads within Mopani District Municipality are in a deteriorating condition; lacks proper monitoring and community involvement. An error in the construction design is amplified in the construction process and may only be detected in the execution phase. Although the construction process is critical, quality awareness is required in all construction projects, with commitment from project manager to the team members in construction SMEs (Abor & Quartey, 2010).

The paper examines SME construction quality factors through regulatory road-building procedures, namely design, construction process, and execution. The study focus is on construction quality process implementation that helps SMEs gain a competitive advantage. The main question to be investigated in this study is "what are the key factors influencing the quality of work (road infrastructure) produced by SMEs?.

2. Literature Review

This literature review presents an overview of the quality of rural road infrastructure produced by South African construction SMEs. The implementation process of project control systems and rural roads' performance is an essential source of knowledge about quality management in the construction industry (Nkomo, Desai & Peerbhay, 2016). While Van Wyk (2003) reviewed the influence of economic, regulatory and public sector capacity on the South African construction industry, Mofokeng and Thwala (2012) conducted a study on mentorship programmes within the Small and medium-sized contractor development programme, and Windapo and Cattell (2013) investigated the perceptions of key challenges facing the performance, development and growth of the South African construction industry. George (2016) examined the financial challenges facing emerging contractors in developing countries using the critical incident technique. In South Africa, construction SMEs are increasingly diversifying, and operate in socio-economic and politically unstable environments, face multiple economic and socio-political challenges, and various regulations, political uncertainty and unpredictable markets (Haupt & Whiteman, 2004; Tshele & Agumba, 2014). These negative external factors place significant pressures on the internal environment of construction SMEs (Dangalazana & Newada, 2005). This study is situated in this challenging road infrastructure and construction process context, where SMEs are responsible and accountable for the quality of work.

Road infrastructure is usually considered as an economic backbone of the community. Local government is responsible for ensuring that local roads are built in mandatory standards for the movement of goods, services and people. Statistics South Africa (2017) showed that SMEs' challenges in managing the construction of rural access roads by SMEs were mostly competency related. In South Africa, the implementation of construction projects by construction SMEs has increased over the past few decades (Oke, Aigbavboa & Mokashoa, 2017). Value and quality of construction are of concern to both public and private sector customers (Haskins, 2010).

Many factors have a potential impact on poor quality and improper construction design (Rumane, 2011). These include the project leader's role as the champion and key strength behind quality enhancement (Bowen, Edwards & Cattel, 2012); making appropriate responses to technological changes, and project management (Hall & Sandelands, 2009). poor utilisation of available tools and practices to improve road infrastructure and organisational performance (Institution of Civil Engineers, 1996). The study deduced that poor communication and lack of awareness were the main challenges facing rural road project implementation (Muhwezi, Acai & Otim, 2014). Also, that efficient and effective quality procedures and requirements can often make a rural road project successful. The South African Government recognises that skills and capabilities are critical success factors driving the performance of construction SMEs that can be further enhanced by providing appropriate skills training programmes (Department of Public Works, 1999; Hall & Sandelands, 2009).

2.1 Construction process and design

In the construction process and design literature, construction quality is becoming a most important research area for practitioners (Haupt & Whiteman, 2004; Hall & Sandelands, 2009; Honnakker, Carayon & Loushine, 2010). To measure perceived construction quality, a road construction quality assurance process measurement tool (QAPMT) was developed by Nyakala et al. (2018), tested in various SME construction projects successfully. It is based on 35 items, comprising eight dimensions: level of the skill acquisition process, project planning and control techniques, project construction design, financial management skills, quality standards, organisational structures, and people involvement. The QAPMT, which is used to measure perceived construction quality, can be modified according to project control systems' implementation process. In the road construction industry, various researchers have developed the concept of construction quality and have explored its various dimensions to determine their impact on the design, built, maintained, operated and decommissioned construction projects (Dallasega et al., 2015). A study conducted by Dallasega et al. (2015) found that designing a framework for supporting the management of the execution phase of SME projects has been reported as the most significant areas of quality management and assurance in the construction industry because effective planning is important for the successful implementation of a project. Using an appropriate quality assurance method and

project management techniques to resolve construction road quality is also important (Institution of Civil Engineers, 1996)..

2.2 Construction Quality Management at the site level

The construction industry is widely criticised for the low quality of both the completed product quality and the processes used during the construction and project design phases (Mahmood et al., 2010). Substantial time and costs are currently spent on correcting problems during the execution\construction process, and most projects either suffer from time overrun or cost overrun or both (Masarini & Quinnell, 2010). In addition to the magnitude of time and cost overruns, many studies pinpointed the reasons for cost overruns and delays, revealing frequently similar problems. For example, issues to do with inadequate time, and low cost and design changes control have been identified as a significant cause of poor construction project delivery (Haupt & Whiteman, 2004). Hall and Sandelands (2009) suggested that unwanted industry practices emerged in the major slump in construction activity, comprising an unnecessary scramble for work outside practitioners' typical construction fields.

A study by Honnakker et al. (2010) shows a lack of proper control and appropriate oversight of public funds allocated for construction. A literature study by Rumane (2011) identified existing key elements of quality systems used in construction as quality planning, quality control and quality assurance. On the issue of quality assurance activities, using a quality manual as a key document on-site details the project quality processes and guidelines to be followed on projects. Such manual sets out steps to be taken to convey quality assurance. Managing and controlling actions arises because construction SME environment is dynamic, and projects are often carried out in varying situations. Obare et al. (2016) studied the implementation process of project control systems and performance of rural roads construction projects in Kenya. They found that the project control systems implementation process is practical, easy to understand and applicable to project managers and team members.

As described by Rumane (2011), a construction quality implementation process carries out systematic qualities and uses quality reviews to regulate which processes should be used to complete the project requirements and ensure successful implementation. Haupt and Whiteman (2004) further indicate that quality management principles should be implemented beyond management levels and should comprise the workforce on site. The South African road infrastructure is the heartbeat of economic growth, and it performs the basic yet critical function of providing access and social activities. By implementing quality management principles, construction SMEs could produce work that meets standards.

2.3 The development and implementation of quality procedures and requirements

Rural roads are vital to bringing the development of areas they serve and make a nation develop and grow. There have been limited studies that assess quality management practices in construction projects from the

viewpoint of quality specialists. A road construction project requires a team effort by all parties, including the construction manager, architect, contract owner, and clients to complete a project. Road construction SMEs find it difficult to sustain continuous quality improvements. To address the difficulty and agree on which quality procedures are required to plan and develop road infrastructure to meet customer requirements. A quality management system (QMS) such as ISO 9001 that integrates the various internal processes and provides a process approach for project implementation was developed. A process-based QMS enables the construction SMEs to identify, measure, control, and improve the various construction processes that will ultimately improve project performance.

Practices such as cost-effective quality assurance and control can produce a sustainable competitive advantage and provide sustainability (Nel & Pretorius, 2014). The design quality is an important factor defining the client requirements and describes the needs that the construction project must satisfy (Oke et al., 2017). Kruger, Ramphal and Maritz (2014) suggested that meeting the client's project goals requires an iterative design process in which prerequisite design solutions are defined and improved to meet the target goals.

2.4   Quality benchmarking issues

Construction SMEs can use benchmarking to understand better the best practices of rural road project activities and, therefore enable them to take early corrective actions (Smith & Ngoma-Smith, 2003). Honnakker et al. (2010) noted that top management relates actual or intended project practices to other developments to generate thoughts for improvement. Alao and Jagboro (2017) argued that construction organisations need to gauge how well they perform against others who undertake comparable tasks. Their findings suggest that rural road project managers should investigate other organisations' processes to determine why others' processes are outclassing their own. Incorporating well-respected and knowledgeable road-building team members into quality management roles helps to deliver the value for time and money invested. It ensures that the construction SMEs do not become paralysed by resource surplus while improving the day the job has to continue (Marthur et al., 2013). Emphasis should be placed on the processes during the quality benchmarking and implementation process.

2.5   Continuous improvement and communication

In the perspective of rural road-building projects, once planning is complete; the plan is turned over to the construction team (Oke et al., 2017). Scholars note that the critical functional area of construction processes is often neglected, even though construction processes are at the heart of many construction organisations (Dallasega et al., 2015; Smith & Ngoma-Maema, 2003:345; Alao & Jagboro, 2017:41). Technical support, continuous improvements and performance measurement competencies are often ignored in construction SMEs settings, even though these are pivotal due to their direct effect on customer satisfaction. Implementation of skills developments are requisite for construction planning and

are often acquired only through experimental learning (Hall & Sandelands, 2009: 215; Oke et al., 2017). Efficient operations enable SMEs to improve their efficiency and success to reduce costs and enhance customer service. In South Africa, though construction SMEs are currently at the forefront of local economic growth and are supposed to resolve socio-economic difficulties, this sector faces widespread limitations which include increased competition and a decrease in the cost of construction projects hamper them from continuous improvement and quality reassurance (Nel & Pretorius, 2014). Constructor growth and delivery of services also play an important role in achieving the quality of construction projects. Rural road buildings/projects have to be planned and organised, considering construction design and efficiencies of materials (Nyakala et al., 2019).

3.   Research Methods

The study adopted a quantitative method based on a positivist paradigm, employing a structured questionnaire. The questionnaire was piloted, reviewed, and amended by experts and a professional statistician for ease of data analysis (Welman et al., 2012; Leedy & Ormrod, 2014) before being self-distributed to construction SME in Mopani District Municipality, Limpopo province.   The specific focus was on construction SMEs that have been involved with road building infrastructure between 2014 and 2017. A literature review on construction quality-related process implementation in the construction SMEs, road infrastructure, and local municipality was undertaken. Exploratory Factor Analysis (EFA) was used in data analysis. According to Tabachnick and Fidell (2007), EFA can be seen as a type of technique that analyses the unidimensionality (characteristics) of each of the defined construction quality process implementation (original variables), in order to reduce it to a common score (smaller number of factors) by examining relationships among these quantitative factors. The specific focus was on construction SMEs that have been involved with road building infrastructure between 2014 and 2017.

3.1   Sample and sampling design

The sample size was obtained using the general Rule of Thumb based on an estimated 250 retrieved from the Mopani District Municipality website. The survey targeted construction SMEs listed in Grades 1 to 6 (denotes small and medium enterprises) on the cidb Register of Contractors. The sample was comprised of 160 projects/construction managers, designers, architectural practitioners, administrators, and road construction SMEs. A sample random sampling method was used to select five projects from each of the five sampling frames. The criteria for selecting the study population were that respondents must have been working with the identified construction SMEs and operating at the enterprise's management level listed on the cidb Register of Contractors. This resulted in selecting ten projects (from the initial five projects) from each of the Limpopo Local Municipalities of Mopani District Municipality.

A total of 160 questionnaires were returned, representing a 64% response rate of 250 questionnaires

distributed. According to Kaiser (1974), a rule of thumb prescribes that no less than 50 respondents are appropriate for a correlation or regression with the number increasing with larger numbers of independent variables. This was therefore used as the nominal anchor in determining the sample size. A response rate of less than 25% is not unusual in studies with a population of this size (Lorenzo-Seva et al., 2011; Pallant, 2013). Such a response rate is acceptable to represent the respondents' views and opinions (Field, 2013).

3.2   Research instrument

The research instrument used a five-point Likert item scale ranging from 1 to 5, whereby each participant indicated the degree to which they agreed or disagreed with the questions posed hence emphasising the significance of selecting the desired response (Leedy and Ormrod, 2014). The survey tested the personal experience of construction SMEs regarding their involvement with rural road-building infrastructure over four years (2014-2017) and identified the preferred construction quality procedures implemented by participating in construction SMEs. The quantitative research approach supported dichotomous questions and checkboxes to measure data (Leedy and Ormrod, 2014). Frequencies were utilised to calculate percentages of preferences (Pallant, 2013).

Items/variables on construction quality used in the questionnaire were extracted from the literature review, resulting in the compilation of a questionnaire comprising three sections. Section A requested information on the respondent's gender, educational background, and working experience. Section B established the involvement of the construction SMEs based on road-building infrastructure for over four years. It also examined the preferred construction quality procedures implemented by construction SMEs. The respondents were required to indicate their level of involvement, in practice, with construction quality, procedures and requirements and the responses were tabulated. To reduce bias, fixed closed-ended questions were preferred (Welman et al., 2012; Leedy & Ormrod, 2014).

4.   Data Analysis

Data analysis was conducted using Statistical Package for the Social Sciences (SPSS) Version 24.0 to compute frequency distributions, measures of central tendency and regression analysis (Pallant, 2013). In addition to this, SPSS was used to conduct a factor analysis of road construction quality process and to determine the internal reliability of the factors in the questions on construction quality process implementation, Cronbach's alpha values were tested (Tavakol & Dennick, 2011). Tavakol and Dennick (2011) further state that Cronbach's alpha's acceptable values would range from 0.70 to 0.95. In this study, a cut-off value of 0.70 was adopted (see Table 2).

Furthermore, in order to confirm whether the data from the measurements was sufficient for the test, the validity (factor analysis), the Kaiser-Meyer-Olkin (KMO) test (Kaiser, 1994; Lorenzo-Seva et al., 2011) and Bartlett's Sphericity test (Field, 2013) were performed. According to Pallant (2013), in the KMO test, the test values vary from 0 to 1, values above 0.7 are

recommended, and indicates that sufficient correlations exist between the variables to continue with the analysis (Kaiser, 1994).

5.   Results

5.1   Respondents' profile

The questionnaires were distributed to 250 SME contractors, of which 160 responded. Table 1 displays the profile of the participants. A total of 122 respondents were male (76.3%), while 38 were female (23.8%). This response implies that males still dominate road construction. The highest educational level was a first degree/ diploma (34.4%), grade 11 or lower (20.0%), grade 12 (N3) only (19.4%), honors/B-Tech (23.1%), masters/M-Tech (3.1%), with 8.1% having 12 or more years working in road construction. Further to this, data indicated that the majority of respondents did not have a Masters' qualification. Due to inappropriate tertiary masters' degree, a lack of knowledge and experience is evident; improvement of curriculum and enhanced tertiary architectural education was included as an enabler relating to education and skills provision (Mofokeng & Thwala, 2012). Stimulating professional accreditation and engaging construction management highest educational courses are considered an enabler toward education and skills provision (George, 2016). Table 1 shows that the respondents were distributed by staff positions as follows: project administrators (41.9%), QA engineer or architect (15.6%), client/manager (15.0%), quantity surveyor (11.3%), and government officials (4.4%).

Table 1: Respondents' profile

	Frequency	%
Gender distribution		
Male	122	76.3%
Female	38	23.8%
Highest educational level		
Grade 11 or lower	32	20.0%
Grade 12 (N3) only	31	19.4%
First degree/Diploma	55	34.4%
Honours/B-Tech	37	23.1%
Masters/M-Tech	5	3.1%
Staff position occupied		
Quantity surveyor	18	11.3%
Client/Manager	24	15.0%
Project/Construction Manager	19	11.9%
Architect/QA Engineer	25	15.6%
Project Administrator	67	41.9%
Government Official	7	4.4%
Number of years working in construction		
Less than 3 years	5	3.1%
3-6 years	42	26.3%
6-9 years	37	23.1%
9-12 years	63	39.4%
12 or more years of working	13	8.1%
Total	**160**	**100.0%**

5.2   Validity and reliability

In order to determine the reliability and validity of the measuring instrument, a panel consisting of six authorities

in the discipline of construction project delivery, construction process and road building infrastructure was requested to assess the ability of the questionnaire items to appropriately measure the concepts under investigation (cidb, 2004; Hall & Sandelands, 2009; Lorenzo-Seva et al., 2011; Welman et al., 2012). A pilot test involving a purposive sample of six respondents was also conducted. Feedback obtained from these procedures facilitated further refinement of the questionnaire items (Honnakker

et al., 2010). The scale's internal consistencies in the instrument showed Cronbach alpha coefficients (refer to Table 2) ranging between 0.713 to 0.871, while the alpha score for the entire scale was 0.772. Field (2013) and Pallant (2013) recommended that since these alpha values were all above the minimum acceptable level of 0.70, it was concluded that the measurement scales used in the study were internally consistent and reliable.

Table 2: Mean scores and internal consistencies

Factor name	Number of items	Cronbach Alpha	Mean score	Position in mean score rank
Construction quality management at the site level	6	0.722	4.129	5
Quality Benchmarking issues	7	0.871	3.901	4
The development and implementation of quality procedures and requirements	4	0.707	3.924	3
Continuous improvement and communication	6	0.845	4.163	2
Construction process and design	20	0.713	4.531	1

Scale (Section B): 1=Strongly Disagree: 2=Disagree: 3=Neutral: 4= Agree: 5= Strongly Agree

Table 2 indicates the mean scores of the factor scales considered in the study. These ranged between 3.901 and 4.531, representing clear inclinations towards either the agree/strongly agree or the satisfied positions on the Likert scales. Respondents were, therefore, satisfied with the existing levels of these factors in their road construction projects. As depicted in Table 2, the respondents perceived that the failure of many road construction projects in South Africa could partially be ascribed to the quality of roads constructed by SME contractors. Correlation of the construction quality implementation process and importance variables using factor analysis identified factor 1 as 'construction process and design'; factor 2 as 'construction quality management'; factor 3 as 'the development and implementation of quality procedures and requirements';

factor 4 as 'quality benchmarking issues'; and factor 5 as 'continuous improvement and communication in the construction industry'.

5.3   Regression analysis

The hypotheses formulated to guide the study's direction were tested using linear regression analysis. This inferential statistical technique is performed to identify the variables predicting the best explanation of the total variance in the scores of a set of dependent variables (Pallant, 2013). Construction processes and design was entered into the regression model as the dependent variable. The four factors; namely, construction quality management at the site level; constructing the quality procedures and requirements; benchmarking; continuous improvement and communication, were entered as the independent variables. The results are reported in Table 3.

Table 3: Regression Model

Independent variables: Extrinsic motivation factors	Dependent variable: Construction processes and design			
	Standard Coefficients *Beta*	T	Sig. *Tolerance*	Collinearity Statistics *VIF*
Construction quality management at the site level	0.291	4.265	0.000	0.571
The development and implementation of quality procedures and requirements	0.248	5.844	0.001	0.682
Quality benchmarking issues	0.109	1.995	0.040	0.595
Continuous process improvement	0.276	2.137	0.002	0.709

Model summary: R=0.478 Adjusted R2 =0.438   F=16.727 Std.error of the estimate=0.84386

A comparison of the mean scores shows that construction process and design (mean=4.531) scored the highest mean, meaning that respondents were most satisfied with this factor compared to the other four. The four independent factors accounted for approximately 44% (R^2 = 0.438) of the variance explained in construction processes and design. Collinearity statistics for the four independent variables were satisfactory, indicating that the problem of multicollinearity was insignificant in this study since there were no high correlations between the independent variables. All

tolerance values fell above 0.5, as prescribed by Kaiser (1974). Variance factor (VIF) values fell between 1.0 and 4.0, as recommended by Gorsuch (1983).

6.   Discussion

In Factor 1: Construction quality management at site level factor was supported and consequently accepted in this study because the regression model indicated that the relationship between construction quality management factor at site level and construction process and design

was statistically significant (beta= 0.291; t=4.265; p<0.000). This result demonstrates that quality management activities indicate the process implementation among employees in the construction SMEs. These findings are consistent with the findings of a study conducted by Haupt and Whiteman (2004). They recommend using a formal quality manual and formal control mechanisms (e.g., open book bookkeeping for accountability during construction projects to augment formal control. Haskins (2010) also emphasises that an effective project manager consult their subordinates in relating to early and sustained integration of the key quality management activities, and control processes to improve planning effectiveness and accuracy. Van Wyk (2003) further added that site management should be more informed about the initial stage planning techniques. Construction quality management enhances teamwork and better performance (Honnakker et al., 2010); and enable the success of construction process implementation (Nyakala et al., 2019). Therefore, it is important to ensure that the right people are chosen for the construction process.

In Factor 2: The development and implementation of quality procedures and requirements factor was supported and accepted in this study. There was a statistically significant relationship between the construction process and the development and implementation of quality procedures and requirements (beta= 0.248; t=5.844; p<0.001). This finding depicts that the state of quality procedures and requirements reveals the construction industry's degree of construction process and design. Mahmood et al. (2010) observed that inadequate measurable requirement planning, cost overruns in construction SMEs road infrastructure projects could be attributed to a failure in determining the cost of poor quality and its impact on profitability and requirements. A study by Masarini and Quinnell (2010) found that quality management practices in building construction are a dominant factor influencing construction quality process implementation. A study by Nyakala et al. (2019) suggests that determining major quality planning, procedures, and road-building requirements will provide a support system to construction SMEs. This means that in order for the construction SMEs in the construction industry to grow, project managers must understand quality procedures and requirements in such a way that both employees and the organisation will benefit in the end (Abor & Quartey, 2010).

In Factor 3: Quality benchmarking issues found support and was subsequently accepted in this study since there was a statistically significant relationship (beta= 0.109; t=1.995; p<0.040) between quality benchmarking and construction process and design. This finding illustrates that quality benchmarking is a useful measure of the construction industry's level of construction quality implementation in road building infrastructure. These findings support previous research by Abor and Quartey (2010) and Rumane (2011). Abor and Quartey (2010) found that implementation guidelines should specifically serve as a mechanism for avoiding poor construction quality, inability to network with well-established contractors, and lack of construction process abilities. Rumane (2011) drew similar conclusions in a study that examined the quality benchmarking in the construction industry. Dallasega et al. (2015) further contend that project team leader, and owners should develop quality improvement guidelines for their road construction projects that focus on high-quality, processes and procedures in the interest of construction excellence.

In Factor 4: Continuous process improvement and communication was supported and thus accepted in this study as there was a statistically significant relationship (beta=0.276; t=2.137; p<0.002) between continuous process improvement and communication, and construction process and design. This finding illustrates that continuous process improvement amongst employees in the construction industry depends on the construction process and design. The study supports previous findings by Honnakker et al. (2010) who found that continuous process improvement is a dominant factor influencing the construction process. CIDB (2004) adds that continuous process improvement has emerged as a hindrance to the development and success of construction projects in any country because it determines the extent to which employees are motivated and satisfied to achieve organisational goals.

These findings suggest that the implementation of construction processes will ensure that rural road-building inefficiencies are identified and resolved during the planning phase. These results support previous studies by Thorpe, Summer and Duncan (1996); Arditi and Gunaydin (1997) argue in favour of an appropriate construction quality process implementation contributing towards total quality management with technical approaches that can facilitate quality road infrastructure in the construction industry. Acquiescence, attentiveness and unselfish observance to construction quality process and standards must be established and measured frequently (Hall & Sandelands, 2009). Quality standards and systems need to be incorporated to allow the construction organisation to meet its clients' requirements (Institution of Civil Engineers, 1996).

6. Conclusions and Recommendations

In this study, the factors affecting the quality of work produced by construction SMEs within the local government of the Limpopo province, South Africa, were analysed via a questionnaire based on the rural road quality paradigm. The study found five construction quality implementation processes to be considered by SME contractors and local government managers that seek to institute and develop an effective qualitative rural road infrastructure programme. Based on these findings, this study concludes that the quality process implementation factors that should be considered the construction SMEs are (1) construction process design; (2) construction quality management; (3) the development and implementation of quality procedures and requirements; (4) quality benchmarking issues; (5) continuous improvement and communication.

Objectives for SME construction projects (see Table 2) is confirmed as important characteristics for construction quality process implementation, which is also aligned to literature (cidb, 2004; Abor & Quartey, 2010; Honnakker et al., 2010; Alao & Jagboro, 2017). It

emerged that all factors were statistically significant, which implies that they are a procedural indicator of construction process and design. Therefore, it is appropriate to conclude that the construction process and design in the construction industry depend on construction quality management, quality procedures and requirements, quality benchmarking issues, and continuous process improvement.

The study recommends that for construction SMEs to improve their road construction projects, administrators or contractors and their staff members need to implement construction quality procedure effectively throughout the construction process. They need to concurrently observe, examine, and assess the construction quality process at either operational or strategic process ranks. It is also recommended that practical construction quality process guidance for emerging contractors and construction SMEs must be appropriately implemented and used efficiently. Construction quality process workshops must be provided for the required exceptional quality control of rural road projects.

In the current study, theoretical and practical implications have been provided. On the theoretical perspective, the study presents evidence of the dynamics in the relationship between the factors considered in this study, specifically in the context of the construction SMEs related road-building projects. In this regard, the study serves as a source of reference for future studies on similar issues. On the practical front, construction/project managers in the construction industry will enhance the degree of construction process and design amongst employees in their working settings by implementing effective construction quality process on the four independent variables considered in this study.

Limitations of the Study

There were limitations associated with the sampling of the population and analysis of data. Because the study was not across South Africa, the findings cannot be generalised to road projects and SME contractors in South Africa and contractors not listed on the cidb Register of Contractors.

Further research

The study has raised several issues suitable for further research. A quantitative research approach was used in this study; hence, a qualitative research approach should be conducted to validate the results of this study. Future research using a similar technique can be extended to contractors of different sizes and with different levels of analyses in other provinces and other countries.

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