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Technology management in construction: Lessons for the practice of architecture

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Abstract

The relevance of managing technology to architectural practices in South African construction cannot be overemphasised. As major stakeholders in the construction industry with particular significant contributions in the property sector, practising architects cannot afford not to exploit old technologies, and embrace new technologies with a view to improving their business and competitiveness.

The thrust of the issue addressed in this article is the assessment of the status accorded to issues relating to technology in the form of a technology audit and/or management in architectural practices. In furtherance of this issue, a quantitative survey was conducted among Eastern Cape-based South African Council for the Architectural Profession (SACAP) registered architects.

Selected findings include that respondents perceived that there are no barriers to communication in organisations as technology does not only form part of the organisational business strategy, but also benefits project partners during implementation. In addition, with the use of office technologies, management is able to forecast and plan future requirements for their practices, while marketing-related technologies allow the closing of identified performance gaps as well as the development of best practices by the firms. Therefore, periodical technology audits are recommended for practices intending to remain competitive in the market.

Keywords: Architectural practice, technology audit, South Africa

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Abstrak

Die relevansie van tegnologiebestuur vir argitektuurpraktyke in Suid-Afrikaanse konstruksie kan nie genoeg beklemtoon word nie. As hoofaandeelhouders in die konstruksie-industrie met spesifieke bydraes tot die eiendomsektor, kan praktiserende argitekte nie bekostig om nie ou tegnologie te benut, en nuwe tegnologie te omarm met 'n visie om hul besighede en bekwaamheid te verbeter.

Die dryfkrag van die saak wat in hierdie artikel aangespreek is, is die assessering van die status toegeken aan sake betreffende tegnologie in die vorm van 'n tegnologiese oudit en/of die bestuur in argitekspraktyke. In bevordering van die saak, is 'n kwantitatiewe opname gedoen onder argitekte van die Suid-Afrikaanse Raad vir die Argiteksprofessie (SARAP) gebaseer in die Oos Kaap.

Bevindinge sluit in dat respondente ervaar dat daar geen struikelblokke in kommunikasie in organisasies is nie, omdat tegnologie nie alleen deel vorm van die organisatoriese besigheidstrategie nie, maar dit ook projekvennote gedurende implementering bevoordeel. In aansluiting hierby, met die gebruik van kantoortegnologie, is bestuur in staat om vooruitskattings en toekomstige vereistes vir hul praktyke te beplan terwyl bemerkingsverwante tegnologie die sluiting van geïdentifiseerde prestasiegapings asook die ontwikkeling van beste praktyk by die firmas toelaat. Daarom word periodieke tegnologie oudits aanbeveel vir praktyke om mededingend in die mark te bly.

Sleutelwoorde: Argitekspraktyke, tegnologie oudit, Suid-Afrika

1. Background

Technology can be defined as knowledge, products, processes, tools, methods, and systems employed in the creation of goods and/or services. In other words, it is a way of doing things and the means whereby objectives are accomplished (Khalil, 2000: 1). By investing in technology an organisation is able to undergo organisational changes that lead to faster and economically efficient operations that are particularly required within the Architecture, Engineering, and Construction (AEC) sector (Wainwright, 2010: 210). Thus, technology has had a profound effect on human development and the advancement of civilisation. The Urenio Research Unit (2001: 1) contends that technology leads to socio-economic development, because organisations use technology to advance and/or achieve their goals.

In this context, Barrow (2004: 131) contends that failure to appropriately respond to societal and technology evolution can result in a loss of professional status. To the modern architect this is of serious concern to the profession and other construction stakeholders. In fact, Soons (2004: 10) noted that many South African architectural practices are not yet computer-equipped, or sufficiently abreast with developments in technology to produce the standard of designs or products beneficial to the industry. In

other words, it is important for architectural practices to go beyond the provision of e-mails or outdated computer-aided design (CAD) packages in their practices in order to remain competitive in the market. In particular though, CAD technology that is to a large extent driven in architectural design practice by internal rather than external influence factors may be considered one of the most important IT innovations of the past four decades. The fear of losing competitive advantage, erosion of legitimacy, and the fear of losing stakeholder support may be responsible for the dominance of imitative behaviour among design firms, which then determines the choice of CAD technology adopted for use in a firm (Kale & Arditi, 2005: 1140). Opposed to this trend, external factors such as capacity and interfired adjustability should rather drive decisions when CAD technologies are considered. AEC firms should conduct a comprehensive analysis before adopting a technological innovation.

This is even more important as Building Information Modelling (BIM) technology that reportedly captures behaviour and relationships between parts and assemblies of a building in database form is yet to gain widespread acceptance and usage in the AEC sector despite its ability to trigger significant positive changes in the design and construction process that can translate to increased project success for stakeholders (Brewer & Gajendram, 2011: 638). In particular, Brewer & Gajendram (2011: 638) noted that BIM could provide technological solutions aimed at standardising and streamlining business processes across the design, construction, and operational phases of a building. For example, Ariyici, Coates, Koskela, Kagioglou, Usher & O'Reilly (2011: 190) observed that, because of the need to improve its capacity for greater integration and collaboration with other disciplines in the production process, and to adopt technology change in order to provide a more effective business process, a Liverpool United Kingdom (UK)-based architectural practice had to embrace BIM after using various forms of CAD software packages since 1991. The decision was taken when the firm noted that their use of 2D CAD tool caused some inefficiency such as timescales, deadline pressures, duplications, lead times, lack of continuity in the supply chain, overprocessing, rework, overproduction, conveyance, distractive parallel tasks, lack of rigorous design process, lack of effective design management, and communication (Ariyici *et al.*, 2011: 190).

However, 18 months later, the firm already made significant progress in improving the skills of its employees, technology infrastructure development, and lean process improvements. Ariyici *et al.* (2011:

194) contend that the implementation of BIM in the architectural practice followed a bottom-up approach rather than a top-down approach in order to engage people in the adoption; ensure that people's skills and understanding increase, and firms build up their capacities. In other words, the implementation of technology entails a focus on the technology itself as well as a focus on people and processes at the same time (Ariyici *et al.*, 2011: 194).

Consequently, the thrust of the issue addressed in this article is the assessment of the status accorded to issues relating to technology (CAD, BIM, and so on) in the form of a technology audit and/or management in architectural practices in South Africa.

2. Technology audit and management

Phaal, Farrukk & Probert (2004: 7) contend that technology management deals with effective identification, selection, acquisition, development, exploitation and protection of technology in the form of product, process, and infrastructure needed to achieve, maintain, and develop a market position and business performance in accordance with organisational objectives. This definition suggests that establishing and maintaining the linkages between technological resources and organisational objectives is of the utmost importance and represents a continuing challenge for many firms. Effective technology management requires a number of management processes such as identification, selection, acquisition, exploitation, and protection of technology, which can be deemed not to be very visible in firms as these functions are mostly found distributed within other business processes such as strategy, innovation, and operations. Therefore, technology management focuses on processes needed to maintain a stream of products and services in the market. According to Phaal *et al.* (2004: 7), technology management deals with all aspects of integrating technological issues into business decision-making, and it is directly relevant to a number of business processes, which include strategy development, innovation and new product development, and operations management, to name but a few. Consequently, it can be argued that healthy technology management requires establishing appropriate knowledge flows between commercial and technological perspectives in a firm in order to achieve a balance between market 'pull' and technology 'push' (Phaal *et al.*, 2004: 8). Hence the nature of these knowledge flows depends on both internal and external contexts such as business aims, market

dynamics, organisational culture, and technological context (Probert *et al.*, 2000, cited by Phaal *et al.*, 2004: 8).

In addition, the Business e-Coach (2003: 1) argues that by utilising a technology audit, a firm's need to design a technology plan can not only be highlighted, but the need to improve the management of existing technology capabilities can also be addressed. In this sense, Khalil (2000: 267) suggests that areas of concern with respect to new technology trends and management include:

- Corporate environment (management, strategy, project management, culture, and people);
- Technology categorisation (project control and collaboration, and office and marketing technologies);
- The market and competitors (market needs and competitor status);
- Innovation (idea generation, technology generators, and project progression);
- Value-added functions (research and development and project impact assessment technologies), and
- Acquisitions and exploitations of technologies (technology transfer).

According to the Construction Industry Computer Association (CICA) in the United Kingdom (UK), management often neglects the fact that to be on the cutting edge of competition all practices should have access to the same tools and that the IT skills of their employees is the important difference between firms (CICA, 2002: 1). In addition, CICA suggests that to maximise return on capital investment in information technology (IT) systems, firms cannot afford to neglect training their employees. Failure to train and educate employees may lead to erosion of existing competitive advantages a firm may possess. Therefore, it is important to have a corporate strategy in place for technology. Narayanan (2001: 250) even suggests that technology strategy is the revealed pattern in the technology choices of firms. These choices, which determine the character and extent of the firms' principal technical capabilities, involve the commitment of resources for the appropriation, maintenance, deployment and abandonment of technological capabilities. Thus, effective integration of technological considerations into corporate/business strategy is an important aspect of business planning based on the premise that a technology strategy should not be developed independently from the business strategy, but rather that technological resources should be considered an integral part of

business planning (Phaal *et al.*, 2004: 8). In this context, technological considerations may include external factors such as the nature of technological change and competitor activity and internal factors such as technological capabilities.

To be succinct, while corporate strategy is primarily concerned with sustaining competitive advantage, technology strategy is more concerned with acquiring technology that can lead to an advantage over competitors in order to ensure that a competitive edge is maintained. With respect to technology categorisation, while Khalil's (2000: 4-6) classifications include new technology, emerging technologies, high technologies, low technologies, medium technologies, appropriate technologies, codified versus tacit technologies, Lindsay (2000: 22-23) classifies technology into enabling technology, critical technology, pacing technology, and emerging technology. However, regardless of the classification used, the intent of technological advancement and its implementation is never far from performance improvement.

Improving performance entails marketing activities that are enabled by developing marketing plans to capitalise on the characteristics of technologies so that they can become accessible to clients (Khalil, 2000: 96). Further, relative to innovation, Narayanan (2001: 75) suggests that:

- Market-pull deals with technology advancement directed primarily to a specific market need and secondarily towards increased technical performance, and
- Technology-push, that is the advancement of technology, primarily deals with an increase in technical performance and secondarily with a market need.

Consequently, innovations may be stimulated when a firm strikes a balance between both technological-push and market-pull. Arguably, therefore, technology management focuses on the principles of strategy and organisational involvement in technology choices that are guided by the purpose of creating value for investors (Narayanan, 2001: 8).

Findings that arose from case study research conducted by Brewer & Gajendram (2011: 652) appropriately amplify the need to conduct technology audits in AEC firms as the research results suggest that, despite the enabling environment and technology, temporary project team members failed to embrace its widespread use. In particular, although the architectural practice involved in the project provided both the BIM and other ICT applications necessary

for the project data exchange, it conspicuously failed to champion the use of either. In general, an analysis of the interactions between the project teams revealed disparate understanding of the term BIM, with many viewing it as a vague 3D CAD model, and thus most of them were reluctant to wholeheartedly invest their time and effort in it. As a result, the use of ICT for the project implementation was clearly below par because of cultural issues rooted in attitudes and behaviours.

3. Research method

The quantitative survey was conducted among South African Council for the Architectural Profession (SACAP) registered architects based in the Eastern Cape. A total number of 15 firms were randomly chosen from 51 firms. The firms that responded to the survey were classified as small (1-2 employees); medium (2-5 employees), and large (more than 5 employees). In this context, 4 small-sized firms (26.6%), 4 medium-sized firms (26.6%), and 7 large-sized firms (46.8%) were surveyed. It is significant that a 100% response rate was recorded as all the firms surveyed responded to the survey.

In terms of demographic information, only 10% of the employees in large firms surveyed have a Masters degree qualification; 29% of employees in large-sized firms, 38% of employees in medium-sized firms, and 100% of employees in small-sized firms have a Bachelor degree qualification. Although the respondents did not distinguish in terms of M.Arch. or M.Sc. and/or B.Sc. or B.Arch. qualifications, this level of education is not surprising as SACAP requirements set a minimum qualification benchmark for each grade of registration.

4. Research findings

Given that respondents were required to respond to four-point Likert scale questions, a measure of central tendency in the form of a mean score (MS) was computed to enable a comparison between factors. Furthermore, given that the difference between the lower and upper ends of the scale is 3.00, and that there are four points thereon, the extent of the ranges is determined by dividing 3.00 by 4, which equates to 0.75. Therefore, the ranges used to present the results are:

- Agree to strongly agree/strongly agree ($> 3.25 \leq 4.00$);
- Near agree to agree/agree ($> 2.50 \leq 3.25$);
- Disagree to near agree/near agree ($> 1.75 \leq 2.50$), and
- Strongly disagree/disagree ($> 1.00 \leq 1.75$).

Table 1 indicates 21 assessment areas relative to technology in a corporate environment in terms of percentage responses to a scale of 1 (strongly disagree) to 4 (strongly agree), and a mean score (MS) ranging between 1.00 and 4.00. It is notable that all the MSs are above the midpoint score of 2.50, which indicates that, in general, the respondents can be deemed to agree with the statements.

The $> 3.25 \leq 4.00$ MSs suggest that the respondents perceive that there are no barriers to communication in organisations; technology forms part of business strategy; firm and clients benefit from new technology implementation; commitment to enhancing technology within the firm; investment of time and money to enhance technology implementation; culture support technology; training of employees is of utmost importance to management; willingness to organisational change that favours new technology, and change is an opportunity not a barrier to the use of new technology, fall between agree to strongly agree/strongly agree.

Table 1: Technology in a corporate environment

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Management:						
Commitment to enhancing technology within the firm	0.0	0.0	53.3	46.7	3.47	4
Investment of time and money to enhance technology implementation	0.0	0.0	60.0	40.0	3.40	5
Technology forms part of business strategy	0.0	6.7	26.7	66.7	3.60	2
Firm and clients benefit from new technology implementation	0.0	13.3	20.0	66.7	3.53	3
Willingness to organisational change that favours new technology	0.0	0.0	66.7	33.3	3.33	8
Strategy:						
Defined corporate strategy aimed at achieving firms' visions in place	0.0	33.3	40.0	26.7	2.93	13
Corporate strategy considers technological needs of the firm	0.0	60.0	20.0	20.0	2.60	17
Specific technology strategy currently exist in firm	0.0	60.0	26.7	13.3	2.53	18

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Project management:						
Exploration of new technologies with respect to specific projects	0.0	60.0	26.7	13.3	2.53	19
Assessment and implementation of technology specific to projects	6.7	33.3	40.0	20.0	2.73	15
Clients are encouraged to use new technology in construction	0.0	20.0	43.7	33.3	3.13	11
Culture:						
Culture supports technology	6.7	0.0	40.0	53.3	3.40	6
Change is an opportunity not a barrier to the use of new technology	0.0	6.7	53.3	40.0	3.33	9
No barriers to communication in organisation	0.0	0.0	40.0	60.0	3.60	1
People:						
Employees are encouraged to attend training for skills development	6.7	13.3	33.3	46.7	3.20	10
Employees are rewarded for acquiring new skills	6.7	6.7	53.3	33.3	3.13	12
Reward systems are in place for efficiency and motivational reasons	13.3	33.3	20.0	33.3	2.73	16
Appraisal system is in place for employee promotional assessment	6.7	26.7	46.7	20.0	2.80	14
IT specific employees are in place to maintain firms' IT infrastructure	26.7	33.3	13.3	26.7	2.40	20
Online access to all HR information is granted to employees	26.7	33.3	26.7	13.3	2.27	21
Training of employees is of utmost importance to management	6.7	6.7	26.7	60.0	3.40	7

In addition, $> 2.50 \leq 3.25$ MSs suggest that the respondents perceive that employees are encouraged to attend training for skills development; clients are encouraged to use new technology in construction; employees are rewarded for acquiring new skills; defined corporate strategy aimed at achieving firm's visions is in place; appraisal system is in place for employee promotional assessment; assessment and implementation of technology specific

to projects are usually done; reward system is in place for efficiency and motivational reasons; corporate strategy considers technological needs of the firm; specific technology strategy exists currently in most firms, and exploration of new technologies with respect to specific projects, fall between near agree to agree/agree.

The $> 1.75 \leq 2.50$ MSs indicate that the respondents perceive that IT specific employees are in place to maintain firms' IT infrastructure, and online access to all HR information is granted to employees fall between disagree to near agree/near agree. It is notable that of the 21 corporate environment statements, 9 are $> 3.25 \leq 4.00$.

In brief, the relatively high MSs achieved in the management section of Table 1 suggest that, in terms of corporate environment, firms tend to ensure that management buy-in is in place in order to make sure that they embrace and enhance the overall level of technology in the firm. In the strategy section, although the MSs could be deemed average, they nevertheless suggest that there is a gap between functional strategy deployment with respect to technology and corporate strategy adopted by the respondents. For the project management section, the average to above average MSs achieved underscores the importance of project management in construction. For instance, despite the benefits that may accrue as a result of the implementation of new technology, it is common in construction to encounter risk-averse clients that will rather stick to tested construction methods as opposed to exploring new technologies in order to ensure that a project is delivered within the cost and time constraints. In the culture section, the relatively high MSs may be attributed to the nature of architecture as a profession that fosters creativity in order to inspire competitive edge in a firm. In the people section in Table 1, the generally average MSs achieved suggest that there is major scope for improving the human resources management competency with respect to the implementation of new technologies.

Table 2 indicates the assessment areas relative to categorisation of technology in a corporate environment in terms of percentage responses to a scale of 1 (strongly disagree) to 4 (strongly agree), and a MS ranging between 1.00 and 4.00. It is notable that, with the exception of one MS, all the MSs are above the midpoint score of 2.50, which indicates that, in general, the respondents may be deemed to agree with the statements.

The $> 3.25 \leq 4.00$ MSs suggest that the respondents perceive that employees have e-mail and internet access; core services identified so that management can exploit them, and IT is recognised as an

important success factor for the firm, fall between agree to strongly agree/strongly agree. In addition, $> 2.50 \leq 3.25$ MSs suggest that the respondents perceive that management are aware of current technological trends; ability to satisfy clients' technological needs; new CAD systems are assessed and implemented robustly; digital backup is in place to store all project data; development and implementation of new office technologies is important; automation of administrative functions is important to management; sound and aggressive market technology is used to attract clients; firm is up to date with respect to IT systems required for operations; secondary tasks such as network maintenance, are outsourced; and management is able to forecast and plan future office requirements, fall between near agree to agree/agree. However, the respondents perceive that web-based facilities are used to attract and secure new clients falls between disagree to near agree/near agree, as its MS is $> 1.75 \leq 2.50$.

Table 2: Categorisation of technology in a corporate environment

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Project control and collaboration:						
Core services identified so that management can exploit them	0.0	13.3	40.0	46.7	3.33	2
Management awareness of current technological trends	0.0	20.0	40.0	40.0	3.20	4
Secondary tasks (e.g. network maintenance) are outsourced	6.7	20.0	53.3	20.0	2.87	12
Extranets are in place to encourage collaboration between project teams	40.0	33.3	6.7	20.0	2.07	15
IT is recognised as important success factor for the company	0.0	20.0	26.7	53.3	3.33	3
System is in place for monitoring technological trends	26.7	53.3	20.0	0.0	1.93	16
Office technologies:						
Development and implementation of new office technologies is important	0.0	20.0	53.3	26.7	3.07	8
Automation of administrative functions is important to management	6.7	20.0	40.0	33.3	3.00	9

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Firm is up to date with respect to IT systems required for operations	6.7	20.0	46.7	26.7	2.93	11
New CAD systems are assessed and implemented robustly	6.7	6.7	46.7	40.0	3.20	6
Employees have e-mail and internet access	0.0	13.3	33.3	53.3	3.40	1
Management is able to forecast and plan future office requirements	6.7	13.3	80.0	0.0	2.73	13
Digital backup is in place to store all project data	6.7	26.7	13.3	53.3	3.13	7
Marketing technology:						
Sound and aggressive market technology is used to attract clients	0.0	33.3	40.0	26.7	2.93	10
Ability to satisfy clients' technological needs	0.0	13.3	53.3	33.3	3.20	5
Web-based facilities are used to attract and secure new clients	13.3	46.7	33.3	6.7	2.33	14

The implications of the respondents' perceptions tabulated in Table 2 are interpreted in the light of various MSs achieved in each section. In the project control and collaboration section, the cumulative average MSs achieved suggest that there may be a general lack of adequate organisation-wide technology-driven systems deployed for forecasting future trends in project control and collaboration-related technologies. This inevitably implies that firms may be unable to harness opportunities as they become available in the national and international arena. This assumption is equally supported by the perceived low level of the use of extranets for communication purposes. In addition, the MSs relative to the office technology section suggest that the respondents are of the opinion that the use and implementation of office technologies is important to their practices. In other words, the MSs could be interpreted to mean that the majority of the respondents acknowledge the usefulness of office technologies such as CAD and other administrative software to an architectural practice. While the MSs relative to marketing technologies may be deemed to be average, they nevertheless indicate that architectural practices need to improve their abilities in this section.

Table 3 indicates the perceptions of respondents relative to the influence of technology on the market and competitors in terms of percentage responses to a scale of 1 (strongly disagree) to 4 (strongly agree), and a MS ranging between 1.00 and 4.00. It is notable that all the MSs are below the midpoint score of 2.50, which indicates that, in general, the respondents may be deemed to disagree with the statements.

The $> 1.75 \leq 2.50$ MSs suggest that the respondents are of the opinion that best practice, and policies developed in order to close identified gaps; core competencies and technological status are assessed; competitors are assessed periodically for benchmarking purposes, and market assessment tool is in place for identifying new market trends, fall between disagree to near agree/near agree.

Identifying new market trends is a particularly weak area based on the perceptions of the survey respondents. This finding suggests that improvement must be embarked upon in the area of market needs as anecdotal evidence suggests that, in order to provide a sustained optimum service, firms need to undertake market assessments so that they are aligned with their clients' requirements. Furthermore, with MSs less than 2.50, assessment of competitor status through the use of technology is another area of weakness identified in the study. The findings imply that, without a competitor assessment system in place, firms may be unable to benchmark their performance against the best in the industry.

Table 3: Technological influence on market and competitors

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Market needs:						
Market assessment tool is in place for identifying new market trends	33.3	46.7	20.0	0.0	1.87	4
Competitor status:						
Competitors are assessed periodically for benchmarking purposes	33.3	40.0	26.7	0.0	1.93	3
Core competencies and technological status are assessed	26.7	53.3	20.0	0.0	1.93	2
Best practice, and policies are developed to close identified gaps	20.0	66.7	13.3	0.0	1.93	1

Table 4 indicates the perceptions of respondents relative to technology that drives innovation in terms of percentage responses to a scale of 1 (strongly disagree) to 4 (strongly agree), and a MS ranging between 1.00 and 4.00. It is notable that all the MSs are above the midpoint score of 2.50, which indicates that, in general, the respondents may be deemed to agree with the statements.

The $> 3.25 \leq 4.00$ MSs suggest that the respondents perceive that clients are assured of product and service quality; new products and processes are suggested to clients as alternatives; and clients' briefs are available to all employees or project teams, fall between agree to strongly agree/strongly agree. However, the respondents are of the opinion that improvement of project schedule is made on each project; employees are encouraged to explore and assess new IT systems; employees are persuaded to communicate through existing channels; project cost information is available from the project team at each stage, fall between near agree to agree/agree ($> 2.50 \leq 3.25$), while reward systems are in place to motivate innovation within the firm, falls between disagree to near agree/near agree ($> 1.75 \leq 2.50$).

As the majority of MSs related to idea generation in Table 4 are close to 3.00, it can be assumed that, in general, the respondents are of the opinion that idea generation favours the exploitation of technology in architectural firms. Similarly, the MSs that are relative to technology generator in Table 4 suggest that adequacy of communication interfaces between designers and clients may also favour the generation of technology-driven initiatives. These findings are particularly important in the architectural practice context as profession is service-oriented in that it should always strive to satisfy professional norms and the client.

Table 4: Innovation driven by technology

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Idea generation:						
Employees' inputs are encouraged relative to new project innovations	6.7	13.3	40.0	40.0	3.13	5
Employees are encouraged to explore and assess new IT systems	0.0	26.7	46.7	26.7	3.00	6
Employees are persuaded to communicate through existing channels	6.7	13.3	53.3	26.7	3.00	7

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Reward systems are in place to motivate innovation within the firm	6.7	53.3	26.7	13.3	2.47	9
Technology generator:						
Clients' briefs are available to all employees or project teams	6.7	0.0	46.7	46.7	3.33	3
Clients are assured of product and service quality	0.0	0.0	46.7	53.3	3.53	1
New products and processes are suggested to clients as alternatives	0.0	6.7	53.3	40.0	3.33	2
Project progression:						
Project cost information is available from project team at each stage	20.0	20.0	33.3	26.7	2.67	8
Improvement of project schedule is made on each project	0.0	6.7	66.7	26.7	3.20	4

Table 5 indicates the respondents' perceptions with respect to value-added functions derived from the implementation of technology management initiatives in terms of percentage responses to a scale of 1 (strongly disagree) to 4 (strongly agree), and a MS ranging between 1.00 and 4.00. It is notable that all the MSs are above the midpoint score of 2.50, which indicates that, in general, the respondents may be deemed to agree with the statements.

Though, all the MSs are > 2.50 , only one MS (3.27) is $> 3.25 \leq 4.00$. This suggests that the respondents are of the opinion that concern related to the use of sustainable design and materials in construction projects fall between agree to strongly agree/strongly agree. The MSs relative to R&D further suggest that investment of resources in R&D must be improved, while the MSs relative to project assessment technologies suggest that more importance must be attached to issues relative to project assessment technologies as clients' demand for improved performance is on the upswing.

Table 5: Value-added functions related to technology management

Statement	Response (%)				MS	Rank
	Strongly disagree..Strongly agree					
	1	2	3	4		
Research and development:						
Time and money is spent on materials and techniques related R&D	13.3	46.7	13.3	26.7	2.53	5
Post-project reviews are conducted for future reference	0.0	33.3	60.0	6.7	2.73	4
Project assessment technologies:						
Concern for the environment is prioritised in development projects	13.3	13.3	40.0	33.3	2.93	3
Concern related to the use of sustainable design and materials in projects	0.0	13.3	46.7	40.0	3.27	1
Life cycle implications of designs and materials are assessed	0.0	20.0	40.0	40.0	3.20	2

Meanwhile, the other MSs $> 2.50 \leq 3.25$, which suggest that the respondents perceive that life cycle implications of designs and materials are assessed; concern for the environment is prioritised in development projects; post-project reviews are conducted for future reference, and time and money is spent on materials and techniques related R&D, fall between near agree to agree/agree.

Table 6 indicates the perceptions of respondents with respect to the acquisition and exploitation of technology in terms of percentage responses to a scale of 1 (strongly disagree) to 4 (strongly agree), and a MS ranging between 1.00 and 4.00. Though, the MS is > 2.50 , it nevertheless suggests that the respondents perceive that the ability to transfer technology from other industries to construction falls between near agree to agree/agree.

Table 6: Acquisition and exploitation of technology

Statement	Response (%)				MS
	Strongly disagree..Strongly agree				
	1	2	3	4	
Ability to transfer technology from other industries to construction	0.0	33.3	40.0	26.7	2.93

5. Conclusions and recommendations

The empirical study justified the perception that there is significant scope for the development of technology management principles and/or capabilities within architectural firms in order to enhance

their competitiveness. The findings also suggest that there may not be an existing mechanism that allows management to adequately assess and analyse the use and requirements for technology within their firms. Based on the findings, it can be argued that the respondents are not taking adequate advantage of technology in order to improve and sustain their competitive advantage in the industry. In other words, within a firm technology-related strategies will require objectivity and complete focus in order to assist the firm in positioning itself appropriately in the marketplace. Conducting a technology audit provides a platform for evolving appropriate technology strategy for a firm, as valuable resources related to information will be brought to light in the auditing process.

Consequently, architectural practices should endeavour to embrace the use of technology for building and sustaining competitive advantages in the market as mere internet access or e-mail usage in a firm is not adequate use of information technology. In this sense, systems/strategy for monitoring technological trends should be put in place in the workplace in order to improve, *inter-alia*, firms' project-related efficiency and client satisfaction. Therefore, periodic technology audits are recommended for architectural practices intending to remain abreast of trends and developments in the industry. This is particularly relevant to firms undergoing major organisational changes in the form of mergers or acquisitions. In this context, technology audit is expected to effect complete understanding of the 'existing' capabilities of a firm, and lead to the development of 'future' technology-based capabilities of the firm.

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A systems thinking approach to eliminate delays on building construction projects in South Africa

Peer reviewed

Abstract

It is obvious that the performance of firms and their market competitiveness hinge on project delivery time. Many approaches have been used to reduce the effect of the potential factors of delay on project delivery time. In this study, the system approach has been employed and validated. Inferential statistical analysis was conducted to analyse eighty-eight questionnaires returned during the primary study and twenty-four during the validation phase. The holistic role of professionals in the construction industry was illustrated with the aid of causal loop analysis, showing cause and effect relationships.

Based on the findings that eight out of the twelve categories of problems of delays are construction-related, the study identified seven stages of construction project delivery and various activities in these stages that could reduce the negative influence of delay factors on project delivery time. The interventions category, which has the most influence on the elimination of delays in project delivery, occurs during the construction stage, followed by interventions during the briefing/design stage. The interventions category with the least influence is pre-qualification of suppliers.

The study recommends that adequate planning, pre-qualification of suppliers, provision of work schedule, and prompt payment of interim certificates be focused on to mitigate delays in project delivery time. Furthermore, the following courses should be included in all built-environment education programmes: operational planning; quality; design, and generic management.

Keywords: System thinking, building construction projects, South Africa

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Abstrak

Dit is duidelik dat die prestasie van firmas en hul markmededingbaarheid om projek- voltooiingstyd draai. Baie benaderings is al gevolg om die effek van die potensiële faktore van vertraging op projekvoltooiingstyd te verminder. In hierdie studie is die sisteembenadering gebruik en gevalideer. Inferensiële statistiese analise is gebruik om die agt-en-tagtig vraelyste teruggestuur gedurende die primêre studie en vier-en-twintig gedurende die validasiestadium te bestudeer. Die holistiese rol van professionele persone in die konstruksie-industrie is geïllustreer met die hulp van oorsaaklike lusanalise wat gevolg en effek-verhoudings aandui.

Gebaseer op die bevinding dat agt van die twaalf kategorieë van probleme van vertraging met konstruksie verband hou, het die studie sewe fases van konstruksie projekvoltooiingstyd asook verskeie aktiwiteite in hierdie fases geïdentifiseer wat die negatiewe invloede van vertragingfaktore op projekvoltooiingstyd verminder.

Die intervensieskategorieë wat die meeste invloed op die eliminasië van vertraging van projekvoltooiings gehad het, is dié gedurende die konstruksiestadium, gevolg deur intervensies gedurende die opdrag-/ontwerp stadium. Die intervensieskategorie met die minste invloed is pre-kwalifikasie van verskaffers.

Die studie beveel aan dat daar genoeg gefokus moet word op beplanning, pre-kwalifikasie van verskaffers, voorsiening van werkskedule, en vinnige betaling van tussentydse sertifikate om vertraging in projekvoltooiingstyd te verminder. Verder, behoort die volgende kursusse in alle bou-omgewings onderrigprogramme ingesluit te word: operasionele beplanning, kwaliteit, ontwerp en generiese bestuur.

Sleutelwoorde: Sisteembenadering, bou-konstruksie projekte, Suid-Afrika

1. Introduction

The principle of Right-First-Time holds great value. Right-First-Time requires accuracy and precision. Accuracy means reflecting the realities (specifications), whereas precision implies meeting the specific dates. The processes of construction demand accuracy and very high precision. The capacity of prediction of estimated period of a building construction project indicates level of accuracy. The prediction of project completion time is a means of realising client satisfaction and will result in competitive advantage, all other things being constant. However, both external and internal forces influence the delivery time of projects. The ability to comprehend these influences on project delivery from inception to completion is dependent on experience and the level of training obtained by the planner, best summarised as competence. Furthermore, Sambasivan & Soon (2007: 527) state that the inability of the client and his representatives in the project team to have a comprehensive overview of the construction process from inception to completion of the project, and environmental effects on the process, are very likely

reasons for the non-realisation of projected delivery dates. Lack of project management competence could adversely affect delivery time of a project (Dainty, Cheng & Moore, 2003: 189). According to Cooke-Davies (2001: 185), project management is a tool for project success. The site-based nature of projects characterised by complexity, uncertainty, poor communication in the form of timing, extent, and content, inadequate coordination of organisations and activities, and inadequate integration of tasks, organisations, and personnel, provide an ideal climate for the empowerment of individuals and teams (Tuuli, Rowlinson & Koh, 2010: 205). Therefore, the project management competence level is directly proportional to the level of success a project may attain.

2. Literature review

There is a plethora of literature pertaining to the subject of delay in the delivery of projects: Aibinu & Jagboro (2002: 593-599) in Nigeria; Belout & Gauvreau (2004: 1-11) in Canada; Koushki & Kartam (2004: 126-132), Assaf & Al-Hejji (2006: 349-352), and Faridi & El-Sayegh (2006: 1167-1176) in Saudi Arabia; Frimpong, Oluwoye & Crawford (2003: 321-326) in Ghana; Bryde & Robinson (2005: 622) in the UK, and Toor & Ogunlana (2008: 395-406) in Thailand. Based on the survey of the literature, seventy-six potential factors that could influence project delivery time were identified and classified into twelve categories. These classifications and the factors that constitute each classification are:

- Client understanding of the design, procurement and construction process. Lim & Ling (2002: 303-394) identify the following as factors that lead to this problem: clients' understanding of the project constraints; the ability to effectively brief the design team; the ability to contribute ideas to the design and construction processes; the ability to make authoritative decisions quickly, and the stability of these decisions.
- Quality of management during design. Project success is dependent on, *inter alia*, the performance of the design team. Defective designs adversely impact on project performance, and the participants are responsible for many construction failures (Andi & Minato, 2003: 297). Failure at the conceptual planning and design stages may lead to significant problems in successive stages of the project. Oyedele & Tham (2007: 2097) provide a listing of clients' ranking of designers' performance criteria among which were those that relate to

quality of design coordination, smooth flow of work, *vis-à-vis* conflicting design information, timeliness of issuing of revised drawings, missing information, dimensional inaccuracies as well as delay of release of shop drawings.

- Quality of management during construction. Dainty *et al.* (2002: 217) cited Cooke-Davis (2001) who declares that project management competence represents only one of many criteria upon which project performance is contingent. According to Ponpeng & Liston (2003: 281), problems such as schedule delays, budget overruns, non-achievement of quality standards, as well as a large number of claims and litigation result to a large extent from not selecting the best contractor to construct the facility. Quality of management during construction concerns the steps taken to ensure that products are in accordance with the quality standards and measure the effectiveness/competency of consultants and contractors. The factors that contribute to quality of management during construction are forecasted planning data such as analysis of construction methods; analysis of resource movement to and within site; analysis of work sequencing to achieve and maintain workflow; monitoring and updating of plans to appropriately reflect work status; responding to, and recovering from problems or taking advantage of opportunities present; effective coordination of resources, and the development of appropriate organisational structure to maintain workflow.
- Motivation of staff. Productivity in the construction industry has been steadily declining. Labour efficiency has been cited as poor, resulting in delays. Several techniques can be used to positively influence workers' behaviour. Two of these techniques are the behavioural and economic approaches. The former views motivation from the workers' psychological requirements, and the second views it from the economic approach, placing emphasis on monetary rewards (Andawei, 2002: 2). Motivation variables that could impact on construction time are: pay and allowances; job security; a sense of belonging and identification with the project team; recognition of contribution made; opportunity to extend skills and experience through learning; equitable rewards relative to others' input into the project, and the exercise of power and opportunity for career advancement for future benefit.
- Site ground conditions. The inherent site conditions of a project affect the speed of delivery (Frimpong *et al.*, 2003:

325). This is often due to a lack, or poor investigation of site ground conditions to obtain data regarding site soil conditions. The research of Frimpong *et al.* (2003: 325) found that ground problems and unexpected geological conditions contribute to delays. Other ground factors that impact on the speed of construction include the nature of demolition of work; the nature of restoration work; the structural stability of ground; the extent of ground contamination; the extent of archaeological finds; the impact of the water table; the impact of underground services, and the impact of underpinning existing structures.

- Site access. The condition of site access to a project will determine the rate of flow of materials, machines and people to the project site (Griffith & Watson, 2004). Where there is difficulty in getting to the site, in the form of bad road surfacing, narrowness of the road or a long distance between storage space and entry point, these factors will negatively affect construction speed. According to Toor & Ogunlana (2008: 406), these cause delays in construction.
- Constructability of design. Mbamali, Aiyetan & Kehinde (2005: 1268) define the extent to which a building design facilitates the ease of construction as buildability, the British term, or constructability, the American term, which is defined as the grouping of similar work components and the use of modular dimensions in design to reduce construction cost and time. Oyedele & Tham (2007: 2091) provide a list of factors that could be used to assess constructability, *inter alia*, flexibility of design to changes; dimensional coordination of elements; knowledge of performance of materials and components; effective constructability review of design; effective participation in site inspection and control; the scope of off-site fabrication; complexity of off-site fabrication components; appropriateness of design tolerances; appropriateness of working space; implication upon trade coordination; impact of materials storage and movement, and impact on smooth activity workflow and activity sequencing.
- Management style. People undertake work, which is complex, and they have varying personality traits and characteristics. Supervision is required to enable workers to meet scheduled targets. The following factors could be used in assessing the management style of those in positions of authority: setting specific goals employees are to accomplish; organising the work environment for people; setting timelines; providing

specific direction; conducting regular updates on progress; providing support and encouragement; involving team members through discussion of work, and seeking people's opinions and concerns.

- Management techniques used for planning and control. Project-controlling techniques indicate the direction of the project at each time and reveal progress. According to Burke (2006: 130), there are various types of planning tools, namely the Gantt (Bar) chart, network diagrams, and the CPM, as well as the Programme Evaluation Review Technique (PERT). Others include line of balance, horse blanket, and S-curves.
- Physical environmental conditions. These are factors over which no party to a contract has control (Faridi & El-Sayegh, 2006: 1108). Mbachu & Nkado (2006: 43) contend that sociocultural issues and unforeseen circumstances constitute these factors and constrain successful construction project delivery in South Africa. They include the impact of natural hazards such as fire, and floods; adverse local weather conditions such as rainfall and high temperatures; ambient noise beyond tolerance level, and either the lack or intenseness of lighting conditions.
- Economic policy. This refers to the level of general economic activity and resources available to carry out construction work. Koushki & Kartam (2004: 127) identify twenty-five such factors that could impact on construction time. Those applicable to this study include the availability of materials; the availability of equipment; the availability of trades/operatives; the availability of supervision/management staff; the indirect impact of interest rates/inflation and insolvency, and bankruptcy.
- Socio-political conditions. The socio-political environment concerns projects or individuals while the political environment is concerned with government policy and the effect of political decisions on projects. Political sociology is defined as the study of power and the intersection of personality, social structure, and politics. Factors which constitute this are civil strife or riots, the influence of civil action-groups, and disruptions due to environmental concerns.

3. Methodology

Both the quantitative and qualitative research approaches were used. The sample consisted of architects, clients, contractors, quantity surveyors, and structural engineers in the South African construction industry. Eighty-eight practitioners were surveyed during phase one of the study and twenty-four during the validation of the model. These were used as proxy, and were randomly selected from samples in phase one. The samples for the phase-two investigation are adequate, relative to the statistical tool used for the analysis. Inferential statistical analysis was conducted, which included reliability tests and factor analysis. Relative to phase one, respondents that were over the age of thirty years predominated (76.5%). The highest academic qualifications of respondents were Bachelors (25%), Honours (23%), and BTech (17%), collectively totalling 65%. Managing directors/Managing members/Principal (35%), senior staff (20%), and managers (17%) represent the distribution of respondents' status. The mean number of years of experience of respondents is 17. The types of facility with which respondents are involved include residential, commercial offices, and institutional facilities such as education, and health. The mean value of projects with which respondents have been involved is R866.63 million.

4. Presentation of results and discussion

Table 1 presents the ranking of mean scores (MSs) on the factor categories investigated.

Table 1: Ranking of the influences of factor categories on project delivery time

<i>Factor category</i>	<i>MS</i>	<i>Rank</i>
Construction planning and control techniques	3.98	1
Management style	3.92	2
Economic policy	3.76	3
The quality of management during construction	3.73	4
Site access conditions	3.54	5
Site ground conditions	3.49	6
Motivation of workers	3.40	7
Constructability of designs	3.37	8
Socio-political conditions	3.16	9
Client understanding of the design, procurement and construction processes	3.12	10
The quality of management during design	3.06	11
Physical environmental conditions	2.87	12

Table 1 reveals that construction planning and control techniques (MS = 3.98) used for activity scheduling is the most influential factor category regarding the delivery of projects with reference to time, followed closely by management style (MS = 3.92), and then distantly by economic policy (MS = 3.76), and quality of management during construction (MS = 3.73). The least influential factor category is physical environmental conditions (MS = 2.87). Table 1 also indicates that, with the exception of economic policy, the categories of factors ranked from 1 to 7 are construction-related. This means that the primary cause of delays in the delivery of projects is construction-related. Based on this, a system model was developed to address this problem.

5. Introduction to systems thinking

The evolution of a systems model for this study is an approach to develop a holistic understanding of the delivery process of building construction projects, the complexity of the interrelationships of tasks, the actions of professionals, and the influence the environment has on the process and delivery time of projects. Given that the study investigated the relationship between actions initiated by professionals in the process of construction of a facility and its delivery time, and that Illustration 1 presents a graphic review of the salient conclusions using a primary causal loop analysis and modelling, it is necessary to address systems thinking.

Senge (2006: 1-6) states that the art of systems thinking lies in being able to recognise increasingly dynamic and/or complex and subtle structure amid the wealth of details, pressures and crosscurrents that attend all real management settings. In fact, the essence of mastering systems thinking as a management discipline lies in seeking patterns where others see only events and forces to react to.

Figure 1 presents the holistic role of influences on construction project delivery time in industry performance.

The right-hand ellipse in Figure 1 indicates the holistic role of the pre-qualification of contractors, commitment of designers to improve design, tendering documents and TQM contractors in overall performance, directly and indirectly, and ultimately the image of the construction industry. Clients are the initiators of a project. Whatever affects the client has a direct or indirect effect on other stakeholders in the industry. A lack of client commitment leads to

a lack of designer and contractor commitment to the processes of construction. A client lack of commitment as a result of poor performance will cause, *inter alia*, clients' non-release of funds and slowness in decision-making, ultimately resulting in the contract falling behind schedule.

A lack of client commitment results in client prioritisation of cost which, in turn, results in budget pressure on the contractor in an endeavour to be price competitive, marginalises H&S and engenders accidents, injuries and fatalities which result in absenteeism and reduced productivity. Further, it engenders the use of inadequate/poor materials and unskilled labour, which ultimately results in rework and the project being behind schedule.

Inadequate/poor skills, inadequate materials, as well as inadequate plant and equipment, engender poor practices, which result in accidents, poor labour productivity, rework, and poor schedule performance. However, the aforementioned result in poor performance as a result of both their individual impact and the negative synergy between the other manifestation of poor practices, fuelled by the catalysts of accidents and rework.

A lack of client commitment manifests in, *inter alia*, a lack of pre-qualification of contractors and subcontractors constituting poor practice. A lack of designer commitment manifested in, *inter alia*, the lack of design QA also constitutes poor practice.

Although poor performance results in client, designer, contractor and workers' dissatisfaction due to, *inter alia*, late completion, increased supervision and reduced profit directly as a result of rework and accidents, a further aspect is that of poor image. Poor image marginalises the ability of the industry to attract 'suitable' human resources at both management and worker level.

A problem associated with poor image is the perception that 'anyone can contract', which results in unqualified people entering the industry at both management and worker level. These, in turn, force skilled human resources, at management and worker level, to leave the construction industry for other industries owing to the working and other conditions. The aforementioned merely worsens the situation relative to the level of skills.

The left-hand ellipse indicates that the only way to break the cycle represented by the right-hand ellipse, represented by the break in the arrow between poor performance and client/designer/contractor/owner dissatisfaction, lack of designers' commitment and lack of contractors' commitment is for the industry and the

primary construction industry stakeholders to acknowledge that poor performance can be remedied. The acknowledgement of a problem and the fact that the problem can be remedied is a prerequisite for commitment.

Industry commitment is essential. Registration of contractors based on criteria engenders a core of suitable contractors. Practitioners and industry associations should embrace; promote and engender 'best practice', so too tertiary education and other training bodies, which contribute to the production of 'optimum' human resources. Professional and industry associations can develop 'best practice' guidelines and benchmarks, and enforce construction activities to be practised according to the benchmarks of industry stakeholders. Industry commitment reinforces client, designer and contractor commitment, which is engendered by benchmarking, optimum human resources and 'suitable' contractors.

Client commitment engenders designer and contractor commitment and is essential to realise the selection of an appropriate procurement system for the practice of pre-qualifying contractors, for effective project delivery as well as for constructability reviews.

Contractor commitment is important for the implementation of an H&S programme, the proper planning of resources, plant and equipment, materials, adequate sequencing of activities, and the engagement of skilled workers, which collectively realise total quality management (TQM) contractor and facilitate TQM.

Designer commitment engenders contractor commitment and is essential to realise the selection of an appropriate procurement system, for the implementation and practice of design QA as well as for effective constructability reviews.

An appropriate procurement system facilitates constructability reviews and engenders the pre-qualification of contractors. Design QA complements constructability reviews and the practice of TQM.

TQM results in enhanced H&S, improved labour productivity, and enhanced quality and schedule, which individually and as a result of the synergy between them, result in enhanced performance.

Enhanced performance results in enhanced client, designer, contractor and worker satisfaction which, in turn, results in the project being delivered on schedule, as well as enhanced image, which reinforces the acknowledgement and awareness that poor performance can be remedied. However, a critical aspect is that

6. Proposed model for the delivery of projects on time

The research findings enabled the identification of the factors that are problematic and require attention. These can be summed up as poor performance practices in the building construction industry in South Africa, which lead to the late delivery of projects.

The identification of the problem resulted in the identification of the related aspects linked to each problem. The problem of delay from the findings is mainly construction-related. A construction stage-related problem has associated links to all other stages of project delivery. These stages begin with the briefing up to the handing over of the project. Therefore, the model proposes an intervention at the various stages in order to ensure project delivery on time.

The model is discussed in this section and unfolds in the following sequence:

- Basis for the model;
- The model flowchart;
- Elements constituting the model;
- Validation of the model, and
- Summary of the validation of the model.

6.1 Basis for the model

In developing the model, the aim was to provide a structured systemic process which practitioners in the building industry can adopt in realising building facilities without delays, stemming from the most significantly influencing factor category, which is management style and construction-related. This implies that the construction stage is crucial to the delivery of projects and that whatever transpires in the construction stage affects the project delivery time. Therefore, the construction stage is the focus. But the construction stage cannot on its own be the only determining stage to projects being delivered on time of all the stages of facility procurement. It is important to note that client briefing and quality of design have an impact on the speed of construction, and that client commitment to the project success has an impact on the construction stage of a project. The contributions of the client towards the project success are in terms of commitment to an appropriate procurement system, such as the pre-qualification of contractors/subcontractor/supplier, i.e., sourcing for TQM contractors.

Based on the foregoing, six stages of construction were identified, namely briefing/design, pre-qualification of contractors/sub-

contractors, pre-qualification of suppliers, tendering, construction and testing of installation stages. There might be gaps in the performance of professionals at various stages of construction. Therefore, built environment tertiary education has been proposed as the seventh stage.

6.2 The model flowchart

The model proposed for the delivery of projects on time is presented below:

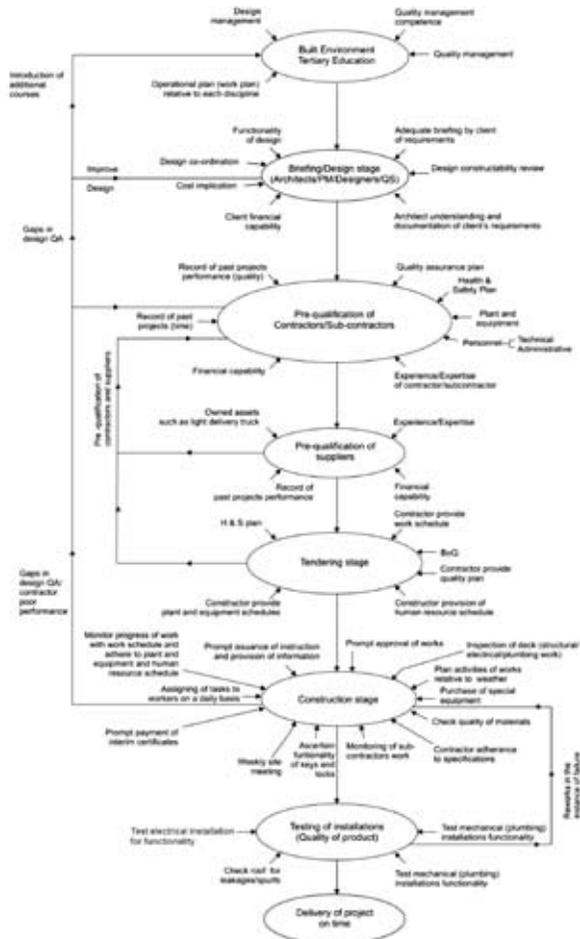


Figure 2: Model for the delivery of projects on time
Source: Compiled by Aiyetan (author)

6.3 Elements constituting the model

In order to achieve the purpose of the development of the model, which is the improvement of the delivery of construction projects, the model processes commence with a description of the stages involved in the realisation of a project. It is based on the fact that the initiator of a project does not need to acquire a built environment qualification before s/he can build.

The model consists of seven stages, hereafter referred to as interventions category. The stages, commencing with the briefing/design stage are:

- The briefing/design;
- Pre-qualification of contractors/subcontractors;
- Pre-qualification of suppliers;
- Tendering;
- Construction;
- Testing of installation before handing over, and
- Built environment tertiary education.

6.4 Validation of the model

A survey was conducted among twenty-four practitioners in the building construction industry in order to validate the model presented (Illustration 2). They included architects, quantity surveyors, contractors, and clients. The MS, percentage frequency and test of means difference were employed in the analysis of the data. To enable interpretation of the MS, the MS range used during the interpretation of means of data from the first phase questionnaire analysis was used.

7. Data presentation and analysis

The Cronbach's α value for interventions category are all ≥ 0.70 . Based on these, the internal consistency of the data can be deemed reliable. Table 2 presents the MSs of the interventions per category.

Table 2: Ranking of interventions categories

Intervention category	Unsure	Responses (%)					MS	Rank
		Minor.....Major						
		1	2	3	4	5		
Construction stage:								
Weekly/monthly meeting with key staff/subcontractors	0.0	0.0	4.2	8.3	29.2	58.3	4.42	1
Determining to what extent planning work two weeks before it takes place will contribute to eliminating delay in project delivery	0.0	0.0	0.0	20.8	25.0	54.2	4.33	
Planning ahead activities of work that weather could affect	0.0	0.0	0.0	20.8	29.2	50.0	4.29	
Prompt inspection and approval of work by consultants	0.0	0.0	0.0	16.7	37.5	45.8	4.29	
Contractor monitoring of subcontractors' work	0.0	0.0	4.2	20.8	29.2	45.8	4.17	
Prompt issuance of instructions	4.2	4.2	0.0	4.2	41.7	45.8	4.13	
Prompt payment of interim certificates and payments	0.0	4.2	9.3	8.3	37.5	41.7	4.04	
Testing of concrete strength regarding ascertaining of its strength against rework	0.0	0.0	4.2	20.8	41.7	33.3	4.04	
Contractor and consultant checking quality of materials supplied as they arrive on site, and carry out steel strength test	0.0	0.0	8.3	16.7	45.8	29.2	3.96	
Briefing/Design stage								
Adequate briefing by the client	0.0	0.0	8.3	12.5	25.0	54.2	4.50	2
Accurate coordination of design	0.0	4.2	0.0	12.5	33.3	50.0	4.25	
Reviewing constructability of design at design stage	0.0	0.0	4.2	16.7	45.8	33.3	4.08	
Well-defined functionality of design	0.0	0.0	12.5	20.8	33.3	33.3	3.88	
Adequate estimation of project cost	0.0	0.0	8.3	29.2	33.3	29.2	3.83	
Ascertaining client financial capability	0.0	4.2	4.2	29.2	33.3	29.2	3.79	
Lack of dimension ambiguity	0.0	0.0	20.8	20.8	33.3	25.0	3.63	

Intervention category	Unsure	Responses (%)					MS	Rank
		Minor.....Major						
		1	2	3	4	5		
Built environment tertiary education								
Operational planning (work planning) relative to each discipline	0.0	0.0	12.5	8.3	45.8	33.3	4.00	3
Quality management competencies	0.0	0.0	8.3	25.0	29.2	37.5	3.96	
Design management	0.0	0.0	12.5	8.3	45.8	33.3	3.88	
Generic management	0.0	4.2	8.3	25.0	41.7	20.8	3.67	
Testing of installation before handing over:								
Testing mechanical (plumbing) installation	4.2	0.0	0.0	20.8	37.5	37.5	4.00	4
Testing electrical installation	4.2	0.0	4.2	16.7	37.5	37.5	3.96	
Ascertaining the functionality of windows fixed	4.2	4.2	12.5	25.0	37.5	16.7	3.38	
Checking roof for leakages	4.2	4.2	4.2	33.5	37.5	16.7	3.46	
Checking drains/spouts against blockage	4.2	0.0	25.0	12.5	37.5	20.8	3.42	
Tendering stage:								
Inclusion of work schedule in tender document by contractor	0.0	4.2	8.3	25.0	41.7	20.8	3.67	5
Inclusion of plant and equipment schedule in tender documents	4.2	0.0	8.3	33.3	41.7	12.5	3.46	
Inclusion of human resource schedule in tender document by contractor	4.2	0.0	12.5	33.3	33.3	16.7	3.42	
Inclusion of quality assurance plan in tender document by contractor	4.2	0.0	12.5	41.7	25.0	16.7	3.33	
Pre-qualification of contractors/subcontractors:								
Ascertaining the financial capability of contractors	0.0	0.0	4.2	16.7	33.3	45.8	4.21	6
Ascertaining past record of contractor	4.2	0.0	8.3	8.3	45.8	33.3	3.92	
Ascertaining contractor's health and safety plan	4.2	0.0	15.5	25.0	37.5	20.8	3.50	
Verification of quality assurance plan of the contractor	0.0	8.3	16.7	29.2	29.2	16.7	3.29	
Verification of equipment, plant and tools	4.2	4.2	29.2	41.7	12.5	8.3	2.79	

Intervention category	Unsure	Responses (%)					MS	Rank
		Minor.....Major						
		1	2	3	4	5		
Pre-qualification of suppliers:								
Ascertaining the financial capability of suppliers	16.7	8.3	20.8	12.5	25.0	16.7	2.71	7
Accessing the past record of supplier	16.7	8.3	20.8	16.7	29.2	8.3	2.58	
Ascertaining the educational qualification of supplier regarding materials performance knowledge	20.8	12.5	12.5	29.2	16.7	8.3	2.33	
Owned assets of supplier such as light delivery vehicles	16.7	12.5	16.7	37.5	8.3	8.3	2.33	

The most important interventions to minimise or eliminate delays in the delivery of projects are those interventions at the construction stage. This stage has the highest mean MS of the seven categories of interventions. Furthermore, it is notable that, although the intervention contractor and consultants inspection of quality of materials on site as they arrive, and conducting of steel strength test has the lowest MS in the category (3.96), it is nonetheless higher than the MSs of most factors in other intervention categories. Briefing/Design stage category of interventions is second in ranking, followed by built environment tertiary education, testing of installations before handing over, tendering stage interventions, pre-qualification of contractor and subcontractor, and pre-qualification of suppliers. Arguably, if pre-qualification of contractors and subcontractors, which is the only screening done to select the best constructor, could be rated the second to the last option in the chain of intervention categories, the judgement of the respondents may be deemed inappropriate. The same contention applies to the intervention category 'pre-qualification of suppliers'.

8. Conclusions relative to validation of the model

The most important category of interventions is that of the construction stage. The interventions at the construction stage have an average MS of 4.19. The MS of 4.19 falls within the range $3.40 \leq 4.20$, and therefore respondents can be deemed to be of the opinion that the interventions relative to this intervention category have between a moderate influence to near major/near major influence on the delivery of projects on time. However, the MS falls just outside the upper category, namely $4.20 \leq 5.00$, which indicates the interventions relative to this intervention category have between a near major to major/major influence. Furthermore, given that all

the MSs are > 3.00 , it can be concluded that all the interventions at the construction stage could eliminate delays in project delivery. The interventions that have a major influence in this category are weekly/monthly meetings with key staff/subcontractor (MS = 4.42); planning work two weeks before it takes place (MS = 4.22); planning activities that weather could affect (MS = 4.29); prompt inspection and approval of work by a consultant (MS = 4.29); contractor monitoring of subcontractors' work (MS = 4.17); prompt issuance of instructions (MS = 4.13), as well as concrete cube and steel tests (MS = 4.04).

Based on the average MSs of intervention categories, it can be concluded that respondents deemed all interventions proposed at each stage of construction to have between a moderate influence to a near major/near major influence on the delivery of projects in South Africa.

The only category of interventions that falls outside the above-mentioned range is the pre-qualification of suppliers (MS = 2.49), which has between a minor to near minor influence/near minor influence on eliminating delays on projects.

However, it could be argued that interventions at the construction stage are deemed as most effective by the respondents for the elimination of delays on project delivery time. The requirements suggested for contract documentation as interventions at both the pre-qualification of contractors/subcontractors and suppliers stage are in place, required for facilitating the smooth flow of activities during construction are ranked sixth and seventh. This amplifies the importance of the interventions at both the pre-qualification of contractors/subcontractors and suppliers categories.

From the foregoing, it can be concluded that interventions at all stages of construction proposed in the model are important for the completion of projects on time.

9. Recommendations from the validation of the model

The following courses/modules are recommended for inclusion in built environment tertiary education programmes for all disciplines: quality management; operational planning; design management, and generic management.

The pre-qualification of suppliers is suggested. A brief description of requirements for consideration during the pre-qualification are assessing the past records of the suppliers; ascertaining the financial

capability of supplies; ascertaining the educational qualification of suppliers regarding their materials performance knowledge, and owned assets, such as light delivery trucks.

At the brief/design stage, attention should be paid to adequate briefing, confirmation of client financial capability, and design quality assurance/constructability reviews.

At the construction stage, focus on adequate planning/resource management, work schedules, and monitoring of subcontractors' work, and prompt payment of interim certificates will contribute to eliminating delays in projects.

At the tendering stage the following should be made part of the tender documents, including pre-tender programme; primary materials; method statement; site layout; subcontractor schedule; human resources schedule; plant and equipment schedule; quality plan, and work schedule.

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Strategic management: An Eastern Cape construction SME case study

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Abstract

Small and Medium-size Enterprises (SMEs) fulfil an important role in the long-term growth and development of the economy of the country. The development and growth of construction SMEs are important for all countries, as a strong SME base has the capacity to produce a high-quality infrastructure for the country.

However, research has revealed the high failure rate of small businesses within the first five years of their existence in South Africa. In addition, research also indicated that lack of long-term planning and lack of strategic thinking are major contributing factors to the failure of most SMEs.

For instance, despite the considerable growth in the industry in the past decade due to government's considerable infrastructural spending occasioned by the 2010 FIFA World Cup, the majority of construction SMEs failed to use the opportunities gained in this period to develop into established construction entities. This study investigates how strategic management can be applied to address the problems faced by construction SMEs, and to explore techniques and tools of strategic management that can make a significant contribution to their growth and development.

The research findings, based on a literature review and a qualitative research approach, suggest that, although many construction SMEs perform poorly, some have the potential to grow and develop into more established entities by proactively managing their firms strategically. In addition, the findings indicate that SMEs that practise strategic management perform better, and that there are many advantages for SMEs that adopt strategic management principles at the organisational level.

Keywords: Construction industry, small and medium-size enterprises, strategic management

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Abstrak

Klein en mediumgrootte ondernemings (KMO's) speel 'n belangrike rol in die langtermyn groei en ontwikkeling van die ekonomie van die land. Die ontwikkeling en groei van konstruksie KMO's is belangrik vir alle lande omdat 'n sterk KMO-basis die kapasiteit het om 'n hoë-kwaliteit infrastruktuur vir die land voort te bring.

Nietemin, navorsing het gewys na die hoë mislukkingsyfer van kleinondernemings binne die eerste vyf jaar van hul bestaan in Suid-Afrika. In aansluiting hierby, toon navorsing ook dat 'n gebrek aan langtermynbeplanning en die gebrek aan strategiese denke groot bydraende faktore tot die mislukking van meeste KMO's is.

Byvoorbeeld, ten spyte van die oorwegende groei in die industrie in die verlede as gevolg van die regering se oorwegende infrastruktuurbesteding vir die 2010 FIFA Sokker Wêreldbeker, het die meerderheid Konstruksie KMO's misluk om die geleenthede in hierdie periode te ontwikkel na gevestigde konstruksie-entiteite. Hierdie artikel ondersoek dus hoe strategiese bestuur toegepas kan word om die probleme wat deur konstruksie KMO's ervaar word aan te spreek, en om tegnieke en toerusting van strategiese bestuur te ontdek wat 'n merkbare bydrae tot die groei en ontwikkeling kan maak.

Die navorsingsbevindings wat op 'n literatuurstudie en 'n kwalitatiewe navorsingsbenadering gebaseer is, stel voor dat alhoewel baie konstruksie KMO's swak presteer, het sommige die potensiaal om te groei en te ontwikkel na meer gevestigde entiteite deur proaktiewe strategiese bestuur van hul firmas. In aansluiting hierby dui die bevindinge ook aan dat die KMO's wat strategiese bestuur toepas, beter vaar, en dat daar baie voordele is vir KMO's wat strategiese bestuurbeginsels op organisatoriese vlak aanneem.

Sleutelwoorde: Konstruksie-industrie, klein en mediumgrootte ondernemings, strategiese bestuur

1. Introduction

The development and growth of construction Small and Medium-size Enterprises (SMEs) are important issues for all countries, as a strong SME base has the capacity to produce high-quality infrastructure for the country (Ofori, 2009: online). Furthermore, construction SMEs also stimulate economic activity in other sectors of the economy (Ofori, 2009: online). However, construction SMEs face many problems when dealing with construction projects, and, as a result, poor performance and poor quality of work are unfortunately prevalent among SMEs in the construction industry (Dlungwana, Noyana, Nxumalo, Rwelamila & Van Huysteen, 2002: 2).

The lack of any long-term planning and the lack of strategic thinking often lead to the failure of SMEs businesses (Analoui & Karami, 2003: 36). However, organisations that practise strategic management usually outperform those that do not (Hunger & Wheelen, 2003: 4; Analoui & Karami, 2003: 10). There is, therefore, the need to investigate how strategic management can be applied to address

the problems faced by construction SMEs by exploring techniques and tools of strategic management that can make significant contributions to the growth and development of construction SMEs in South Africa. Hence, the primary objective of this study is to report on the success factors of a construction SME in the Eastern Cape. These will be used to develop strategic management guidelines for similar entities.

2. Literature review

The South African construction industry has experienced a decade of considerable growth and success, particularly as a result of the government's considerable infrastructural spending. According to a report by the Department of Agriculture and Land Reform (2008: 7), the construction industry managed to increase its contribution to South Africa's GDP by 18% between 2003 and 2008. However, the global recession has, as in most sectors, put a dampener on growth, but the industry was one of only a few sectors to have increased its contributions to GDP during the recession. For example, in the 3rd quarter of 2009, it increased its contribution to GDP by 8.4% from what it was in 2008 (Statistics South Africa, 2009: 41). However, the growth in the construction industry cannot be considered in terms of the number of contractors moving from the lower to the upper grades of the CIDB register of contractors. In fact, 89% of all registered contractors that can be categorised as SMEs fall within level one of the Construction Industry Development Board's classification system as indicated in Table 1 (CIDB, 2010: online).

Table 1: CIDB National Register of Contractors: May 2010

Grade	CE	EB	EP	GB	ME	SW	Total grades	Percentage
1	20.200	1.007	1.836	57.900	2.525	10.237	93.705	89.04
2	1.532	172	84	2.058	185	438	4.469	4.25
3	512	90	46	539	83	90	1.360	1.29
4	727	168	117	755	132	115	2.014	1.91
5	522	147	132	464	150	156	1.571	1.49
6	567	50	57	487	75	47	1.283	1.22
7	224	19	36	195	36	28	538	0.51
8	72	2	9	60	16	7	166	0.16
9	47	6	16	32	21	10	132	0.13
Total	24.403	1.661	2.333	62.490	3.223	11.128	105.238	100.00

Source: CIDB, 2010

In terms of the 2004 CIDB Regulations, made by the Minister of Public Works in terms of the CIDB Act, 2000, construction SMEs in the lowest level of the CIDB's National Register of Contractors are restricted in terms of the size of the projects for which they may tender (CIDB Regulations, 2004: online). Construction SMEs registered in grade one, which is the lowest level, may only tender for projects up to a value of R200.000. Contractors in grade nine may tender for an unlimited value (CIDB, 2004: online). The bottom structure of the construction industry is thus overloaded, while the top structure contains only an elite few that have the benefit of competing for multimillion rand projects, as the contractors in the lower levels are restricted to tendering for small non-complex projects (Cameron, 2007: online). For this reason, the CIDB has continually expressed its concern over the high concentration of lower level contractors that fail to move up the grades (Cameron, 2007: online). The situation in the Eastern Cape is particularly a source of concern as the CIDB (2010: online) noted that the number of grade-one contractors in the province is disproportionately high at 91.8% of all contractors registered in the Eastern Cape (Table 2). When compared with other provinces, for instance, the percentage in the Eastern Cape is significantly higher as grade-one contractors constitute 58.0% and 61.5% of the total number of registered contractors in the Western Cape and KwaZulu-Natal, respectively.

Table 2: CIDB's Register of Contractors registered in the Eastern Cape: October 2010

Grade	CE	EB	EP	GB	ME	SW	Total grades	Percentage
1	2.736	96	194	8.228	175	1.186	12.615	91.81
2	128	12	7	210	9	58	424	3.09
3	89	9	9	59	4	10	180	1.31
4	101	11	5	81	9	11	218	1.57
5	51	10	14	44	15	14	148	1.08
6	49	4	1	45	2	1	102	0.74
7	17	4	3	16	1		41	0.30
8	6			7			13	0.10
9	1						1	0.01
Total	3.177	146	233	8.690	215	1.280	13.741	100.01

Source: CIDB, 2010

Although construction SMEs face similar problems as do their counterparts in other sectors of the economy, they have to deal with the unique characteristics of the industry, with adverse implications for

the firms (Ofori, 2009: online). In brief, in the South African construction context, construction SMEs face many problems when dealing with construction projects and, as a result, poor performance and poor quality of work prevail among SMEs in the construction industry (Dlungwana *et al.*, 2002: 2). As an illustration, the construction industry is driven mainly by projects and thus the success of companies is “inextricably linked to the success of the projects they execute” (Barry & Sebone, 2009: 186). It follows that, if SMEs consistently deliver poor quality on projects, the projects may fail and this, in turn, may lead to the low success rate of SMEs. In addition to the problems faced by all SMEs in all the sectors of the economy, Ofori (2009: online) identifies three unique characteristics of the industry that have adverse implications for construction SMEs:

- The contractor's low level of bargaining power in view of the tendering process;
- The project-based nature of work which implies discontinuity, and
- The way in which work is financed, in other words the client only pays for work that has been completed.

2.1 Strategic management in construction

Due to the industry's inherent characteristics, strategic management can be deemed important to businesses operating in the construction industry where the degree of rivalry is high and where adverse competition is a serious threat to the success of a business (Skaik, 2009: online). The strategic management process usually starts with strategy formulation. Before an organisation begins the process of strategy formulation it should scan its external environment to identify threats and opportunities, and its internal environment to identify strengths and weaknesses (Hunger & Wheelen, 2003: 30). Environmental analysis must precede strategy formulation in the strategic management process. Environmental analysis is a tool used by businesses to avoid strategic surprise and to ensure the long-term health of the business (Hunger & Wheelen, 2003: 30).

2.2 Strategy formulation

The strategic formulation process begins with the crafting of the mission statement, which provides the framework within which the business's strategies are formulated (Hill & Jones, 2008: 8). The mission statement sets out the purpose of the company and provides a basis for strategic objective-setting and decision-making. It is important that the mission statement be communicated and made clear

to all internal and external stakeholders of the business. It should be understandable and clearly make sense to all stakeholders, in order to avoid confusing stakeholders about the purpose of the firm (Analoui & Karami, 2003: 114).

The second step in strategy formulation is specifying achievable objectives (Analoui & Karami, 2003: 122). Strategic objectives provide guidance on how the business should fulfil and reach the goals specified in the vision and mission statements (Dess, Lumpkin & Eisner, 2010: 29). According to Hunger & Wheelen (2003: 6), the objectives of a business are the end result of planned activities, which should stipulate time frames for the achievement of measurable goals. In this regard, it is often argued that business owners should develop SMART objectives, in other words objectives that are specific, measurable, appropriate, realistic, and time-bound (Dess *et al.*, 2010: 29). They are specific in that it is exactly clear what it is that the business is required to achieve in order to reach the objectives. They are measurable in that each objective has a yardstick which measures progress against fulfilling the objective. It is appropriate in that the objectives are consistent with the vision and mission of the business. It is realistic in that it is on target with the business's current capabilities and available resources, as well as with the opportunities that currently exist in the organisation's environment. According to Analoui & Karami (2003: 129), the third step in strategy formulation is developing strategies by:

- Conducting a SWOT analysis;
- Conducting an industry analysis;
- Conducting a resource analysis, and
- Taking into account the business's strategic objectives.

2.3 Porter's five forces

In formulating strategy, it is important for the strategist in the business to analyse the industry in which the business operates (Analoui & Karami, 2003: 77). Harvard Business Professor, Michael Porter, is a pioneer with regard to the concept of industry environment and industry analysis (Pearce & Robinson, 2003: 67). The cornerstone of his work is the concept of five forces that shape competition in an industry (Pearce & Robinson, 2003: 67). Porter's five forces model is the most commonly used analytical tool for examining a business's competitive environment (Dess *et al.*, 2010: 56). According to Porter (1985: 4), competition in an industry depends on five forces. The competitive forces are the threat of new entrants (also described as

barriers to entry), powerful suppliers, powerful buyers, the threat of substitute products, and rivalry.

The threat of new entrants refers to the possibility that the profits of established firms in the industry may be eroded by new competition (Dess *et al.*, 2010: 56). In general, the contracting sector of the construction industry has low barriers to entry coupled with a high degree of fragmentation (Cheah & Chew, 2005: 552). The capital investment requirements for entry are low; there is an efficient rental equipment market, and the subcontracting mechanism offers advantages to construction SMEs (Acar & Oney-Yazici, 2006: 443). Access to distribution channels is, therefore, not problematic for construction SMEs. Entry is easy for construction SMEs at the lower end of the industry in terms of firm size (Langford & Male, 2001: 52). As project size, complexity and technological requirements increase, fewer firms are able to undertake such work (Langford & Male, 2001: 52).

In terms of the power of suppliers, Acar & Oney-Yazici (2006: 438) contend that the five forces model is based on the assumption that when suppliers are powerful, they can exert pressure on the producers to capture some of the industry's profits. One of the indicators of the power of suppliers in an industry is the number of suppliers in the industry. A supplier group is powerful if the industry within which it operates is dominated by only a few companies (Hunger & Wheelen, 2003: 39). When suppliers dominate an industry, it means that the cost of switching suppliers is high, and the suppliers are said to be more powerful in an industry (Acar & Oney-Yazici, 2006: 438).

As far as the power of clients is concerned, buyers and clients in an industry are powerful if they are able to force prices down, bargain for higher quality or more services, and play competitors against each other (Dess *et al.*, 2010: 58). Buyer power refers to the impact of the client on an industry (Acar & Oney-Yazici, 2006: 438). The power balance between a business and its clients determines the extent with which the business has the freedom to set its product price. In the construction industry, construction SMEs have a contractual relationship with their clients and the price of the product is, therefore, determined before the construction phase. Thus, the clients have a high bargaining power as they specify demands associated with projects, and the switching costs for clients are also low as many contractors operate in the same market (Acar & Oney-Yazici, 2006: 440).

In addition, the threat of substitute products refers to the ability of substitute products to satisfy the same need as another product, hence posing a threat to the existing service providers or producers (Analoui & Karami, 2003: 83). Acar & Oney-Yazici (2006: 443) argue that a substitute product, as meant by Porter, does not exist in the construction industry, because no other product can replace, for example, a building for residential purposes. The degree of rivalry is the amount of direct competition in an industry (Hunger & Wheelen, 2003: 37). If the degree of rivalry is intense, rival businesses target customers of other businesses using attraction strategies such as publicity and advertising (Analoui & Karami, 2003: 83). A competitive move by one business could have an effect on the other competitors (Analoui & Karami, 2003: 83).

2.4 Competitor and resource analysis

Competitor analysis is a tool for analysing the external environment and, more particularly, the industry. According to Pearce & Robinson (2003: 76), competitive analysis is a tool in terms of which a business determines which firms are its competitors and what the major determinants of the competition are. It profiles the current and potential future strategies of competitors and attempts to work out their possible responses to any changes in the strategy the firm may make (Langford & Male, 2001: 76). Resource analysis, on the other hand, is a tool for analysing the internal environment. The main reason for analysing the resources of a business is to explore those resources that enable an organisation to compete and survive against its competitors. The resources of a business are those assets that contribute to the generation of value added (Analoui & Karami, 2003: 92). Resource analysis determines the extent to which the resources of a firm add value, and it provides the business with a competitive advantage over its rivals (Analoui & Karami, 2003: 92).

2.5 SWOT analysis

Langford & Male (2001: 75) indicate that a SWOT analysis is shorthand for describing the strengths and weaknesses of a business and the opportunities and threats it faces. The main purpose of the SWOT analysis is to identify strategies to exploit external opportunities, counter threats, build on and protect strengths, and eradicate weaknesses (Hill & Jones, 2009: 19). A SWOT analysis involves both external and internal environmental analysis. A SWOT analysis is used regularly in business to stimulate self-reflection and group discussions about how to improve the business and how to position it for success (Dess et al., 2010: 81).

SWOT analysis has its limitations, as it is merely a starting point for a discussion on how to develop effective strategies to deal with threats and weaknesses and to exploit opportunities and strengths (Dess *et al.*, 2010: 81). In other words, SWOT is not an end itself, but a means to the kind of action steps necessary to enact strategic change (Dess *et al.*, 2010: 81).

2.6 Levels of strategy

According to Pearce & Robinson (2003: 6), the hierarchy of strategy comprises three levels: the corporate strategy at the top, the business strategy in the middle and the functional level strategy at the bottom of the hierarchy (Pearce & Robinson, 2003: 6). The corporate strategy decides what type of business the organisation should be in and how the overall group of activities should be structured and managed (Analoui & Karami, 2003: 53). For instance, in the construction industry, subcontracting and joint ventures (JV) are corporate strategies that could be used by construction SMEs to grow and develop their businesses (Ofori, 2009: online). A construction SME may also decide to form a joint venture partnership with a larger established business. In the construction industry, among SMEs, a JV is used as an opportunity for the SME to grow and develop the company (Ofori, 2009: online) in the domestic market and to win construction contracts, by means of the bidding process, that it would not normally win through the competitive bidding process if it were to rely on its own skills, experience and resources. Another strategy is the diversification strategy. For example, when construction firms diversify, they go into related markets such as property development, housing development, supplying building materials, plant and equipment hiring as well as mechanical and electrical engineering (Langford & Male, 2001: 106). Such diversification allows the business to divert resources from within its current profile to the diversified activities (Fellows, Langford, Newcombe & Urry, 2002: 196). In other words, it makes more sense for construction businesses to diversify into related areas as they can source the inputs needed for the new products from within their current capabilities, skills and resources.

In addition, business level strategies determine how the business will compete in the selected market arena in which it chooses to operate (Pearce & Robinson, 2003: 6). In fact, a business that practises strategic management adopts one or more generic strategies that characterise the business's orientation in the marketplace (Pearce & Robinson, 2003: 13). The three generic strategies are the cost

leadership strategy, the differentiation strategy, and the focus strategy (Dess et al., 2010: 15).

Kenyon & Mathur (1997: 179) define cost leadership as having "lower equivalent costs than competing substitutes". The low-cost leader is a business that can produce at the lowest cost and thus gain competitive advantage in any market by being able to provide the products and services at the lowest cost (Analoui & Karami, 2003: 132). When a business is able to differentiate its products along some attributes which customers value, and the cost of doing so is lower than the extra revenue envisaged, then differentiation strategy is an appropriate strategy to pursue (Analoui & Karami, 2003: 133). In other words, the customer feels that the cost to buy the product is well below the product's value in comparison to other available alternatives (Pearce & Robinson, 2003: 193). The purpose of the differentiation, according to Kenyon & Mathur (1997: 78), is to make the business's product less price-sensitive. In other words, customers give less weight to the price in their buying decisions (Kenyon & Mathur, 1997: 78). In the construction industry, the level of conformance with governing standards and specifications, the extent to which innovative means and methods of construction are used, the quality of workmanship, the quality of human relations, the rigour involved in schedule management, and the level of professionalism in construction management practices are usually the differentiating factors in the construction service (Arditi, Makinde & Polat, 2008: 256).

In addition, a focus strategy, often referred to as a niche strategy, focuses on a narrow segment of the market (Analoui & Karami, 2003: 134). When a firm decides to adopt a focus strategy, the firm will typically concentrate on finding a niche in the marketplace and will develop its competitive advantages for that niche. According to Hernandez (2008: online), companies that develop and exploit a particular specialty niche tend to have a greater degree of success than "those that try to be all things to all customers", as a successful focus strategy depends on clearly defining the niche, conducting an analysis of the niche, and reaching out to the niche by satisfying the niche market's own particular needs.

3. Research method

In this study, a qualitative approach was followed because the aim is to gain an understanding of the problem. A single case study method was chosen for this study as it allows collecting rich data and assists in the understanding of phenomena in their real life and

context (Acar & Oney-Yazici, 2006: 438). Therefore, a construction SME operating in the Eastern Cape was chosen as the subject for the case study.

The interview was used as the primary data-gathering method for this study. More specifically, a focus interview was chosen and questions were carefully designed to provide adequate coverage for the purpose of the research. The concepts and topics in the literature review were used to elicit information from the respondent.

4. The case study

The business selected for this study is an Eastern Cape-based construction SME. The business was selected for the following reasons:

- The owners successfully developed the business from a micro or very small enterprise to an established medium-sized business, that is now capable of successfully completing multimillion rand projects within the time, cost and quality constraints of the project.
- The owners applied strategic management tools to develop the business.

One of the managing members of the construction SME was interviewed to obtain the primary data for the research. More specifically, a focus interview was used and questions were carefully designed to provide adequate coverage for the purpose of the research. The interviewee is one of the four owners actively involved in the management of the business and is also the business's chief strategist.

4.1 Interview results: The history of the SME

Is the SME managed by the owner or an appointed manager?

The construction SME is managed by its owners.

What is the size of the SME in terms of number of employees and annual turnover?

The business has now grown into an established medium-sized enterprise both in terms of annual turnover and in number of employees. It is currently employing 200 employees and is thus at the upper end of the definition of a medium-sized enterprise in terms of number of employees. The business is capable of successfully completing multimillion rand projects in both general building and

civil engineering construction works. It focuses mainly on specialist concrete rehabilitation works, which is a very narrow segment of the construction industry within the civil engineering works category.

What type of legal entity is the SME?

It is a close corporation owned by five members, of whom four are actively involved in the management of the business.

How long has the SME been operational?

The business started in 1996 as a very small enterprise. When the business started it only employed 20 permanent employees who were all unskilled labourers. All the skilled labour required for a project executed by the business was initially outsourced by subcontracting to other construction SMEs. In the beginning the business only concentrated on small projects for general building works such as painting, repairs, renovations and waterproofing. As the business grew and more opportunities arose, the business started recruiting more semi-skilled and skilled labour. In 2004, the firm shifted its focus from general building works to civil engineering construction works. The business has now grown into an established medium-sized enterprise employing 200 employees, capable of successfully completing multimillion rand projects, in both general building and civil engineering construction works. Its focus is mainly on specialist concrete rehabilitation works, which is a very narrow segment of the construction industry within the civil engineering works category.

Has the SME ever participated in any contractor development programme in terms of which it received mentoring, the benefits of targeted procurement or any other type of development assistance?

No.

In which geographical areas does the SME operate?

The business operates in the Eastern Cape.

4.2 Interview results: Strategy formulation

4.2.1 Strategic objectives

Do you set strategic objectives for the SME? If yes, give examples.

The business has set the following strategic objectives:

- To be registered as a Grade-8CE contractor in terms of the CIDB grading classification system by the year 2011.

- To be a large enterprise by the year 2013.

Are these objectives SMART (Specific, Measurable, Appropriate, Realistic, Time-bound)? If yes, please explain the metrics to determine whether they are smart or not.

In this regard, the organisation is already registered as a grade-7 contractor, which means that registration as a grade-8 contractor is the next milestone to reach. Furthermore, the business has already reached the upper end of the description of a medium-sized enterprise in terms of the number of employees permanently employed in terms of the National Small Business Act, 1996. If the business grows any further in terms of number of employees and annual turnover, and if it starts operating on a national level, it will be regarded as a large enterprise. The strategic objectives are also time-bound in that there is a time frame for reaching each of the objectives.

Being registered as a grade-8CE contractor means that the business would be able to tender for projects up to R130 million rand. This would have a positive impact on the annual turnover of the business. The business would also benefit from decreased competition as there are only seventy-two businesses registered nationally in grade 8CE, as opposed to 224 businesses registered in grade 7CE (see Table 1).

To achieve these objectives, the firm has set certain action plans in motion. In this regard, the business registered as a grade-7CEPE contractor. PE stands for potentially emerging. Potentially emerging contractors are allowed to tender for certain projects falling within the maximum tender range of one grade higher than their current grade, provided that the client has earmarked the project specifically for potentially emerging contractors.

4.2.2 Corporate level strategies

Which corporate level strategies, if any, does the SME apply?

The construction SME grew from a very small enterprise to an established medium-sized enterprise by employing a variety of strategies at the corporate level, including joint venture partnerships, acquisitions, subcontracting, vertical integration and diversification.

Why have you decided on the particular corporate strategy and how does the strategy contribute to the success of the SME?

4.2.2.i) Joint venture partnerships

The firm has successfully used joint venture partnership as a corporate strategy to develop the business very effectively since 2001. In 2001 the business was able to tender for its first multimillion rand construction project by entering into a joint venture partnership with an established enterprise. The project involved repairs and renovations at the Port Elizabeth Prison. The firm, on its own, had the human resources in terms of skilled labour that was required to tender for the project, but did not own the resources in terms of plant and equipment that was required to successfully complete the project. The firm was not able at the time to put up the guarantees required for a large project. Clients in the construction industry require contractors to provide security for the successful completion of large projects in the form of bank or insurance guarantees to the value of 10% of the contract price. Since the firm did not at that point have the financial resources necessary to obtain a bank guarantee it pooled its resources with an established enterprise that had the necessary plant and equipment and could obtain a bank guarantee required for the large project. The joint venture successfully completed the project, and the firm benefited from the project in that they gained the necessary experience from working on a large project and their turnover increased for the duration of the joint venture partnership.

In 2003, another opportunity arose to complete a multimillion rand project for renovations at the Nelson Mandela Metropolitan University in Port Elizabeth. The firm once again pooled its resources with an established firm through a joint venture partnership in order to tender for the project. It successfully tendered for and completed the project. The project provided the firm with a consistent income for a period of two years from the commencement of the project and it enabled the business to grow to an extent where it employed 80 permanent employees when the project was completed. The strategy of forming joint venture partnerships worked effectively because, by pooling its resources together with a larger firm that owned the plant and equipment necessary to tender for larger projects, the firm was able to provide sustainable and consistent revenue for the business. By forming joint venture partnerships, the firm took responsibility for its own growth and development instead of relying on government initiatives such as contractor development programmes.

4.2.2.ii) Acquisition

In 2004, the construction SME acquired all the assets of an established construction firm. By acquiring this firm, the construction SME acquired the necessary financial and physical resources in order to tender for multimillion rand projects on its own without having to form joint venture partnerships with other businesses. In addition, it enabled the construction SME to direct its business operations towards concrete structural civil engineering works. Before the acquisition, the construction SME mainly focused on general building works, such as masonry, painting and waterproofing. The decision to venture into civil works was also informed by the fact that profit margins in general building works were becoming smaller as more construction firms entered the industry. With the necessary financial resources the construction SME was able to actively recruit suitable qualified employees to supervise civil engineering works. This enabled the business to tender on its own for its first multimillion rand civil engineering works project to the value of R12 million in 2004.

4.2.2.iii) Subcontracting

The firm uses subcontracting both as a means to conclude agreements with main contractors in order to execute portions of a larger project and as a strategy to outsource certain parts of projects of which they have been appointed as the main contractor.

Outsourcing parts of a project to subcontractors enables the construction SME to remain flexible in the type of construction projects for which it tenders. For instance, a specific construction project might have various sections over different disciplines. A project that has been classified as general building works seldom exclusively consists of only general building works. It might have an electrical works section or a mechanical engineering works section. Should the construction SME's workforce not have a particular skill required by a particular section of the project, it merely outsources that part of the contract to a subcontractor who specialises in the particular skill. For instance, electrical works are often outsourced to electrical subcontractors.

In the same way, the construction SME undertakes specialist work outsourced by large construction enterprises through a subcontract arrangement. By subcontracting and dealing directly with a main contractor, the construction SME is able to sidestep the very competitive bidding process it would have to go through in order to contract directly with the client. The main contractor remains responsible to the client to finish the work in the time and to the

standard agreed to in the contract and, therefore, carries all the risks of executing the work on the contract. For example, the construction SME has subcontracted for large enterprises such as Murray and Roberts and WBHO.

4.2.2.iv) Vertical integration

The construction SME applied vertical integration successfully when specialist imported material, supplied by only one supplier in the Eastern Cape, became very expensive. The construction SME investigated the opportunity to import the material directly from Germany, and discovered that it was more cost-effective to import the material in bulk directly from Germany. This decision entailed importing material in bulk and stocking the material as it was not cost-effective to purchase and ship material every time the business successfully tendered for a project. When the construction SME does not successfully compete for a project, it sells the imported material to the rival business that won the tender. This meant that they started to compete directly with the local supplier of the imported material. The business benefited from vertical integration in that it removed its dependency on a supplier that dominated a specific market and that became too expensive. Furthermore, it gave the construction SME a cost advantage over its competitors, in that it was able to reduce its cost of sales in respect of the particular product.

If the SME has diversified, which markets have you diversified into? Why?

4.2.2.v) Diversification

The construction SME decided to diversify into a related market such as property development. The idea is not to construct new developments, but rather to carefully choose old dilapidated buildings located in an area with potential, renovate them and sell them at a profit. The plan is still in its infancy stage and the construction SME is currently seeking suitable property in the correct area. The reason why the construction SME decided to diversify is to increase profitable growth. The construction SME already has the necessary skills, capabilities and resources within the business necessary to branch into this related area.

4.2.3 Business level strategies

Which business level strategies does the SME follow?

The construction SME follows a combination of cost leadership strategy and focus strategy. Price often trumps all in construction services, and by consistently pricing their tenders lower than their competitors, the construction SME was able to secure tenders on a consistent basis. An example of this is:

According to the interviewee, the preliminaries and general section in a tender document for a construction project usually constitutes about 20% of the overall tender price and consists inter alia of costs such as supervision and site management costs. One of the reasons why the construction SME is able to price lower is because their site management is not top heavy, in other words, they are able to cut out unnecessary supervision staff and appoint only the supervisory staff necessary to supervise the project to the quality standard required by the client. This perhaps goes to show that the firm ensures that supervisory staffs are competent enough to deliver projects to the required targets.

Another reason why the construction SME has a cost advantage over their competitors is because of the advantage they have in owning all of their access equipment as opposed to hiring the equipment. An example of access equipment is scaffolding equipment necessary to gain access to a site. According to the interviewee, the costs associated with hiring access equipment could total 25% of the overall costs of a project. The construction SME did a cost-benefit analysis to compare the costs of purchasing their own plant and equipment to access sites, as opposed to hiring equipment for each and every project. Although initially a huge capital investment was required for purchasing the equipment, these costs and the maintenance costs were easily offset by the fact that they have no charge for hiring access equipment in the pricing of a tender for each project and could consistently tender lower for projects. Furthermore, depreciation on assets and renting out the access equipment to other construction firms during the times when it is not required by the construction SME further offset the purchasing and maintenance costs of the plant and equipment. These factors enabled the construction SME to consistently win more projects on the basis of price and give them a competitive cost advantage.

The construction SME found a niche in the construction market in that they are one of only ten serious competitors in the Eastern Cape in the specialist concrete rehabilitation works market. Specialist concrete rehabilitation works is a specific market within the broader civil engineering construction works market. The fact that they have found this niche market means that they have a golden opportunity

to dominate the specific niche market, as the company benefits from decreased competition of bids.

4.3 Interview results: Porter's five forces analysis

- *Do you consider the entrants of new construction firms into the industry to be a threat to the business success of the SME?*
- *What strategies, if any, have you designed to neutralise the threat of new entrants?*

The construction SME is very aware of the threat of new entrants, especially with regard to the niche market that the business serves. In order to combat the threat of new entrants, the business analyses the techniques and resources of its competitors at the tender stage in order to assess whether it could possibly be edged out on price. It then proceeds to price its tender in such a way that it combats any threats their competitors may pose in this regard in the future.

- *Can you easily substitute the services and products supplied by your suppliers (in other words, is it easy to shop around, switch one supplier for another)?*
- *What effect, if any, does the power of suppliers have on the business success of the SME?*
- *What strategies, if any, has the SME put in place to neutralise the power of suppliers?*

According to the interviewee, there are sufficient suppliers in the industry to allow the construction SME to play suppliers off against each other in order to obtain a better price. Suppliers do not wield any significant power in the construction industry. It is possible to negotiate lower prices with suppliers. In the one instance where one of the suppliers of specialist imported material did wield significant power in terms of being the only supplier of the specific material in the Eastern Cape, the construction SME was able to neutralise the power of the supplier through vertical integration. In other words, the SME took over a link in the chain controlled by one of their suppliers by importing the material, stocking it and when they failed to secure a particular tender, selling it off at a markup to rival firms who secured the tender. In other words, they became a supplier of the imported material and entered into competition with the existing supplier in the market.

- *Can your clients easily force down prices by playing one business off against each other?*
- *If yes, how does the power of the client affect the business success of the SME?*

The clients in the construction industry wield bargaining power as price trumps all construction procurement. Especially in the general building class of works, there are so many competitors that the profit margins of SMEs are consistently being driven lower. The construction SME operates in a niche market and the degree of rivalry in the particular niche is lower than in the other classes of works. For instance, there are only ten serious competitors in the particular niche in the Eastern Cape. The new entrants in the market over the past three years have increased the rivalry to a degree, but because of its cost advantage, the firm has been able to withstand the threat of new entrants.

4.4 Interview results: Competitor analysis

How do you determine or predict the competitive behaviour of your competitors?

For each tender, public sector clients organise compulsory pre-tender site meetings. All potential bidders are invited to attend and no construction SME may submit a tender for a particular project unless it has attended the pre-tender site meeting. The construction SME considers the pre-tender site meeting as the ideal opportunity to know exactly who the competitors are for a specific tender. The construction SME analyses all the competitors in terms of their human resource capability which allows them to estimate the rival's labour and supervision costs. They also analyse their rival's resources in terms of plant and equipment and is able to estimate what effect these resources will have on the way the preliminaries and general section of the tender document is priced.

4.5 Interview results: Resource analysis

Which of the following resources enable the SME to compete and survive against your competitors?

- *Tangible resources (equipment, property, plant, machinery).*
- *Intangible resources (brand name, technology).*
- *Organisational capacities and capabilities (human resource skills and competencies, management style).*

The construction SME's tangible resources in terms of their plant and equipment are a source of competitive advantage for them. For example, unlike most of their rivals, they do not have to hire access equipment such as scaffolding for each project, as the SME owns its own access equipment. In this way they save on costs for hiring equipment which, according to the interviewee in civil engineering

works, could easily constitute 25% of the tender price. When the plant and equipment is not required, the SME leases the equipment to its competitors. The interest paid on the capital sum spent on purchasing the equipment and the maintenance cost of the equipment are offset against the rental earned on the equipment and the tax saving caused by the depreciation on equipment. The resources are costly for other SMEs to imitate and they, therefore, provide the construction SME with a competitive advantage.

The construction SME's human resources are also a source of competitive advantage. The SME's elaborate training and compensation strategy ensures that they retain the skills and competencies in the organisation in order to maintain their competitive advantage.

4.6 Interview results: SWOT analysis

Do you conduct SWOT analysis to determine the SME's strengths and weaknesses, and opportunities and threats?

According to the interviewee, the construction SME conducts SWOT analysis to keep abreast of its strengths and weaknesses and to identify threats and opportunities in their environment. In the past, loss of skilled workers to larger firms offering higher salaries threatened the business success of the SME, but it has been able to weather the storm by adopting the human resource strategies to combat the threat. Currently, the construction SME regards new entrants entering their niche market as its biggest threat. They are, however, confident that they will be able to keep new rivals at bay by maintaining their cost advantage.

The construction SME regards its major weakness to be the lack of standardised processes within the organisation to ensure that the SME's operations run smoothly and that waste is kept to a minimum. The interviewee indicated that one of the problem areas identified is the lack of synchronisation between the pricing of the tender and the actual buying of the supplies for the tender. The lack of synchronisation has in the past caused rework and waste on a project. The strengths of the construction SME are its highly skilled workforce, its ability to innovate and be on the cutting edge of the latest technology, and its extensive resources in the form of plant and equipment. These strengths are continuously exploited to ensure that the construction SME maintains its competitive advantage.

5. Conclusions and recommendations

Based on the literature reviewed as well as the lessons from the case study, it can be argued that strategic management provides development opportunities for construction SMEs. An SME intending to survive and succeed in the competitive industry must thus evolve corporate and business strategies such as joint venture partnerships, acquisitions, subcontracting, vertical integration, and most importantly diversification of its business and project portfolio. In order to maintain competitive advantages, the construction SMEs should also adopt either a low-cost strategy or any other strategy such as focus strategy, marketing strategies, training and retention strategies to ensure that the company's order book is constantly at a certain acceptable level.

In addition, construction SMEs should be aware of Porter's five forces that influence the industry. These forces are the threat of new entrants, the power of suppliers, the power of clients, rivalry and the threat of substitute products. Strategies should be devised to neutralise the threat of new entrants. If these strategies are no longer effective and the degree of rivalry threatens the business success of the SME, the SME should consider targeting a different market area of the construction industry for the business's services. For example, the case study organisation started as a very small SME that focused on general building services such as painting, repairs, renovations and waterproofing and then diversified into the civil engineering sector due to poor profit margins in the building sector.

6. Further research

This study showed how strategic management guidelines can be applied to construction SMEs to facilitate their growth and development. The study covered a wide variety of concepts of strategies applied by construction SMEs. As price is such a key determining factor of whether an enterprise is awarded a tender, one area which is of particular importance for construction SMEs is maintaining a cost advantage. Therefore, research should be carried out to examine in more detail how construction SMEs may maintain a cost advantage while still delivering a product that satisfies all the client's needs. The issues that deserve particular attention are, for instance, how lean construction and designing a shorter works programme could contribute to cost advantages.

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Preferential procurement in the public sector: The case of Amathole

Peer reviewed and revised

Abstract

The end of the apartheid era in South Africa ushered in a new institutional environment through changes to legislative frameworks in government departments. A key aspect of the transformation is the economic empowerment of the mainly historically disadvantaged groups in the country through procurement.

The thrust of the issue is the assessment of the extent of compliance with Act No. 5 of 2000: Preferential Procurement Policy Framework Act (PPPPA), 2000 at government departments, with particular focus on the Amathole region of the Eastern Cape Province.

The assessment was undertaken in a qualitative and quantitative research study conducted among key construction industry stakeholders such as public-sector clients, architects, engineers, and quantity surveyors based within the Amathole region.

Selected findings include that there is a perceived low level of awareness of preferential procurement in the public sector as the majority of the institutions investigated have not completely implemented procurement responsibilities as a dedicated function within their organisations. Another significant finding arising from the study is that there are conflicting perceptions among consultants regarding procurement strategies for different types of project.

Keywords: Construction, consultants, procurement, public sector, South Africa

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Abstrak

Die einde van die apartheidsera in Suid-Afrika het 'n nuwe institusionele omgewing deur veranderinge aan wetgewingsraamwerke in regeringsdepartemente ingelei. 'n Sleutelaspek van die transformasie is die ekonomiese bemagtiging van die hoofsaaklik historiese agtergeblewene groepe in die land deur verkryging.

Die kruis van die saak is die assessering van die omvang van inwilliging met Wet No. 5 van 2000: Wet op Raamwerk vir Voorkeurverkrygingsbeleid deur regeringsdepartemente met spesifieke fokus op die Amathole streek van die Oos-Kaapprovinsie.

Die assessering is deur 'n kwalitatiewe en kwantitatiewe navorsingstudie onder sleutelkonstruksie industrie-aandeelhouders soos openbare sektor kliënte, argitekte, ingenieurs, en bourekenaars binne die Amathole streek gedoen.

Geselekteerde bevindings sluit in dat daar 'n lae vlak van bewustheid oor voorkeurverkryging in die openbare sektor is omdat die meerderheid instansies wat ondersoek is nie volledig verkrygingsverantwoordelikhede as 'n toegewyde funksie binne hul organisasies geïmplementeer het nie. 'n Ander noemenswaardige bevinding uit die studie is die botsende persepsies onder konsultante aangaande die strategieë vir verskillende projektipes.

Sleutelwoorde: Konstruksie, konsultante, verkryging, openbare sektor, Suid-Afrika

1. Background

According to the Construction Industry Development Board (CIDB) (2004: 1), procurement was identified as a tool to achieve economic reform to regulate a bias in award of contracts in favour of historically disadvantaged individuals (HDIs) in South Africa. This type of procurement, termed preferential procurement, was formally initiated in 1998 in South Africa. At the beginning, an interim strategy for public sector procurement reform in South Africa, commonly known as the ten-point plan, was developed by the Department of Public Works. The ten-point plan paved the way for the promulgation of Act No. 5 of 2000: *Preferential Procurement Policy Framework Act (PPPFA), 2000* (Republic of South Africa, 2000a: 1).

The PPPFA introduced a principle of equity and black economic empowerment within the traditional system. The PPPFA primarily regulates the establishment of conventional procurement systems with point-scoring parameters that relate to cost and empowerment indicators. HDIs are targeted to benefit when procuring services in the public sector of South Africa through preferential means. Different options could hence be considered to contract for professional services. The PPPFA identifies two categories of point-scoring. These two categories are referred to as 90:10 and 80:20 point-scoring systems (CIDB, 2004: 5). They are differentiated by a contractual value, and the procuring institution must specify such value in the

preferential procurement policy. The initial points are allocated to cost and the latter points to empowerment indicators. The PPPFA also prescribes that all government institutions must develop preferential procurement policies for awarding such contracts in a credible fashion. In particular, the PPPFA requires state institutions to determine their preferential procurement policy and to implement it within the framework through a preference point system, which dictates that (CIDB, 2004: 5):

- for contracts with a Rand value above a prescribed amount, a maximum of 10 points may be allocated for specific goals provided that the lowest acceptable tender scores 90 points for price;
- for contracts with a Rand value equal to or below a prescribed amount, a maximum of 20 points may be allocated for specific goals provided that the lowest acceptable tender scores 80 points for price;
- any other acceptable tenders which are higher in price must score fewer points on a *pro rata* basis, calculated on their tender prices in relation to the lowest acceptable tender in accordance with a prescribed formula, and
- the contract must be awarded to the tenderer who scores the highest points unless objective criteria in addition to that pertaining to specific goals justify the award to another tenderer.

Further, the framework provides examples of specific goals in that it states that specific goals may include contracting with HDIs, any specific goal for which a point may be awarded, and any goals contemplated must be measurable, quantifiable and monitored for compliance (CIDB, 2004: 5). To this end, the Department of Treasury is a custodian of Act No. 53 of 2003: *Broad Based Black Economic Empowerment (BBBEE) Act, 2003*. The BBBEE Act complements the PPPFA, and broadens the target areas for business sectors in order to address the six critical areas of empowerment (South Africa, 2003: 1):

- increasing the number of black people that manage, own and control enterprise and productive assets;
- facilitating ownership and management of enterprises and productive assets by communities, workers, cooperatives and other collective enterprises;
- human resource and skills development;

- achieving equitable representation in all occupation categories and levels in the workforce;
- preferential procurement, and
- investing in enterprises that are owned or managed by black people.

In essence, in addition to the BBBEE, public-sector clients have to comply with the prescripts of the PPPFA in relation to empowerment, which sets the framework within which organs of state must implement their empowerment policies (SAACE, 2006: 2). To be succinct, as construction is one of the sectors targeted by the BBBEE Act, built-environment consultants are thus relevant to the implementation of the reform. Hence, the focus of the study among built-environment consultants is justified, taking into account the role they play with respect to the facilitation and implementation of construction-related investment projects. An additional responsibility would then be to ensure the successful integration of empowerment or social goals with project development goals. Hence it is important that targeted procurement be rightfully implemented in appointing built-environment consultants.

In order to gain understanding of these issues, the study assesses the extent to which PPPFA directives are observed by the Public Sector using the Amathole region as a case study. The PPPFA directives were tested by measuring compliance with its prescripts through the lens of public-sector employees and selected consultants based within the Amathole region. The adequacy of management systems, including statutory decision-making processes, integration of procurement responsibilities, and the capacity of institutions to comply with the directives, were investigated.

2. Literature review

The perceived reliance of the public sector on consultants (Bowen, Pearl, Cattell, Hunter & Kelly, 2007: 63) underscores the need to examine how their services are procured for construction project purposes. The extent of integrating project-development objectives with social objectives is related to how preferential procurement forms an inherent element of overall project goals (CIDB, 2007: 1). Hence, preferential procurement should be considered at the earliest possible stage of the project and should be carried through the subsequent stages in sequence.

Empowerment targets should be included when procurement is driven by preferential principles. Such issues as employment and/or

training of HDIs should feature as early as the conceptual stage. In South Africa, there are six prescribed built-environment professions recognised by Act No. 43 of 2000: *Council for Built Environment Act, 2000*. These professions include the (South Africa, 2000b: 1):

- Architectural profession;
- Project and Construction Management professions;
- Engineering profession;
- Landscape Architectural profession;
- Property Valuers profession, and
- Quantity Surveying profession.

However, this study is limited to three professions, namely the architectural profession, the engineering profession, and the quantity surveying profession. These professions have different roles to perform in different project environments. In particular, appointments of professional services by state institutions are essentially governed by a number of legislative frameworks. According to Table 1, legislative frameworks that directly affect procurement in South Africa total five in number (SAACE, 2006: 2). Of this number, two are directly related to equitable procurement systems.

Table 1: Procurement-related legislative frameworks in South Africa

<i>Constitution of the Republic of South Africa (Act No. 108 of 1996) – Section 217 states that government procurement systems must be fair, equitable, transparent, competitive, and cost-effective</i>				
Fair, transparent, competitive, and cost-effective			Equitable	
Public Finance Management Act (Act No. 1 of 1999)	Municipal Finance Management Act (Act No. 56 of 2003)	Construction Industry Development Board Act (Act No. 38 of 2000)	Preferential Procurement Policy Framework Act (Act No. 5 of 2000)	Broad Based Black Empowerment Act (Act No. 53 of 2004)
PFMA	MFMA	CIDB	PPPFA	BBBEE
Public-sector clients	Public-sector clients	Public- and private-sector clients	Public-sector clients	Public- and private-sector clients

Source: SAACE (2006: 2)

The PFMA and MFMA that emanated from National Treasury, *inter alia*, prescribe how procurement in the public sector should be undertaken. The CIDB Act provides for the establishment of the Construction Industry Development Board (CIDB), which is an entity of the Department of Public Works. The Act mandates the CIDB to, *inter alia*, provide strategic leadership to industry stakeholders in

order to stimulate sustainable growth as well as reform and develop the industry in order to bring about improved performance of the industry (South Africa, 2000c: 1). Pursuant to its mandate therefore, the CIDB embarked on the publication of statutory regulations and guidelines such as the CIDB standard for uniformity in construction procurement (SFU), which refers to the CIDB best practice guidelines for construction procurement for procurement-related issues.

Specifically, the CIDB best practice guideline number A7 addresses the procurement of professional services (CIDB, 2007: 9). The recommended procedures for the appointment of professional service providers according to the guideline took cognisance of the importance of quality and price. Where quality is deemed to be the most important criteria, the guidelines state that negotiated procedure, proposal procedure using the two-stage system, open procedure, qualified procedure, proposal procedure using two envelopes, and quotation envelopes, should be used for complex projects. Where price is deemed to be the most important criterion, the guideline recommends negotiated procedure, nominated procedure, open procedure, and quotation procedure for the appointment of consultants for routine projects.

However, the then South African Association of Consulting Engineers (SAACE), now known as Consulting Engineers South Africa (CESA), recommended that the selection procedure for the appointment of consultants should be ability-based or quality-based (SAACE, 2006: 4). In terms of ability selection, the appointment may be made by referral, panel or roster. It is notable that the roster system of selection has been popular in South Africa as it ensures that work is automatically rotated among firms on the roster, using a number of specific selection criteria, which include position on roster, size of firm, fields of competence, locality of offices, and empowerment criteria (SAACE, 2006). In addition, in terms of quality-based selection that comprises prequalification, submission of proposals, evaluation of proposals, and agreement, SAACE (2006: 5) recommends that firms may be selected based on skills and qualifications of personnel; technical competence; targeted selection criteria such as empowerment goals or local capacity; reputation; experience on similar projects; capacity to undertake the project; understanding and commitment to the client's interests; impartiality; professional integrity; quality management system, and knowledge of local issues.

Nevertheless, although the construction sector is perceived to be promoting government's policy and preferential procurement with its perceived benefits, Kajimo-Shakantu & Root (2006: 306)

argue that preferential procurement policies remain a 'contested' concept from a conflict theory perspective. They contend that, despite the efforts and progress made by government since the inception of the PPPFA, access to work opportunities provided by preferential procurement is not always translated into sustainable empowerment. In particular, they observe that the reason why preferential procurement is so significant to the South African construction industry is the dual role of government as a major client of the sector and policymaker, as well as it being labour-intensive with low barriers to entry coupled with the structure of the construction industry. However, these have not overcome the challenges of meeting socio-economic objectives (Kajimo-Shakantu & Root, 2006: 303). They note that inadequate management systems and lack of capacity within the public sector, poor and inconsistent procurement practices by client bodies, fronting and the abuse of subcontractors, poor management and inadequate skills, lack of permanent relationships in structured joint ventures, lack of access to capital and finance, and high competition and unprofitable tender prices are challenges working against the realisation of the benefits of preferential procurement practices.

3. The research

Given the extensive roles allocated to local government in terms of the implementation of municipal infrastructure projects, the perceptions of stakeholders in the public sector were deemed important to the findings of this particular study. As vividly amplified in the Department of Provincial and Local Government (DPLG), (2006) document entitled *Municipal infrastructure: Roles and responsibilities*, the contributions of the public sector to the provision of municipal infrastructure cannot be overemphasised.

As a result, the sample frame of the research project was constituted by twelve institutions, which include all nine (9) municipalities in the district, and three provincial departments. The common element within the organisations that were surveyed is that they are all responsible for major public sector capital infrastructure programmes. The three provincial departments include the Department of Public Works (DPW), the Department of Transport (DoT), and the Department of Housing (DoH). These departments are either individually or collectively responsible for a number of projects related to the delivery of roads, transport infrastructure and municipal infrastructure for housing development. The nine municipalities are Mbashe, Mnquma, Great Kei, Amahlathi, Buffalo

City, Ngqushwa, Nkonkobe and Nxuba local municipalities, and the Amathole District Municipality (ADM).

According to a recently released report, ADM has the second largest economy in the province, contributing 33% to the provincial economy (ADM, 2011: 24). East London, Bhisho, Butterworth and King Williams Town are areas of significant economic activity in the district which is concentrated mainly within the Central Business Districts (CBD) of these major towns. These towns also function as centres of economic activity for neighbouring areas and smaller towns, with manufacturing, trade, finance and community services sectors dominating the district's economy. The report further notes that the economy of the district is dominated by the community services sector. The dominance of this sector that includes the government sector is partly attributed to the location of the Provincial Government Head Offices in Bhisho. This sector is also a major employer as it accounted for 38% of all formal jobs in the ADM.

However, a growing modern economy linked to global production chains in East London is contrasted with an extremely poor rural economy in former homeland areas (ADM, 2011: 25). An unemployment rate of 30% was recorded in the area in 2009 and 50% of the population in the district were estimated to be living below the minimum living level threshold. High levels of poverty and inequality thus exist, especially in the eastern part of the district. Therefore, the ADM report contends that there is a major need for investment in social and economic infrastructure throughout the district, but especially in the rural areas (ADM, 2011: 25). This contention therefore amplifies the need to re-examine the dynamics related to procurement or rather preferential procurement in the public sector in the district.

Forty consulting firms constituted the sample stratum. A random sample undertaken during interviews to avoid bias of views resulted in a sample size of thirteen. In addition, Leedy & Ormrod (2005: 200-207) provide guidance for the descriptive method adopted for data-generation and analysis. The qualitative data-generation stage was preceded by preliminary research done to arrive at important constructs for the interview. This approach comprised personal interviews of the procurement managers of one municipality, one provincial department and one district municipality using a non-standardised semi-structured schedule, accompanied by questionnaires distributed to targeted professionals working in built-environment consulting practices in the region.

A pilot study using the draft questionnaire at two public-sector institutions and two built-environment consultants yielded useful feedback. The feedback was incorporated in the final version of the questionnaires, which were administered to the respondents. Due to the busy schedule of the targeted managers and consultants, a copy of the questionnaire was e-mailed to each respondent for his/her personal attention. E-mailed questionnaires were also followed-up with telephonic reminders.

Findings from an extensive literature survey and the outcome of these interviews were used for the second quantitative data-production stage comprising the design, pre-test and administration of a structured questionnaire among selected public-sector institutions and practising professionals in the region. The structured questionnaire for procurement managers consisted of three sections. The first section (A) of the questionnaire addressed the demographic background of the respondent and section two (B) aspects of knowledge and background relating to the basis for operational effectiveness such as existence of policy and strategies used on procuring consultants. Section three (C) addressed institutional capacity, which included aspects such as training and development of personnel.

4. Findings and discussion

Table 2 indicates the academic profile of the public-sector procurement officials who responded to the survey. It is notable that 42% of the respondents are engineers, while quantity surveyors and architects collectively constitute only 16%. In effect, 58% of the respondents are professional built-environment practitioners. Table 3 indicates the respondents' perceptions of compliance with PPPFA legislative directives in their respective institutions. It is notable that out of the 13 possible responses, 92% of the respondents are of the opinion that, in terms of compliance, their institutions can be deemed to be complying with PPPFA directives by having functional tender committees and ensuring that employees have thorough knowledge of the PPPFA. Further, 67% of the respondents perceive that compliance with tender evaluation points (either 80/20 or 90/10), as stipulated in the PPPFA, is adequate in their institutions, while only 50% affirm that their institutions have PPPFA-related procurement policy in place. However, it is instructive to note that there is more compliance within the provincial departments than in the municipalities. In particular, only 40% of the municipalities have fully complied with the PPPFA directives.

Table 2: Professions of procurement officers

Profession	Municipalities	Provincial government	Total	
			No.	%
Engineer	5	0	5	42.0
Quantity Surveyor	1	0	1	8.0
Architect	1	0	1	8.0
Supply chain	1	0	1	8.0
Others	1	3	4	33.0
Total	9	3	12	100.0

Table 3: Compliance with legislative directives

Legislative directive	Municipalities	Provincial government			Total	
		DPW	DoT	DoH	No.	%
Knowledge of PPPFA	8	1	1	1	11	92.0
Procurement policy in place	3	1	1	1	6	50.0
Tender evaluation point i.e 80/20	5	1	1	1	8	67.0
Functional tender committee	8	1	1	1	11	92.0

Table 4 indicates that the respondents are of the opinion that seven public-sector institutions have tender technical personnel (58%); twelve public-sector institutions have tender committees (100%), and five public-sector institutions have audit committees as part of PPPFA-related required management structures (42%). In particular, four municipalities have tender technical personnel, nine municipalities have tender committees, and three municipalities have audit committees in place. It is also notable that, with the exception of the DoT, all three provincial departments have the desired management structures in place.

Table 4: Institutional set-up for procurement function

Statutory structures	Municipalities	Provincial government			Total	
		DPW	DoT	DoH	No.	%
Tender technical	4	1	1	1	7	58.0
Tender committee	9	1	1	1	12	100.0
Audit committee	3	1	0	1	5	42.0

Table 5 indicates the respondents' perceptions of the extent of compliance of their respective institutions with operational capacity requirements in terms of PPPFA procurement. In general, only three municipalities and the provincial departments place statutory structures such as procurement officers, a procurement unit, and

procurement employees in place. In effect, only 50% of the public sectors have operational capacities required for the implementation of PPPFA procurement directives. Therefore, within the surveyed institutions, the capacity of procurement units varies from one support employee to a multi-disciplinary team of personnel who account to the procurement officer.

Table 5: Operational capacity indicators

Statutory structures	Municipalities	Provincial government			Total	
		DPW	DoT	DoH	No.	%
Procurement officer	3	1	1	1	6	50.0
Procurement unit	3	1	1	1	6	50.0
Procurement staff	3	1	1	1	6	50.0

Hence, it can be assumed from the above analysis that institutions follow different processes in the procurement of consultants, since appointments are strongly dictated by institutional capacity arrangements or limitations. The analysis of the aforementioned findings ultimately led to the emergence of two distinct categories of institutions pertaining to the discourse. The categories include:

- Category 1: Institutions with procurement units, and
- Category 2: Institutions without procurement units.

The implications of this assumption are that category 1 institutions seem to follow the process presented in Figure 1 with the contract influences being undertaken by the line functions. The procurement unit would then be involved with the procurement strategies and the monitoring of such during the contract execution stage. In terms of category 2 institutions, there seems to be no distinctive line drawn between the contracting influences and the procurement strategies to the extent that procuring officers fuse these two into one process without a clear stage breakdown, as if there is no distinction.

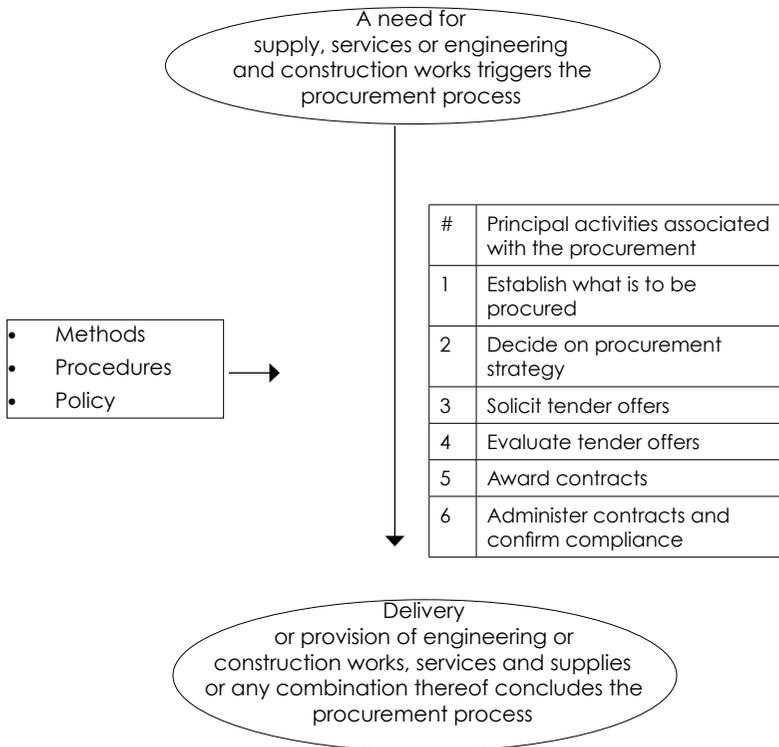


Figure 1: Components of a procurement system
 Source: Watermeyer, 2004: 33

Having considered the issues that may influence the appointment of consultants by public-sector institutions based at Amathole, the views of built-environment consultants were sought in order to arrive at robust perspectives relative to PPPFA implementation. To this end, Table 6 indicates the professional group, as well as the age of the businesses that were surveyed. In particular, all respondents to the survey were directors of their respective businesses at the time of the research, possessing either an academic diploma or degree qualification. Out of the thirteen consulting practices surveyed, 61.5% have been in existence for over ten years, 23.1% have been in existence for over six years, but less than ten years, while 15.4% have been in existence for less than five years. Therefore, it can be assumed that the majority of the built-environment respondents are

sufficiently experienced in the industry to provide valid inputs relative to the subject under investigation.

Table 6: Profile of built-environment consultants

Age of firm (years)	Engineer	Architect	Quantity surveyor	Total	
				No.	%
0 - 5	1	1	0	2	15.4
6 - 10	1	1	1	3	23.1
> 10	8	0	0	8	61.5

Table 7 indicates the level of the consulting practices' awareness of the PPPFA. The table suggests that 76.9% of the engineers that responded to the survey are aware of the PPPFA, while 7.7% of the architects and quantity surveyors surveyed affirmed their awareness of the Act. Perhaps, the high percentage of awareness reflected relative to engineers may be ascribed to the fact that engineering consultancies constitute the greater percentage of respondents.

Table 7: Awareness of Act No. 5 of 2000: Preferential Procurement Policy Framework Act, 2000

Profession	Yes (%)
Engineer	76.9
Architect	7.7
Quantity surveyor	7.7

Table 8 indicates the respondents' perceptions relative to public-sector compliance with PPPFA requirements. The findings suggest that 61.5% of the respondents are of the opinion that they comply with the 'developed equity plan'-related PPPFA directive; 76.9% with the 'established equity targets'-related PPPFA directive; while 15.4% with the 'established equity committee'-related PPPFA directive. However, it is notable that none comply with the 'HDIs in equity committee' directive.

Table 8: Observing preferential procurement policy requirements

PPPFA directive	Engineer	Architect	Quantity surveyor	Total	
				No.	%
Developed equity plan	8	0	0	8	61.5
Established equity committee	2	0	0	2	15.4
HDIs in equity committee	0	0	0	0	0.0
Established equity targets	8	1	1	10	76.9

Table 9 indicates the respondents' perceptions of procurement methods used for engaging built-environment consultants after the promulgation of the PPPFA Act in 2000. Specifically, the respondents perceive that on average: 31.5% of appointments are based on open competition; 12.7% are based on closed competition, and 45.5% are based on selection/roster. However, given the 5.0% and 6.7% response percentages, the appointments based on pre-qualified competition and negotiated contracts can be deemed to be limited.

Table 9: Profile of procurement methods used by clients

Procurement method	Engineers (%)										Architects/ Quantity Surveyors (%)			Mean (%)
	1	2	3	4	5	6	7	8	9	10	11	12	13	
Open competition	0	55	25	50	20	30	60	60	60	0	50	0	0	31.5
Closed competition	0	15	60	0	60	0	10	20	0	0	0	0	0	12.7
Pre-qualified competition	0	15	0	0	20	0	10	20	0	0	0	0	0	5.0
Negotiated contract	0	10	67	0	0	0	10	0	0	0	0	0	0	6.7
Selection/ Roster	0	5	67	50	0	70	10	0	40	100	50	100	100	45.5

5. Conclusions and recommendations

The findings of this study reveal that in Amathole, the level of preferential procurement awareness in the public sector can be deemed to be low. The majority of the public-sector institutions have seemingly not institutionalised procurement responsibilities as a dedicated function within their organisations. This is more prevalent in local government in the region, as only the district municipality, and one local municipality achieved a significant level of compliance.

Although there are conflicting perceptions among consultants regarding procurement strategies for different types of project, there is, however, an observed improvement in HDI shareholding patterns. In addition, there is a limited structured approach regarding the matters of HDI integration on governance structures such as equity committees within consultants. Therefore, it is recommended that capacity-building programmes be streamlined to focus on preferential procurement requirements. A comprehensive programme must be developed to deal with the gaps identified in the study across the public sector.

In addition, synergy must be developed between provincial and local government procurement policies and structures for effective preferential procurement monitoring. This must be conducted under the supervision of a neutral procurement ombudsman to prevent social complexities as envisaged in the Ten-point plan. Perhaps the CIDB can perform the function of ombudsman. Policy must address, *inter alia*, the dynamic nature of services being procured, and the different types of project. Consultation with stakeholders such as consultants should be given priority when developing such policies so that common ground is achieved with procurement strategies.

In this way, public-sector institutions would be obliged to take charge of their responsibility and can be monitored on a continuous basis with persistent support being provided in a structured manner. Integrating procurement as part of the performance management systems and developing a balance scorecard wherein preferential procurement inputs, processes and outputs are clearly stipulated and easy to monitor is deemed necessary.

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Jacques Laubscher

Tracing the origins of the Southern African building regulations, with specific reference to the period between 1650 and circa 1740

Peer reviewed

Abstract

This paper uses contemporary definitions of building regulations and building standards to establish the first performance standard (and the source of building regulations) for Southern Africa. Specific focus is given to the period between 1650 and circa 1740. The author argues that the original premises remain relevant in the built environment.

Keywords: Building regulations and its origin, building standards, building codes, Code of Hammurabi, Jan van Riebeeck, regulating the built environment

Abstrak

Binne die artikel word 'n kontemporêre definisie van 'n bouregulasie en boustandaard gebruik ten einde die eerste voldoeningstandaard, asook die oorsprong van bouregulasies vir Suider-Afrika, te bepaal. Daar word spesifiek verwys na die periode 1650 tot circa 1740. Die gebruik van die gemelde bouregulasie-definisie illustreer die universele geldigheid van die oorspronklike argument.

Sleutelwoorde: Bouregulasies, oorsprong van bouregulasies, boustandaarde, boukodes, Wet van Hammurabi, Jan van Riebeeck, kontrole van die bou-omgewing

1. Methodology

The desk study focuses on the origin of building regulations of the built environment and is presented from a historic perspective (in chronological order). The first section of this article serves as an introduction that provides a brief overview of the origin of the regulatory framework. Thereafter a comprehensive definition of building regulations is provided and the relation between regulations and standards is stated. These aforementioned definitions are used

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to trace the origin of building regulations for Southern Africa. Specific focus is given to the period between 1650 and *circa* 1740.

2. Introduction

In early settlements, development associated with population growth continued to widen the gap between natural and man-made, thus further distancing man from his habitat. Glazewski (2000: 230) argues that the origin of planning can be traced to North Africa, where the "... ancient Egyptians used the familiar grid pattern to house workers on the pyramids in the third millennium BC".

When Herodotus of Halicarnassus visited Giza in *circa* 450 BCE, he was informed that it had taken 400.000 men 20 years to finish the pyramid of Cheops. By contrast, "... the British archaeologist Petrie estimated that 100.000 men would have sufficed" (York, 1997: 4). Notwithstanding the difference in estimates, a *laissez-faire* approach to the built environment would have inhibited development. It could therefore be argued that specific regulations were introduced in order to manage the man-made environment, building works and associated processes. According to David (2003: 56-59), it was necessary to organise the sites that housed the royal workmen, craftsmen and labourers. Often the sites "... were chosen because they were near to the worksite ... even the proximity of a good water supply was not considered essential to these town sites, the requirements of isolation and security being greater" (David, 2003: 59). However, these built environment regulations mostly focused on the man-made, while negating the possible symbiotic relationship between architecture and nature.

Advances in medicine impacted on the built environment in terms of additional health requirements. Descriptive examples can be found in, for instance, the Roman system for sewerage removal and the aqueducts constructed for the provision of fresh water. Population estimates indicate that at its peak Rome had approximately one million inhabitants. According to Cowan (1985: 68), "... the AD 300 census of Rome listed 1.797 *domus* (houses) and 46.602 *insulae* (blocks of flats) ...". With the development of civilisation, man increasingly exerted his influence on the natural habitat, using its resources to support his endeavours.

Unfortunately, events of catastrophic proportions usually necessitated the refinement of the rudimentary requirements employed to provide order within the built environment. After the great fire of AD 64, Emperor Nero issued a decree limiting the height of buildings,

banning mid-walls between *insulae*, requiring accessible roofs for firefighting at porticoes, and restricting the use of timber. In addition, he cut straight wide roads through the burnt-out areas of the city to act as fire breaks and to provide access for firefighters (Cowan, 1985: 68-70). In more recent history, the Fire of London in 1666 is perhaps the most widely recognised such event (Tricker & Algar, 2006: xiii). In 1667 the British Parliament passed the London Building Act, which restricted the use of timber, specified a minimum thickness for external walls, and banned inflammable roof coverings (Cowan, 1985: 205, 209). The origin of building regulations in Southern Africa displays similar characteristics, and is discussed later in more detail.

Since the Industrial Revolution, development within the built environment has continued unabated with associated control measures being introduced. However, the relationship between architecture and nature has changed to one of master and servant. Glazewski (2000: 11) states that "... virtually all environmental problems stem from the way we decide how to use and manage land". He further elaborates on this by claiming that "... the form of tenure on specific land invariably has environmental consequences ..." (Glazewski, 2000: 11).

3. Definitions of building regulations

The *Dictionary of Architecture and Building Construction* (Davies & Jokiniemi, 2008: 52-53) does not differentiate between building codes and building regulations, and provides the following overall definition:

A statutory code which regulates the construction, alteration, maintenance, repair, and demolition of buildings and structures.

Likewise, Watermeyer (2003: 6) does not distinguish between the two terms, and defines a building code or regulation as follows:

A document used by [a] local, state or national government body to control building practice through a set of statements of 'acceptable' minimum requirements of building performance. This is usually a legal document. Acceptable requirements are typically established on the basis of socio-political and/or community considerations.

The book entitled *Building regulations in brief* (Tricker & Algar, 2006: [i]) provides the most concise description of a building regulation:

A statutory instrument, which sets out the minimum requirements and performance standards for the design and construction of buildings, and extensions to buildings.

For the purposes of this article, a **building regulation** is acknowledged as:

- a regulating instrument, that
- describes a minimum standard, that
- should be implemented during the building process (that initiates with design, and continues through construction, maintenance, alteration and repair to demolition of buildings and/or structures), with the aim of
- protecting public health and safety during
- the construction, occupation and post-occupation phases of
- buildings and/or structures.

3.1 The relationship between building regulations and building standards

In the construction industry, a building regulation often refers to a building standard, and it is important to note the distinction between the directive and the yardstick with which its implementation is measured. Watermeyer (2003: 6) presents a standard as a benchmark, claiming that essentially it is “a series of technical documents that standardise ... some activity in relation to building and construction)”.

In the 2008-edition of the *Dictionary of Architecture and Building Construction*, Davies & Jokiniemi (2008:360) do not specifically include the term 'building standard', but provide the following definition for a **standard**: “any product, method, process or procedure which has been established as an exemplar ... or otherwise represents the norm”. A **norm**, on the other hand, is described as a “standard, an officially recognised exemplary standard of measurement, quality, regulative legislation or classification” (Davies & Jokiniemi, 2008: 251).

A **building standard** could thus be defined as:

- an official technical point of reference, that
- standardises building and construction activity,
 - (generally) in terms of 'quality', or 'performance,' and
 - (occasionally) in terms of size, or procedure
- thus providing measurement criteria.

According to the *Dictionary of Architecture and Building Construction* (Davies & Jokiniemi, 2008: 52) **building codes of practice** are described as:

legal documentation setting out the requirements to protect public health and safety, and outlining standards of good practice with regard to the construction and occupation of buildings.

4. The origin of building regulations

4.1 The code of Hammurabi

Watermeyer (2003: 25) claims that "... building standards have been in place since man was able to capture his thoughts in writing". According to Cowan (1985: 27), the oldest surviving building code can be traced back to the reign of King Hammurabi in Mesopotamia. Hammurabi's Code of Laws is inscribed on a basalt stele (Figure 1) that is on display in the Louvre. The code dates back to *circa* 1780 BCE, and was originally translated by L.W. King in 1910 and edited by Richard Hooker in 1996 (Hooker & King, 1999: online).



Figure 1: The 2.25 m high basalt stele erected by King Hammurabi of Babylon
Source: Iselin, 2011: online

The first translator of the code, Charles F. Horne, argued in 1915 that Hammurabi's code implied the existence of an earlier set of laws (King & Horne, 2006: online). This claim is corroborated by researchers at the Louvre who maintain the source of the Hammurabi Code as "... two Sumerian legal documents drawn up by Ur-Namma, King of Ur (c. 2100 BC) and Lipit-Ishtar of Isin (c. 1930 BC)" (Iselin, 2011: online). Nonetheless, the Hammurabi Code is considered "...

the most important legal compendium of the ancient Near East" (King & Horne, 2006: online), and it represents the earliest known example of a ruler proclaiming publicly to his people an entire body of laws. The code is grouped into different chapters that focus on family law, slavery, and professional, commercial, agricultural and administrative law (Iselin, 2011: online). It was displayed publicly, and comprised 282 different Codes of Laws. Cuneiform script was used, and Stockdale (2005) notes its efficiency in "... the expansion of literacy, and subsequent governmental regulation and authority over an increasingly literate public".

Six specific codes refer to the built environment. Code 228 deals with payment after the completion of a successful building project, while the remaining five codes (229-233) list different manners of recourse, should a structure prove unsafe. It could be argued that this set of six official codes represents the origin of contemporary building regulations (Table 1). It is noteworthy that the largest part of the code refers to a minimum standard – requiring the builder to guarantee the safety of the construction. These objectives remain relevant to this day, and echo the primary purpose of architecture; to safely house man and his possessions.

Table 1: A synopsis of Hammurabi's Code of Laws according to the various requirements, subsequent events and the relevant obligations or recourses

<i>Hammurabi's Code of Laws:</i>						
No.	Requirement	►	Event	+	Post-event	= Obligation or Recourse
Objective 1: Erection of the structure and its associated cost:						
228	If a builder builds a house, and	►	the builder completes it	+	none	= Payment (fee/surface)
Objective 2: Should a structure prove unsafe during its occupation, the following recourses are available (it is presumed that the house was paid for in accordance with Code 228):						
229	If a builder, builds a house, and it is not properly constructed, and it	►	collapses (<i>falls in</i>), and	+	kills the owner, then	= Death to the builder See 232.b that is implied, although it might be difficult to achieve See 232.c that is implied, although it might be difficult to achieve

No.	Requirement	►	Event	+	Post-event	=	Obligation or Recourse
230	If a builder, builds a house, and it is not properly constructed, and it	►	collapses (<i>falls in</i>), and	+	kills the son of the owner, then	=	Death to the builder's son See 232.b that is implied, but not expressly stated See 232.c that is implied, but not expressly stated
231	If a builder, builds a house, and it is not properly constructed, and it	►	collapses (<i>falls in</i>), and	+	kills a slave of the owner, then	=	The builder has to pay slave for slave See 232.b that is implied, but not expressly stated See 232.c that is implied, but not expressly stated
232	If a builder, builds a house, and it is not properly constructed, and it	►	collapses (<i>falls in</i>), and	+	damages the owner's goods, then	=	The builder has to compensate the owner for the ruined goods and re-build the house at his own cost (own means)
233	If a builder, builds a house, and it is not properly constructed, and the	►	walls fail (<i>seem toppling</i>)	+	none	=	The builder has to re-build the walls at his own cost (own means)

Source: adapted from Hooker & King, 1999: online

The Hammurabian codes focus on the relationship between owner and builder, while the interests of a larger settlement (and by implication the interests of the neighbours) are not explicitly addressed. It could be argued that the stratification of society according to class and community structure implied settlement patterns and associated rules of engagement. However, as the number of inhabitants in a particular settlement increased, it inevitably led to an increased number of risks.

4.2 The growth of settlements

Klitzke (1959: 173) states that "... ever since man began to use fire as his servant, he discovered ... that it frequently could not be controlled. When man congregated in cities, the servant turned master even more often". Watermeyer (2007: 26) supports this point of view, and argues that settlement growth brought "... the scourge of fire and health risks associated with poor sanitation". Larger communities therefore necessitated a form of orderly settlement planning through regulation.

Arguably the best known assimilation of these regulations could be found during the reign of the Roman Empire. *The Encyclopaedic Dictionary of Roman Law* provides the following definition for the construction of a house (Berger, 1991: 353):

Aedificatio: Building a house. The construction of houses is governed by building regulations (statutes, senatusconsulta, imperial enactments) and is subject to the supervision of magistrates (aediles, censors for public buildings, under the Empire the praefectus urbi and his staff). Among the imperial enactments the building regulation by Emperor Zeno is the most important. The interests of the neighbors are protected by OPERIS NOVI NUNTILATIO, a kind of protestation against a new construction which may be detrimental to the owners of adjacent buildings or lands. On the other hand, the house builder who gives sufficient guaranty is protected by a special interdict no vis fiat aedificanti (= that force should not be used against the builder of a house) against disturbance. Unless special permission is granted, building on public places is prohibited. Demolition of constructions already erected may be enforced by an INTERDICTUM DE LOCIS PUBLICIS.

From the above it is evident that the Roman Empire introduced a hierarchical structure to govern the construction of buildings within the Empire. Emphasis was placed on a larger environment, with specific rights and obligations assigned to neighbouring properties. In addition, the construction process was supervised by a governing authority.

Similar laws that fall within the ambit of building regulations in *The Encyclopaedic Dictionary of Roman Law* are:

- **Ambitus:** Describes the open space between neighbouring houses (Berger, 1991: 360).
- **Lex municipalis tarentina:** A municipal charter that contains provisions about the building regulations, among others (Berger, 1991: 557).
- **Lex lulia de modo aedificiorum:** A building regulation that determines the maximum height of houses and the thickness of walls (Berger, 1991: 554).
- **Lex lula municipalis:** Although Caesar's authorship and the date of the law are debatable, some of the topics dealt with in the *Tabula Heracleensis* are building and traffic regulations (Berger, 1991: 554).
- **Servitus altius non tollendi (sc. aedes):** This "urban servitude imposed on the owner of a building the duty not to build higher over a certain limit. A counterpart was a servitude *ius*

altius tollendi which gave the beneficiary the right to build higher" (Berger, 1991: 703).

- **Servitus ne prospectui officiator:** According to this servitude, the owner of an immovable property has the "right to prevent his neighbour from building a house or planting trees which might impede the beneficiary's pleasant view" (Berger, 1991: 703).
- **Servitus oneris ferendi:** This urban servitude involves the right of a beneficiary to have his building supported by a neighbour's wall. "The latter was bound to keep his wall in good condition" (Berger, 1991: 703).

Cowan (1979: 90) finds that fire damage and structural failure have featured in safety regulations from a very early time, and specific building regulations in this regard in the City of London go back as far as the 12th century.

5. The origin of building regulations in Southern Africa

In 1650 the United East India Company decided to occupy the Cape of Good Hope as a refreshment station, and tasked Governor Jan van Riebeeck to build a fort in Table Bay (Figure 2). Just over two weeks after arriving in 1652, Van Riebeeck (and his party) managed to mount a canon on 3.75 metre-high earthen ramparts. These walls tapered from six metres at ground level to five metres at their highest point (Hartdegen, 1988: 6-7).



Figure 2: Map of the fort erected under the guidance of Jan van Riebeeck
 Source: Castle of Good Hope, 2010: online

Unfortunately, the earth was barely workable and because the “Company instruction did not specify alternative solutions ... the ramparts were a leaky crumbly structure[s]” (Hartdegen, 1988: 7). The imminent failure of the walls required immediate maintenance. Ras (1959: 23) notes that heavy rain caused the collapse of one side of the *Walvis Bastion* and the partial collapse of the curtain walls in August 1654.

The Company instruction above is most probably the first prescriptive specification implemented in Southern Africa. However, the failure of the ramparts of the fort could also be described as the first failure of a prescriptive standard imposed on the South African built environment.

According to the publication *Our Building Heritage* (Hartdegen, 1988: 7), “... much of South Africa’s building heritage rests on a building system derived almost exclusively from mud, stone, shells, reed, thatch and timber, developed and refined by the European pioneers of the seventeenth century”. Hartdegen (1988: 7) also describes the experimentation with various building methods and

materials by a hundred men (*including eight masons*) to construct stores, sheds and living quarters within the fort.

In his diary, Van Riebeeck noted: "Although we have found reeds for thatch, we want people who know how to lay them on, for what has already been done, has been done in such a slovenly and insufficient manner that it must be taken off again" (Hartdegen, 1988: 9).

The third volume of H.B. Thom's translation of Van Riebeeck's diaries includes the following inscription entered on Wednesday, 7 January 1660 (1952: 173):

Line no.

...after mature

deliberation, and in the interests of the Hon. Company and for the security of the said buildings and the goods stored in them, it has been considered essential, and has also been decided that the thatch should be removed from the roofs of all the Company's buildings and replaced by baked tiles. Furthermore it has been decided that we should try and sell the thatch to the free burghers so as to defray the additional costs as far as possible. To this end an agreement has been reached with the free brick and tile maker, Wouter Cornelissen Mostert, who is also the free miller, whereby he shall forthwith make as many tiles for the Hon. Company as are required for the said purpose at a rate of 40 guilders a thousand, counted whole on the roof, each tile being in Rhineland measure, 6 inches wide and 12 inches long. The Hon. Company shall at its own cost convey the tiles by cart or wagon from the oven. And as straight laths must be sawn for such a tiled roof, an agreement has also been made with the free sawyer, Leendert Cornelissen of Seevenhuijsen, to deliver

the required laths (each to be sawn not less than one inch square) at a rate of 13 guilders per hundred foot of plank from which they are cut.

Resolved and affirmed in the fort of Good Hope on the above date.

*(Signed) Jan van Riebeeck,
Roeloff de Man,
Abraham
Gabbema,
Pieter Evrards and
Gijsbert van
Campen (Secretary)*

If the earlier definition of building regulations is applied to the journal entry (Table 2), this inscription could be interpreted as the first official transcribed building regulation for Southern Africa.

Table 2: A comparison of the diary entry by Jan van Riebeeck with the requirements of a building regulation

<i>The first building regulation in Southern Africa</i>		
<i>Definition: building regulation</i>	<i>Selected keywords from the Journal of Jan van Riebeeck: 7 January 1660 (Thom, 1952: 173)</i>	<i>Line no.:</i>
a) a regulating instrument, that	... in the interests of the Hon. Company ...	ii
	... considered essential ...	ii
	... Resolved and affirmed ...	xviii
b) describes a minimum standard, that	... decided that the thatch should be removed from the roofs ...	iv
	... and replaced by baked tiles ...	v
c) should be implemented during the building process (that initiates with design, and continues through construction, maintenance, alteration and repair to demolition of buildings and/or structures), with the aim of	It is implied that the changing of the roofing materials should take place during the alteration/replacement/maintenance phase of the buildings' lifespan	n/a
d) protecting public health and safety during	... security of the said buildings and the goods stored in them ...	ii-iii
e) the construction, occupation and post-occupation phases of	See c	
f) buildings and/or structures.	... all the Company's buildings ...	iv-v

The journal entry proposed a standard in addition to the regulation. When the regulation is further investigated it becomes evident that the specification for the roof tiles and battens follows a performance approach. An agreement is reached with a free burgher to manufacture as many baked tiles as necessary for the purpose of providing a fire-resistant roofing material. A price per 1.000 units (counted per whole tile on the roof) is agreed on, as well as the size of the tiles and the standard of measure (Rhineland)¹.

In a similar agreement with carpenter Seevenhuijsen, he is to provide laths that are cut in straight lengths of a minimum size. The rate of payment is determined per length of timber from which the battens are cut. It could be presumed that the Company was responsible for the supply of the timber and the carpenter was only required to saw it to the correct size, while the actual batten lengths were of less importance.

This building regulation was formulated in accordance with a contextual approach. The danger of fire necessitated the change of a particular roofing material, while cost dictated that an indigenous solution be sought. This regulation was only applicable to certain Company buildings inside the fort, although the settlement continued to expand.

Outside the walls of the fort, in the village of *De Kaap*, the first homes consisted of single-storey rectangular wooden frameworks with wattle-and-daub walls. Where thatch was used as a roofing material, the reeded ceiling was usually smeared over with a coating of clay to form a "... *brandzolder*, or fire ceiling in the event of fire. In later years, thatched roofs were prohibited because of the fire hazard, and a tax of two shillings a month was levied on each chimney" (Hartdegen, 1988: 11).

It could be argued that the risk of fire necessitated the development of the first official building regulations for Southern Africa. In accordance with the arguments presented earlier (see par 4.2), the community and authorities shared an interest, and the introduction of a tax levy on each chimney is possibly the first time that building regulations in the European tradition were enforced locally. Nevertheless, the associated cost of exchanging one roofing material for another remained excessively high, and it was only once the risk grew too great that alternatives were implemented.

1 To accept these terms, Mostert must have had adequate faith in the strength of the fired tiles, their loading and transport from the oven to the buildings, their possible storage, and finally their installation on the roof, because Mostert's involvement in the process after manufacture is not entirely clear.

De Bosdari (1953: 47) indicates that in 1712 the thatched village of De Kaap had grown to 170 private dwellings and this required a form of settlement planning, which is described by Bierman (1955: 13) as follows:

Reeds vroeg in die bestaan van die dorpie in die Tafelvallei gryp die owerheid in om sindelikheid en orde te bewaar. Die Valsrivier kry gemesselde walle en sluise en 'n deftige naam, die Heerengracht; strate wat mekaar reghoekig oorkruis word uitgelê, en die boupersele weerskante raak aan streng bou-ordonnansies onderhewig. Om brand in die rietdak te voorkom, mag die dak nie te na aan die grond sak nie; om brandverspreiding deur die rietdakke te verhoed, mag geboue nie teenmekaar staan nie. Onder dié toestande raak die tradisionele boerehuise uit die Tafelvallei weg – hy trek binneland toe – en sy plek word deur die stadshuis ingeneem, want korte jare na die stigting, is „de Caabse uithoek” reeds 'n stad.²

According to Bierman (1955: 34-35), traders in the Kaap often built double-storey houses, with the bottom storey used to store products, and the living quarters situated above. Frequent conflagrations resulted in the abandonment of thatch after the 1717 instruction by the Council of Policy (De Bosdari, 1953: 47). Within the built-up area, flat roofs were proposed as an alternative. However, the resulting problem of water tightness was difficult to overcome.

The Council of Seventeen of the United East India Company issued the following recommendation on how to construct a new flat roof (Hartlegen, 1988: 11):

The walls of the building being finished and the beams laid thereon, laths or ribs are to be laid upon them, each three or four inches, the broadest (sic) side resting on the beams. No planks are to be used; otherwise the defects of the roof will not be visible from below. Over these ribs, grey or other burnt bricks which are made here, eight by four inches, are laid with the heads meeting each other on the laths. The floor having been thus laid, the builder is to take four parts of stamped lime shells taken out of the oven (kiln) and two parts

2 Very early on in the existence of the Table Valley village, the authorities stepped in to preserve cleanliness and order. The Vals River received built embankments and sluices, and a dignified name, the Heerengracht; streets that intersected at right angles were laid out, and the adjacent building sites became subject to strict building regulations. To prevent fire in the thatched roofs, they were not to descend too close to the ground; to prevent fire spreading through the thatched roofs; buildings were not allowed to stand too close to each other. Under these circumstances the traditional farmhouse of the Table Valley disappeared – it migrated inland – and its place was taken by the townhouse, because a few short years after its establishment, the remote Cape hamlet had already become a town (Translated by author, 2011).

ordinary mason lime and two parts finely powdered bricks. All these materials are to be well mixed whilst dry, and gradually cocoa-nut oil is to be thrown until the whole is thoroughly prepared like dough. It is then at once to be laid on one and a half inches thick, and rubbed in with the trowel and steadily beaten together as much as possible with wooden mallets. The mallets are not to be too heavy and the beating must be gentle or moderate lest the bricks are broken. Whilst busy with this, the second layer is to be prepared, viz, ten parts finely sifted lime, three parts finely sifted gravel of baked bricks and one part of Bengal Gor or sediment of sugar (draf zucker = molasses). This composition is to be treated in the same way as the first and to be put on when ready, about one inch thick, and carefully beaten down on the other layer. Finally a liquid composed of lime, oil and Gor is made with a strong hand and a smooth trowel well rubbed on the last coat.

In 1736, five houses were gutted by a fire fanned by a Southeaster. One of the houses was rebuilt with a flat roof, and "... many other people followed ... [t]his example ... At the beginning of the 18th century Cape Town was a thatched village: by the end of it, the fear of fire has changed it into a flat-roofed town" (De Bosdari, 1953: 47).

The establishment of a settlement and its associated growth necessitated the development of some form of regulation. The various municipalities performed this regulatory function and individually developed their own sets of municipal by-laws that addressed the built environment, among others. Holden (2006: [1]) states that "... every town council in South Africa had its own set of building by-laws, many of which were archaic and convoluted". According to Watermeyer (2007: 26), the 19th-century lawmakers developed building laws to ensure proper sanitation and to diminish possible conflagrations, while 20th-century lawmakers "developed minimum standards for the construction and maintenance of buildings, designed to protect public health, safety and general welfare".

6. Conclusion

This article determines the origin of building regulations for Southern Africa by revisiting the diary of Jan van Riebeeck. Unfortunately, the diary documents the first failure of a performance specification in Southern Africa. Comparing the entry dated 7 January 1660 with a contemporary definition of a building regulation highlights the relevance of regulatory requirements in the built environment and alludes to the limited changes of these constraints over the years.

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