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A critical review of the effectiveness of the Department of Labour (DoL) Occupational Health and Safety (OH&S) Inspectorate in relation to the construction industry in South Africa

Peer reviewed

Abstract

Irrespective of all the efforts made by the Department of Labour (DoL) and other relevant stakeholders to improve construction occupational health and safety (OH&S) performance, there is still a very high level of accidents and fatalities in South Africa. Injuries and accidents to workers help no community in any nation. The construction industry in South Africa is generally known to be one of the most hazardous and has one of the most dismal OH&S records among all industrial segments with an unacceptably high level of injuries and fatalities resulting in considerable human suffering. A doctoral study was recently conducted with the aim of investigating the effectiveness and performance of the DoL OH&S Inspectorate in South Africa. Information was sought and obtained from various respondents including civil and building contractors, OH&S consultants, project managers, DoL inspectors, and designers by means of questionnaires.

The research identifies interventions which could contribute to a significant reduction in the number of accidents, which in turn is likely to result in: a reduction in the cost of accidents (CoA); a reduction in the cost of workers' compensation insurance; alleviation of fatalities, injuries, pain and suffering, and a reduction in the indirect CoA to society and the national health care system.

The salient findings of the study are presented and elucidate that the DoL OH&S Inspectorate is not effective in terms of OH&S relative to the construction industry in South Africa. Conclusions and recommendations included reinforce the need for a reviewed OH&S Inspectorate model framework. The structured normative model consists of fundamental elements which guide to improve the effectiveness of the DoL OH&S Inspectorate. The findings of the study with recommendations are included.

Keywords: Effectiveness, Occupational health and safety, Inspectorate

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Abstrak

Ten spyte van die Departement van Arbeid en ander betrokke rolspelers se pogings om die prestasie van die Beroepsgesondheid en Veiligheid in die konstruksiebedryf te verbeter is daar nogsteeds 'n baie hoë vlak van ongelukke en sterftes in Suid-Afrika. Beserings en ongelukke van werkers het 'n baie negatiewe uitwerking op die gemeenskap en die samelewing. Die konstruksiebedryf in Suid-Afrika is oor die algemeen bekend as een van die mees gevaarlike en het een van die powerste rekords onder al die nywerheidssegmente met 'n onaanvaarbare hoë vlak van ongelukke en sterftes wat lei tot geweldige menslike leiding. 'n Doktorale studie is onlangs uitgevoer met die doel om die doeltreffendheid en prestasie van die Departement van Arbeid se Beroepsgesondheid en Veiligheidsinspektoraat in Suid-Afrika te ondersoek. Inligting is deur middel van vraelyste van verskeie respondente verkry. Hierdie respondente sluit in siviele en boukontrakteurs, Beroepsgesondheid en Veiligheidskonsultante, projekbestuurders, inspekteurs en ontwerpers van die Departement van Arbeid.

Die navorsing identifiseer intervensies wat kan bydra tot 'n betekenisvolle afname in die aantal ongelukke. Dienooreenkomstige beteken dit ook 'n afname in die koste wat ongelukke meebring, vergoeding wat werkers vir ongelukke eis, verligting van sterftes, beserings, pyn en lyding en die indirekte koste van ongelukke vir die gemeenskap en die nasionale gesondheidsorgstelsel.

Die belangrikste bevindings van die studie wat uitgelig en waarop uitgebrei word, is dat die die Departement van Arbeid se Beroepsgesondheid en Veiligheid in die konstruksiebedryf nie doeltreffend is nie. Gevolgtrekkings en aanbevelings beklemtoon die behoefte aan 'n hersiene Beroepsgesondheid en Veiligheidsinspektoraat raamwerk model. Die gestruktureerde normatiewe model bestaan uit fundamentele elemente wat kan lei tot die verhoging van die doeltreffendheid van die Beroepsgesondheid en Veiligheidsinspektoraat van die Departement van Arbeid.

Sleutelwoorde: Effektiviteit, beroepsgesondheid en veiligheid, inspektoraat

1. Introduction

The construction industry in South Africa is generally known to be one of the most hazardous with an unacceptably high level of injuries and fatalities resulting in considerable human suffering. From general statistics released throughout the world and also from past historical perspectives it is clear that OH&S has always been problematic (Hinze, 1997). Comparisons have often been made between the construction industry and other industrial sectors. When examining the nature of construction, the work is often performed under the most arduous and extreme climatic conditions. The terrain is generally not favourable to the safe movement of people, materials, and machines.

Smallwood (2000 citing Griffith 1995; Chan & Chan 1996; Hinze 1997) refers to the uniqueness of the construction industry when motivating commitment to OH&S. The authors further state that although many characteristics which result in the uniqueness of the construction

industry may be found in other industries, the characteristics collectively constitute a challenge in terms of construction OH&S.

According to Strydom (2002) the South African construction industry in 2001 was regarded by the DoL as one of the worst OH&S performers in terms of injuries and fatalities and was ranked after industries such as fishing, transport, forestry, textiles, and mining. Over the years the construction industry has consistently been among those industries with high injury and fatality rates (DoL, 2000). Reducing occupational diseases and accidents would not only improve and save people's lives, but it would reduce the hundreds of millions of Rand paid annually to victims of work related accidents and relieve the pressure placed on the country's monetary situation.

2. Review of the literature

2.1 OH&S Statistics

Attention and awareness to OH&S in the construction industry has increased in South Africa over the past decades. Although construction work has become healthier and safer over the years, there is still much to be accomplished. When recent statistics published by the DoL are analysed, it is notable that a considerable number of fatalities still occur each year in the construction sector. The construction sector has a high number of fatalities compared to other sectors of industry.

Statistics released by the DoL indicate that in 1997, of the 6 267 work related accidents, 509 (8.1%) were in the construction sector, while of the 7 028 accidents in 1998, 675 (9.6%) were in this sector. Further statistics released show that of the 482 deaths in 1997, 74 (15.3%) were in construction and of the 584 deaths in 1998, 76 (13.0%) were construction related. This indicates a marginal decrease of 2.3%. In 1997 deaths increased 4% on the previous year. By comparison, according to the DoL Annual Report (2001), of the 337 incidents that have taken place, 68 (20.1%) fatalities occurred in the construction sector. This shows a decrease of 10.5% on 1998 figures. Statistics released by the DoL indicate that in 2000, 337 work related incidents occurred in the construction sector. Further statistics released show that in 2000 there were 68 deaths. This indicates an increase of 9.1% on the previous year.

Statistics released by the Federal Employers Mutual Assurance (FEMA) indicate that fatalities caused by motor vehicle accidents during the course of employment are also noticeably high. The

claims registered and finalised by FEMA, for the period January 2001 to December 2001, a total of 47 fatalities are recorded with an incumbent cost of claims totalling R4,230,291.38. In comparison, the period January 2002 to December 2002, indicates a total of 43 fatalities, with an incumbent cost of claims totalling R7,904,816.21. This represents a 53% increase in the total cost of claims paid out compared to the previous year. The period January 2004 to September 2004, indicates a total of 42 fatalities, with a total value of claims paid totalling R20,498,431.39. This is a substantial increase of 38% relative to 2002.

On the contrary to the background presented Szana (2007) states that the DoL conducted numerous inspections, highlighting consolidated statistics for March 2007, and from recent 'blitz' inspections:

- 923 construction sites were visited;
- 1 273 employers were visited — principal and other contractors;
- 604 employers were compliant (47.4%);
- 669 employers were non-compliant (52.6%); and
- 962 notices were served: 41 (4.3%) improvement, 766 (79.6%) contravention, and 155 (16.1%) prohibition.

According to Szana (2007) during national 'blitz' inspections conducted in March and April 2007, a total of 374 inspectors inspected 1,909 workplaces, of which 975 (51%) were compliant, and 815 (42.6%) were non-compliant. 255 (17.5%) improvement, 1,028 (70.6%) contravention and 172 (11.8%) prohibition notices were issued - a total of 1,455.

According to Szana (2007) during national 'blitz' inspections conducted in August 2007 on construction organizations, a total of 441 inspectors visited 1,415 workplaces, of which 759 (53.6%) were compliant, and 829 (58.6%) were non-compliant. 86 (6.2%) improvement, 1,015 (73.1%) contravention, and 287 (20.7%) prohibition notices were issued - a total of 1 388.

According to Strydom (2002) a major contributing factor to the poor record of the construction industry is the scarcity of OH&S inspectorate expertise. There is but a small band of OH&S inspectorate personnel employed, as well as a scarcity of OH&S practitioners and consultants active in the construction industry due to the low priority that employers place on OH&S, as well as the poor remuneration offered as a consequence of this.

Strydom (2002) further states, that for a variety of reasons, the DoL is experiencing a serious staff shortage, high turnover of staff, and a lack of experienced skilled staff. This has led to a situation where employers no longer believe that the DoL has any 'teeth' and consequently OH&S in the workplace is suffering. The current vacancy rate is 47.8%. Within this context, it appears that the DoL inspectorate is understaffed and not carrying out its duties effectively with regards to OH&S in the construction industry. It is therefore important and urgent that this matter be addressed.

According to Makhonge (2005) the challenges facing the inspection system in Kenya is that the traditional approach which has been practiced for a long period of time results in the occupier of a factory / construction site primarily waiting for a government inspector to inspect and point out a contravention of the law, on occasions requiring that the occupier be taken to court before any tangible improvements are made. If no inspector visits the factory, the workplace OH&S improvements implemented by the employer are usually very basic.

Relative to the United States of America (USA), the USA's DoL Annual report states that the construction industry did not meet its goal of reducing injuries and deaths (Agnvall, 2001). The DoL's goal was to decrease fatalities in the construction industry by 3%, however, the fatality rate declined only 2% from the 1993 - 1995 base line. During that three year period, the fatality rate was 14.5 per 100 000 workers, and subsequently the rate reduced marginally to 14.2 per 100,000 workers during the period 1996 - 1999.

Based on the OH&S statistics presented, it can be concluded that there is a high injury and fatality rate in the construction industry, compared to other sectors of industry in the majority of countries. However, in general, South African statistics tend to be higher than those of other countries globally. This phenomenon remains a concern for South Africa.

2.2 OH&S Management

The OH&S of the human being at work on site or in any working environment is a complex problem. It is the subject of many conventions, inquiries, reports, legislation, regulations and volumes of literature. Various authors such as Hinze (1997), Rowlinson (1997) and Levitt & Samelson (1993) argue that OH&S is a corporate responsibility, which demands the skills of OH&S managers, and that those responsible for OH&S within the workplace must provide input to all

operations. It appears that in the present corporate environment, the performance of any organisation is measured by its management of resources and the main objectives of management appears to be, to increase productivity, and reduce costs to the detriment of the OH&S of its workforce. The question is thus asked: Is this indirect neglect having a negative effect on the OH&S of the workforce? Furthermore, to what extent does and can the OH&S Inspectorate influence management commitment and induce the realisation that H&S complements the other parameters such as cost, quality, and time.

2.3 Behavioural issues

Attention to OH&S in the construction industry has increased dramatically over the past decades. Hinze (1997) states that the time for OH&S awareness has arrived and that OH&S is no luxury, it is a necessity. According to Smallwood (1995), OH&S education is important for both management and workers as incidents and accidents occur downstream of culture, management system and exposure. However, culture and management system in turn, are both influenced by OH&S education and that a lack of education can in turn have an effect on behaviour.

2.4 Phase OH&S Intervention in sequence

Hinze (1997: 201) maintains that "Working on a project without establishing a strong safety culture, is like holding a dead man's hand," and that support for OH&S must begin at top management level. This requires that the CEO must be committed to enhancing the organisation's OH&S efforts wherever possible.

Hinze (1997) further states that the OH&S culture on a project is solid when OH&S is foremost in the minds of all project and organisation personnel, beginning at worker level and proceeding all the way to top management. An OH&S culture should be based on the conviction that no worker should ever be placed in a situation in which an injury has a high probability of occurring. This however would be the reward, but is this being implemented and is the DoL Inspectorate executing its duties effectively to assure that workers are not being placed in unhealthy and unsafe situations?

2.5 The importance of culture

Smallwood (2000: 70) defines culture as:

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the learned behaviours as well as the beliefs, attitudes, values and ideals that are characteristic of a part of society or population.

This analogy best postulates the relationship between management commitment, education and training and their influence on the occurrence of incidents. Culture in turn is collectively comprised of values, purpose, vision, goals, mission and, assumptions.

Table 1: Incidents are downstream

<i>Culture</i> →	<i>Management System</i> →	<i>Exposure</i> →	<i>End Point</i>
Purpose	Education / Training	Behaviour	Incidents
Mission	Practices	Conditions	
Values	Programme	Plant & equipment	
Vision	Site layout	Facilities	
Goals	Behavioural consequences		
Assumptions	Accountability		
	Inspections		
	Priorities		
	Attitude		
	Measurement system		
	Improvement model		
	Resources		
	Investigations		

Source: Krause, 1993: 40

In the case of statistically based quality improvement, management does not look at product defects namely, downstream factors, but at upstream factors of production, which are predictive of defects. In terms of the behaviour-based accident prevention process, accident frequency rates represent downstream indicators. Accident prevention relies instead on sampling the mass of OH&S related behaviours which lie upstream and which precede any particular incident.

Table 1 illustrates the upstream → downstream sequence postulated by Krause (1993) - culture at the upstream end influences management system, which influences exposure, which may or may not result in incidents at the end point. In the case of statistically based quality improvement, management does not look at product defects i.e. downstream factors but at upstream factors of production which are predictive of defects. In terms of the behaviour based accident prevention process, accident frequency rates represent downstream indicators.

It is also notable that 'inspections', an important function of the DoL Inspectorate is positioned as a management system and is categorised as downstream. In terms of Krause's model, the DoL Inspectors intervene at 'Exposure' stage when conducting inspections in addition to 'Management system' stage. They also intervene after an accident has taken place relative to the 'End point'.

2.6 Legislation

In South Africa, the OH&S Act No. 85 of 1993 constitutes the basis of OH&S legislation, with which all organisations have to abide. The management of an organisation is therefore legally required by law to enforce OH&S to ensure that their workers are not injured. It is also stated in the Act that the DoL Inspectorate has certain powers relative to the enforcing of legislation. Is this being carried out? As a requirement of success, management should also commit themselves to OH&S, which in the long term is beneficial to both the organisation and its workers. Are the various regional inspectorates sufficiently staffed to be effective in policing OH&S? In addition the new Construction Regulations were promulgated on the 18 July 2003 under section 43 of the OH&S Act, after consultation with the Advisory Council for OH&S. The intention of the promulgation of the new regulations is to have a set of legislation specifically directed at and applicable to the construction industry.

In summation, managers with an OH&S responsibility have a key role in their organisations for ensuring that appropriate OH&S systems are in force and that they comply with the law and statutory regulations. Their role is to see that both the general policy and strategic decisions relating to OH&S are in place. Failure to comply is likely to result in prosecution of the said organisations and in certain circumstances the responsible person can be held personally criminally liable and face civil proceedings. In practice, this should be the task of the DoL Inspectorate. However, is the DoL Inspectorate effectively conducting its duties?

2.7 The Role of the DoL Inspectorate

According to a media statement released on the 8 April 2002 by the DoL, labour and business signed an historical accord jointly committing to prioritise the promotion of OH&S in the workplace. The DoL has established a fifteen-point programme of action and is committed to addressing the respective interrelated challenges within a period of five years. Point eight of this programme specifically aims to adequately deal with the negative consequences of occupational

accidents and ill health of individuals, enterprises of the state and to accelerate measures aimed at reducing accidents and improving the OH&S of workers (DoL, 2000).

According to the statement, the Chief Directorate consolidated working relationships to ensure cooperative governance with other departments. In doing so, the result was that during the year 2000, 5,950 incidents and 493 fatalities were investigated and finalised. Notices served on employers, included 6,970 contraventions of the regulations and 649 contraventions of the Act.

During the year 2000, 10,060 inspections were conducted thus exceeding the 6,408 targeted for the year. A total of 1,887 incidents and 636 complaints were also registered with the DoL (DoL, 2001).

The report further states that during 2000, the DoL currently employed 82 inspectors with OH&S qualifications. However, mention is also made that the DoL inspectorate operated with a shortage of inspectors with OH&S competencies and that the vacancy rate was 47.8%. Reasons for the vacancy rate include a lack of experience in the engineering disciplines, affirmative action and the poor remuneration being offered by the DoL.

3. Methodology

The methodology adopted in this study is the descriptive method, which entails the technique of observation (Leedy, 1993). Quantitative methods and observation over a period of 3 years included the use of questionnaires.

The research project was conducted in six phases. The pilot survey constituted Phase 1, conducted among general contractors (GCs) in the Eastern Cape, followed by Phase 2 in the form of the empirical survey conducted among GCs, members of the Master Builders South Africa (MBSA), and the South African Federation of Civil Engineering Contractors (SAFCEC).

Phase 3 to 6 entailed the surveying of OH&S officers, practitioners, and consultants, construction members of the Association of Construction Project Managers (ACPM), DoL Inspectors, both currently employed and retired, and designers in the form of member practices of the South African Institute of Architects (SAIA) and the South African Association of Consulting Engineers (SAACE), and members of the South African Institution of Civil Engineers (SAICE).

3.1 Phase 1 (Pilot Study)

The population for the pilot study comprised of general contractors, respondents from the Eastern Cape, Border and Southern Cape regions who are members of the MBSA. A total of 164 questionnaires were mailed / faxed to the contractors in the demographic region of the Eastern Cape, comprising of the Nelson Mandela Metropolitan area, Border and the Southern Cape regions in July 2004. Only 19 contractor responses were received resulting in a response rate of 12.0% ($19 / 164 - 5$). In contrast, 17 responses were received in response to a total of 22 questionnaires that were mailed / faxed to OH&S consultants, designers, project managers, Safety, Health and Environment (SHE) officers, engineers, insurers, and quantity surveyors, which equates to a response rate of 77%.

3.2 Phase 2

The Phase 2 survey was conducted among GC members of the MBSA and SAFCEC - a total of 626 (503 and 123) questionnaires were mailed / faxed to building and civil engineering GCs in the nine provinces of South Africa. A total of 107 (84 and 23) questionnaires were received, which equates to an overall response rate of 18.0% ($107 / 626 - 19 + 3 + 1$).

3.3 Phase 3

During Phase 3, engineers, OH&S consultants in two categories, namely, construction OH&S consultants and generic OH&S consultants, insurers, Quantity Surveyors and Safety Health and Environment (SHE) were surveyed - a total of 236 questionnaires were mailed / faxed to OH&S consultants in the nine provinces of South Africa. A total of 55 questionnaires were received, which equates to an overall response rate of 23.0% ($55 / 236 + 5 + 3 + 1$).

3.4 Phase 4

Phase 4 addressed Project Managers, in the form of members of the ACPM in South Africa. A total of 101 questionnaires were mailed to them in the nine provinces of South Africa per e-mail and via the postal service. A total of 14 questionnaires were received, which equates to a response rate of 13.8% ($14 / 101 + 3 + 5 + 1 + 1$).

3.5 Phase 5

During Phase 5 Inspectors currently employed by the DoL Inspectorate in South Africa were surveyed. A total of 113 questionnaires were mailed via the postal service to the Inspectorate in the nine provinces of South Africa. It is notable that 8 inspectors responded indicating that they were not allowed to complete the questionnaire until permission / approval was granted by their respective district manager. A total of 22 questionnaires were received, which equates to a net response rate of 19.4% (22 / 113).

3.6 Phase 6

During Phase 6, randomly selected designers in the form of 248 Architects registered with the South African Institute of Architects (SAIA), and 167 and 179 Consulting Engineers registered with the South African Institution of Civil Engineers (SAICE), and the South African Association of Consulting Engineers (SAACE) respectively, were surveyed nationally - a total of 594. A total of 79 questionnaires were received from 19 Architects, 55 Consulting Engineers, and 5 'Others', which equates to an overall response rate of 13.2%.

4. The findings

Despite the promulgation and implications of the Construction Regulations, it is notable that only 10 of the inspectors (7.6%) have attended courses, which implies that 9 inspectors appear to have no knowledge thereof. It is also notable that the highest number of courses attended by the inspectors is relative to scaffolding (9.9%), and the OH&S legislation (9.9%) respectively (Table 2).

Table 2: Courses completed by DoL Inspectors

Course	Response	
	No.	%
Scaffolding	13	9.9
Excavations	3	2.2
OH&S Representative	8	6.1
Hazardous biological agents regulations	8	6.1
Diving regulations	4	3.0
Major hazardous installation regulations	8	6.1
Explosives regulations	2	1.5
Construction regulations	10	7.6
Asbestos regulations	6	4.5
Environmental regulations	6	4.5

Facilities regulations	6	4.5
Lead regulations	6	4.5
Noise-induced hearing loss regulations	6	4.5
Driven machinery regulations	5	3.8
General machinery regulations	5	3.8
OH&S legislation	13	9.9
International Labour Office (ILO)	7	5.3
SAMTRAC	6	4.5
ASTRAC	0	0.0
COIDA	9	6.8

Table 3 indicates the number of year's construction experience which the responding inspectors possess. It is notable that 13.6% of the inspectors have less than one year of construction experience, and 27.3% have only 1 year of construction experience. Therefore, 40.8% effectively have one year or less of construction experience. Furthermore, 27.3% indicated 5 years experience and only 9.1% had more than 10 years of construction experience.

Table 3: Total number of years of construction experience

Category (years)	Years (%)
<1	3.6
1	7.2
3	9.0
4	4.5
5	27.2
6	9.0
>10	9.0

4.1 Inspections

The finding indicates that 38.8% of the respondents agree that there was no increase in the number of inspections by the DoL Inspectorate (Figure 1). In contrast 27.7% believe to the contrary.

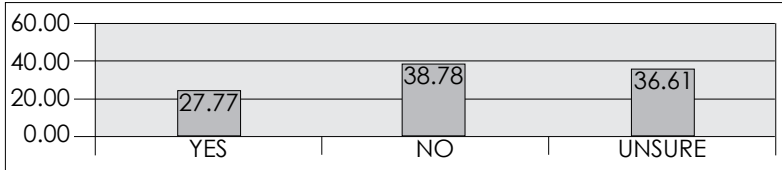


Figure 1: Percentage increase in number of inspections

Furthermore, given the 36.8% negative response, construction sites can be deemed to have not been subjected to an increase in 'blitz' inspections (Figure 2). 29% responded positively. However, in terms of industry sector, 51.2% of building and 73.9% of civil engineering contractor respondents agree that there was a minimal increase in 'blitz' inspections. It is notable that 32.5% of the respondents responded 'Unsure'.

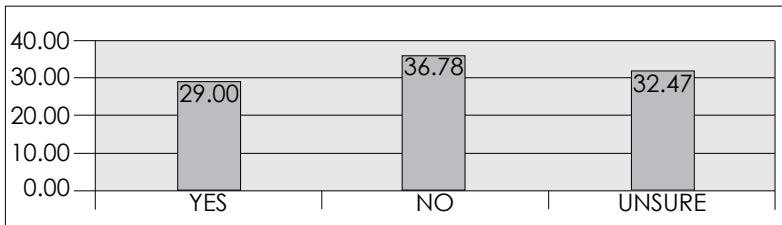


Figure 2: Percentage increase in number of 'blitz' inspections

4.2 Mean Scores as a measure of Central Tendency

Fifteen aspects forming the nucleus of the study are presented. The mean scores, which are a measure of central tendency, are based upon percentage responses to a five point Likert type scale originate from the stakeholders surveyed during the six phases of the study. However, in some instances, certain mean scores of a particular stakeholder group may not be presented due to them not having been actively involved in a certain activity.

In order to facilitate the interpretation of the findings, Table 4 provides a summary of the performance of the OH&S Inspectorate in terms of mean scores ranging between 1.00 and 5.00, based upon percentage responses to a scale of 1 to 5. The overall mean score is presented in the extreme right hand column of the table. The overall percentages are also shown in histogram format.

4.2.1 Aspect 1

Given that the overall mean score of 2.80 for all phases is < 3.00, in general the DoL can be deemed to be ineffective in terms of conducting their duties. It is notable that only the Inspectors (Phase 5) can be deemed to perceive the DoL Inspectorate to be effective.

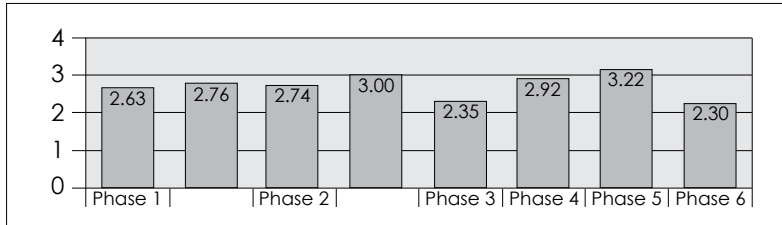


Figure 3: Effectiveness of the DoL Inspectorate in terms of conducting their duties

	Aspect	Rating of the DoL Inspectorate relative to various aspects (MS)								Mean score
		Pilot study (Phase 1)		Contractors (Phase 2)		Consultants (Phase 3)	Project Managers (Phase 4)	Inspectors (Phase 5)	Designers (Phase 6)	
		Bldg.	Cons.	Bldg.	Civil	Cons.	Pm.	Insp.	Design	
1.	Effectiveness of DoL Inspectorate in terms of conducting their duties	2.63	2.76	2.74	3.00	2.35	2.92	3.22	2.30	2.74
2.	Competence of DoL in terms of construction knowledge and skills	2.78	2.76	2.74	3.00	2.51	3.07	3.04	*	2.46
3.	Frequency of DoL Inspectors visiting sites	1.94	*	2.42	2.43	*	*	*	*	2.26
4.	Effectiveness of DoL Inspectors conducting 'blitz' inspections	*	3.12	*	2.63	*	*	3.45	*	3.06
5.	Appropriateness of the checklists used by the DoL Inspectorate during inspections	2.83	3.12	3.16	2.95	3.11	*	3.63	*	3.13
6.	Performance of DoL Inspectorate in terms of liaison and promotion	2.50	2.68	2.75	2.66	2.21	*	2.90	*	2.61

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7.	Prevailing culture of DoL Inspectorate in terms of morale, motivation and satisfaction	2.50	2.81	2.95	2.60	2.40	*	2.36	*	2.60
8.	Support for the current framework of the DoL Inspectorate	3.10	2.68	3.32	3.50	2.72	3.50	3.40	3.33	3.19
9.	Effectiveness of the DoL Inspectorate in terms of enforcing legislation	2.73	2.35	3.02	2.61	2.47	2.78	3.09	*	2.72
10.	Support for DoL accreditation system based on contractors OH&S performance	3.73	3.82	3.77	3.72	3.53	4.07	3.45		3.71
11.	Support for the implementation of an incentive scheme which recognises a reduction in OH&S injuries and fatalities	3.94	4.23	4.17	4.21	4.24	4.46	4.00		4.14
12.	DoL Inspectorate contribution to improvement in organisations' OH&S performance	2.22	3.00	2.35	2.13	2.29	3.00	3.54		2.64
13.	Rating of South African OH&S legislation relative to 'best practice'	3.00	2.76	3.01	2.90	2.94	2.78	2.68		2.86
14.	Effectiveness of DoL Inspectorate in terms of assuring OH&S	*	*	2.66	2.56	*	2.84	3.22		2.75
15.	Significance of DoL Inspectorate relative to accident prevention in construction	*	*	2.93	2.60	2.64	2.76	3.68		2.90

Table 4: Mean scores of general tendency obtained from various aspects of the questionnaires

4.2.2 Aspect 2

Given that the overall mean score of 2.46 for all phases is < 3.00, in general the DoL Inspectorate can be deemed to be not competent in terms of construction knowledge and skills (Figure 4). The marginally elevated score of both the Project Managers 3.07 and the Inspectors 3.04 possibly indicates that the respondents do not have, or seldom have personal contact with the DoL Inspectorate and are not aware of the *status quo* with respect to the competency of the Inspectors.

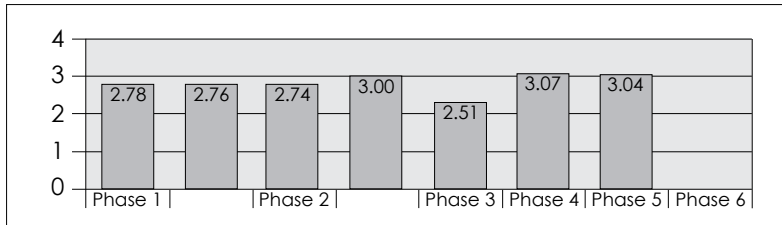


Figure 4: Competence of the DoL in terms of construction knowledge and skills

4.2.3 Aspect 3

Figure 5 indicates that the respondent sample strata consisted of only the building and civil engineering contractors. The consultants, project managers, inspectors, and designers do not generally have contact or record of visits to sites, and were therefore not asked to respond to this question.

All the mean scores are < 3.00, which indicates that construction sites can be deemed to not have been subjected to DoL Inspectors' visits.

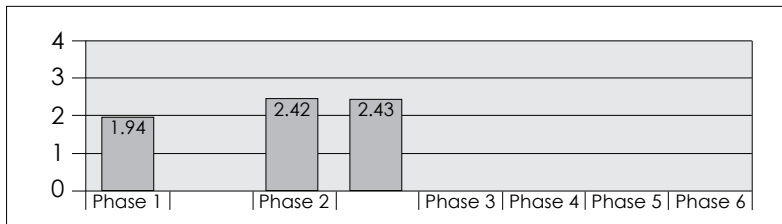


Figure 5: Frequency of DoL Inspectors visiting sites

4.2.4 Aspect 4

Given that 66.7% of the mean scores, are > 3.00, in general the effectiveness of the DoL Inspectorate in conducting 'blitz' inspections can be deemed to be more effective than ineffective (Figure 6). The consultants and project managers have no direct contact and record and therefore the question was not included. The respondents namely, the building and civil contractors agree that the DoL Inspectors were not effective in conducting 'blitz' inspections. However, it is notable that the consultants surveyed during the pilot study, and the Inspectors disagree with the aforementioned declaration, manifested in the elevated mean score > 3.00. In general 60.0% of

the building and civil engineering GCs agree that sites were subjected to 'blitz' inspections.

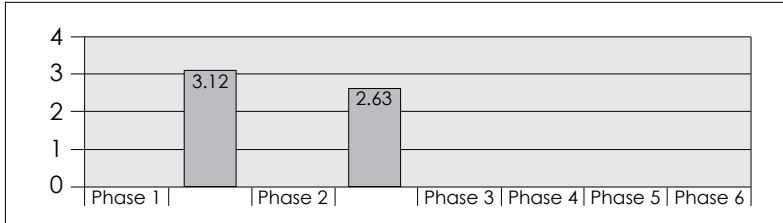


Figure 6: Effectiveness of the DoL Inspectors conducting 'blitz' inspections

4.2.5 Aspect 5

The majority of the responding sample strata mean scores indicate that the checklists used during inspections can be deemed to be appropriate rather than inappropriate. However, this is marginally so. Furthermore, it is notable that the building contractors responding to the pilot study conducted in the Eastern Cape (2.83) and the civil engineering contractors nationally (2.95), do not concur. The standardisation of the checklists in the various areas is therefore questioned. Are all checklists used by the DoL inspectorate comparable?

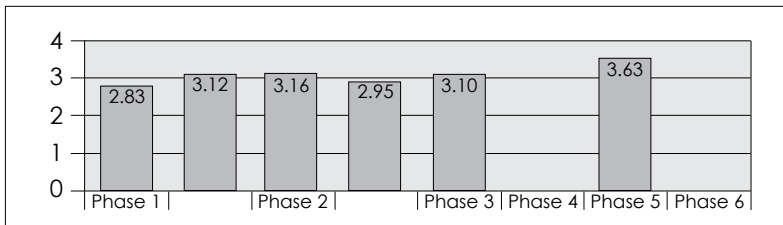


Figure 7: Appropriateness of the checklists used by the DoL Inspectorate during inspections

4.2.6 Aspect 6

The sample stratum consisted of building and civil engineering contractors, and inspectors. The project managers were not asked this question as they do not have direct personal contact with the DoL Inspectorate and are not aware of the *status quo* with respect to the liaison and promotion of the DoL Inspectorate. Given that the mean scores are < 3.00 relative to all sectors, including the Inspectors, the DoL Inspectorate can be rated poor rather than good in terms of liaison and promotion (Figure 8).

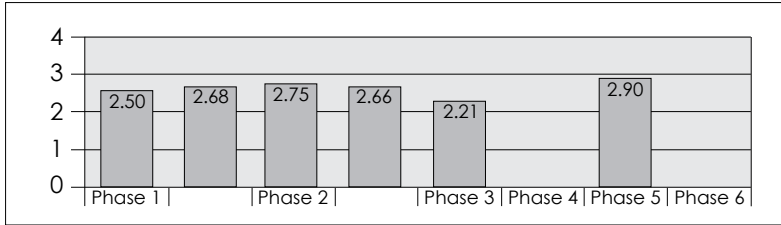


Figure 8: DoL Inspectorate in terms of liaison and promotion

4.2.7 Aspect 7

Given that all the mean scores are < 3.00, all sectors can be deemed to perceive the culture of the DoL Inspectorate in terms of morale, motivation, and satisfaction to be poor rather than good (Figure 9). The level of 'unsure' responses indicate that respondents do not have, or seldom have personal contact with the DoL Inspectorate, and are not aware of the present situation with respect to morale, motivation, and satisfaction. It is notable that the Inspectors who are employed by the DoL Inspectorate (phase 5) can also be deemed to perceive the culture to be poor rather than good.

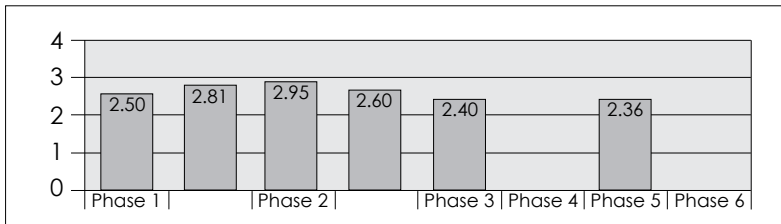


Figure 9: Prevailing culture of DoL Inspectorate in terms of morale, motivation, and satisfaction

4.2.8 Aspect 8

Figure 10 indicates that with the exception of the consultants, there is support for the current framework of the DoL Inspectorate. The overall mean score of 3.19 (Table 4) indicates that the stakeholders view the current framework to be effectual and supported rather than opposed. From the responses received it can be argued that not all the stakeholders are aware of the components of the current framework.

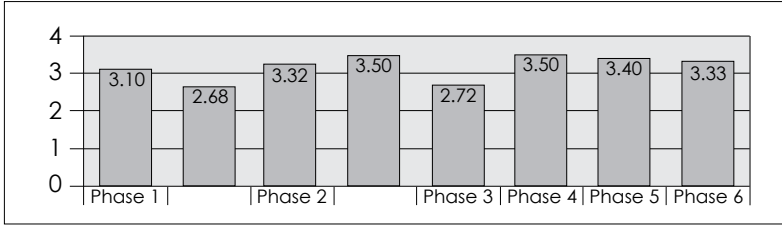


Figure 10: Support for the current framework of the DoL Inspectorate

4.2.9 Aspect 9

With the exception of the mean scores relative to building contractors (3.02) and inspectors (3.09) which are marginally > 3.00, the majority of the mean scores indicate that the DoL Inspectorate is not effective in enforcing legislation. The mean of 2.72 as shown in the rating of Figure 11 indicates that the consultants, civil engineering contractors and project managers contend that prescribed legislation is not being enforced.

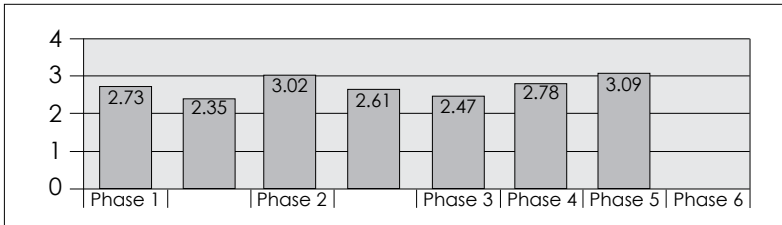


Figure 11: Effectiveness of the DoL Inspectorate in terms of enforcing legislation

4.2.10 Aspect 10

The mean scores presented in Figure 12 indicate overwhelming support for an accreditation system based on OH&S performance. It appears that such a system is welcomed by all respondents / stakeholders / contractors, which system could have a positive effect in terms of reducing fatalities and injuries. This is supported by an overall mean score of 3.72. Furthermore, it is notable that the inspectors' mean score is also > 3.00 and thus can be deemed to support an accreditation system.

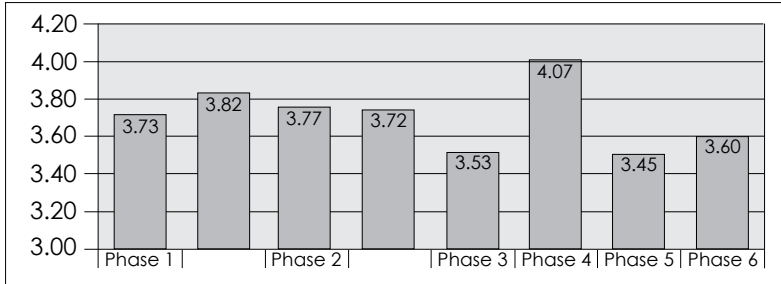


Figure 12: Support for DoL accreditation system based on contractors' OH&S performance

4.2.11 Aspect 11

The mean scores presented in Figure 13 clearly indicate support for the implementation of an incentive scheme that recognises a reduction in fatalities and injuries. All stakeholders surveyed support such an initiative.

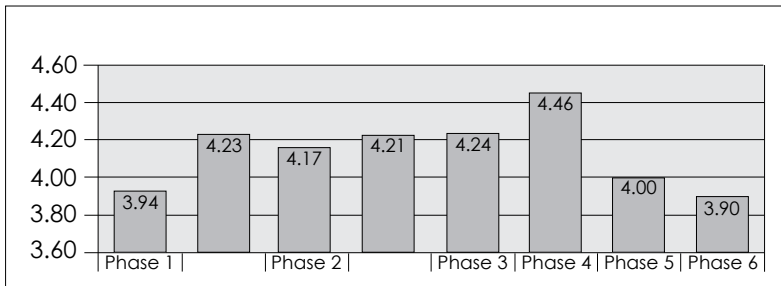


Figure 13: Support for the implementation of an incentive scheme which recognises a reduction in OH&S injuries and fatalities

4.2.12 Aspect 12

Given that the majority of the mean scores ≤ 3.00 , the DoL Inspectorate can be deemed to have not contributed to an improvement in organisations' OH&S performance. With the exception of the consultants, project managers, and DoL Inspectors, the contribution is perceived to be low.

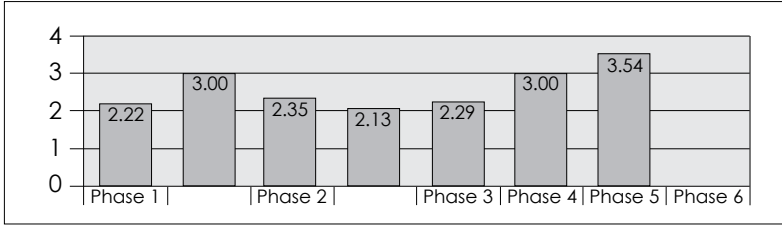


Figure 14: DoL Inspectorate contribution to improvement in organisations' OH&S performance

4.2.13 Aspect 13

Given that with the exception of one mean score, all mean scores are ≤ 3.00 , which indicates that South African OH&S legislation cannot be deemed to be perceived to be equal to 'best practice' (Figure 15). It is notable that the mean scores range from 2.68 to 3.01 – there is congruence in terms of perception.

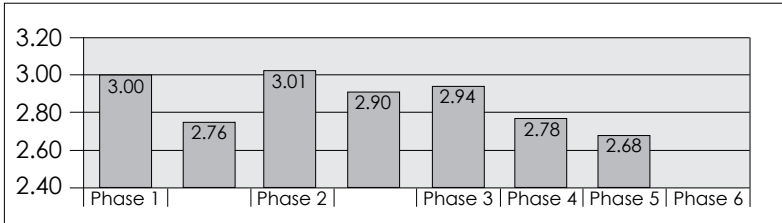


Figure 15: Rating of South African OH&S legislation relative to 'best practice'

4.2.14 Aspect 14

Figure 16 indicates that the respondent sample strata consisted of only the building and civil engineering contractors, project managers and inspectors. The mean mean score of 2.75 indicates that the DoL Inspectorate can be deemed to be ineffective, as opposed to effective, in assuring OH&S. However, it is notable that the Inspectors can be deemed to perceive that the DoL Inspectorate is effective, the mean score of 3.22 being > 3.00 .

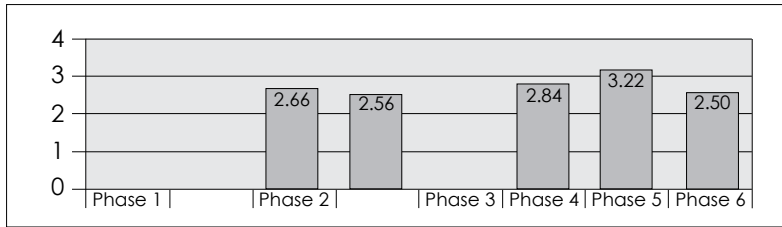


Figure 16: Effectiveness of the DoL Inspectorate in terms of assuring OH&S

4.2.15 Aspect 15

With the exception of the Inspectors' mean score of 3.68, all the mean scores ≤ 3.00 , which indicates that the DoL Inspectorate can be deemed to be insignificant rather than significant in terms of accident prevention in construction.

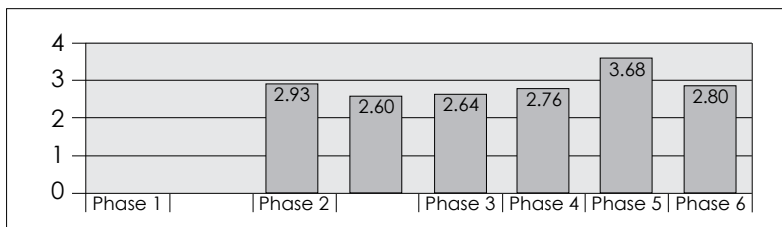


Figure 17: Significance of the DoL Inspectorate relative to accident prevention in construction

5. Conclusion

Based upon the findings of the study it can be concluded that there is a distinct need for a change in the approach of and methodology adopted by the South African DoL Inspectorate relative to OH&S in construction. Based on the survey of the literature and the empirical findings, it generally appears that the South African DoL Inspectorate is not effective in conducting their duties. However, contractors, clients, designers and various other relevant stakeholders have a particularly important role to play in eliminating and reducing hazards and risks.

The salient specific findings are: the DoL Inspectorate is not effective in terms of executing their duties; the number of inspections / 'blitz' inspections conducted by the DoL Inspectorate is inadequate; the number of inspections/ 'blitz' inspections conducted by the DoL

Inspectorate is infrequent; the DoL Inspectorate is not effective in terms of identifying the root cause of fatalities; the DoL Inspectorate is not effective in terms of addressing issues during inspections; the DoL Inspectorate is not fulfilling its role of reducing the consistently high fatality and injury rate; the DoL Inspectorate is not effective as a means of assuring OH&S; the DoL Inspectorate is not effective relative to accident prevention in construction; the DoL Inspectorate does not assess legislation relative to best practice in construction; there is a need for an OH&S accreditation system, and there is a need for an OH&S Inspectorate incentive scheme.

Various OH&S activities account for a significant proportion of fatal and major injuries. However, it appears that inspection of these activities is not being conducted by competent inspectors knowledgeable of the construction industry and its activities.

OH&S performance is increasingly prominent on the agendas of many organisations. Several powerful factors contribute towards this trend. The construction industry does not have a good OH&S record and faces tough legal and financial penalties for breaches of the law. A positive change of attitude among all players in the construction industry is vital. What is needed is to embed these vital factors as morals and values and as part of all that the construction industry does, and not to regard them merely as optional extras where time allows. The quote attributable to Hinze (1997) "Working on a project without establishing a strong safety culture is like holding a dead man's hand" provides a suitable closure to this topic.

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Comparative analysis of design management procedures in manufacturing and architecture

Peer reviewed

Abstract

Design changes due to lack of constructability, cost overruns, delays and dissatisfied clients are but a few of the problems experienced in construction on the account of the poor management of the design processes. This research was conducted to determine the adequacy of design management processes used by Eastern Cape (EC) architectural practices and compare these with the design management processes used in manufacturing in order to establish practices, theories, principles, technologies and deliverables that can be transferred from the manufacturing into the construction industry to improve efficiency of architectural design management. A questionnaire was designed to acquire primary, factual and attitudinal data from EC architectural practices while secondary data were acquired through a literature review. The main findings were that design management processes, continuous improvement philosophies, lean principles, and Information and Communication Technology (ICT) used by EC architectural practices are not similar to those used in manufacturing. Therefore EC architectural practices could increase their efficiency by adopting some of the design management processes, ICT, continuous improvement philosophies and lean principles originating from the manufacturing industry.

Keywords: Architectural profession, construction, design management, manufacturing, process improvement

Abstrak

Ontwerpveranderinge as gevolg van die onuitvoerbaarheid van konstruksie-ontwerpe, onbeplande kostes, vertragings en ontevrede kliënte, is net 'n paar probleme wat tydens die konstruksieproses ondervind word; dit is dikwels as gevolg van die swak bestuur van die ontwerpproses. Navorsing is onderneem om die geskiktheid van bestuursprosesse vir ontwerp, wat deur Oos-Kaapse argitekspraktjke gebruik word, te bepaal en dit te vergelyk met ontwerpbestuursprosesse wat in die vervaardigingsbedryf gebruik word, ten einde praktjke, teorieë, beginsels, tegnologiese oplossings en die uitkomst te identifiseer en dit uit die vervaardigingsbedryf na die konstruksiebedryf oor te dra om die effektiwiteit van argitektoniese ontwerpbestuur te verbeter. 'n

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Vraelys was gebruik om basiese-, feitelike- en meningsdata van Oos-Kaapse argitekspraktyke te bekom, terwyl sekondêre data deur 'n literatuurstudie ingewin is. Die belangrikste bevindinge was dat die ontwerpbestuursprosesse, deurlopende verbeterings-filosofieë, essensiële beginsels, en Inligting en Kommunikasie Tegnologie (IKT) wat deur Oos-Kaapse argitekspraktyke gebruik word, nie ooreenstem met dié van die vervaardigingsbedryf nie. Gevolglik kan Oos-Kaapse argitekspraktyke moontlik hul dienste verbeter deur sekere van die bestuursprosesse, IKT, deurlopende verbeteringsfilosofieë en essensiële beginsels uit die vervaardigingsbedryf aan te neem.

Slutelwoorde: Argitekspraktyk, konstruksiebedryf, ontwerpbestuur, prosesverbetering, vervaardigingsbedryf

1. Introduction

Cull (2004: 8) reported that the South Africa construction industry would be required to double its output over the next 10 years, according to a status report compiled by the Construction Industry Development Board (CIDB). Hodgson (CIDB, 2004) noted that, over the past two years, just over half of all projects in South Africa were completed on time, within budget and relatively defect free. The increased pressure on the construction industry to improve its practices and continuous criticism of its less than optimum performance have led to research on improvement of processes and efficiency.

Rethinking Construction is a report produced by Sir John Egan's Construction Task Force in the United Kingdom. The Report commissioned by John Prescott, the Deputy Prime Minister, was published in July 1998 and is known as the 'Egan Report'. The central message of *Rethinking Construction* is that through the application of best practices, the industry and its clients can collectively act to improve their performance. The *Egan Report* (1998) suggested that there are significant inefficiencies in the construction process and that there is a potential for a systematised and integrated project process in which wastage can be reduced and both quality and efficiency improved. There are many practitioners and academics who believe that the construction industry has much to learn from manufacturing. Howell (1998) suggested that this learning could be a two-way process: manufacturing could learn from construction in areas of project based management and construction could learn from manufacturing's developing and developed solutions. The *Egan Report* recommended that the construction industry could change, by rethinking the fundamentals of its delivery processes; and offered clues as to how some of the problems might be overcome by transferring practices from the manufacturing industry to achieve continuous improvement on its performance and products. Kilpatrick (2003) is of the opinion that many industries can improve

their performance by implementing lean principles, which can be defined as:

a systematic approach to identifying and eliminating waste through continuous improvement.

The architectural profession is an integral part of the construction industry's supply-chain, and some inefficiency experienced by the construction industry is directly or indirectly influenced by poor management of design processes. The increased pressure on the construction industry to improve its practices, an increased workload and demand for better quality, coupled with numerous problems facing the architectural profession, have forced architectural practices to reconsider their service delivery processes. Allinson (1993: 164) stated that:

getting a project from A to B is dependent upon an inextricably bound union of design and management.

Therefore contemporary architectural practice has a need to reconcile issues of management, design and professionalism. RIBA (2005: 11) also noted that the success of the architectural profession and its practitioners relies partly on their approach to the future as they are well placed to take advantage of future opportunities and emphasised the need to act proactively.

2. Design management

De Mozota (2003: 67) defined design management as

an approach whereby organisations make design-relevant decisions in a market and customer-oriented way as well as optimizing design-relevant processes.

Gorb (2003: 1) defined design management as

the effective deployment by line managers of the design resources available to a practice in order to help the practice achieve its objectives.

Therefore, design management acts as an interface between management and design; and functions as a link between technology, design, design thinking, and management.

2.1 Manufacturing as a reference for construction

Certain construction practitioners, such as Ball (1988: 10) believed that in the past the construction industry was unique and that principles from manufacturing could not be adopted because of this uniqueness. Those beliefs were later dismissed by Egan (1998) who pointed out that some of the problems in construction might be

overcome by transferring established practices from the manufacturing industry. This view has been affirmed by a number of authors like Langford & Murray (2004) and Kagioglou *et al.* (2000). Egan (1998: 18) stated that

The parallel is not with building cars on the production line; it is with designing and planning the production of a new car model.

Authors like Egan (1998) and Kagioglou *et al.* (2000) suggested that construction should use the manufacturing industry as a reference for overcoming some of the problems in construction. Kagioglou *et al.* (2000) suggested that there are mainly two areas in which construction could benefit from manufacturing, namely the project and operational/production processes.

2.1.1 Management of the project process

The project process in manufacturing relates to the design and construction processes; Kagioglou *et al.* (2000: 12) stated that

it considers the development of a solution from a need identified in the market place to the implementation of the solution and the whole life cycle of the product.

According to De Mozota (2003: 13) the project process consists of five phases, namely investigation, research, exploration, development, realisation and evaluation, and there are various techniques and tools used by design managers in manufacturing to plan, organise and monitor progress in these design phases. The project processes utilise various New Product Development (NPD) models (the sequential approach, stage gate and development funnel processes); the NPD models have distinct differences, but have three similar activities, namely pre-development, development and post-development.

2.1.2 Management of the operational/production process

The operational/production process relates to the way in which the production of products is undertaken and includes the utilisation of process improvement philosophies and Information and Communication Technology (ICT). According to Kagioglou *et al.* (2005), Oakland (1995), Koskela (1997) and Thompson & Strickland (2004), process improvement is usually achieved by: management and continuous improvement of existing processes, designing and redesigning of new processes, concurrent engineering and Lean Production. It is acknowledged by authors like Kagioglou *et al.* (2005) and

Sun & Howard (2004) that improved processes in manufacturing have been realised by significant ICT support.

3. Research method

The data for this research were collected using primary and secondary sources. A questionnaire was designed to acquire primary, factual and attitudinal data from EC architectural practices. Secondary data were acquired through a literature review of international and national publications which included conference papers, reports, journals, articles, theses and the internet. Secondary data were utilised to establish criteria and theories against which empirical research of the primary data was measured.

The aim of the research was to determine the adequacy of design management processes used by Eastern Cape (EC) architectural practices and compare these with the design management processes used in manufacturing in order to establish practices, theories, principles, technologies and deliverables that can be transferred from the manufacturing into the construction to improve efficiency of architectural design management. Design management processes is defined by De Mozota (2003: 67) as

any set of managerial techniques which aim to realise the potential of design as some form of socio-economic benefit.

3.1 Target population

The survey was conducted in the EC amongst professional architectural practices registered with the South African Institute of Architects (SAIA). SAIA has two architectural institutions for the EC, namely the Border-Kei Institute of Architects (BKIA) and the Eastern Cape Institute of Architects (ECIA). The BKIA is comprised of 38 member practices with 43 from the ECIA, a total of 81 practices. Altogether 24 architectural practices were randomly selected from these 81 practices registered with BKIA and ECIA, the sample being chosen by the process known as randomisation. Walliman (2001: 201) refers to randomisation as

Selecting a sample from the whole population in such a way that the characteristics of each of the units of the sample approximate the characteristics of the total population.

Therefore the composition of the sample is derived from 1:3 proportion of the population and the sizes of practices of the sample varying from small to medium (there are no large practices in the EC, according to the SAIA [2005] classification).

3.2 Questionnaire survey

A quantitative research approach through action research was adopted as it is perceived to be objective in nature and involves collection and analysis of numerical data and applying statistical methods for analysis of the data. This comprised the design and administration of a questionnaire among the sample population. A web-site was created to enable respondents to submit their response to the questionnaire on-line.

3.3 Literature review

A comprehensive literature review on the following aspects were undertaken to acquire the required insight into the topic:

- Design management processes and protocols in construction, which identified existing design management processes and protocols in construction as well as problems.
- Design management processes used in manufacturing, which identified the management of design, creativity and product development in manufacturing.
- Process improvement philosophies and lean production principles as used in manufacturing, which identified continuous improvement philosophies, concurrent engineering and lean production principles used in manufacturing.
- ICT used in manufacturing, which explored the use of ICT for simulation, integration, communication, visualisation; and the use of ICT during product development activities.

4. Survey results

Table 1 indicates that a 100% response rate was achieved and this formed the basis for the analysis and the subsequent conclusions.

Table 1: Response rate

<i>Practice Classification:</i>	<i>Questionnaire distribution</i>	<i>Number of responses</i>	<i>Percentage of responses against distribution (%)</i>
Small	12	12	100
Medium	12	12	100
Total	24	24	100

A 100% response rate may indicate that all respondents realise the importance of research into this field.

4.1 Adequacy of existing design management processes used by architectural practices in the EC

All architectural practices in the survey indicated that they used the SAIA Work Stages protocol for management of the design process. Table 2 reflects respondents' ratings of problems with existing design management processes and pre-project phases where 1 = minor problem and 5 = major problem. The highest ranking problem statement is 'Lack of risk assessment between design phases' with an average rating of 4.23, this also reflects the findings of the literature review and indicates that EC architectural practices generally do not identify, assess and mitigate risks during design. Usually these risks emerge later in the project and they adversely affect the project time, cost and quality parameters.

Table 2: Problems with existing design management processes and pre-project phases

Problems: (Rating: 1 = Minor problem, 3 = Neutral, 5 = Major problem)	Practice Classification		Average all	Ranking
	Small	Medium		
	Rating			
Lack of involvement of appropriate expertise in the conceptual phases	2.17	2.17	2.17	7
Poor co-ordination of information in design and project planning phases.	2.09	2.17	2.13	8
Poor design management process definition and control.	2.59	2.33	2.46	5
Poor management of briefing stage by architects.	1.75	2.09	1.92	9
Incorrect information and mistakes regarding the nature of client's problem statement.	2.83	2.59	2.71	3=
Poor co-ordination of design information between design consultants.	2.50	2.50	2.50	4=
Poor assessment of process performance between design phases.	3.09	2.75	2.92	2
Lack of risk assessment between design phases.	4.17	4.42	4.23	1
Poor communication between design consultants and construction team.	2.42	2.58	2.50	4=
Design changes and buildability problems during construction.	2.59	2.83	2.71	3=
The final building not satisfying client requirements.	2.42	2.00	2.22	6

The respondents rated 'Poor assessment of process performance between design phases' as the second highest problem, while 'Poor management of briefing stage by architects' was rated last.

4.2 Similarities between design management processes as used in manufacturing and by EC architectural practices

4.2.1 Investigation phase

Table 3 lists the methods used in manufacturing during project appraisal and responses indicating which ones are used by EC architectural practices. The method used by all respondents is the interview (formal and informal) while the literature review is the second most used method followed by user surveys and questionnaires. No respondents indicated that they used the focus group method. It can thus be concluded that at least one of the methods used in manufacturing are used by EC architects.

Table 3: Methods used during project appraisal stages of design process

Methods	Practice Classification		Total	Average all %	Ranking
	Small	Medium			
Literature review	4	7	11	46	2
User surveys and questionnaires	3	6	9	38	3
Focus groups	0	0	0	0	
Informal or formal interviews	12	12	24	100	1
None	0	0	0	0	
Other	0	0	0	0	

4.2.2 Research phase

Other results from the research revealed that respondents do not use any method for establishing clients' value criteria, 59% indicated that they use scope management tools and 92% that they use schedule and time management tools.

Table 4: Documents/deliverables produced during appraisal and definition stages

Documents/deliverables	Practice Classification		Total	Average all %	Ranking
	Small	Medium			
Stakeholder list	9	10	19	79	3
Statement of need	4	3	7	29	7=
Business case	6	6	12	50	5
Business plan	4	5	9	38	6
Project execution plan	3	4	7	29	7=
Terms of reference	6	10	16	67	4
Performance management report	0	0	0	0	8=
Communication strategy	0	0	0	0	8=
Procurement plan	0	0	0	0	8=
Project brief	11	9	20	83	2
Design brief	12	12	24	100	1
Value management	0	0	0	0	8=
Risk management plan	0	0	0	0	8=
Other	0	0	0	0	

Table 4 lists the documents/deliverables used in manufacturing during the appraisal and definition stages, and responses indicating which ones are used by EC architectural practices. The respondents indicated that they produced design briefs (100%), project briefs (83%), stakeholder lists (79%) and terms of reference (67%). Some 50% indicated that they produced a business cases, while the least produced were business plans (38%), statements of need (29%) and project execution plans (29%). None of the respondents indicated that they produced performance management reports, communication strategies, procurement plans, value management and risk management plans.

The findings suggest that architectural practices focus more on the documents/deliverables needed for production of the designs as indicated by the most produced deliverables and that they ignore deliverables needed for communication, process definition, process management and measurement. Therefore architectural practices do not produce documents and deliverables needed for effective management of the design process and this often results in the final products not being delivered on time, at the right cost and quality.

4.2.3 Exploration phase

Table 5 indicates that none of the respondents use the 6-3-5 or C-Sketch methods for conceptualisation of design solutions. Altogether 54% of respondents indicated that they use the Gallery method and the most used method is the 'Individual Criticism' method. The Individual Criticism method is similar to the Gallery method, the only difference with the Individual Criticism method being that feed-back is given by an individual instead of a group. The reason for the popularity of the Individual Criticism method is that it is easier to implement and less time consuming as compared with other methods.

Table 5: Methods used for conceptualisation of design solutions

Methods	Practice Classification		Total	Average all %	Ranking
	Small	Medium			
6-3-5 method	0	0	0	0	3=
C-Sketch method	0	0	0	0	3=
The Gallery method	3	10	13	54	2
Individual Criticism method	12	10	22	92	1
(Some practices indicated that they used more than one method)					

Other results from the research revealed that respondents do not use any method for evaluating concept designs, that they used 2D CAD renderings (100%), 3 Dimensional CAD (54%) and scale models (46%) for actualisation of design solutions, and that they used the Percentage-Complete Matrix (42%) and QS estimates (75%) for monitoring and controlling project budget.

4.2.4 Development and realisation phases

Table 6: Documents/deliverables produced between design concept and technical documentation stages

Documents/deliverables	Practice Classification		Total	Average all %	Ranking
	Small	Medium			
Concept design plan	1	3	4	17	3=
Outline concept design	3	5	8	33	2
Full concept design	12	12	24	100	1=
Value engineering	0	0	0	0	4=

Technical drawings	12	12	24	100	1=
Prototype and testing	0	0	0	0	4=
Cost plan	0	0	0	0	4=
Other	0	0	0	0	
(Some practices indicated that they used more than one method)					

Table 6 lists the documents/deliverables used in manufacturing during the design concept and technical documentation stages and which ones are used by EC architectural practices. All respondents indicated that they produced concept design plans (100%), full concept designs (100%) and technical drawings (100%). The above documents are the standard set of documentation that architects need to produce for design development, contract procurement and construction. A third of respondents indicated that they produced outline concept designs and 17% indicated that they produce concept design plans. These two sets of documentation are produced during the feasibility study and most projects undertaken in architectural practices do not require feasibility studies. No respondents indicated that they produce Value Engineering (VE) because it requires an articulation and prioritisation of client's and designer's values. None of the respondents indicated that they produced Prototypes or cost plans as costing on architectural projects is normally performed by the Quantity Surveyor.

4.2.5 Post-project evaluation

Table 7: Activities/documents produced after completion of projects

Activities/ documents	Practice Classification		Total	Average all %	Ranking
	Small	Medium			
Maintenance plan	1	3	4	17	3
Post-project review	4	5	9	38	2
None	7	4	11	45	1
Other	0	0	0	0	
Total	12	12	24	100	

Table 7 indicates that 38% of respondents indicated that they produce a post-project review and only 17% produce a maintenance plan. This indicates that only 55% of practices produce activities/documents after project completion is 55%. The remaining 45% of respondents indicated that they did not produce any activities/documents with the majority being smaller practices. This is

unsatisfactorily as preparing maintenance plans and manuals are vital tools for property owners. Buys (2004: 182) states that a maintenance plan should be prepared so that any expected future maintenance is provided for.

4.3 Similarities between continuous improvement philosophies and lean production principles as used in manufacturing and those used by EC architectural practices

Table 8: Process improvement philosophies and lean principles implemented in architectural practices

<i>Philosophies and principles</i>	<i>Practice Classification</i>		<i>Total</i>	<i>Average all %</i>	<i>Ranking</i>
	<i>Small</i>	<i>Medium</i>			
Continuous improvement	6	6	12	50	1=
Business Process Re-engineering	0	0	0	0	2=
Concurrent Engineering	0	0	0	0	2=
Lean Production	0	0	0	0	2=
None	6	6	12	50	1=
Other	0	0	0	0	
Total	12	12	24	100	

Table 8 lists philosophies and principles used in manufacturing for process improvement and responses indicating which ones are used by EC architectural practices. Altogether 50% of respondents indicated that they implement the continuous improvement philosophy, and the remaining 50% indicated that they did not implement any improvement philosophy or lean principles, i.e. Business Process Re-engineering, Concurrent Engineering and Lean Production principles. These findings indicate that there is a great scope for improvement in EC architectural practices if they adopt the process improvements and philosophies from manufacturing. The EC architectural practices would not only make dramatic initial increases in efficiency and quality, but they would obtain the greatest value through sustained improvements.

Other results from the research revealed that two-thirds of respondents indicated that architectural practices can become more efficient by rethinking their service delivery processes, while the remaining respondents indicated that they invested between 0.1-0.5% of their annual business volume in research and development, process

improvement is not adequately addressed in board meetings, they are not adequately benchmarking other design practices and industries, they are encouraging employees to make suggestions to improve office processes and 58% of respondents indicated that they are not rewarding employees for improvement of office processes, they are not adequately identifying and eliminating non-value adding activities, and that they are not adequately transferring processes from other industries.

4.4 Similarities between ICT used in manufacturing to that used by EC architectural practices

Table 9: ICT and collaborative tools used by practices

ICT and collaborative tools	Practice Classification		Total	Average all %	Ranking
	Small	Medium			
Internet	12	12	24	100	1=
Extranet	0	0	0	0	
Intranet	0	0	0	0	
E-mail	12	12	24	100	1=
Other:	0	0	0	0	
(Some practices indicated that they used more than one method)					

Table 9 indicates that the most utilised ICT and collaborative tools are the internet and e-mail, used by all respondents from both classifications, while no respondents indicated that they used the extranet or intranet.

Other results from the research revealed that: EC architectural practices are not adequately identifying and implementing ICT according to the needs of each project, not all EC managers are aware of current trends and technologies in project control, collaboration, CAD and management; they are only using standard ICT tools (e-mail and internet), and that they are not using extranets for project control.

5. Conclusion

The results indicated that architectural practices in the EC use the SAIA Work Stages protocol for management of the design process. Respondents indicated that the SAIA Work Stages protocol was adequate for their design processes as it contributed to a limited extent to 10 of 11 problems identified by the literature review. However,

the SAIA Work Stage Protocol contributed to a lack of risk between design phases. The researcher found that there is inconsistency in the way the SAIA protocol is implemented; this is due to the fact that the SAIA does not stipulate a definite set of deliverables in its phases. The inconsistency is made worse by the utilisation of temporary multi-organisational teams for each project, this making it difficult for professionals to organise themselves into a team working environment due to variations in their roles and responsibilities. The inconsistency has resulted in difficulties in performance measurement, control and attempts at continual improvement in design processes.

The results also showed that design management processes used by EC architectural practices at various stages are not similar to those used in manufacturing. Research by Egan (1998) and Kagioglou *et al.* (2000) has established that productivity in construction lags behind that of manufacturing and therefore EC architectural practices can increase their efficiency by adopting some of the design management processes, theories and deliverables used in the manufacturing industry.

The results revealed that EC architectural practices are not using similar process improvement philosophies and lean principles as used in manufacturing and that the majority of EC architectural practices do not implement any process improvement philosophy. EC architectural practices can therefore improve their services by considering continuous improvement and lean practices originating from manufacturing.

The results also indicated that EC architectural practices are not always utilising ICT for simulation, integration, visualisation and communication of design projects. Therefore more effective utilisation of ICT during design management processes will result in improved communication and collaboration that will ensure design constructability and clear communication through ICT tools.

It is recommended that further research be conducted to develop an improved SAIA design management process protocol, using manufacturing principles as reference point, which will also consider the whole life cycle of construction projects whilst integrating participation under a common framework. Furthermore, more in-depth research on how lean principles, as applied in manufacturing, can be applied to construction design management to improve performance.

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The capacity of emerging civil engineering contractors

Peer reviewed

Abstract

Construction management competencies are essential to realise sound practices among and to realise optimum performance by, *inter alia*, emerging civil engineering contractors. Such competencies enable the success of the business of construction and the management of projects, with increased efficiency and reduced costs as a benefit. The article presents the findings of a Masters study, the objectives in general being to determine the current practices and performance of emerging civil engineering contractors in the Nelson Mandela Bay Metropole. The descriptive method was adopted in the empirical study.

The salient findings of the study are: most of the emerging civil engineering contractors do not possess civil engineering related qualifications; construction resources are inappropriately managed leading to construction failures; skills programmes are not well structured and supported; there is a lack of capacity at all management levels of the organisations in terms of managing the business of construction and projects; the nine functions of organisations in the form of general management, technical or production, procurement, marketing, financial, human resources, public relations, legal, and administration and information technology, are not comprehensively represented; and self-ratings indicate inadequacy relative to the controlling function of management work, and relative to certain activities of the organising function.

The article concludes that emerging civil engineering contractors lack the requisite competencies and resources to realise sustainable contracting organisations.

The article recommends that formal civil engineering and construction management education and training should be promoted throughout the industry for all categories of civil engineering contracting organisations. The article further recommends that all nine functions should be adequately staffed with suitably qualified people in order to manage and undertake the work successfully. Organisations should have the requisite construction-related resources, and owners and managers should market their organisations to ensure the sustainability thereof.

Keywords: Emerging contractors, civil engineering, construction, management

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Abstrak

Konstruksiebestuurbevoegdheid is van uiterste belang om deeglike uitvoering van, en optimale werkverrigting deur, onder andere, opkomende siviele ingenieurs, te verseker. Sodanige bevoegdhede verseker die sukses van die konstruksie besigheid en bestuur van projekte, met toenemende doeltreffendheid en 'n afname in onkoste as bykomende voordeel. Die artikel gee die bevindinge weer van 'n Meesterstudie, met die oogmerk in die algemeen, om die huidige praktyk en werksprestasie van opkomende siviele ingenieur-kontraakteurs in die Nelson Mandela Metropool, vas te stel. Die beskrywende metode was gebruik in die proefstudie.

Die mees uitstaande bevindinge is as volg: meeste van die opkomende siviele ingenieur-kontraakteurs het geen siviele-ingenieur verwante kwalifikasies nie; konstruksiehulpbronne word ondoeltreffend bestuur wat lei tot konstruksie mislukkings; vaardigheidsprogramme word nie goed gestruktureer en ondersteun nie; daar is 'n tekort aan kapasiteit op alle bestuursvlakke in terme van besigheidsbestuur van konstruksie en projekte; die nege funksies van organisasies in die vorm van algemene bestuur, tegniese of produksie, verskaffing, bemaking, finansies, menslike hulpbronne, publieke skakeling, regsangeleenthede, en administrasie en inligtingstegnologie, is nie omvattend verteenwoordig nie; en self-evaluering dui onvoldoende beheersfunksie van bestuurswerk aan, en ook met betrekking tot sekere aktiwiteite van die organiseringsfunksie.

Die artikel kom tot die gevolgtrekking dat opkomende siviele ingenieur-kontraakteurs tekortskiet aan die nodige bevoegdhede en hulpbronne om volhoubare kontraakteurs-organisasies te verwesentlik.

Die artikel beveel aan dat formele siviele ingenieurs- en konstruksiebestuur onderrig en opleiding aangemoedig moet word in die industrie vir alle kategorieë van siviele ingenieur kontraakteur-organisasies. Die artikel beveel verder aan dat al nege funksies voldoende beman word deur toepaslik opgeleide persone, om sodoende die bestuur en onderneming van werk suksesvol te kan uitvoer. Organisasies behoort die vereiste konstruksie verwante hulpbronne te hê, en eienaars en bestuurders behoort hul organisasies te bemark ten einde die lonendheid daarvan te verseker.

Sluitelwoorde: Opkomende kontraakteurs, siviele ingenieurs, konstruksie, bestuur

1. Introduction

South African's Gross Domestic Product (GDP) grows at between 4%-5% per annum, of which 5.1% is invested in construction. The construction industry employs more than 500 000 people of which only 45% are estimated to be working in the formal sector.

The need for sustained growth of the construction industry is given impetus by government's commitment to infrastructure investment to achieve economic growth and to address the infrastructure backlog emanating from apartheid. The performance and capability of the construction industry is pivotal to transport and communication, import and export, industrial development, and to all the logistics of a growing economy that increasingly supports an

integrated and economically-active population. It is in the context of these challenges that government has proclaimed the construction industry as a national asset to be developed, maintained and transformed through a range of policy, institutional and practical initiatives. Active promotion of an efficient and effective construction industry that is comprised of adequately qualified and well-trained practitioners, that reduces waste, and that improves the working environment of its people for better employment and greater productivity. Consequently the sustainability of emerging contractors is complementary to the objectives of government.

Fellows *et al.* (2002: 6) state that construction management entails the management of the business of construction as well as the management of projects, which in practice are interdependent. The nine recognised functions applicable to all organisations, need to be integrated and are equally important in terms of the functioning and sustainability of an organisation, namely: general management; technical or production; procurement; marketing; financial; human resources; public relations; legal; administration and information technology (Smallwood, 2006: 64). The general management function in turn, is constituted by the five functions of management work, namely planning, organising, leading, controlling, and coordinating (Allen, 1973: 50). The first four functions of management in turn collectively entail nineteen activities. Planning includes forecasting, developing objectives, programming, scheduling, budgeting, developing procedures, and developing policies. Organising includes developing organisation structure, delegating, and developing relationships. Leading includes decision-making, communicating, motivating, selecting people, and developing people, and controlling includes developing performance standards, measuring performance, evaluating performance, and correcting performance.

According to Rwelamila *et al.* (1997: 369) the inability to manage the business of construction due to poor management accounting, inaccurate estimating, and under pricing, causes insolvency in civil engineering contracting organisations. Lack of adequate marketing skills, strategic and operational factors further exacerbates failure in civil engineering contracting organisations. Furthermore, although it is important to be able to successfully manage projects, the ability to manage the business of construction is critical in terms of sustainability. Furthermore, Hutchings & Christofferson (2001: 265) state that quality workmanship and products, good subcontractors / subcontractor relations, customer communications and relations, teamwork, work ethic / commitment, and effective sales and

marketing are success related factors in terms of the management of construction. Good subcontractors employ the bulk of the workforce, and they need to produce site supervision and quality workmanship which satisfies the customer.

Jacquet (2002: 6) reinforces the importance of competencies and states that in order for an incumbent to perform in a chosen operating field of expertise, an adequate qualification relative to the relevant industry is a pre-requisite. Construction management competencies complemented by adequate resources, yield successful construction results. This includes personnel who possess adequate construction-related qualifications, and the relevant management and technical skills. Furthermore, implementing the right technology is critical to an organisation's success, and sustaining a skilled, highly educated and motivated knowledge workforce is equally a valuable asset. Gamble (2004: 192-193) states that 92% of emerging civil contractors have a low-level of knowledge and skills and he recommends the establishment of an ideal Further Education and Training (FET) curriculum that must make a clear distinction between a low, intermediate and high level of knowledge and skills. This would strengthen intermediate level knowledge and skills and create a platform that will move away from the manner in which emerging civil engineering contractors are associated with trade apprenticeships that are characterised by 'mindless' doing in response to pre-specified procedures. The current skills development programmes are not structured to cater for this notion. Given the low-level of knowledge and skills attributed to emerging contractors, it is notable that training is receiving much attention from contemporary business as an important career development tool. It yields better job performance of individuals, career satisfaction, and enhances rapid growth of individuals within the organisational structure. However, the current training programmes available do not strive to achieve construction-related strategic objectives, and do not focus on addressing sustainable construction. Chileshe *et al.* (2005: 18) support this by stating that Higher Education Institutions (HEIs) need to form a collaborative endeavour jointly with the business world of construction with the aim of formulating a holistic construction curriculum that will serve the needs of the contracting environment.

Given the poor performance of emerging civil engineering contractors and the abandonment of projects in cases, which results in cost overruns to clients as a result of the projects having to be completed by other contractors, a study was conducted to determine the capacity and causes of failure of such contractors. The following constitute the hypotheses which were evolved for testing:

- Emerging civil engineering contractors lack construction related qualifications;
- Emerging civil engineering contractors lack construction management competencies;
- A range of factors contribute to the failure of emerging civil engineering contractors;
- The level of skills development in emerging civil engineering contractors is inadequate; and
- The level of construction resources in emerging civil engineering contracting organisations is inadequate.

2. Review of the literature

This section provides a review of the literature pertaining to emerging civil engineering contractors in terms of the possession of construction-related qualifications, construction management skills, existence of construction resources, the availability of skills programmes, and factors associated with construction failures.

2.1 Existence of construction-related qualifications

The Construction Education and Training Authority (CETA) (2004: 4) cites the *Black Construction Industry Report* which states that levels of formal education of emerging civil engineering contractors are low, with only 13% of the sample having Grade 12. 53% of the sample has a level of education between standard 6 and 9, with one third having a level of education less than standard 5. Similarly, the level of training is low, with 36% having received on the job training, but no qualification, 32% with trade certificates and 15% with other qualifications. Of the 15%, only 1% has a higher education diploma or degree in management.

2.2 Civil engineering education

Lawless (2005: 126) states that civil engineering programmes do not address the construction process; neither do they include business and project management skills. There is a dire need to address the construction process and the completion of such courses with the aim of preparing graduates to manage the business of construction and that of projects. The civil engineering competencies recommended by the South African Qualification Authority (SAQA) do not include those that are required to manage the business of construction relative to

the eight recognised functions which are complemented by general management in all the respective levels of management of contracting civil engineering construction organisations. The SAQA registered qualifications only focus on theory and application of Civil Engineering Technology. Given that civil engineering and related contracting organisations should be structured according to these functions, the sustainability of an emerging civil engineering contracting organisation is dependent upon the effective management and integration of these functions (Smallwood, 2006: 65).

2.3 Construction management competencies

Table 1 presents the top ten construction management skills per level of management based on frequency of use emanating from the findings of Phases 1 and 2 of a 'Practice of Construction Management' study conducted in South Africa (Smallwood, 2006: 73). It should be noted that the mean of all levels for Phase 1 was used as the basis for the identification of the top ten. It is notable that in general the five functions of management work are expressed as skills. Furthermore, the ranking of oral communicating is notable. The implication of these findings is that the managers of the business of construction and projects need to be empowered with such skills. However, the reality is that management focused programs such as construction management are the most likely to achieve such empowerment (Smallwood, 2006: 73).

Table 1: Top ten skills for all levels of construction management based on frequency of use

Skill	Levels of management							
	Operational		Middle		Top		Mean	
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
Communicating (Oral)	2	1	3	1	1=	1=	1	1
Communicating (Written)	14	2	13	2	4=	4	9	2
Decision making	8=	8	1=	4=	1=	3	2=	3
Organising	5	6	5	4=	12	6=	7=	4
Administrative	8=	7	6=	8	4=	5	5=	5=
Leadership	10=	11	10=	10	7	1=	7=	5=
Coordinating	6=	4	6=	11	4=	8	4	7
Planning	3=	9	4	4=	13	11	5=	8
Interpersonal	10=	13	10=	9	14=	9	10	11
Controlling	3=	10	1=	15	3	10	2=	13

Source: Smallwood, 2006: 69

Table 2 presents the top ten construction management knowledge areas per level of management, based on frequency of use, emanating from the findings of Phases 1 and 2 of the 'Practice of Construction Management' study conducted in South Africa (Smallwood, 2006: 73). As previously noted, the mean of all levels for Phase 1 was used as the basis for the identification of the top ten. Notable findings include: the importance of technology; the management of parameters such as cost, quality, subcontractors, and productivity; planning, and project management. The implication of these findings is that the managers of the business of construction and projects need to be empowered in terms of technology and management, and especially relative to the management of resources within defined parameters. The implication of these findings is that the managers of the business of construction and projects need to be empowered with such skills. However, the reality is that management focused programs such as construction management are the most likely to achieve such empowerment.

Table 2: Top ten knowledge areas for all levels of construction management based on frequency of use

Knowledge area	Levels of management							
	Operational		Middle		Top		Mean	
	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2	Phase 1	Phase 2
Construction methods (building)	1	1=	1	2	6=	9=	1	2
Cost control	3	9	2	4	2=	15	2	6=
Quality management	4	8	6	7=	6=	20	3	6=
Contract administration	5=	16	3=	3	9	12	4=	8
Subcontractor management	2	4	8=	6	12=	25	4=	5
Contract documentation	10=	18	3=	9	6=	22	6	15
Planning (programming)	7	10=	7	16=	17	17	7	12
Customer service	19	21	10	7=	1	2	8	4
Project management	18	27=	3=	10=	12=	16	9	20
Productivity	14	5	12	14=	18=	23=	10	9

Source: Smallwood, 2006: 87

2.4 Causes of construction failures

A study conducted by Rwelamila *et al.* (1997: 369) identified marketing, followed by operational management and strategic factors, as the predominating factors that cause contractor failures (Table 3).

These findings highlight the importance of the management of the business of construction, and more specifically the importance of the marketing function.

Table 3: Factors associated with contractor failures

Factor	Response (%)				
	Strongly Agree	Agree	Disagree	Strongly disagree	Unsure
Operational management	35.0	33.0	18.0	13.0	1.0
Strategic factors	20.0	37.0	27.0	15.0	1.0
Personal	10.0	10.0	40.0	37.0	3.0
Technological	10.0	27.0	33.0	25.0	5.0
Environmental	2.0	15.0	53.0	25.0	5.0
Marketing	70.0	30.0	0.0	0.0	0.0
Rises in costs	20.0	23.0	33.0	17.0	7.0

Source: Rwelamila *et al.*, 1997

2.5 Existence of construction resources

The availability of adequate construction resources promotes sustainable growth of the construction industry and the sustainable participation of the emerging contractor sector. The existence of construction resources enhances performance and best practices by all participants in the construction delivery process.

Smallwood (2006: 87) states that eleven construction resources need to exist in all contracting organisations and that the requisite competencies must be present at all levels of management in a contracting organisation. This is supported by Emery *et al.* (2005: 2) who state that emerging civil engineering contracting organisations have inadequate resources for the business of construction, in that they do not have adequate capacity both technically and financially.

2.6 Extent of skills development

The CIDB, DPW, and CETA co-authored Report (2005: 1-10) records the availability of the following construction skills programmes:

- Department of Public Works: Contractor Incubator Programme;
- Sakhasonke Emerging Contractor Development Programme;

- Department of Transport – Kwazulu Natal: Vukuzakhe Emerging Civil Engineering Contractor Programme;
- Limpopo Sakhasonke Contractor Development Programme;
- CSIR – Boutek: South African Construction Excellence Model (SACEM) and Emerging Contractor Development Model (ECDM);
- SAFCEC Emerging Contractor Development Model;
- Ethekwini Municipalities: Ethekwini Emerging Contractor Learnership Programme; and
- Expanded Public Works Programme (EPWP) Contractor Learnership Programme.

Jacquet (2002: 6) states that although much work has been done in terms of formulating skills development programmes in construction, there is a need to further develop the programmes in such a structured manner that they will suit the environment in which the business of construction and that of projects are managed.

2.7 Investment in skills training

Table 4 indicates that civil engineering contracting organisations concentrate on training that develops low level skills, is short in duration, and tends to focus on application in the workplace rather than high levels of skills development (Badroodien, 2004: 156).

Table 4: Civil engineering construction organisations' level of training

<i>Level per annum</i>	<i>Type</i>	<i>Outcomes</i>
Training investment as percentage of payroll (%)	In-house	0.4
	Outsourced	0.2
Number of hours of training per employee (Hrs)	Managers	21
	Semi-skilled	16
	Trained and unskilled	11
Training places per employees (No.)	Managers	0.3
	Semi-skilled	0.3
	Trained and unskilled	0.3

Source: Badroodien, 2004: 156

Chand (2005: 12) is of the opinion that for a contracting organisation to compete and sustain its business practices, a highly skilled workforce delivers higher quality production returns than mediocre

workers. Competitive organisations rely on employees who provide innovative solutions to problems the organisation might encounter.

3. Research methodology

The survey of the literature led to the identification of civil engineering and construction management competencies, construction resources, management functions, organisation functions that are necessary to sustain emerging civil engineering contracting organisations.

3.1 Research method

A descriptive survey method was adopted, which involved the use of structured questionnaires for an in-depth exploration of the constructs underlying all subject matter of the research. This type of research observes the existing conditions, and describes the characteristics of the variables of interest in a given situation (Cropley & Harris, 2004: 7). A preliminary research approach comprising of a quantitative method of data production using the questionnaire was employed in order to obtain the data from the target population. The need for content validity was not established as no pilot study and pre-testing was done on the questionnaire. The reliability for internal consistency of the factors was validated from a scale of self-rating by the respective emerging civil engineering contractors.

3.2 Sample Strata

The sample strata consisted of ten successful and ten unsuccessful emerging civil engineering contractors that were undertaking projects for which the lead researcher was providing a consulting service, and four established civil engineering contractors that were contracting in the Nelson Mandela Metropole at the time of the study. The emerging civil engineering contractors were differentiated on the basis of their having completed projects and having not completed projects respectively. The questionnaire surveys were administered by the lead researcher to ensure the standardisation of data gathering, to decrease non-response errors and to increase response rates as recommended by Cooper & Schindler (1998: 21). Nine of each of the successful and unsuccessful emerging civil engineering contractors completed the questionnaires, which equates to a response rate of 90%. All four of the established civil engineering contractors completed the questionnaire.

3.3 Analysis of the data

The data was analysed using MS Excel. Descriptive statistics and a measure of central tendency in the form of a mean score between 1 and 5 were computed based upon responses to the five-point Likert - scale questions. This was done to interpret percentage responses to the five-point Likert - scale and to enable ranking of variables and a comparison of the emerging successful, unsuccessful and established successful civil engineering contractors. Variables in the form of *inter alia*, knowledge, skills, and factors were ranked based upon their mean scores. Further, a standard deviation was computed for each variable in case two or more variables tied in terms of achieving the same mean scores. In the case of such an event, the variable with the lower standard deviation was ranked higher. Mean scores and standard deviations were computed to two decimal places.

4. Research

Section 4.1 presents the salient findings of the study in the form of Tables 5-17. Section 4.2 presents a summary of the findings, and the testing of the hypotheses is presented in Section 4.3.

4.1 Findings

The findings presented in the tables in the form of frequencies and mean scores are introduced and discussed. In the main, successful and unsuccessful emerging civil engineering contractor organisations are compared, but relative to certain aspects emerging and established civil engineering contractor organisations are compared.

Table 5: A comparison between emerging and established civil engineering contractors' qualifications per level of management per function

	Qualifications per level of management (%)																							
	Top				Middle				Operational															
	Emerging		Established		Emerging		Established		Emerging		Established													
General management	27.8	44.4	22.3	5.6	0.0	16.7	49.9	0.0	0.0	0.0	16.7	16.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		
Production	5.0	22.7	11.6	0.0	0.0	0.0	0.0	5.0	11.6	21.6	5.0	0.0	33.3	33.3	8.9	5.0	3.8	0.0	0.0	0.0	0.0	0.0	33.3	0.0
Procurement	11.1	59.1	24.3	0.0	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	40.0	40.0	0.0	0.0	5.6	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Marketing	10.0	58.6	31.5	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Financial	12.5	49.1	13.4	0.0	0.0	0.0	100	17.9	0.0	7.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
HRs	16.7	27.9	16.4	5.0	22.2	11.1	11.1	5.6	20.0	8.6	0.0	0.0	11.1	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Public relations	15.0	45.0	10.0	2.5	40.0	0.0	0.0	5.0	20.0	2.5	0.0	0.0	20.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0
Legal	16.7	25.0	11.1	0.8	8.3	0.0	66.7	8.4	24.3	5.6	8.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Admin and IT	26.0	33.1	9.1	0.0	13.7	18.2	0.0	13.7	18.2	0.0	0.0	0.0	20.0	40.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Table 5 provides a comparison between emerging and established civil engineering contractor's qualifications per level of management and function in their contracting organisations in terms of percentage responses. When comparing the qualifications of emerging and established civil engineering contractors', it is notable that the responsibility for functions in emerging civil engineering contractor organisations is concentrated at top management level, and that top management of established civil engineering contractor organisations has higher qualifications. It is also notable that top management of emerging civil engineering contractors have more non-construction qualifications than that of established contractors. Although there is more middle management responsibility relative to the various functions in emerging than established, the qualifications are 'low level'. Further, it is also notable that there is limited responsibility at operational management level in both categories of contractor organisations.

Therefore, based upon percentages, emerging civil engineering contractors can be deemed to be deficient relative to adequacy of qualifications (4-year degree) at top, middle and operational management levels, and sufficient relative to adequacy of qualifications (3-year degree) at top and middle management. Established civil engineering contractors can be deemed deficient relative to adequacy of civil engineering construction qualifications of practitioners at top and middle management level and those functions that correlate with the nature of the business of construction.

Table 6: A comparison between successful and unsuccessful emerging civil engineering contractor ratings of management in their organisations relative to the functions of management work

Activity	Successful		Unsuccessful		Mean	
	MS	Rank	MS	Rank	MS	Rank
Planning:						
Forecasting	3.89	4 =	4.00	3 =	3.95	3
Developing objectives	3.33	13 =	3.56	15 =	3.45	14
Programming	3.67	6 =	3.44	8 =	3.56	9
Scheduling	3.44	11 =	4.00	18 =	3.72	7
Budgeting	3.44	11 =	3.67	3 =	3.56	9
Developing procedures	3.33	13 =	3.11	12 =	3.22	17
Developing policies	3.11	19	4.00	20	3.56	9
Organising:						
Developing organisation structure	3.56	9 =	3.25	19	3.41	15

Delegating	3.67	6 =	3.67	12 =	3.67	8 =
Establishing relationships	4.11	1	3.67	12 =	3.89	4 =
Leading:						
Decision-making	4.00	2 =	4.44	1	4.22	1
Communicating	4.00	2 =	4.22	2	4.11	2
Motivating	3.67	6 =	4.00	3 =	3.84	6
Selecting people	3.89	4 =	3.89	6 =	3.89	4 =
Developing people	3.33	13 =	3.78	8 =	3.56	9 =
Controlling:						
Developing performance standards	3.33	13 =	3.33	13	3.33	16
Performance measuring	3.22	17 =	3.22	17 =	3.22	17 =
Evaluating performance	3.00	20	3.00	20	3.00	20 =
Correcting performance	3.22	17 =	3.22	17 =	3.22	17 =
Coordinating	3.56	9 =	3.56	9 =	3.56	9 =

Table 6 provides a comparison between successful and unsuccessful emerging civil engineering contractor ratings of management in their organisations relative to the five functions and related activities of management work in terms of mean scores (MSs). It is notable that all the activities have MSs above the midpoint score of > 3.00, which indicates that in terms of the mean, both categories of emerging civil engineering contractors rate their management more adequate than inadequate. However, it should be noted that three MSs are on the limit of the range, namely 3.00.

When comparing the MSs the following can be noted:

- Planning: five (71.4 %) out of seven unsuccessful MSs are > successful MSs, and two (28.6 %) out of seven successful MSs are > unsuccessful MSs;
- Organising: one (33.3%) out of three successful and unsuccessful MS is equal, and two (66.7%) out of three successful MSs are > unsuccessful MSs;
- Leading: one (20.0%) out of five successful and unsuccessful MS is equal, and four (80.0%) out of five unsuccessful MSs are > successful MSs;
- Controlling: all four (100.0%) out of four activities for both unsuccessful and successful MSs are equal; and
- Coordinating: all (100.0 %) out of four activities for both unsuccessful MS and successful MS are equal.

It is notable that the greatest difference between MSs is relative to scheduling, developing policies, establishing relationship, decision-making and developing people. In general it is also notable that unsuccessful emerging civil engineering contractors rate their management's competencies more adequate than successful emerging civil engineering contractors do, however, not relative to the function of organising. This higher percentage may be attributable to a lack of understanding of the actual activities and related competencies, and or an overestimation of adequacy. Furthermore, this could also be construed to be a lack of appreciation of limitations.

Table 7: A comparison between successful and unsuccessful emerging civil engineering contractors' ratings of their organisations' level of adequacy in the top ten knowledge areas of construction management

<i>Subject areas</i>	<i>Successful</i>		<i>Unsuccessful</i>		<i>Mean</i>	
	<i>MS</i>	<i>Rank</i>	<i>MS</i>	<i>Rank</i>	<i>MS</i>	<i>Rank</i>
Industrial relations	4.33	1 =	3.78	6	4.06	1 =
Construction methods (Civil)	4.11	3 =	4.00	1 =	4.06	1 =
Planning (programming)	4.00	4 =	4.00	1 =	4.00	3
Contract documentation	3.89	7 =	4.00	1 =	3.95	4
Quality management	4.33	1 =	3.50	10	3.92	5
Project management	3.89	7 =	3.89	5	3.89	6
Productivity	4.00	4 =	3.75	7	3.88	7
Total quality management (TQM)	3.67	9 =	4.00	1 =	3.84	8
Subcontractor management	4.00	4 =	3.56	9	3.78	9
Plant and equipment management	3.67	9 =	3.67	8	3.67	10

Table 7 provides a comparison between successful and unsuccessful emerging civil engineering contractors' ratings of their organisations' level of adequacy in the top ten subject areas of construction management in terms of MSs. It is notable that all subject areas have MSs above the midpoint score of 3.00, which indicates that in terms of the mean, both categories of emerging civil engineering contractors rate their knowledge areas in construction management more adequate than inadequate.

When comparing the MSs the following are notable:

- Five (50.0%) out of the ten subject areas of the successful MSs are > than unsuccessful MSs;
- Two (20.0%) out of the ten subject areas of the unsuccessful MSs are > than successful MSs; and

- Three (30.0%) out of the ten subject areas of the successful and unsuccessful MSs are equal.

In general it is notable that successful emerging civil engineering contractors rate their organisation's level of adequacy in the top ten construction management skills more adequate than unsuccessful emerging civil engineering contractors do, however, not relative to the subject area of contract documentation, and total quality management. Further, it is also notable that the greatest difference between MSs is relative to quality management and industrial relations.

Table 8: A comparison between successful and unsuccessful emerging civil engineering contractors' ratings of their organisation's level of adequacy in the top ten construction management skills

Skill	Successful		Unsuccessful		Mean	
	MS	Rank	MS	Rank	MS	Rank
Leadership	4.11	1 =	4.33	1 =	4.22	1
Decision making	4.11	1 =	4.22	3	4.17	2
Communicating (Oral)	3.89	8 =	4.33	1 =	4.11	3
Communicating (Written)	4.00	3 =	4.00	5 =	4.00	4 =
Coordinating	4.00	3 =	4.00	5 =	4.00	4 =
Planning	3.89	8 =	4.11	4	4.00	4 =
Organising	4.00	3 =	4.00	5 =	4.00	4 =
Controlling	4.00	3 =	3.89	9	3.95	8
Interpersonal	4.00	3 =	3.78	10	3.89	9
Administrative	3.56	10	4.00	5 =	3.78	10

Table 8 provides a comparison between successful and unsuccessful emerging civil engineering contractors' ratings of their management's level of adequacy in the top ten construction management skills in terms of MSs.

It is notable that all ten (100%) of the skills have MSs above the mid-point score of 3.00, which indicates that in terms of the mean, both categories of emerging civil engineering contractors rate their management's skills more adequate than inadequate.

When comparing the MSs per skill the following are notable:

- Two (20.0%) out of the ten subject areas of the successful MSs are > than the unsuccessful MSs;

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- Five (50.0%) out of the ten subject areas of the unsuccessful MSs are > than the successful; and
- Three (30.0%) out of the ten subject areas of both successful and unsuccessful MSs are equal.

It is also notable that the greatest difference between MSs is relative to oral communicating and administrative. In general it is notable that unsuccessful emerging civil engineering contractors rate their management's skills more adequate than successful emerging civil engineering contractors do, however, not relative to the skills of interpersonal and controlling. These higher ratings may be attributable to a lack of understanding of the actual skills and related competencies, and or an overestimation of adequacy. Furthermore, this could be construed to be attributable to a lack of appreciation of limitations.

Table 9: A comparison of training statistics relative to successful and unsuccessful emerging civil engineering contractors

<i>Measure</i>	<i>Response per aspect (%) / Hrs / No</i>	
	<i>Successful</i>	<i>Unsuccessful</i>
Training investment as a percentage of payroll (%)	0.7	0.2
Number of hours of training per employee per annum (Hrs)	71.1	68.6
Training places per employee (No)	3.1	1.6

Table 9 provides an overview of salient training statistics relative to both successful and unsuccessful emerging civil engineering contractors.

When comparing the successful and unsuccessful measures, the following can be noted:

- Training investment as a percentage of payroll (%): the successful percentage is 28.6 % > the unsuccessful percentage;
- Number of hours of training per employee per annum (hrs): both successful and unsuccessful categories allocate more or less the same number of hours per employee; and
- Training places per employees: the successful number is almost double that of the unsuccessful.

When considering the three measures it can only be deduced that the training undertaken by the successful emerging civil engineering

contractors is more expensive than that of the unsuccessful per employee.

Table 10: A comparison of the extent to which various aspects contribute to the failure of contractors according to successful and unsuccessful emerging civil engineering contractors

Aspect	Successful		Unsuccessful		Mean	
	MS	Rank	MS	Rank	MS	Rank
Operational Management	4.78	1	4.11	1 =	4.45	1
Strategic factors	4.00	2	3.89	3 =	3.95	2
Rises in costs	3.67	3	3.89	3 =	3.78	3
Technological	3.22	4	4.11	1 =	3.67	4
Personal	3.00	5 =	3.78	5	3.39	5
Marketing	3.00	5 =	3.00	7	3.00	6 =
Environmental	2.89	7	3.11	6	3.00	6 =

Table 10 provides a comparison of the extent to which various aspects contribute to the failure of contractors according to successful and unsuccessful emerging civil engineering contractors in terms of MSs. It is notable that all the aspects have MSs > the midpoint score of 3.00, which indicates that in terms of the mean, both categories of emerging civil engineering contractors consider the aspects to contribute to the failure of contractors. However, it should be noted that two MSs are on the limit of the range, namely 3.00.

When comparing the MSs per function, the following can be noted:

- Two (28.6%) out of the seven aspects of successful MSs are greater than unsuccessful MSs;
- Four (57.1%) out of the seven aspects of unsuccessful MSs are greater than successful MSs; and
- One (14.3%) out of the aspects of MSs is equal.

It is also notable that the greatest difference between MSs is relative to technological. In general it is notable that unsuccessful emerging civil engineering contractors rate the extent to which various aspects contribute to the failure of contractors higher than successful emerging civil engineering contractors do.

Table 11: A comparison of skill programme undertaken by and need for training in successful and unsuccessful emerging civil engineering contractor's organisations.

Skills programme	Response per form (%)			
	Successful		Unsuccessful	
	Yes	Need	Yes	Need
Knowledge management	10.0	50.0	55.6	22.2
Personal and team effectiveness	60.0	40.0	33.3	44.5
Monitoring and evaluation of projects	20.0	40.0	44.5	33.3
Negotiation and conflict management	40.0	20.0	55.6	22.2
Professional business writing skills	30.0	30.0	22.2	66.7
Meeting management	60.0	40.0	33.3	66.7
Computer skills	40.0	40.0	22.2	77.8
Health systems management	20.0	40.0	22.2	66.7
Human resource management	50.0	30.0	44.4	55.6
Mentoring and coaching	60.0	40.0	66.7	33.3
Labour relations	50.0	50.0	44.4	44.5
Financial management for non-financial managers	60.0	30.0	16.7	77.8
Quality and customer relations management	60.0	40.0	33.3	44.5
Construction contracts sustainable development	70.0	30.0	33.3	44.5

Table 11 provides a comparison of skills programme undertaken by and need for training in successful and unsuccessful emerging civil engineering contractors in terms of percentage responses:

- Ten (66.7 %) out of the fifteen successful 'yes' percentages are > unsuccessful 'yes' percentages;
- Five (33.3 %) out of fifteen unsuccessful 'yes' percentages are > successful percentages;
- Four (26.7%) successful 'need' percentages are > unsuccessful 'need' percentages; and
- Eleven (73.3 %) unsuccessful 'need' percentages are > successful 'need' percentages.

In general the successful emerging civil engineering contractors have subscribed more to training than the unsuccessful emerging civil engineering contractors; however, the latter have a greater need than the former.

However, in terms of 'yes' percentages, there is a notable difference between successful and unsuccessful emerging civil engineering relative to knowledge management, monitoring and evaluation of projects and computer skills. Unsuccessful emerging civil engineering

contractors do not consider skills development training relative to negotiation and conflict management, mentoring and coaching important in their organisations. The converse is notable in successful emerging civil engineering contracting organisations relative to personal and team effectiveness, meeting management, human resource management, mentoring, labour relations, financial management for non-financial managers, quality and customer relations management, costing and estimating organisational development, and construction contracts sustainable development.

Furthermore, in terms of 'need' percentages there is notable difference between successful and unsuccessful and successful emerging civil engineering contractors relative to quality management, information technology, human resource planning, and budget control.

Table 12: A comparison between successful and unsuccessful emerging civil engineering contractors' ratings of the adequacy of resources in their organisations

Resource	Successful		Unsuccessful		Mean	
	MS	Rank	MS	Rank	MS	Rank
Management	3.67	2	3.56	2	3.62	1
Competencies	3.78	1	3.44	3	3.61	2
Supervision	3.33	5 =	3.67	1	3.50	3
Information	3.50	4	3.33	4	3.42	4
Innovation	3.56	3	3.00	5 =	3.28	5
Labour	3.11	9	3.00	5 =	3.06	6
Plant & equipment	3.33	5 =	2.56	9 =	2.95	7 =
Finance	3.33	5 =	2.56	9 =	2.95	7 =
Technology	3.22	8	2.67	8	2.95	7 =
Materials	3.00	10	2.78	7	2.89	10
Co-contractors	2.89	11	2.56	9 =	2.73	11

Table 12 provides a comparison between successful and unsuccessful emerging civil engineering contractors' ratings of the adequacy of resources in their organisations in terms of MSs.

It is notable that with the exception of finance, technology, materials, plant and equipment, and co-contractors, all the resources have MSs above the midpoint score of 3.00, which indicates that in terms of the mean, both categories of emerging civil engineering contractors rate their resources marginally more adequate than inadequate. However, it should be noted that three MSs are on

limit of the range, namely 3.00. It is also notable that ten (90.9%) out of the eleven resources relative to successful emerging civil engineering contractors are greater than those relative to unsuccessful emerging civil engineering contractors. Further, it is also notable that only one (9.1%) out of the eleven resources relative to unsuccessful emerging civil engineering contractors is greater than those of successful emerging civil engineering contractors. These higher percentages may be attributable to a clear understanding of actual resources, and a realistic estimate of adequacy. Furthermore, it is also notable that the greatest difference between MSs is relative to, plant and equipment, and finance.

Table 13: A comparison between the form of functions in emerging and established civil engineering contractor organisations

Function	Response per form (%)							
	Emerging						Established	
	Separate			Included with another			Separate	Included with another
	Successful	Unsuccessful	Mean	Successful	Unsuccessful	Mean		
General management	14.3	14.3	14.3	85.7	85.7	85.7	0.0	100.0
Production	14.3	14.3	14.3	85.7	85.7	85.7	50.0	50.0
Procurement	50.0	28.6	39.3	50.0	71.4	55.4	50.0	50.0
Marketing	60.0	50.0	55.0	40.0	50.0	52.5	100.0	0.0
Financial	85.7	25.0	55.4	14.3	75.0	65.2	0.0	100.0
Human resources	85.7	50.0	67.9	14.3	50.0	58.9	0.0	100.0
Public Relations	66.7	62.5	64.6	33.3	37.5	51.1	50.0	50.0
Legal	85.7	71.4	78.6	14.3	28.6	53.6	100.0	0.0
Administration & IT	14.3	28.6	21.5	85.7	71.4	46.5	0.0	100.0

Table 13 provides a comparison between the form of functions in emerging and established civil engineering contractor organisations, in terms of percentages. In terms of 'separate' functions it is notable that only four (44.4%) out of the nine established functions' percentages are > the mean emerging percentages, and five (55.6 %) out of the nine emerging functions' percentages are > than the established percentages.

It is also notable in terms of 'included with another', only four (44.4%) out of the nine established functions' percentages are > emerging, and five (55.6 %) emerging percentages are > than the established percentages. Further, it is notable that the greatest difference between mean emerging and established civil engineering contractors in terms of 'separate' is relative to production, marketing, financial, and human resources relative to 'separate' and marketing, financial, legal, and administration and information technology relative to 'included with another'.

Table 14: A comparison of the deployment of management in emerging and established civil engineering contractor organisations

Level	Deployment of management per level of management (%)											
	Top				Middle				Operational			
	Emerging			Established	Emerging			Established	Emerging			Established
	Successful	Unsuccessful	Mean		Successful	Unsuccessful	Mean		Successful	Unsuccessful	Mean	
Single	22.2	44.4	33.3	75.0	44.4	66.7	55.6	50.0	44.4	44.4	44.4	25.0
Multi	77.8	55.6	66.7	25.0	55.6	33.3	44.4	50.0	55.6	55.6	55.6	75.0

Table 14 provides a comparison of the deployment of management in emerging and established civil engineering contractor organisations in terms of percentage responses.

When comparing the percentage responses of emerging and established civil engineering contractors' organisations, it is notable that the top management of emerging civil engineering contractor organisations is responsible for more than one level of management, whereas the top management of established civil engineering organisations is dedicated more to a specific level. It is also notable that at middle management level, management in emerging and established civil engineering contractors are generally responsible for either a single or more than one level of management. However, the operational management of established civil engineering contractor organisations is responsible for more than one level and albeit it to a lesser extent, the management of emerging civil engineering organisation.

Table 15: A comparison of emerging and established civil engineering contractors' ratings of their management's competencies relative to the functions of construction management

Activity	Rating of competencies per activity per category of contractor (MS)			
	Emerging			Established
	Successful	Unsuccessful	Mean	
Planning:				
Forecasting	3.89	4.00	3.95	3.50
Developing objectives	3.33	3.56	3.45	3.25
Programming	3.67	3.44	3.56	3.75
Scheduling	3.44	4.00	3.72	3.75
Budgeting	3.44	3.67	3.56	3.25
Developing procedures	3.33	3.11	3.22	3.00
Developing policies	3.11	4.00	3.56	3.00
Organising:				
Developing organisational structure	3.56	3.25	3.41	3.75
Delegating	3.67	3.67	3.67	3.00
Establishing relationships	4.11	3.67	3.89	3.75
Leading:				
Decision-making	4.00	4.44	4.22	3.25
Communicating	4.00	4.22	4.11	2.75
Motivating	3.67	4.00	3.84	3.50
Selecting people	3.89	3.89	3.89	2.75
Developing people	3.33	3.78	3.56	2.75
Controlling:				
Developing performance standards	3.33	3.33	3.33	2.50
Performance measuring	3.22	3.22	3.22	2.50
Evaluating performance	3.00	3.00	3.00	2.25
Correcting performance	3.22	3.22	3.22	3.00
Coordinating	3.56	3.56	3.56	2.25

Table 15 provides a comparison between emerging and established civil engineering contractors' ratings of their management's competencies relative to the functions of construction management in terms of MSs. It is notable that overall thirty three of the MSs, most relative to emerging contractors have MSs > 3.00, which indicates that both categories of contractors rate their management's competencies more adequate than inadequate. However, it should be noted that seven MSs are on limit of the range, namely 3.00.

When comparing the MSs of the two categories of contractors, the following can be noted:

- Planning: five (71.4%) out of seven emerging MSs are > established MSs, and two (28.6%) out of the seven emerging MSs are < established MSs;
- Organising: two (66.7%) out of three emerging MSs are > established MSs, and one (33.3%) out of the seven emerging MS is < established MS;
- Leading: five (100.0%) out of five emerging MSs;
- Controlling: four(100.0%) out of four emerging MSs are > established MSs; and
- Coordinating: one (100.0 %) out of one of emerging MS is > established MS.

Further, it is notable that the greatest difference between MSs is relative to communicating and coordinating. In general it is notable that emerging civil engineering contractors rate their management's competencies more adequate than established civil engineering contractors do. These high ratings, particularly those relative to unsuccessful emerging civil engineering contractors, may be attributable to a lack of understanding of the related competencies, and or an over estimation of adequacy.

Table 16: A comparison of emerging and established civil engineering contractors' ratings of their organisations' level of adequacy in the top ten knowledge areas of construction management

Knowledge areas	Rating of knowledge areas per category of contractor (MS)			
	Emerging			Established
	Successful	Unsuccessful	Mean	
Construction methods (Civil)	4.33	3.50	3.92	4.25
Cost control	3.89	3.89	3.89	3.75
Quality management	4.00	3.75	3.88	3.50
Contract administration	4.33	3.78	4.06	3.75
Co-contractor management	3.67	3.67	3.67	2.50
Contract documentation	4.00	3.56	3.78	3.75
Planning (programming)	4.11	4.00	4.06	4.00
Customer service	3.67	4.00	3.84	3.25
Project management	4.00	4.00	4.00	3.75
Productivity	3.89	4.00	3.95	3.50

Table 16 provides a comparison between emerging and established civil engineering contractors' ratings of their organisations' level of adequacy in the top ten knowledge areas of construction management in terms of MSs.

It is notable that with the exception of co-contractor management relative to established civil engineering contractors, all the MSs of both categories are > 3.00, which indicates that both categories of civil engineering contractors rate their knowledge areas in construction management more adequate than inadequate.

It is also notable that nine (90.0%) out of the ten knowledge areas of emerging MSs are > established MS. However, relative to construction civil one (10.0%) out of the ten knowledge areas of the established MS is > the emerging MS.

Therefore, based upon MSs, established civil engineering contractors can be deemed to be deficient relative to certain construction management knowledge areas in their organisations, in particular co-contractor management. As previously stated, the high ratings, particularly those relative to unsuccessful emerging civil engineering contractors, may be attributable to a lack of understanding of the related knowledge areas, and or an over estimation of adequacy. In the essence, emerging civil engineering contractors rate their adequacy higher than established civil engineering contractors do.

Table 17: A comparison of emerging and established civil engineering contractors' ratings of their organisations' construction management knowledge and skills

Competency	Rating of construction management competency per category of contractor (MS)			
	Emerging			Established
	Successful	Unsuccessful	Mean	
Knowledge	4.33	3.56	3.95	4.25
Skills	4.11	3.44	3.78	4.00

Table 17 provides a comparison between emerging and established civil engineering contractors' ratings of their organisations' construction management knowledge and skills in terms of MSs.

It is notable that both established MSs are > unsuccessful emerging MSs, but not the successful emerging MSs.

It is also notable that established civil engineering contractors have higher MSs in the all encompassing competencies, whereas

emerging have higher MSs in most of the single competencies, knowledge, and skills than the established do.

4.2 Summary

Emerging civil engineering contractors do not have adequate construction-related qualifications. Construction management competencies are not clearly understood in terms of their need and the application thereof. Emerging civil engineering contractor organisations are inadequate in terms of having the critical construction resources – *inter alia*, the resource that supervises the activities of the physical construction process. Overall, emerging civil engineering contractors rate themselves lower than established civil engineering contractors in terms of overall knowledge and skills. However, successful emerging civil engineering contractors rate themselves higher. The nine universal functions in an organisation are not fully represented in emerging civil engineering contractor organisations in terms of management dedicated thereto.

4.3 Testing of the hypotheses

Table 5 indicates that emerging civil engineering contracting organisations are comprised of individuals who do not have formal construction-related qualifications. No emerging civil engineering contractor has an employee in possession of a higher education diploma or degree in the discipline of construction management, which could be deemed the ideal qualification in terms of managing a construction contracting organisation.

Table 6 indicates that unsuccessful emerging civil engineering contractors generally overrate themselves relative to successful emerging civil engineering contractors, in terms of their management's competency relative to the functions of management work. Table 7 indicates that successful emerging civil engineering contractors rate their adequacy relative to the top ten knowledge areas of construction management higher than unsuccessful emerging contractors do. Table 10 indicates that unsuccessful emerging civil engineering contractors recognise the extent to which various aspects contribute to the failure of contractors more so than successful emerging civil engineering contractors do, they do not do so relative to operational management, and strategic factors. Table 9 indicates that the level of training is of low skill in terms of skills development as an investment. Table 11 indicates that successful emerging civil engineering contractors have undertaken substantially more training than successful emerging civil engineering contractors.

Table 12 indicates that successful emerging civil engineering contractors rate themselves higher than unsuccessful emerging civil engineering contractors do in terms of adequacy of resources in their organisations. Table 13 indicates that in terms of the mean, functions in emerging civil engineering contractors' organisations are generally afforded separate status more so than they are in established civil engineering contractor organisations. Table 14 indicates that in terms of the mean, the top management of emerging civil engineering contractors is working at more than one level of management, which is not the case in established civil engineering contractors. Table 14 further indicates that established civil engineering contractors have less individuals at more than one level of management than emerging civil engineering contractors have. Table 17 indicates that in terms of the mean, emerging civil engineering contractors rate themselves lower relative to overall construction management knowledge and skills than established civil engineering contractors do.

The results of the testing of the hypotheses are as follows:

- Emerging civil engineering contractors lack construction related qualifications is supported;
- Emerging civil engineering contractors lack construction management competencies is partially supported;
- A range of factors contribute to the failure of emerging civil engineering contractors is partially supported;
- The level of skills development in emerging civil engineering contractors is inadequate is supported;
- The level of resources in emerging civil engineering contractors is inadequate is supported;
- Construction management competencies are more pervasive in successful established civil engineering contractor organisations than in emerging civil engineering contractor organisations is supported; and
- Established civil engineering contractor organisations are better resourced than emerging civil engineering contractor organisations is supported.

5. Conclusions

Emerging civil engineering contracting organisations are not fully competent in terms of the functions and activities of management work that constitutes the general management function, which is necessary to achieve intended results. Marketing, which is a key function in that effectiveness thereto, is essential to realise a sustainable business. The environment and information technology are not seen as important aspects in order to record success.

6. Recommendations

Construction management as a discipline needs to be marketed with the intent of attracting more recruits to the discipline from potential construction-related practitioners.

Emerging civil engineering contractors need to be adequately educated. Civil engineering programmes directed towards empowering future contractors need to be management, economics, and science and technology focused. Further, barriers to entry to the civil engineering construction industry need to be implemented and regulated by enforcing criteria to register. If government pursues emerging civil engineering construction as a paradigm, then there is a need for government to embark on a national training initiative. Given that construction is a science, art, and profession, the reality needs to be acknowledged and accepted by all built environment practitioners, and the concept of emerging civil engineering contractors needs to be reviewed.

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Perceptions of crime and the built environment: the case of the Bloemfontein Central Business District (CBD)¹

Peer reviewed

Abstract

Internationally, inner-city crime has been a well-documented area of urban studies. In South African urban discourse, however, crime studies and inner-city crime studies *per se* have been scant. Therefore, it is the aim of this article to address the paucity of academic reflection, in this regard in South Africa, by means of a case study on the spatial patterns of crime distribution, perceptions of crime, and fear of crime in the inner city of Bloemfontein, and how these factors influence urban morphology (and *vice versa*). This case study on one of South Africa's middle-order cities may potentially comprise a valuable contribution, since the majority of inner-city studies on crime thus far have focused predominantly on the three major metropolitan areas of South Africa. Therefore, three arguments shall be put forward. Firstly, the impact of decentralised shopping centres on the prevalence of crime in inner cities will be highlighted. Secondly, the relationship between crime and 'grime' (physical decay and neglect) as causal factors in inner-city areas will be discussed. Thirdly, it will be argued that the fear of crime in the inner-city is an important consideration to be taken into account when assessing the spatial patterns and perceptions of this occurrence. In the case of Bloemfontein, this fear does not seem to be only racially related as black and white people experience the same levels of fear. By means of these arguments, an attempt will be made to contribute to the understanding of inner-city crime and its relationship to the urban form.

Keywords: Inner-city crime, decentralisation, grime (decay), Bloemfontein CBD, location

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¹ This article draws extensively from a CBD economic development study conducted for the Mangaung Local Municipality

Abstrak

Binnestadmisdaad is internasionaal 'n goed gedokumenteerde veld in stedelike studies. In die Suid-Afrikaanse diskoers oor stede was studies oor geweld en studies oor binnestadgeweld *per se* tot dusver egter redelik skaars. Hierdie artikel het dus ten doel om die leemte in akademiese nadenke op hierdie gebied in Suid-Afrika deur middel van 'n gevallestudie oor ruimtelike verspreiding van misdaad, persepsies oor misdaad en vrees vir misdaad in Bloemfontein se binnestad te vul, asook hoe hierdie faktore die stedelike morfologie beïnvloed (en omgekeerd). Hierdie gevallestudie oor een van Suid-Afrika se middelorde-stede hou die moontlikheid in dat dit 'n waardevolle bydrae kan lewer aangesien die meeste studies oor misdaad in die binnestad tot dusver oorwegend op óf Kaapstad óf Johannesburg gefokus het. Daar word drie argumente geopper. Eerstens, die impak wat gedentraliseerde winkelsentra op die voorkoms van misdaad in die binnestad het, word uitgewys. Tweedens, die verhouding tussen misdaad en 'morsigheid' as faktore wat misdaad in die binnestad veroorsaak, sal bespreek word. Derdens, word daar geargumenteer dat die vrees vir misdaad in die binnestad 'n belangrike rol speel wanneer die ruimtelik patrone en persepsies van misdaad geassesseer word. Dit lyk asof die vrees in Bloemfontein se geval nie net rasverwant is nie. Deur hierdie argumente word gepoog om 'n bydrae te lewer tot die verstaan van misdaad in die binnestad en die verhouding daarvan met stedelike vorm.

Slutelwoorde: Misdaad, geweld in die binnestad, desentralisering, morsigheid, Bloemfontein se SSG, ligging

1. Introduction

Internationally, inner-city crime has been a well documented study area in urban studies (see, for example, Foster, 1990; Robins, 1992; Sanders, 2005). However, in South African urban discourse, research on the spatial distribution of inner-city crime has been fairly limited. This is surprising, considering the array of literature on urban morphology and the impact of *apartheid* on these areas (Smith, 1992; Beavon, 2004), as well as an ever-increasing number of papers assessing post-*apartheid* urban transformation (e.g. Donaldson & Van Der Merwe, 2000; Donaldson & Marais, 2002; Dewar, 2004). There are, however, a few existing research documents in which the relationship between inner cities and crime does, in fact, feature prominently (see, for example, Allen, 2002; Newham, 2002; Reid & Dirsuweit, 2002; Lemanski, 2004; Liebermann & Coulson, 2004). Other related research delineates the effects of gated communities as a response to crime (Hook & Vrdoljak, 2002; Landman, 2002; Landman & Schönteich, 2002), and the relationship between crime and the built environment (Bremmer, 1998; Liebermann, 2003). At the same time, some extensive work has been conducted on inner-city change; and reference is made to crime, amongst other issues (cf. Morris, 1999; Gnad, Bähr & Jürgens, 2002; Donaldson, Jürgens & Bahr, 2003; Hoogendoorn & Visser, 2007). Nevertheless, very little emphasis has been placed specifically on inner-city crime in South

Africa. Therefore, it is the aim of this article to address the paucity of academic reflection on inner-city crime in South Africa by means of a case study on the different perceptions of crime and to an extent the spatial distribution of this occurrence. The article will in the first instance argue that the development of decentralised shopping centres has been an underlying factor in the increase of crime in inner-city areas. Secondly, that the relationship between crime and 'grime' are the causal issues of inner-city crime. Thirdly, that fear for crime is a prominent aspect that needs to be more clearly understood.

In order to develop these arguments, the article unfolds as follows: Firstly, an international literature review will be provided in respect of the contentious issue of inner-city crime. This will be followed by a national literature review pertaining to crime research, which will continually refer back to the inner-city experience. Finally, the situation with regard to crime in the Bloemfontein Central Business District (CBD) will be presented as a case study.

Methodologically, the article is based on empirical data gathered over several months during 2005, as well as on two residential surveys conducted in 2001 and 2004. Four specific methods that were used are mentioned in more detail. First, semi-structured interviews were conducted with property owners and managers in Bloemfontein's CBD. Second, the section reflects on the experiences of potential CBD customers. For this purpose, 688 interviews were conducted with customers. Of these, 304 individuals (44.1%) were interviewed in the CBD and 384 individuals (55.8%) were interviewed at one of the main decentralised shopping centres in Bloemfontein. Third, the article draws on the results of 308 questionnaires, 208 of which were completed during June 2005 by respondents from formal business units, and 100 by respondents from informal enterprises. The final phase of the study consisted of a longitudinal study of the changing residential environment in the Bloemfontein CBD which was used as a source of background and contextual information. Two surveys were conducted, one in 2001 and in 2004; and some of the responses to the questions in these surveys reflect people's perceptions regarding crime.

2. An international review of inner-city crime

The past two decades have seen a growing realisation on the part of policy makers, policy agents, and researchers that understanding the context of crime – the 'where' and 'when' of a criminal event – comprises the key to understanding how crime can be controlled

and prevented (Cahill, 2004). According to Foster (1990), crime is an ever-present and pervasive characteristic of many inner-city areas. Sah (1991) moreover argues that crime and the fear of crime have deeply negative impacts on personal and societal well-being. The aim of this section is to explore the place-bound effects of inner-city crime, the reasons why there is more crime in the inner city, and how such crime is generated. The literature indicates that the relationship between decentralised development and inner city crime, the relationship between crime and grime and the fact that perceptions on crime are central to decisions regarding location and relocation of businesses and individuals has already been extensively debated.

One of the most puzzling aspects relating to crime and linked to the question of why crime is prevalent in inner-city areas is not the overall level of crime, nor the relationships between the factors that lead to crime, but rather the fact that crime is a deterrent to social capital and economic opportunity in inner-cities. Oc & Tiesdell (1997) suggest that changes in the central city are compounded by many factors, such as disurbanisation and the creation of non-centralised shopping malls. Thus, the deterrence of economic opportunity in CBDs is often created by the effects of decentralised commercial developments. For example, Thomas & Bromley (2000) argue that, in the past 30 years, the pre-eminent status of city centres in the retail system of British cities has been challenged by the competitive impact of retail decentralisation. Arguably, businesses participating in decentralisation adopt an attitude of 'reroute to remain'. According to Burnham *et al.* (2004), high crime rates near the CBD, whether real or perceived, could increase concerns for personal safety and thereby induce the migration of affluent residents to the suburbs, with a concomitant relocation of employment opportunities and businesses. The consequence is that the CBDs from which such relocation takes place is increasingly subjected to economic and social decay with the consequent influx of criminal elements.

Research confirms the above. For example, Deutch & Epstein (1998) found a correlation between the distance from crime hotspots such as inner-city areas, and criminal activity - for example, in terms of a reduction in the frequency of crime. In addition, Zenou (2003) mentions that it has consistently been pointed out in the relevant literature that, within cities, crime is highly concentrated in a limited number of areas. For instance, in the metropolitan areas of the USA, crime rates are much higher in central cities than in suburbs. Furthermore, Thomas & Bromley (2000) argue that early redevelopment strategies have created significant degrees of spatial fragmentation

between functions, and have led to the loss of a substantial residential population. In the present social climate globally, these changes have resulted in negative implications for the perception of safety, as well as the generation of fear and anxiety among users of the city centre.

Sah (1991) implies that the rates of participation in crime in different societal groups often correlate with such background variables as location (city centres versus suburbs versus rural communities), age structure, and ethnicity (for example, blacks versus whites), even after a large number of economic and deterrence variables have been controlled. Dorfman & Schiraldi (2001) argue that, in many instances, society tends to equate race with location, and, accordingly, to favour the suburbs, as against the inner city.

Many city centres world-wide are 'no-go' areas for numerous groupings (Mooney, 1999: 126). Therefore, it is clear from the above that mental associations are created between the locality of crime, the presence of the 'underclass', and their influence on drug trafficking. Grogger & Willis (2000) argue that, in the popular view, the arrival and widespread use of drugs such as cocaine led to increases in central-city crime and accelerated trends towards urban decay. Popular and ethnographic reports link drugs to gang violence, high murder rates, urban unemployment, poverty, and family disruption.

In conclusion, this section has attempted to review the international experience of inner-city crime, with specific reference to spatial preferences, the deterrence of economic opportunity, the effects of decentralised shopping centres, and perceptions in respect of crime. The focus will now fall on inner-city crime in the South African context.

3. The impact of crime on South African society: a link to inner-city crime?

3.1 Crime in South Africa: an overview

As the available literature on inner-city crime in South Africa is limited, the section first provides a broad overview of inner-city crime and its spatial distribution, followed by an overview of existing research on inner cities and crime. It is common knowledge, corroborated by research, that crime is a major problem in South Africa. Dirsuweit (2002) states that crime has become a national obsession. Shaw (1995) argues that both political and social transformation have had a profound effect on South African cities. Maintaining order in

the cities during the period of reconstruction and democratisation has been crucial to promoting the welfare of the new society. Shaw (1995) encapsulates the situation in suggesting, for many South Africans, the decline in political violence marked the end of South Africa's transition to democracy; but that the political violence for many former white group areas such as Central Business Districts were then replaced by growing levels of crime. Although it should be admitted that a fair amount of ambiguity exists regarding levels of crime before and after 1994 because of changes in legislation (see for example, Du Plessis & Louw, 2005).

In the opinion of many, the failure of local government to enforce municipal by-laws, coupled with the physical decline of public space (mainly in inner-city areas), created a sense of urban lawlessness, leading to heightened crime and perceptions of crime (Morris, 1999).

According to Dirsuweit (2002), in a survey of 110 countries conducted in 1997, Interpol ranked South Africa as having the highest *per capita* rates of murder and rape. Interpol also found that South Africa had the second highest *per capita* rate of murder and the fourth highest number of cases of serious assault and other sexual offences. To highlight the severity of crime, Louw (1999) presents the findings of a study on crime in South Africa's four major metropolitan areas, namely Johannesburg, Durban, Pretoria, and Cape Town:

- Johannesburg had the highest incidence of crime, with 62% of all respondents having been victims of crime.
- Durban had the second highest incidence, with 59% of all respondents having been victims.
- Fifty-four percent of all respondents in Pretoria had been victims.
- Lastly, 49.5% of all respondents in Cape Town had been victims.

More recent research by Ipsos Markinor suggests that:

- "60% of South Africans believe that crime has increased over the past six months
- 90% of South Africans have not experienced any form of crime over the past six months
- 39% of South Africans know someone who has been a victim of crime over the past six months

- 50% of South Africans think the police are not doing enough to combat crime
- 33% of South Africans believe the government is handling the issue of combating crime well. Down from 54% a year ago
- 63% of South Africans have done nothing to address crime in their communities
- 4% of South Africans have taken an active role by either joining as a police reservist or by taking part in community policing forums" (Ispos Markinor, 2007: online).

With crime rates being very high in South Africa, crime and the fear thereof have locally created certain 'fear-based' spatial distributions. The absence of a thorough analysis of the fear of crime, in terms of, *inter alia*, the displacement of anxieties about transition and the 'stereotyping' of others, may hamper the effectiveness of interventions aimed at dealing with the spatial processes of crime, and the fear of crime (De Bruyn, 2002). Altbeker (2005) points out that the results of surveys that have been conducted all over the world suggest that the fear of crime is higher in diverse societies than in uniform societies.

3.2 Inner-city crime in South Africa: some perspectives

Although relevant research in respect of inner-city crime is limited, a number of contributing comments need to be made. According to Allen (2002), the discourse in respect of race is an ever-present issue within the South African inner-city context, especially in view of the fact that white people often equate black people with criminality. The challenge, however, lies in the examination of the various ways in which the different communities experience fear, as well as an ethnographic approach to the fear of crime (Dirsuweit, 2002). Dirsuweit & Reid (2002) rightfully point out that urban citizenship entails the freedom to move around in, use the public facilities of, and express one's identity, in a particular city. A situation, in which violence and crime are rife in the city, comprises an extreme instance of the curtailment of these rights. Such a situation erodes people's sense of safety and restricts choice. This factor underpins the urgency of the need to prohibit crime in the inner city.

In conclusion, with regard to the South African situation, it is clear that inner-city crime specifically has received very little attention as a specific topic of research as crime statistics are seldom provided for smaller geographic entities. Nevertheless, intensive research has

been conducted on the relationship between actual crime and the fear of crime, as well as on levels of victimisation. Reducing the negative perceptions in respect of crime, while concomitantly bringing down the actual crime rate to a corresponding level, could prove to be essential towards creating a stable society. The lack of research can be regarded as an opportunity to contribute to the development of a theoretical base with regard to inner-city crime in South Africa and to determine how it differs from the international experience. In addition, this research could contribute to the understanding and development of the current South African society and how they negotiate inner-city areas.

4. Inner-city crime: a Bloemfontein case study

4.1 A historical background on Bloemfontein and the Bloemfontein CBD and its relevance to inner-city crime

With a view to facilitating a more in-depth understanding of perceptions of crime and its spatial influence in the Bloemfontein inner city, a broad historical overview will now be provided. Bloemfontein has been described as a quintessential *apartheid* city (Krige, 1991; 1998). This statement refers, amongst other factors, to the 'effective' manner in which the various population groups were segregated, with the CBD (see Figure 1) as the focus of convergence for commercial purposes. Residential segregation goes back a long way (see Krige, 1991). The residential component of the Bloemfontein CBD was a 'whites-only' area under *apartheid*. Jürgens *et al.* (2003) point out that Bloemfontein's CBD witnessed a shift in racial composition from a 'whites-only' area in 1991, to an area with a desegregation level of almost 50% in 2001. The estimates in 2005, suggest that the levels of desegregation have increased even further, to approximately 77%. However, more importantly, the Bloemfontein City Council has taken various decisions in favour of decentralised shopping centres since the early 1980s (Hoogendoorn & Visser, 2007). Krige (1998) noted that, since 1994, nearly all private development has taken place towards the west of the CBD. The latest of these decentralised developments have also been designed with a view to discouraging crime. For example, secure and under-cover parking and limited entrances to retail complexes are major characteristics of the new architecture aimed at limiting crime in these malls. These decentralised developments have played a fundamental role in causing white customers initially, and later, middle-class customers in general, to avoid the CBD as a shopping area. At the same time, these developments have increased the pressure on the police service to

provide effective policing in areas surrounding decentralised commercial shopping centres. Furthermore, as a result of the withdrawal of the middle- and higher-income groups from the CBD, it was necessary for the CBD to undergo a phase of adjustment to a new clientele. This meant that, for the last ten to fifteen years, very little private-sector finance went into the CBD. Overall, buildings were not always maintained, while public spaces and services did not always receive adequate attention. The low levels of public investment in services - that went hand in hand with the development of decentralised commercial areas led to the further deterioration of the CBD and creating conditions conducive to crime. The result was that crime increased steadily over a period of time. In the late 1990s, closed-circuit television (CCTV) cameras were erected in strategic places to curb the incidence of crime. At that stage, it seemed as if some of the crime in the inner city had been displaced to suburbs such as Westdene, adjacent to the CBD (Hoogendoorn, 2005). It is thus clear that the increase of crime in the Bloemfontein CBD since the 1980s cannot be viewed in isolation from the purposeful development of decentralised complexes.

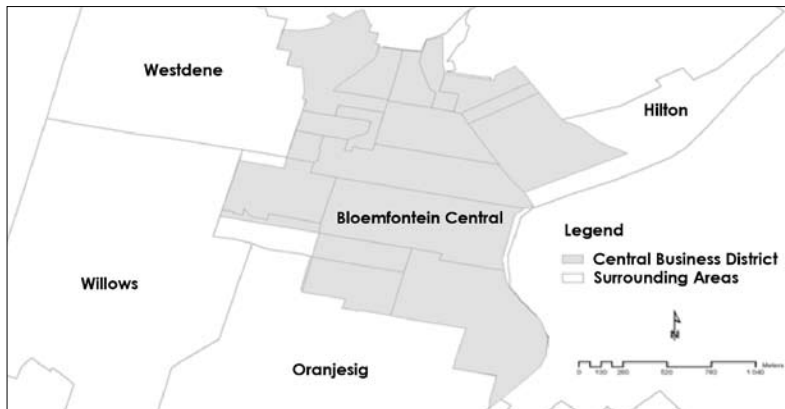


Figure 1: The Bloemfontein Central Business District

In the light of the foregoing overview, the focus will now shift to patterns of crime in the CBD, as well as to the results of the various interviews that were conducted for this study.

4.2 Patterns of crime in the Bloemfontein CBD

Statistics of crime are not always available and are often unreliable given that, for example, many crimes are not reported, as well as that many crimes are not recorded because of institutional impediments. Therefore, there might be some ambivalence as to the accuracy of crime statistics holistically. In addition, they do not always take crime waves into account (Altbeker, 2005). Despite these acknowledged shortcomings, a brief assessment of the available statistics will now be provided. In order to underline the severity of the crime situation in Bloemfontein's CBD, a comparison will be drawn between the CBD and three former white group areas in Bloemfontein (no other comparisons being available at the time of research). During June 2005 – November 2005, 16 categories of priority crimes were identified by the Park Road Policing Precinct which is the head offices of the South African Police Force in Bloemfontein, including, *inter alia*, malicious damage to property, robbery, common assault, and theft of (and from) vehicles. The cases were reported in Bloemfontein's CBD for June 2005 alone, numbered 1413, while Westdene, bordering the CBD to the west, had only 215 reported cases in June 2005. Willows, to the south of the CBD, had only 101 reported cases during June 2005. Lastly, Heuwelsig, an upper-class suburb in the north of Bloemfontein, had 27 reported cases during the period (Community Policing Forum, 2005; Landman & Liebermann, 2005) (Figure 2).

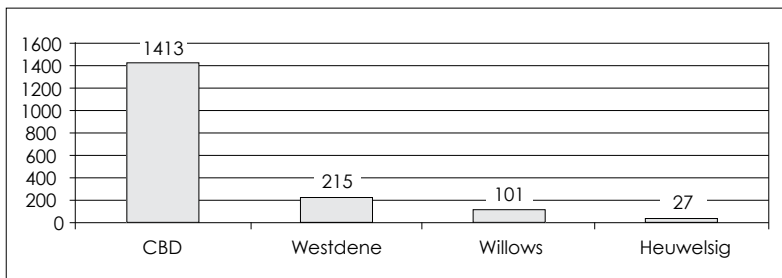


Figure 2: Reported crimes in June 2005 – Nov 2005, Bloemfontein

On the basis of Figure 2, two main comments need to be made. Firstly, it is evident that the crime rate in the CBD is extremely high in comparison with that of the other areas of Bloemfontein such as Westdene and Willows which has a similar residential and commercial base. These statistics do however need to be viewed in a specific context. The primary crime hotspots in the CBD are located around the Sanlam Centre, with 107 incidents having been reported from January to June 2005, and the Middestad Centre, with 45 incidents

(Landman & Liebermann, 2005). At the same time, it should be recognised that if the number incidents of crime were to be considered in relation to the number of people in each of these areas, the resulting ratio would not reflect quite so negatively on the CBD.

Secondly, the following question needs to be asked in this regard: In what way is crime in Bloemfontein's CBD different from crime in other parts of Bloemfontein? The number of reported crimes in the CBD is six times higher than the number of crimes reported in, for example, Westdene, which has the highest crime rate after the CBD. Crime-related evidence suggests that crime within the CBD is constantly present, while other areas of Bloemfontein tend to undergo fluctuations. Thus, crime is not a constant phenomenon in these areas. The existence of the crime hotspots in the CBD (Landman, 2002) testifies to the permanency of crime in these particular areas. Another difference is that crime in the CBD is more serious in nature, with rape and murder, as well as armed robberies (a major cause of concern for businesses), being more prevalent than in the suburbs. Therefore, an investigation was undertaken to determine the perceptions of customers, business owners, residential owners and property owners in the CBD in Bloemfontein with regard to crime.

4.3 The perceptions of businesses in respect of crime in the CBD in Bloemfontein

Business owners hold many negative perceptions of the CBD. The key disadvantage for formal-economy businesses relates to safety and crime (50.6%) and, to a lesser extent, to the (lack of) cleanliness of the area. The migration of key customer cohorts to decentralised business nodes elsewhere in Bloemfontein also plays a part. An important aspect relating to this issue is that enterprise owners in the informal economy, who are often more vulnerable to crime, do not share this concern. Indeed, only 3.1% of owners of informal-economy enterprises cited crime and safety issues as disadvantages resulting from their location in the CBD. It seems that to them their fight for legitimate existence is a more important consideration than crime. At the same time, informal businesses are also mobile enough to avoid crime hotspots, while formal businesses have fixed locations. Of all business owners (formal and informal) 9.5% were not satisfied with the levels of cleanliness. According to most of the landowners, the crime situation in the CBD is exaggerated. Landowners argued that newspapers tend to focus excessively on the CBD. This happens despite the fact that (according to them) more crimes are committed, comparatively speaking, in Westdene or at Mimosa

Mall. What seems evident from the discussions held with landowners is that it took the CBD approximately ten years to adapt to a new clientele after the middle- and high-income groups had withdrawn from the CBD. However, they are of the opinion that the CBD has, in fact, succeeded in adapting to the new clientele, and that what the CBD currently requires is effective basic service delivery such as refuse removal, cleaning of streets and upgrading of infrastructure to name a few examples. This process of adaptation to the new clientele nevertheless entailed a period of uncertainty and also a downscaling of many public-sector investments.

4.4 Customers' perceptions of the CBD in Bloemfontein

This section explores two customer cohorts' perceptions of Bloemfontein's CBD. The first group of interviews was conducted with customers in the CBD (mainly black respondents) while the second group of interviews was conducted with customers at decentralised commercial centres (mainly white respondents). Table 1 provides a reflection of the negative perceptions of the CBD, as experienced by these two groups of customers. The second table indicates the responses returned when these customers were asked what, in their opinion, would be likely to induce people to return to the CBD for the purposes of their general shopping (Table 2).

Table 1: Negative experiences within the CBD, 2005

Negative experiences	Location of survey participant		Total (%)
	In the CBD (%)	Decentralised shopping centre (%)	
Crime and feeling unsafe	26.3	40	34.3
Dirt and grime	28.7	19.5	23.6
Distance, transport costs and transport problems	1.5	3.9	2.8
Foreigners	2.7	0.4	1
Hawkers, street children and schoolchildren	23.5	3.9	12.5
Infrastructure-related problems, e.g. leaking pipes, toilet facilities	2.7	7.5	5.4
Lack of entertainment	0.3	0.4	0.4
Fewer economic opportunities	2.4	1.7	2
Negative social experiences	4.9	4.3	4.6
Overcrowded; life too fast, busy, noisy	5.5	7.5	6.6
Racial problems	0.9	9.7	5.8
Total	100	100	100

Table 1 reflects the negative experiences of customers within the CBD. For people residing and working within the CBD, the main problems are the effects of crime (26.3%), the dirt and grime (28.7%), and hawkers and street children (23.5%). The problems experienced by customers at decentralised centres are similar except that the percentages in respect of crime are higher (40%). This is probably an indication of white fears - as has already been pointed out by other researchers in South Africa (Allen, 2002) - since the majority of respondents at the decentralised areas were white people. However, as suggested in the relevant theoretical sources, and as we will also argue later, the relationship between crime and grime should not be underestimated. If these two categories of problems are merged, the differences between the responses of the CBD respondents and those of the respondents at the decentralised shopping centres in respect of crime become less significant. It seems that the perceptions of white people are different from those of black people in the CBD. This factor influences the cultural variability and accessibility of the CBD.

Table 2: Suggestions concerning what could be done to induce people to come back to the CBD, 2005

Suggestions	Location of survey participant		Total (%)
	In the CBD (%)	Decentralised shopping centre (%)	
Crime-prevention measures; make CBD safer; policing	36.2	37.9	37.2
Economic improvement	14.5	10.3	12
Entertainment amenities and social development	1.5	1.6	1.6
Find ways of solving problems related to hawkers and street children	9.1	3.5	5.9
Cleanup operations	23.6	13.3	17.7
More development, shops, sports grounds, art, and culture	4.1	0.7	2.1
Negative evaluation - nothing can be done	3.7	6.7	5.5
Removal of unwanted elements (e.g. racial conflict)	4.4	6.5	5.6
Traffic and parking	0.3	4.6	2.8
Upgrading of services and aesthetic values	2.2	14.5	9.2
Total	100	100	100

Table 2 explores the issues that could be dealt with in order to revitalise the CBD and induce people to come back. Both surveyed groups, within the CBD (36.2%) and at decentralised shopping centres (37.9%), felt that crime could be prevented or reduced if policing were more visible. Another possibility is that, if elements of gentrification were to be introduced, this could be instrumental in improving inner-city districts (cf. Visser, 2002). At the same time, it should be noted that, despite some differences between the two groups regarding their perceptions of crime, the results in Table 2 suggest that respondents in both the CBD (mainly black respondents) and the decentralised commercial centres (mainly white respondents) felt that improved safety was a crucial factor towards ensuring a larger clientele. This finding suggests that aspects of fear for crime are not racially bound. Furthermore, both groups felt that (re)investment within the CBD, as well as general economic improvement, could be beneficial in terms of revitalisation of the CBD. Cleanliness was also an issue, especially with the respondents within the CBD (23.6%). It seems that, particularly in the opinion of the customers in the CBD, a correlation existed between crime and grime.

4.5 CBD residents' perceptions in respect of crime

This section focuses on the perceptions in respect of crime amongst the residential population of Bloemfontein's CBD. Respondents were asked what they disliked most with regard to the CBD (Figure 3). For the purposes of comparison, the information in Figure 3 is taken from two surveys conducted in 2001 and 2004.

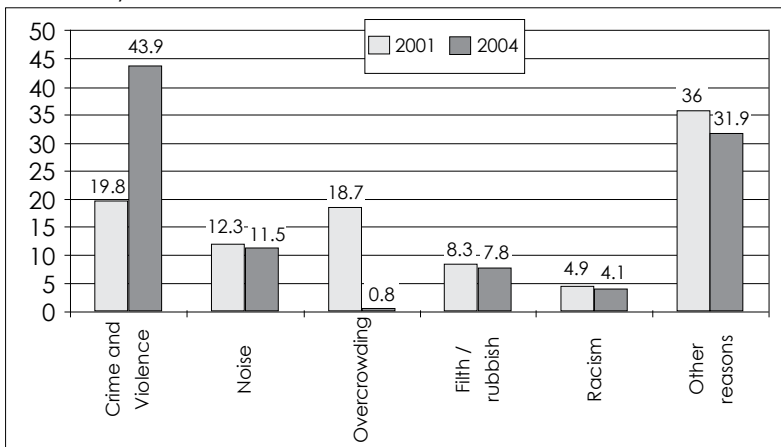


Figure 3: What respondents disliked most about the CBD, 2001 and 2004

Figure 3 reflects the respondents' dislike of specific aspects of the CBD, according to two similar studies conducted in 2001 and 2004. Respondents' most important objection concerning the CBD was related to the situation regarding crime and violence. There was also a considerable increase in the negative perceptions pertaining to these aspects between 2001 and 2004 (from 19.8% to 43.9%). In 2001, the second most important negative aspect cited regarding the CBD related to noise (11.5%). A noteworthy aspect is that, in 2001, 18.7% of the respondents cited the levels of overcrowding in the CBD as a negative aspect. However, in 2004, not even 1% of the respondents mentioned this aspect. It seems clear that those who, in 2001, viewed overcrowding as the most negative aspect of the CBD, subsequently changed their opinions, and now (2004) regarded crime and violence as the most negative aspect. Furthermore, the crime waves that in 2004 affected adjacent areas of the CBD i.e. Westdene and Willows, as well as the fact that this situation was comprehensively reported on in local and national newspapers, may also have had an effect on the respondents' perceptions (Hoogendoorn, 2005).

The foregoing section focused on people's perceptions regarding crime. In view of the negative reactions related to the CBD outlined above, an attempt will now be made to assess the current situation with regard to crime and grime. Figure 4 provides an overview of the percentage of respondents who were mugged, burgled, or whose cars were stolen, as well as the percentage of respondents who perceived the CBD to be dirty (See Figure 4).

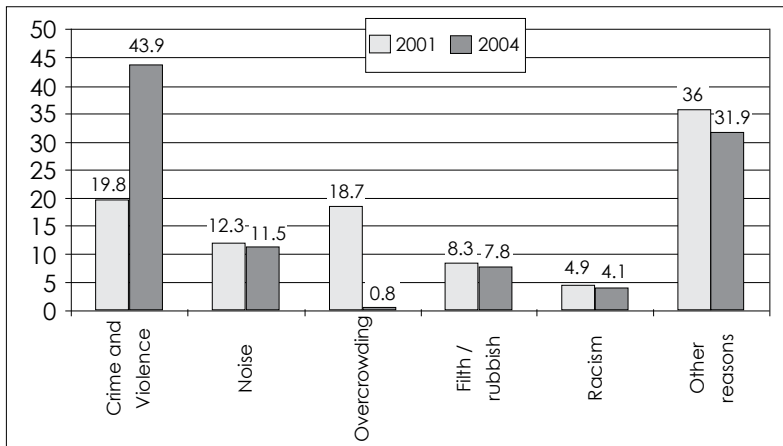


Figure 4: Changes in perceptions regarding crime and the environment perceptions in the CBD, 2001 and 2004

A number of important considerations should be mentioned in respect of the percentages recorded in Figure 4 above. It seems that the number of people who became victims of crime decreased between 2001 and 2004. The proportion of persons who were mugged decreased from 61.8% in 2001 to 40.2% in 2004. Similarly, the percentage of respondents claiming that their flats had been burgled declined from 67.4%, to 20.7%. A decrease is also observable in the percentage of respondents whose cars were stolen or broken into. It is also significant that the percentage of respondents who perceived the CBD to be dirty, declined from 41% in 2001, to 32.7% in 2004. Concerning the above factors, as well as the comments made earlier in respect of what residents seemed to dislike about the CBD, three important concluding comments can be made. First, according to statistics, crime is undeniably a serious problem in the CBD. Nearly one-third of the respondents had been mugged; 20% had been burgled; and just under 20% had been victims of car theft or car burglary. Second, the increase in the perception of crime being a problem in the CBD was not accompanied by an increase in the number of real cases reported by respondents. Third, this increase could be an indication of an urban environment which, despite a decrease in victimisation, was not conducive to a change in individuals' perceptions. The then current spatial arrangements of the physical infrastructure and buildings tended not to make people feel comfortable.

5. What can be learnt from the empirical evidence concerning crime and the CBD?

A number of aspects should be noted in this regard. First, we are of the opinion that one of the main reasons for crime in the CBD is related to the development of decentralised commercial centres since the early 1980s. These centres have succeeded in directing the traditional middle- and high-income customers away from the CBD. To a large degree, these centres have led to the segregation of commercial areas in the city (initially in terms of race, but later in terms of income). Since the early 1990s, the withdrawal of the historical clientele has placed immense pressure on the existing businesses. At the same time, the provision of public services to the CBD does not seem to have been regarded as priority. Moreover, such services (including police services) have had to be provided to a much larger area. In the process of adapting to a new clientele, the CBD struggled to define its function within the city. Thus, decentralised development resulting in poor public services in the CBD, coupled with the search for a new function for the CBD by the private

sector, contributed extensively both to an increase in crime and fear of crime in the CBD. Second, in addition to the influence of decentralisation, the architecture of the newly-constructed decentralised centres is far less crime-friendly than the architecture of the CBD. The designers of the new commercial developments have ensured that the architecture of these developments provide barriers to crime. Therefore, in future developers in the CBD and elsewhere, could implement the principles of Crime Prevention through Environmental Design (CPTED) which as been explored within literature for a fair extent (see for example Liebermann & Coulson, 2005).

Third, as suggested by the literature on crime in South Africa and elsewhere, the fear of crime is an important consideration. Our research supports the findings of existing research in this respect. Fear of crime is evident from the perceptions of business owners, residents, and customers. It is noteworthy that fear of crime can be observed in all racial groups, and not only in the white population. In the fourth instance, the poor levels of service and the perceived lack of cleanliness further exacerbate the fear of crime. Finally, no specific comments have been made regarding the existence of subcultures in the Bloemfontein CBD. This is partly attributable to the fact that the Bloemfontein CBD has a far smaller contingent of non-South Africans than have other areas.

6. Conclusion

This article largely confirms the findings of the existing literature on inner-city crime and development. Yet, the empirical evidence and basic arguments about the relationship between crime, inner cities and decentralised developments in the case of Bloemfontein suggest increasing evidence that the management of these aspects have been contributing to inner-city crime. It is evident from the research that the middle- and higher-income populations (mainly white) avoid moving into the inner city as decentralised alternatives became available. Ongoing informalisation of local economies, which serves to underscore the 'Africanisation' of Bloemfontein's inner city, encompassing also its cultural atmosphere, is already firmly established (Jürgens *et al.*, 2003). The effects of the desegregation of the CBD, as well as the continued informalisation of local economies, led to the decentralisation of white businesses, or 'white flight' to adjacent areas such as Brandwag, Westdene and Wilflows. This decentralisation in turn led to economic deterrence and decay for the CBD, which created an opportunity for the infiltration of inner-city crime, owing to the fact that higher-order businesses

(formal enterprises which have moved out) depend on high levels of security for their clients, while lower-class businesses (more informal enterprises who remained in the CBD) do so to a lesser extent. Furthermore, decisions by 'city fathers' to support decentralised development have had a major impact on crime in the CBD. It has been argued in this article that, in the South African context, decentralised shopping centres mean further segregation of commercial space, which, in many cases, means that police resources are stretched despite the rise of the private security industry. What is also evident is that crime in Bloemfontein's CBD occurs mainly in certain specific areas, despite attempts by the police to disrupt criminal activities in these hotspots (Landman & Liebermann, 2005). Furthermore, the architecture of the CBD allows for the prevalence of crime – more so than in the case of the newly erected decentralised commercial centres. The features of the CBD's architecture include dark alleys, narrow roads, old dilapidated buildings and *culs-de-sac*. This can mainly be attributed to the age of many of the buildings that were not originally built with the specific intention of prohibiting crime. In contrast, decentralised shopping centres specifically cater for ensuring the safest possible shopping experience for their customers. Finally, we have argued that, as in the case of other areas, fear of crime is a prominent factor. However, in this case study, this fear was not exclusively linked to a single race group – even if some racial patterns are discernible in this regard.

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A review on the effectiveness of the Joint Building Contracts Committee Series 2000 Principal Building Agreement – A contractors' perspective

Peer reviewed

Abstract

With the growth experienced in the building industry, it is increasingly important to have a contract document that can be used on projects that is reasonably acceptable to all parties concerned. The focus of the study was to determine the effectiveness of the *Joint Building Contracts Committee Series 2000 Principal Building Agreement (JBCC 2000 PBA)* (Edition 4.1, March 2005) as used in the building industry. Although edition 5 (2007) was made available after this study was conducted, contractors still have the choice to use either one of them.

Primary data was collected by means of interviews and a structured questionnaire sent to selected contractors in the South African building industry. Secondary data was obtained from the literature reviewed in relevant publications. The main findings were that the *JBCC 2000 PBA* is the most favoured contract document used by contractors in the building industry but that there are still areas of concern with regards to the difficulty in interpreting and implementing numerous clauses of the document, amendments being made to the document without any legal advice and that developing building contractors experience difficulties in general where the *JBCC 2000 PBA* is used as contract document on projects.

The study concluded with recommendations for amendments to the contract document to ensure that the document will be acceptable to all contractors in the building industry and ultimately to be an internationally acceptable document.

Keywords: Contract document, construction guarantee, contractors, disputes, JBCC 2000 PBA, retention

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Abstrak

Met die groei wat in die boubedryf ondervind word, is dit belangrik om 'n kontrakdokument daar te hê wat redelik aanvaarbaar is vir beide betrokke partye. Die doelstelling van die navorsing was om die effektiwiteit van die *Joint Building Contracts Committee Series 2000 Principal Building Agreement (JBCC 2000 PBA)* (Uitgawe 4.1, Maart 2005) soos wat in die boubedryf gebruik word, te bepaal. Alhoewel uitgawe 5 (2007) beskikbaar gemaak is nadat hierdie studie gedoen is, het kontrakteurs nogsteeds die keuse om enige twee van die uitgawes te gebruik.

Primêre data was versamel met behulp van onderhoude en 'n gestruktureerde vraelys gestuur aan geselekteerde kontrakteurs in die Suid-Afrikaanse boubedryf.

Sekondêre data was verkry deur 'n literatuurstudie. Die studie het aangetoon dat die *JBCC 2000 PBA* die mees gewilde kontrakdokument is wat deur kontrakteurs in die boubedryf gebruik word, maar het ook bevestig dat daar areas van kommer is met betrekking tot die interpretasie en implimentering van sommige klausules in die dokument, veranderinge word aan die dokument aangebring sonder enige regsadvies en dat ontwikkelende kontrakteurs dit oor die algemeen moeilik vind op kontrakte waar die *JBCC 2000 PBA* gebruik word.

Ten slotte word aanbevelings gemaak ten opsigte van wysigings tot die kontrakdokument wat sal verseker dat die dokument aanvaarbaar sal wees vir alle kontrakteurs in die boubedryf asook internasionaal as 'n aanvaarbare dokument erken sal word.

Sleutelwoorde: Dispuut, JBCC 2000 PBA, konstruksie-waARBorg, kontrakdokument, kontrakteur, refensie

1. Introduction

In recent years the conditions of the contract agreement have played an important role in the building industry. This is inevitably so because projects have become bigger and projects of greater magnitude tended to create problems that could hardly be solved without a keen appreciation of the meaning and intention of the conditions of the contract agreement.

According to Fouchè (1999: 35) in Roman law an *obligatio* (obligation) is defined as a legal bond whereby a person is obliged to deliver some or other thing. It is clear that an *obligatio* must be between two or more persons or bodies which represent the employer and the contractor in the building industry. The *obligatio* creates a right in favour of the creditor, namely the right to claim the due performance from the debtor. In most contracts the parties are simultaneously creditors and debtors. From this it is clear that the *obligatio* creates a personal relationship between the two parties which is crucial for any building contract from the initial stage of the contract as per Fouché. Both employer and contractor must know their obligations towards each other and be absolutely sure what is expected from each of them in terms of the contract agreement.

According to Hughes & Barber (1992: 43), the contract agreement is an integral part of any construction project. The contents and mechanism of the agreement together with the relevant sundry documents must be well known to the two parties concerned as well as to the consultants appointed to perform the professional services on the project. Any misunderstanding or wrong interpretation of the agreement may lead to a dispute or even the cancellation of the contract, which will involve costs.

Malherbe & Lipshitz (1979: 72) state that the following principles are essential for the creation of a contract:

- There must be agreement between the contracting parties to create a legal and binding contractual relationship embracing rights, responsibilities, prerogatives and privileges; and
- The parties must be at one as to the consequences contemplated by such agreement or, in other words, as to their intention in the application of agreed contractual relations.

The tendering process creates an adversarial relationship between the employer and the contractor. The contractor must survive financially on the prices in his tender. A tight economy aggravates this relationship. This is further worsened where sub-contractors are also tendering on the same contract. Everyone must make money on each contract to survive. Onerous and wrongful conditions of contract have the effect of disadvantaging contractors, which will sour the relationship even more. Samuels (1996) mentioned that many parties, the employer, contractor, architect, quantity surveyor, engineers and project manager are involved in the construction process. This makes the contracting process an involved and often complex process.

Loots (1995: 13) define a contract as *an agreement that is intended to be enforceable by law*. He also mentions that a wrong decision concerning the choice of process, materials, anticipated rock, soil, or weather conditions cannot always be avoided, but a person with sufficient knowledge of the law of contract can almost always avoid a wrong contractual decision. Galbraith & Stockdale (1993: 76) mention that it has become customary in English law to regard an agreement to consist of an offer and acceptance.

It is therefore important to have a contract document that is manageable and workable and where all parties concerned under-

stand the contract document to eliminate or minimise the possibility of any disputes on the contract.

2. The JBCC 2000 Principal Building Agreement

2.1 General overview

According to Binnington (1992), the standard form of agreement applied to building contracts in South Africa has been the *Agreement and Schedule of Conditions of Building Contract* and has been used for some sixty years by both the public and private sector within the building industry. Initially *the Agreement* was approved and recommended by the Institute of South African Architects, the Association of South African Quantity Surveyors, the Building Industries Federation (South Africa) (BIFSA) and the South African Property Owners' Association (SAPOA). This so called *Standard Building Contract Agreement* or 'white form' was widely accepted in the industry. It was even adopted by various government departments or para-statal organisations, with various amendments, to suit their own requirements.

A totally new contract agreement was necessary that could be used uniformly within the building industry (Finsen, 1991: v). In 1984, a committee was appointed for the purpose of redrafting a total new set of Agreements. This committee was known as the Joint Building Contracts Committee (JBCC) which consisted of representatives from the Institute of South African Architects, the Association of South African Quantity Surveyors, the Building Industries Federation of South Africa, the South African Association of Consulting Engineers, the South African Property Owners' Association and the Specialist Engineering Contractors Committee. There were no representatives from any of the governmental bodies who, in turn, used their own versions of the old 'white form' of Agreement or in some cases their own forms of Agreement.

According to Finsen (1999: 56), the first entirely new *JBCC Principal Building Agreement* and associated documents were published during 1991. Although *the Agreement* was still in an infant stage, the possibility existed that a revised Agreement with some changes and amendments would see the light to suit the requirements of the building industry. While most part of the substance of the original contract had been embodied in the new contract agreement, a number of substantial changes with the intention of improvement, had been included which should have enabled the document to

be used in a practical and effective way without the necessity for a host of special conditions.

At the same time a new *Nominated/Selected Subcontract Agreement* was issued which, like its predecessors, was intended to be issued in conjunction with the new Principal Agreement. These documents were all intended to be read the one with the other, since knowledge of the Principal Agreement is an essential part of the operation of the Subcontract Agreement according to Finsen (1999).

After several years of intensive re-examination and re-drafting of the 1991 Agreement, the new *JBCC Series 2000* was published in 1998 to replace the 1991 version. During April 2003 a third revised edition was published. The fourth edition saw the light during March 2004 in which the State's provisions were included to meet the needs of the National Department of Public Works. Adjudication was included and is now the default method of dispute resolution. A revised fourth edition which is suitable for the Public and the Private sector was published during March 2005 according to Finsen (2005: iv).

This *Agreement* is thus a contract document specifically tailored to South African construction law and circumstances of the building industry. It sets out the full details of the obligations and rights of employers, contractors and sub-contractors. The duties of the professionals in administering the contract are also explicitly defined.

Finsen (2005) also mentioned that it was the intention of the JBCC to draft a series of documents that would meet the needs of all facets of the building industry and that there would be little or no need for amendments or the publication of new editions.

It has been noted by participants of this survey that revised editions have been coming out at a dramatically increased frequency. Finsen (2005) mentioned that with the changing circumstances in the building industry, the JBCC had published four editions within seven years. These frequent changes to the document could have some negative effects in the building industry, mainly where the contractors have to familiarise themselves with the latest revisions to the contract document.

According to Bold (2007: e-mail), sales of the *JBCC 2000 PBA* for 2006 and 2007 were 6901 and 7452 respectively which denotes a 7.98% year to year increase. The sales of the *JBCC 2000 PBA* over the period 2005 to 2007 account for 47% of the sales since the introduction of the series 2000 in 1998. It is clear from the above that there is a constant demand for the *JBCC 2000 PBA*, on a yearly basis, to be used as contract document.

2.2 Risk analysis: Construction guarantee vs Retention clause

Entering into a contract, both parties concerned are at risk. The employer needs the project to be completed on time and within budget and the contractor on the other hand needs payment for work done. Comparing the risk analysis between the two parties where the retention clause is applicable, the employer is highly at risk most part of the contract period. With the construction guarantee in place, the risk is evenly spread where it is mostly needed during the contract period.

According to clause 3.1 of the *JBCC 2000 PBA*, the employer shall provide a payment guarantee where required by the contractor in the accepted tender. The risk profile is well related where a payment guarantee is in place comparing to the retention clause where a changing risk profile exists.

2.3 The use of the JBCC 2000 PBA in State contracts

The most significant changes to the *JBCC 2000 PBA* have been in respect of State requirements. It had been thought that the 1998 publication would satisfactorily cater for the State's requirements and that the document would be adopted by the State. This was not the case and after lengthy negotiations with various State bodies, it would appear that a document was drafted incorporating specific State requirements.

It was therefore necessary to make provision of substitute clauses in a number of instances. These substitute clauses are contained in clause 41 '*State Clauses*'. All the clauses that are affected by these substituted clauses have been identified with a hash – '#'. This makes the document slightly difficult to read in State contracts where the contractor must take notice of all the clauses identified with '#' and read them in conjunction with the substitute clauses in clause 41. The contractor must also familiarise himself with specific clauses relating to State clauses when completing clause 42 '*Pre-Tender Information*' of the *JBCC 2000 PBA*.

Some of the major effects of the aforementioned clauses effectively withdraw the Principal Agent's authority with regards to payment and completion certificates, extension of time and additional payment, loss and expense and final payment and reserves for the State itself all the aforementioned duties. It constitutes that the employer is judge in his own case. It is also clear that no longer any equitable balance of risk can be said to be incorporated into the *JBCC 2000*

PBA where the State's substitute clauses are incorporated in their present format.

According to Finsen (2005: 48) there is room for many mistakes and it is hoped that the JBCC may be persuaded to prepare separate documents for State use containing the appropriate State provisions.

2.4 Amendments to standard contract agreements

Persons entering into or preparing contracts using the *JBCC 2000 PBA* are warned by the Joint Building Contracts Committee of the dangers inherent in modifying any part of it. If it is considered essential to make changes, users are advised to ensure that such changes are drafted by qualified legal persons with extensive knowledge of the *JBCC 2000 PBA* and the building industry.

Persons who set about copying and/or modifying standard printed forms of contract very rarely do so to the benefit of the contractor. More often the changes made are towards reducing the employer's risk to the prejudice of the contractor's risk which is often substantially increased.

More frequently modifications to the printed contracts are made which result in upsetting the equitable balance of risk inherent in the contract and far too often such changes are drafted by persons, including members of the building industry professions, who are lacking sufficient legal knowledge with disastrous results to either of or even both parties to the contract.

The objective of any contract is to obtain mutual intention, which is fair and reasonable to both parties and which should also apply to amendments according to Hughes & Barber (1992).

Terms are included in a written contract so as to qualify the intention of the parties to the contract. Over the years, a number of rules have developed and been laid down as regards to the process of construing a contract, and in particular for building contracts as mentioned by Hughes & Barber (1992: 114).

According to Hughes & Barber (1992), these rules refer to, *inter alia*:

- the background against which a contract must be interpreted;
- the conduct of the parties;
- the use of general words for a profession;
- the deliberate inclusion and omission of items; and

- the list of items and extrinsic evidence as regards ambiguity.

As most standard forms of contract are not always fully comprehensive in that they may not always represent all the details or the true intention of the parties, these standard contract documents sometimes need to be amended. Supplementary general terms are therefore almost a necessity. This leads to the fact that there are almost always revisions and/or amendments to standard forms of contract in order to meet the specific requirements of the individual projects.

Amendments can be costly to any one of the parties in the event of a dispute arising as a result of ambiguous amendments made to the contract document.

Uff (1991: 147) states that the following considerations should be taken into account when drafting amendments:

- the object of the document must be borne in mind;
- it must be ascertained whether the document is dependent on other documents, and if so, how the amendments will carry through;
- the appropriate form of the document must be selected and the document must achieve the means in the simplest and clearest manner possible;
- the form of drafting must be ascertained as the document may be as a result of negotiating and compromise or as result of legal advice; and
- the formal requirements must be ascertained, this may include evidentiary requirements or statutory requirements.

Collier (1979: 233) states that amendments are often made after the conclusion of the contract. Care must be taken in the drafting as amendments usually involve omissions and additions to the contract wording. It is therefore recommended that all amendments should be in writing and signed by both parties. A legal person should also be consulted to investigate the consequences of such changes.

Amendments do not have to be specifically in favour of the contractor or the employer. This is often a subjective view and such a practice is labelled 'unfair terms', according to Collier (1979). These terms are subject to a 'reasonable test' in court should a dispute arise. There must be a balance as to the risk imposed on the contractor and employer and this will always affect the consequences

of any amendments as one party will under normal circumstances try to pass on the risk to the other party involved.

3. Research method

Research was conducted to determine the effectiveness of the *JBCC 2000 PBA*. The use of a suitable research methodological approach is necessary to achieve the objective of any study. A two-stage approach was used to obtain data for the research. The first stage comprised interviews with ten randomly selected contractors to obtain/determine pre-questionnaire information. The second stage comprised a quantitative research approach by means of a structured questionnaire distributed amongst randomly selected building contractors in South Africa who are registered with their respective MBA's.

A total of 359 contractors were selected to participate in the questionnaire survey; this constitutes 31,2% of the total building industry population. This is acceptable for research of this nature according to Gay & Airasian (cited in Leedy & Ormrod, 2005). Having taken cognisance of the questionnaire design process, it was decided that self administered questionnaires would be the most appropriate survey instrument to use in this study. The questionnaire was divided into 4 sections, namely general information, *JBCC 2000 PBA*, joint ventures and amendments to *JBCC 2000 PBA*. Of the 359 questionnaires posted, 70 were returned which equates to a response rate of 19,5%.

4. Findings

The following findings emanated from the analysis of the completed questionnaire. Percentages indicated in tables and figures below reflects the percentages of respondents, mean = (point total / sample size) and relative index (RI) = Mean - 1 / k - 1.

4.1 JBCC 2000 PBA as a contract document in terms of flexibility and complexity

The majority (69%) of contractors indicated that the *JBCC 2000 PBA* is only a little flexible whereas the minority of contractors indicated that the document is either very flexible (13%) or not flexible at all (18%). The majority of contractors (67%) indicated that the *JBCC 2000 PBA* is only a little complicated while the minority of contractors indicated that the document is very complicated (13%) and 20% indicated that it is not complicated at all.

The Relative Index (RI) indicates that most contractors experience the JBCC 2000 PBA as little flexible (RI = 48%) and somewhat complex (RI = 46%) (Refer to Table 1).

Table 1: JBCC 2000 PBA in terms of flexibility and complexity

	Mean	RI	Not at all (0% - 33%)	A little (33% - 67%)	A lot (67% - 100%)
Flexibility	1.96	0.48	12	46	9
			18%	69%	13%
Complexity	1.92	0.46	13	43	8
			20%	67%	13%

4.2 Difficulties in understanding clauses in the JBCC 2000 PBA

More than half (66%) of the contractors indicated that they sometimes experience difficulties in understanding some of the clauses in the JBCC 2000 PBA whereas the minority indicated that they frequently (16%) or never (18%) experience difficulties in understanding some of the clauses of the JBCC 2000 PBA (Refer to Figure 1).

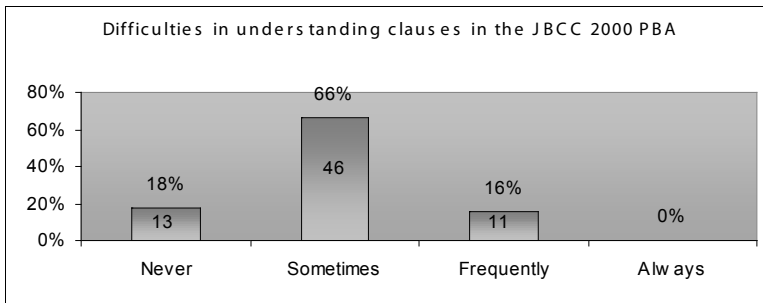


Figure 1: Difficulties in understanding clauses in the JBCC 2000 PBA

It is clear from the above results that where the JBCC 2000 PBA is used as a contract document, most contractors do not understand some of the clauses which could lead to disputes.

4.3 Knowledge of the contents of the JBCC 2000 PBA

Figure 2 reflects that the majority (70%) of contractors do have a moderate level of knowledge of the JBCC 2000 PBA. The results also indicate that the minority of contractors either have no knowledge (7%) or an extensive (23%) knowledge of the JBCC 2000 PBA.

When entering into an agreement it is vital that both parties (employer and contractor) should have an extensive knowledge of the contract. However, the analysis clearly indicates that this is not the case, with reference to the contractor, which in itself creates a risky situation.

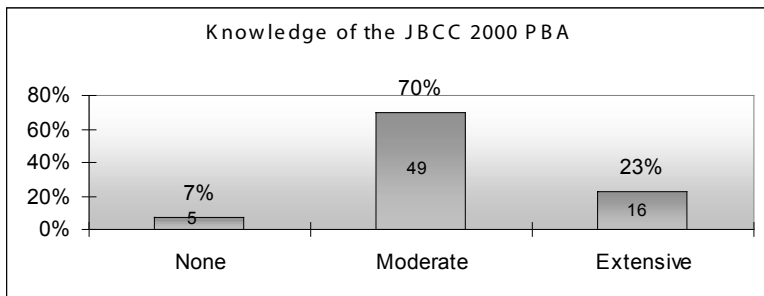


Figure 2: Knowledge of the contents of the JBCC 2000 PBA

4.4 Extent of use of the JBCC 2000 PBA on projects

The analysis indicates that less than half (30%) of contractors always make use of the JBCC 2000 PBA on their projects. Less than half (41%) of the contractors frequently make use of the JBCC 2000 PBA while the minority of contractors indicated that they never (9%) or sometimes (20%) make use of the JBCC 2000 PBA on their projects (Refer to Table 2). Table 2 also reveals that the majority of contractors frequently (RI = 64%) use the JBCC 2000 PBA on their projects. It is clear from the above that the JBCC 2000 PBA is not used on all construction projects.

Table 2: Extent of using *JBCC 2000 PBA* on projects

	Mean	RI	Never (0% - 25%)	Sometimes (25% - 50%)	Frequently (50% - 75%)	Always (75% - 100%)
Extent of using <i>JBCC 2000 PBA</i> on projects	2.93	0.64	6	14	29	21
			9%	20%	41%	30%

4.5 Balance of risk

Table 3 indicates that the minority (7%) of contractors indicated that there is never a balance of risk between the employer and contractor where the *JBCC 2000 PBA* is used while 22% indicated that there is always a balance of risk. Less than half of the contractors indicated that there sometimes (38%) or frequently (33%) exists a balance of risk between the employer and contractor.

Most contractors experience that there is frequently (RI = 57%) a balance of risk between themselves and the employer. One possible interpretation could be that the employers amend the *JBCC 2000 PBA* in such a way that most of the risk is shifted onto the contractor.

It is clear from the above results that in the majority of cases, no balance of risk exists between employer and contractor. This in itself is not a desirable situation.

Table 3: Balance of risk between employer and contractor

	Mean	RI	Never (0% - 25%)	Sometimes (25% - 50%)	Frequently (50% - 75%)	Always (75% - 100%)
Balance of risk between employer and contractor			5	26	23	15
	2.70	0.57	7%	38%	33%	22%

4.6 Type of construction guarantee offered according to clause 14 of the JBCC 2000 PBA

Table 4: Type of construction guarantee offered according to clause 14 of the JBCC 2000 PBA

<i>Guarantee offered</i>	<i>Mean</i>	<i>RI</i>	<i>Never (0% - 25%)</i>	<i>Sometimes (25% - 50%)</i>	<i>Frequently (50% - 75%)</i>	<i>Always (75% - 100%)</i>
Variable guarantee	2.61	0.54	15 23%	17 26%	13 19%	21 32%
Fixed construction guarantee with payment reduction	1.48	0.16	39 70%	9 16%	6 11%	2 3%
Advance payment guarantee	1.22	0.07	47 85%	6 11%	0 0%	2 4%

From table 4 it is clear that the majority (77%) of contractors offer the variable construction guarantee (sometimes to always) as security while the minority (23%) never offer the variable construction guarantee as security. It can also be seen from the overall analysis that the majority of contractors frequently (RI = 54%) offer the variable construction guarantee as security.

The majority (70%) of contractors never offer the fixed construction guarantee with payment reduction as security while the remaining 30% of the contractors sometimes to always offer the payment reduction guarantee as a form of security.

With reference to the advance payment guarantee, the majority (85%) of the contractors never offer this as a means of security while the minority (15%) of the contractors only sometimes or always offers the advance payment guarantee as a form of security for their projects.

Table 4 also indicates that most contractors never offer the payment reduction guarantee (RI=16%) or the advance payment guarantee (RI=7%) as construction guarantees.

From above analysis it is clear that the most favoured form of construction guarantee offered by contractors is the variable construction guarantee. It should be noted that the advance payment guarantee is not an alternative to the variable or fixed construction guarantee with payment reduction but merely a form of guarantee

to cover the value of bulk materials or equipment orders for which the contractor, usually the specialist sub-contractor, is not in a position to make the “up front” payment that is usually required before delivery.

4.7 Retention clause as an alternative form of construction guarantee

A noticeable omission from the *JBCC 2000 PBA* is the previously used retention clause. According to Figure 3, more than a third (36%) of contractors indicates that they are not in favour of the inclusion of a retention clause in the *JBCC 2000 PBA* while the minority (7%) are unsure.

However, the analysis clearly indicates that more than half (57%) of contractors indicated that they would prefer to have the retention clause included in the *JBCC 2000 PBA* as an alternative form of construction guarantee.

As the variable construction guarantee is being offered by the majority of contractors and with the payment reduction guarantee and the advance payment guarantee hardly being offered as indicated in Table 4, the inclusion of a retention clause should be considered by the *JBCC*.

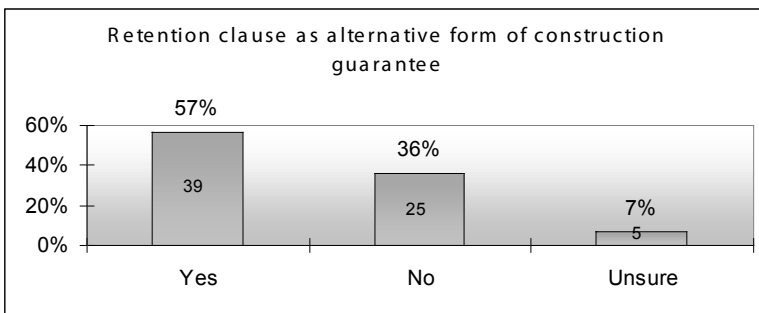


Figure 3: Retention clause as alternative form of construction guarantee

4.8 Amendments to the *JBCC 2000 PBA*

Table 5 illustrates that in the minority (25%) of cases, there was no need to amend any clause in the *JBCC 2000 PBA* while in only 1% of cases clauses were always amended. However, it is clear that in the majority (74%) of cases, clauses in the *JBCC 2000 PBA* were sometimes or frequently amended. The analysis also indicates that

most contractors sometimes (RI=36%) amend clauses of the *JBCC 2000 PBA* in general.

One possible interpretation could be that there still exists a need from either party to the contract, or from or a professional consultant, to amend the *JBCC 2000 PBA* clauses where necessary to meet specific requirements not covered in the *JBCC 2000 PBA*.

Table 5 also shows that when amendments were made, almost two-thirds (65%) of the contractors never obtained legal advice regarding any amendments made to the *JBCC 2000 PBA*. It is also evident from the analysis that most contractors never (RI=15%) seek any legal opinion when amending clauses to the *JBCC 2000 PBA*.

This is a reason for concern as this may result in a number of disputes arising from amendments without legal consultation.

The analysis also indicates that in 53% of cases where amendments were made to the *JBCC 2000 PBA*, these never led to disputes, while 47% of any amendments made, sometimes to frequently did. Since the success of a contract depends on it running smoothly without any disputes, the outcome of this survey is not very encouraging. The analysis also reveals that in most cases where amendments were made to the *JBCC 2000 PBA*, these never (RI=20%) led to disputes.

With reference to mediation and arbitration, the minority of adjustments made to the *JBCC 2000 PBA* led to mediation or arbitration (28% and 30% respectively). Although these results are not that excessive, it is still not desirable.

It is thus evident that when amending clauses to the *JBCC 2000 PBA*, there exists a fairly high possibility that it might end up either in a dispute, mediation or arbitration which could have been prevented if such amendment had not been made.

Table 5: Amendments to clauses of the *JBCC 2000 PBA*

	Mean	RI	Never (0% - 25%)	Sometimes (25% - 50%)	Frequently (50% - 75%)	Always (75% - 100%)
Extent of amendments to clauses	2.07	0.36	17	30	20	1
			25%	44%	30%	1%

Consultation with legal consultant	1.46	0.15	34	14	2	2
			65%	27%	4%	4%
Disputes	1.59	0.20	34	22	8	0
			53%	34%	13%	0%
Mediation	1.31	0.10	43	15	2	0
			72%	25%	3%	0%
Arbitration	1.34	0.11	43	15	3	0
			70%	25%	5%	0%

4.9 JBCC 2000 PBA as an acceptable document

According to Table 6, more than half (56%) of contractors agree or strongly agree to the statement that the *JBCC 2000 PBA* is an acceptable document and with no need for any amendments. The minority (12%) of the contractors disagree or strongly disagree to the statement while the remaining minority (32%) are neutral. The RI (65%) also reveals that most contractors agree with the statement.

The results indicate that the *JBCC 2000 PBA* can be regarded as an acceptable and workable contract document to the majority of contractors and with minor amendments it could be acceptable to all contractors.

Table 6: *JBCC 2000 PBA* as acceptable document with no amendments needed

	Mean	RI	Strongly disagree Strongly agree				
			1	2	3	4	5
			<i>JBCC 2000 PBA</i> as acceptable document with no amendments needed	3.61	0.65	5	3
			7%	5%	32%	31%	25%

5. Conclusion

The research indicated that the *JBCC 2000 PBA* is, to a certain extent, is effectively used in contracts in the building industry. Contractors also indicated that the *JBCC 2000 PBA* is an acceptable document, but with a need for minor amendments. The majority of contractors have a moderate knowledge of the *JBCC 2000 PBA* and experience the document as only little flexible and somewhat complex.

The *JBCC 2000 PBA* is also revised at frequent intervals, which is not preferred by respondents.

'State clauses' in the *JBCC 2000 PBA* can create confusion to some contractors and it is recommended that a separate PBA should be developed for 'State contracts' only.

Although the *JBCC 2000 PBA* makes no provision for a formal retention clause, contractors are providing security based on a retention clause as an alternative form of construction guarantee. The majority of respondents indicated that they would prefer the inclusion of the retention clause as an alternative form of construction guarantee in terms of clause 14.

The main reason for amendments to the contract document was to make the contract more favourable for a particular party. Amendments to the contract document, especially those without any legal advice, are causing problems resulting in arbitration, mediation or litigation, and having a negative effect on the building industry as a whole.

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An investigation of training and mentoring of emerging contractors in the Eastern Cape

Peer reviewed

Abstract

Having an effective mentoring programme in place in the construction industry is critical to the development and growth of emerging contractors as well as the industry as a whole. A survey was undertaken among the mentees who attended a specific mentoring programme in the Eastern Cape to establish the need for training, mentoring and monitoring of emerging contractors. Primary data was collected by means of a telephonic survey of the emerging contractors as well as the mentors and service providers regarding the mentoring programme. Secondary data was obtained from the survey of the literature. The main findings were that there is a huge need for training and mentoring of emerging contractors and that monitoring after completion of the programme is a necessity. Furthermore, although it was determined that all facets of training and mentoring are important, in order to ensure the overall development of emerging contractors, the development of financial and management skills on site requires the most attention.

Keywords: Training, mentoring, monitoring, emerging contractors

Abstrak

Om 'n effektiewe mentorskap-program in plek te hê vir die konstruksie-industrie is krities vir die ontwikkeling en groei van opkomende kontrakteurs, sowel as die industrie as geheel. 'n Studie is onderneem tussen opkomende kontrakteurs wat 'n spesifieke mentorskap-program in die Oos Kaap bygewoon het, om vas te stel of daar 'n vraag na opleiding, mentorskap en monitering van opkomende kontrakteurs bestaan. Primêre data is gevorder deur middel van 'n telefoniese vraelys aan opkomende kontrakteurs oor die mentorprogram so wel as die mentors en diensverskaffers van die program. Sekondêre data was gevorder vanaf literatuur. Die hoof bevindinge is dat daar 'n groot aanvraag vir opleiding en mentorskap van opkomende kontrakteurs is, en dat monitering na voltooiing van die mentorskapprogram 'n noodsaaklikheid is. Verder is daar gevind dat, alhoewel alle fasette van opleiding en mentorskap belangrik is, om te verseker dat algehele ontwikkeling van die opkomende kontrakteur plaasvind, finansiële en bestuursbekwaamheid die meeste aandag benodig.

Sleutelwoorde: Opleiding, mentorskap, monitering, opkomende kontrakteurs

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1. Introduction

The Greeks defined the term 'mentoring' as early as 800BC (Caruthers, 1991). A more recent definition of mentoring is: *A Mentor is a trusted councillor or teacher and can be seen as the process of walking alongside someone to learn from them (Anon, 2005: online).* Training is a method of instruction and should not be confused with mentoring. According to Anon (2005: online) *Training involves the transfer of learning from one individual, usually an expert, to another individual or a group.* Furthermore, as a result of mentoring having been viewed as a career development tool in organisations, researchers have focused on identifying the antecedents and consequences of mentoring, and have not specifically focused on integrating mentoring with other career and organisational constructs such as the construction industry (Greenhaus & Callanan, 1994).

Since 1994, the democratically elected government of South Africa has brought about various changes and challenges. The construction industry entered into a new 'era' with a plethora of 'emerging contractors' entering the market. This resulted in changes in mindsets and new approaches as to how projects should be managed from a consulting point of view, as well as from the emerging contractors' perspective. For a number of years the main focus was on 'economic empowerment', which in the building industry specifically refers to black emerging contractors (Sigcau, 2000; Hauptfleisch, 2000). This in turn resulted in new challenges, *inter alia*, to ensure that not only 'empowerment' is experienced, but that sustainable business enterprises are realised. However, due to the poor performance of emerging contractors in the form of either late completion or non completion of projects, it became clear that there was a dire need for the training of emerging contractors.

Initially, training constituted a minor component in terms of realising sustainable business enterprises and more and more emphasis was placed on 'mentoring' as well as 'monitoring' of emerging contractors. Various training and mentorship programmes have been developed and implemented. In terms of the Skills Development Act of 1998, the Construction Education and Training Authority (CETA) were formed (CETA, 2006). The CETA developed a sector skills plan through a consultative process, which allowed for a 'training and development strategy' for the sector (CETA, 2006). Furthermore, the national government launched the Emerging Contractor Development Programme (ECDP), which focused on the building industry (Department of Public Works, 2002). This was specifically designed with the empowerment of black emerging contractors in mind

(Hauptfleisch, 2000). Sigcau (2000: online) highlights the importance of mentoring as follows:

In essence, we are talking of black contractors who are struggling to overcome business impediments as a result of apartheid, and who therefore need support to ensure that they do indeed merge into the mainstream of the South African economy.

The critical research question is whether the need for training and mentoring still exists and if the level of literacy or skills relative to certain facets of building affect firstly, the focus of mentoring and training, and secondly the outcome or results obtained through the mentoring and training programmes.

This article reports on research conducted relative to a specific mentoring programme and presents the findings, conclusions and recommendations for the future development of similar programmes.

2. Research method

The primary objective was to establish the level of literacy, building literacy or competency of emerging contractors and determine whether a need for training and mentoring relative to certain facets exist. Furthermore the objective was to determine what effect the training and mentoring had on emerging contractors that had undergone training on a mentoring programme.

The descriptive survey method was used for data generation and analysis (Leedy & Ormrod, 2004). The quantitative research method was applied which relies on measurement of variables to compare and analyse the data. A questionnaire was developed relating to the research problem and sub-problems and the required data was gathered through telephonic interviews. Telephonic interviews were used as it was quicker and most of the target population were contactable by phone. The research population targeted was from areas where the questionnaire, in many cases, would not have reached the correspondents by post and where certain questions posed would have required an explanation to ensure that the interpretation of the question is fully understood. Neuman (1991) states that the telephonic interview is a popular survey method as about 95% of the population can be reached by telephone. Babbie (2004) remarks that sometimes respondents will be more honest in giving answers especially socially disapproved answers if they do not have to look you in the eye. Du Plooy (2001) agrees that the fact that respondents do not have time to think about their answers can increase the control over and the accuracy of respondents.

The data was analysed with the help of a data analyst and the software package SPSS Version 14. Secondary data was obtained through a literature review of relevant publications and sources from libraries and the internet, which was used in the compilation of the questionnaire for the survey.

3. Sample population

The sample population comprised of respondents that were part of the original Eastern Cape Development Corporation (ECDC) mentoring programme. The population was classified according to two geographic profiles obtained from the ECDC. A total number of 34 possible respondents were identified comprising of 22 emerging contractors or mentees, 10 mentors or consultants and 2 service providers who provided the academic training component of the programme. 27 constituents of the entire research population were sampled utilising availability as a sampling method and this formed the basis for the data analysis and the drawing of subsequent conclusions. It should be noted that some members of the population were not contactable or had left the industry. A number of the respondents, mentors as well as the training providers requested that the results be made available to them, underscoring the importance of the study. Leedy & Omrod (2004) provide guidelines for the identification of a sufficient sample and for a small population of less than 100, in which case the target population requires no sampling.

4. Survey results

The perceptions of the respondents were measured on the basis of a five point Likert type scale. The five points were scaled as: 1 = Very low or poor; 2 = Low or below average; 3 = Average; 4 = High or above average, and 5 = Very high or excellent.

The data was analysed firstly by exploring the demographic characteristics of the research participants. The demographics section is sub-divided into descriptives and cross-tabulations. The descriptives' section examines the frequency scores of the variables town, gender, age, home language, total experience in the building industry, total experience in management, highest qualification, as well as personal involvement.

Secondly, the data was examined through the compilation of descriptive and inferential statistics. In terms of descriptive statistics, the variables, namely literacy, need for mentoring, need for training, effect of training and mentoring as well as the need for monitoring,

were examined through a mean, standard deviation, minimum and maximum scores. Findings in terms of descriptive statistics were prepared by a means comparison with sub-grouping of the variables, variable 1: training and mentoring, and variable 2: literacy and the effect of training and mentoring.

4.1 Sample population and response rates

Table 1 illustrates the composition of the sample population and the response rates.

Table 1: Sample population and response rates

Designation	Sample population		Response rate	
	Number	Percentage	Number	Percentage
Training service provider	2	5.9	2	100.0
Mentors	10	29.4	10	100.0
Emerging contractors	22	64.7	15	68.2
Total	34	100	27	79.4

An overall response rate of 79.4% was achieved, which included a 100% response rate relative to both the training service providers and mentors, but only a 68.2% response rate relative to the emerging contractors. 79.4% is a relatively high overall response rate and therefore the findings should provide a true and accurate reflection of the prevailing status.

The respondents all originate and are resident in the Eastern Cape and although spread throughout the rural areas, it is notable that the two major urban areas, Port Elizabeth and East London, had an equal representation of 29.6%. The majority of respondents (74.1%) were male and the remaining 25.9% female, reflecting the distribution in an environment that has historically been dominated by males. Of the respondents, 33.3% were within the 35-44 age category closely followed by the age group 45-54 (29.6%). The age group 34 and below were represented by 18.5% of the respondents.

Cross-tabulations of demographic data were used to highlight some correlations between descriptive demographic variables. Cross tabulations were conducted relative to gender and age, gender and personal involvement, personal involvement and home language, and experience in the building industry and personal involvement.

4.2 Home language and form of involvement

14 of the 15 contractors were Xhosa speaking, compared to 1 Afrikaans speaking contractor (Table 2). This indicates that the emerging contractor programme is addressing the needs of previously disadvantaged individuals.

Table 2: Home language relative to form of involvement

Language	Form of involvement (No.)		Total
	Mentor / Consultant	Contractor	
Xhosa	2	14	16
Afrikaans	3	1	4
English	7	0	7
Total	12	15	27

4.3 Experience and form of involvement

The majority of the mentors had more than 15 years experience in the building industry (Table 3). This indicates that the mentors should be considered capable as they possess the requisite experience. Most of the contractors had less than ten years experience in the building industry, whereas only 2 contractors had more than ten years experience, which clearly indicates that the correct people are being mentored.

Table 3: Experience per form of involvement

Years experience	Form of involvement (No.)		Total (%)
	Mentor / Consultant	Contractor	
0-5	0	3	11.1
6-10	2	6	29.6
11 – 15	2	2	14.8
16–20	1	3	14.8
21 +	7	1	29.6
Total	12	15	100.0

4.4 General literacy and skills of emerging contractors

The questionnaire addressed the general literacy and competencies of the emerging contractors and the findings indicate that the general literacy pertaining to reading and writing was of an acceptable standard, the mean score of 3.56 being > 3. Although cross-cultural communications (4.11), interpretation of building plans (3.30), and management and administration of building sites (3.04) achieved

mean scores above 3, interpretation of bar charts (2.67) and financial management (2.67) did not. This clearly indicates the lack of critical skills in terms of managing projects and also the business of construction, and that the emerging contractors lack, or need financial skills and programming skills. Furthermore, the mean score relative to management and administration of building sites (3.04) is marginally above 3, which indicates a need for enhancement of this skill.

4.5 Need for training and mentoring

The need for training in financial management was identified as the greatest, with a mean score of 4.11, further supported by the fact that not a single respondent scored a 1 relative to this skill. Furthermore, the standard deviation was the second lowest of all the elements, indicating that there is low dissent among respondents relative to this skill. This need was closely followed by training in construction programmes and bar charts (3.74), and training in the interpretation of building plans (3.63). Although, the management and administration of building sites has a mean score of 3.44, there is a need for training relative thereto. Given that the reading and writing mean score is 3.00, this skill can be deemed to be the one requiring the least enhancement.

As expected, that in terms of the need for mentoring there is a strong correlation with the need for training, with scores ranging from 1, a very low need for mentoring, and 5, a very high need for mentoring. However, the need for mentoring in financial management (3.89) was identified as the greatest. This is further supported by the fact that not a single respondent had scored a 1 relative to the skill. As with the need for training in financial management, the standard deviation was the second lowest of all the elements, indicating that there is low dissent among respondents relative to this skill. This need was closely followed by the need for mentoring in interpretation of bar charts and follows the same trend as in the case of training. Table 4 indicates that with the exception of reading and writing, overall there is a need for mentoring relative to all the skills.

Table 4: Need for mentoring

<i>Mentoring pertaining to</i>	<i>No. of respondents</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean score</i>	<i>Standard Deviation</i>
Reading and writing	27	1	5	2.67	1.27
Interpretation of building plans	27	1	4	3.48	1.01
Interpretation of bar charts	27	1	4	3.85	0.91

Management and administration of building sites	27	1	4	3.48	1.01
Financial management	27	1	4	3.89	0.97

4.6 Effect of training and mentoring

With the exception of reading and writing, the mean scores for all the skills were above 3.00, which indicates that the training and mentoring can be deemed to have enhanced the respective skills (Table 5). The mean score relative to reading and writing, which scored significantly lower than the other skills, indicates where training and mentoring had the least effect. However, previously cited statistics indicated that there was not a major need for improvement relative to this particular skill.

Table 5: Effect of training and mentoring on skills

<i>Skill</i>	<i>No. of respondents</i>	<i>Minimum</i>	<i>Maximum</i>	<i>Mean score</i>	<i>Standard Deviation</i>
Reading and writing	27	1	5	2.63	1.18
Interpretation of building plans	27	1	4	3.07	0.78
Interpretation of bar charts	27	1	5	3.30	0.87
Management and administration of building sites	27	1	4	3.11	0.97
Financial management	27	1	4	3.04	0.71

4.7 Need for monitoring

The need for monitoring, which includes continuous training and mentoring, achieved a very high mean score, namely 4.37. Monitoring can be deduced to be extremely important since the intervention makes an overall difference in the sustainable performance of contractors. However, 88.8% of the respondents perceived monitoring to be of the utmost importance reinforcing the deduced need therefore. The continuous monitoring of mentees, especially after the completion of the training and mentoring programme will ensure that the programs are having the desired effect on the mentees and the building industry.

4.8 Summary of the findings

Figure 1 provides an overview of the findings. It is important to remember that in terms of interpretation of the graph, that the mean scores relative to the level of literacy / skill and the effect of training and mentoring (Ef/TM) should be the inverse of those relative to the need for mentoring and training.

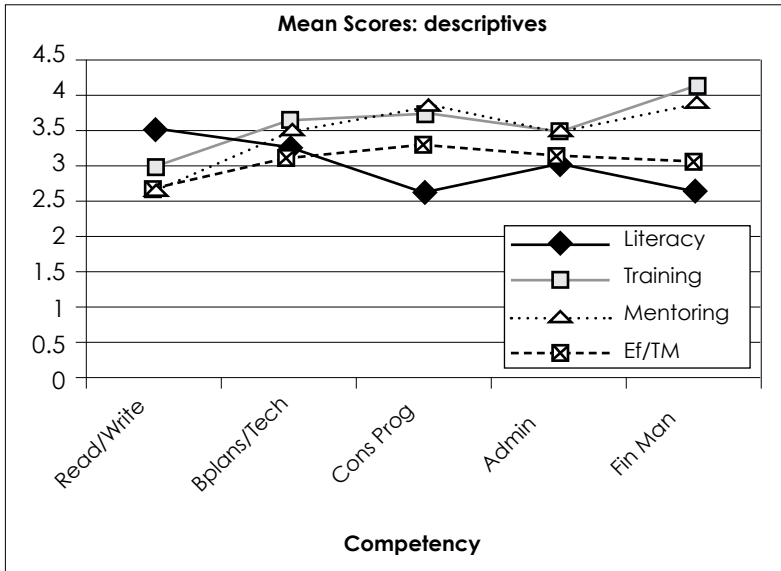


Figure 1: Mean scores – Descriptive statistics

With the exception of literacy (reading and writing), the level of skill relative to all other skills, namely average to low, indicates the need for training and mentoring relative to these skills. Where the mean score is high, thus indicating a high level of skill, the inverse, a low mean score indicating a low need for training and mentoring occurs, and vice versa.

The greater the difference between the average mean score of literacy / skill and effect of training and mentoring, and the average mean score of the need for training and mentoring, the greater the need for training and mentoring relative to that skill, since this is indicative that the proficiency is low and that the need for training and mentoring is high.

5. Conclusions

An enormous amount of money is spent on training and mentoring programmes by government and other role players in the industry. The results of the survey indicate that for the programmes to have the desired effect, the following recommendations should be considered by the implementation agencies or institutions that are involved with training and mentoring in the construction industry:

- All facets of the training programme should be covered and are equally important to the success of the mentees;
- More time should be spent relative to financial management and cost control on a building project;
- Trainers and mentors should ensure that the emerging contractors, after completion of the programme, have the ability to not only read and interpret the construction programmes, but have the ability to develop and understand construction programmes or bar-charts themselves;
- Mentors should dedicate more time to the mentoring of emerging contractors relative to administration and management of a building site, and
- Institutions or implementing agencies that administer training and mentoring programmes should budget for the monitoring of emerging contractors to ensure the successful completion of a sustainable programme.

A lack of funding should not be seen or used as an excuse not to train and mentor emerging contractors. The growing economy, which fuels the building industry, requires the delivery of projects to requirements, which needs to be achieved using sustainable contractors, emerging contractors included. However, this can only be achieved through substantial investment in the training and mentoring of emerging contractors. Sustainability of these contractors can further be ensured by the funding and implementation of monitoring programmes after completion of mentoring programmes to ensure that the initial investment is secured for the industry.

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Ruben Ndiokubwayo & Theo Haupt

Origin – cause matrix: a practical approach for identification of waste associated with variation orders

Peer reviewed

Abstract

This article has a two-fold aim, namely of reviewing the literature pertaining to waste associated with variation orders and providing a tool for identification of waste zones arising from a variation order. Literature was reviewed about the administration and waste associated with variation orders. Two case studies for the purpose of the study consisted of completed apartment complexes in Cape Town. Variation orders on the respective projects were grouped by number and value in an origin-cause table. The literature review confirmed the likelihood of waste of resources following the occurrence of variation orders. Arguably, the excessive occurrence of variation orders was among factors that contributed to overall higher construction delivery costs and time overruns. By auditing each variation order in terms of the value, origin agent and the cause, it was possible to identify some project aspects that yielded waste of resources. Typically, these were the cost of errors originating from the consultant and the client. The origin-cause matrix could be a tool to provide a breakdown of the probable magnitude of waste associated with variation orders. The study was confined to a limited number of apartment-type construction projects to provide insight into the potential impact of variation orders on project performance. The origin-cause matrix could be a practical tool used to track construction project activities that yield waste. The topic discusses issues that have not been widely covered by previous research studies. The origin-cause matrix was designed as a tool for identification of waste based on a theory of waste formation.

Keywords: Causes, non value-adding, origin agents, variation orders, waste

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Abstrak

Hierdie artikel het 'n tweeledige doel, naamlik 'n literatuuroorsig oor afval wat geassosieer word met wysigingsopdragte, asook die verskaffing van 'n instrument vir die identifisering van afval sones wat ontstaan as gevolg van wysigingsopdragte. 'n Literatuurstudie oor die administrasie van afval as gevolg van wysigingsopdragte is gedoen. Twee gevalllestudies oor voltooide woonstel-blokke in Kaapstad is vir die doel van die studie gebruik. Wysigingsopdragte vir die onderskeie projekte is groepeer deur nommers en waarde in 'n ontstaan-oorsprong matriks saam te voeg. Die literatuuroorsig bevestig die waarskynlikheid dat afval van hulpbronne ontstaan as gevolg van die voorkoms van wysigingsopdragte. Argumentsonthalwe, die oortollige voorkoms van wysigingsopdragte was onder faktore wat bygedra het tot 'n oorhoofse konstruksie afleweringkoste asook tydoorskryding. Deur elke wysigingsopdrag te oudit in terme van waarde, oorsprong-agent en die oorsprong daarvan, was dit moontlik om sommige projek-aspekte te identifiseer wat vermorsing van hulpbronne oplewer. Tipies, was hierdie aspekte die koste van foute voortspruitend uit die konsultant en kliënt. Die ontstaan-oorsprong matriks kan 'n instrument wees om 'n afbreking van die moontlike grootte van afval geassosieer met wysigingsopdragte te verskaf. Die studie is beperk tot 'n aantal woonsteltipe konstruksie projekte om insig te verskaf in die potensiele impak van wysigingsopdragte op projek-aanbieding. Die ontstaan-oorsprong matriks kan as 'n praktiese instrument gebruik word om konstruksieprojekte aktiwiteite te volg wat afval oplewer. Die onderwerp bespreek gevalle wat nie wyd gedek is deur vorige navorsing nie. Die ontstaan-oorsprong matriks is ontwerp as 'n instrument vir die identifisering van afval gebaseer op 'n teorie van afvalvorming.

Sleutelwoorde: Oorsake, nie-waardetoevoeging, oorsprong-agente, wysigingsorders, afval

1. Introduction

A construction contract is a business agreement that is subject to variability. Contractual clauses relating to changes allow parties involved in the contract to freely initiate variation orders within the ambit of the scope of the works without alteration of the original contract. Variation orders involve additions, omissions, alterations and substitutions in terms of quality, quantity and schedule of works. Without contractual clauses, the building contractor would have to agree to erect without any change the building shown on the drawings and represented in the bills of quantities for a contract sum. Ssegawa *et al.* (2002) argued that the spirit in which variation orders are permitted allows the contract to proceed without compiling another contract to cater for the changes. Most contracts make provision for possible variations given the nature of building construction (Finsen, 2005; Wainwright & Wood, 1983). A degree of change should be expected since it is difficult for clients to visualise the end product they procure (Love, 2002). Unforeseen conditions¹

1 Such as for example adverse ground conditions affecting foundations, which become apparent only during excavation.

may arise which require measures that have not been provided for in the contract (Finsen, 2005).

However, the disadvantage of the variation clause is that architects tend not to crystallise their intentions on paper before the contract is signed because they know the variation clause will permit them to finalise their intentions during the term of the contract (Wainwright & Wood, 1983). An unfortunate aspect of the variation clause is that it tends to encourage clients to change their minds and embark on building projects without having properly thought through their project requirements (Finsen, 2005). Traditionally, the clients' *prima* perceived requirements include functionality, durability and optimality. In order to achieve these requirements, clients appoint consultant-teams to advise them on design and optimum use of resources. On the other hand, contractors concern themselves predominantly with construction input costs and their reduction. Little recognition is given to the fact that the clients or their agents may be sources of higher construction costs. Clients and consultants typically forget that issuing numerous variation orders result in higher construction costs. For example, a client who targets a completion date may want works to start on site while the design is still at a sketchy stage. In some cases, the construction works may overlap the design where the contractor will have to wait for the detailed design. As a result, some works are put on hold and others are subject to abortion or demolition. Arguably, the costs for aborted works are wastage of resources and are typically transferred to the client. They contribute to higher construction delivery costs. The construction industry does not grasp that the reduction of the occurrence of variation orders may optimally lower construction delivery costs. Ibbs (1997) concluded that the greater the amount of change the greater the negative impact on both productivity and cost.

2. Categorisation of site instructions

Variation orders are often issued in the form of site or contract instructions. Consequently, variation orders have rightly or wrongly been loosely referred to as site or architect's instructions. It is unclear from the work of various authors and standard forms of contract what instructions should be regarded as variation orders or not. According to Uff (2005) disputes often arise as to whether an instruction actually constitutes a variation order because the contract is silent on a definition of what may constitute a variation. Ssegawa *et al.* (2002) contend that there is no single definition of what a variation is. Not all architect's instructions constitute variation orders such as

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for example, an instruction to remove defective work (Wainwright & Wood, 1983; FIDIC, 1999). The JBCC² (2005) defines a contract instruction as *a written instruction signed and issued by or under the authority of the principal agent to the contractor*. The FIDIC³ (1999) general conditions clause 3.3 stipulates that the engineer may issue to the contractor instructions and additional or modified drawings which may be necessary for the execution of the works and the remedying of any defects, all in accordance with the contract. But, not all instructions vary the contractual arrangements or the way the works are being undertaken. Consequently, some contract instructions may be considered as variation orders while others may not. It is useful to categorise site instructions on the basis of whether they are variation orders or not. With reference to clause 17 (JBCC, 2005) of the Principal Building Agreement, Finsen (2005) derived five categories of contract instructions including:

- Instruction to vary the design, quality or quantity of works, for example to carry out an additional work. This is a variation order.
- Instruction to resolve discrepancies between contract documents, for example to rectify errors. This is a variation order.
- Instruction to reiterate or enforce contractual provisions, for example to remove from site goods that do not conform to original specifications: this is not a variation order. It becomes a variation order if incidental to instruction in terms of categories 1 and 2.
- Instruction to deal with monetary allowance, for example to indicate how to spend money budgeted under prime cost: this is not a variation order. It becomes a variation order if incidental to instruction in terms of categories 1 and 2.
- Instruction to protect the client's interest, for example to remove from site camp a worker that constitutes a nuisance. This is not a variation order at all.

2 The Joint Building Contracts Committee

3 FIDIC is a French acronym that stands for *Fédération Internationale des Ingénieurs-Conseils* interpreted in English as International Federation of Consulting Engineers

3. Nature of variation orders

The nature of variation orders can be determined by referring to both the reasons for their occurrence and subsequent effects. Arain & Pheng (2005) distinguished two types of variation orders, namely beneficial and detrimental variation orders.

3.1 Beneficial variation orders

A beneficial variation order is one issued to improve the quality standard, reduce cost, schedule, or degree of difficulty in a project (Arain & Pheng, 2005). It is a variation order initiated for value analysis purposes to realise a balance between the cost, functionality and durability aspects of a project to the satisfaction of the client. A beneficial variation order eliminates unnecessary costs from a project; and as a result, it optimises the client's benefits against the resource input by eliminating unnecessary costs. However, it should be noted that regardless of how beneficial a variation order might be, non value-adding costs are likely to accrue as a result. For example, a variation order to solve the discrepancies between contract documents involves the abortion of works that have already been executed. Cost for aborted works should not have been incurred if discrepancies were not found between contract documents.

3.2 Detrimental variation orders

A detrimental variation order is one that negatively impacts the client's value or project performance (Arain & Pheng, 2005). Arguably, a detrimental variation order compromises the client's value system. A client who is experiencing financial problems may require the substitution of quality standard expensive materials to sub-standard cheap materials. For example, on a construction project situated in a salty environment, steel window frames result in steel oxidation if selected *in lieu* of timber or aluminium frames.

4. Waste associated with variation orders

4.1 Concept of waste vis-à-vis variability

The paradigm of waste as used in construction has various meanings depending on one's point of view. Very often, waste has been referred to as physical losses of material occurring during the construction process. According to Formoso *et al.* (1999) most studies on waste are based on the conversion model where material losses are considered to be synonymous to waste. Waste is defined as:

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any inefficiency that results in the use of equipment, materials, labour, or capital in larger quantity than those considered as necessary in the production of the building. (Formoso et al., 1999: p. 325)

However, it should be understood that the contractor recognises allowable waste as the percentage for losses of material allocated to bill rate components by the estimator at tender stage and it varies from one material to another. Unfortunately the existing estimating and contract valuation techniques do not provide a clear breakdown of losses of materials resulting from variation orders. For example, cement that hardens in the stores following a variation order to suspend works is not allocated to the variation order account. Waste of materials resulting from the occurrence of variation orders may, for example, emanate from the following circumstances:

- Compensating waste arising when material ordered for one specific purpose is used for another. For example, facing bricks ordered for external wall erection may be used for internal plastered walls when there is a shortage of common bricks.
- Waste due to the uneconomic use of plant arising when the plant lies idle on site as a result of a variation order. Saukkoriipi & Josephson (2006) estimated the waste for non-productive use of resources at more than 10% of a project's production cost.
- Waste of materials due to incorrect decisions, indecision or inconsistent inspection of works by the project consultant.
- Waste of materials after demolition of a portion of work caused by the variation order to change a trade. For example waste for breaking down a wall to accommodate a new door.
- Waste due to the wrong use of material or waste stemming from materials wrongly specified.

Other authors have defined waste as being not only physical losses of materials. Al-Hakim (2005) defined waste as *anything that adds no value to producing the required services*. The understanding of waste would require an explanation of what value-adding and non value-adding activities are. An activity is value-adding if it is judged to contribute to customer value or satisfy an organisational need (Tsai, 1998). From the perspective of the client, Saukkoriipi (2005) defined non-value adding activities as *those which absorb resources without adding value to the customer*. The value consists of two components, namely production performance and freedom from defects (Koskela, 1992). The production of services requires resources and flow of activities over a certain portion of time.

According to Koskela (1992), the 'philosophy of production consists of both conversion and flows. Since only conversions add value, the improvement of flow activities should primarily be focused on reducing or eliminating them, whereas conversion activities have to be made more efficient. Therefore, waste reduction is enhanced by avoiding flow variability. In construction terms this refers to avoiding excessive occurrence of variation orders.

4.2 Identification of the origin agent, causes and cost of variation orders

While most construction industry stakeholders are arguably interested in the reduction of overall production costs, they are not always aware of the extent of non-value adding activities on construction projects (Saukkoriipi, 2005). Consequently, there is a lack of knowledge about non value-adding costs associated with variation orders. The realistic quantification of such costs is problematic due to lack of appropriate techniques for their measurement. In common practice, non value-adding costs arising from variation orders that are typically transferred to the client are underestimated. For example, one may be able to calculate the costs of aborted works, but non value-adding costs arising from non-productive time, redesign and overheads are not attributed to such an activity. Very often these costs are unknowingly transferred under the account of contingencies.

It is necessary to uncover non value-adding activities arising from variation orders in order to take proactive measures to reduce them. The reason for variation orders and the magnitude of the associated non value-adding costs should be known. A clearer understanding of variation orders and subsequent waste might be possible if they are categorised by their origin and identification of possible waste zones. Koskela (2000) suggested a framework of the formation for waste and value loss that takes into account the following, namely:

- Waste and value loss;
- Factors causing loss; and
- Root causes.

Every time a task is divided into two subtasks executed by different specialists, non value-adding activities increase, such as, for

4 Philosophy of production refers to an evolving set of methodologies, techniques and tools, the genesis of which was in the Japanese JIT (Just In Time) and TQC (Total Quality Costs) effort in car manufacturing (Koskela, 1992)

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example, inspecting, moving and waiting (Koskela, 2000). Similarly, when a variation order is issued, numerous non value-adding activities/costs are likely to arise. These include travelling and communication expenses; idle plant and labour during the waiting time, demolitions, time taken by the designer to understand the required change and redesign; cost and time for litigation in case the misunderstanding arises between the contractor and the client or his/her consultant. These represent a waste of resources and are typically paid for by the client. In addition, a delay of the consultant to issue an appropriate instruction may result in remedial works. Acharya *et al.* (2006) suggested that consultants should aim at getting an understanding of the overall scope and goals of the project, make sure they understand deliverables and offer specific suggestions when they makes sense; and do all relatively quickly without having negative effect on productivity. Furthermore, a lack of judgment and experience of the designer contributes to errors and omissions in the design. However, factors influencing the occurrence of variation orders and their adverse impact on project performance vary from one project to another. Factors include the nature of works, the complexity of the project, procurement method and completeness of design before the works commence on site. Studies revealed a significant reduction in both cost increase and time delay as a result of a complete design before commencement of works on site; hence, the prevention of the likelihood occurrence of variation orders (Koushki *et al.*, 2005).

Variation orders can be avoided if their origin and causes were clearly known (Mohamed, 2001). The identification of the originating root involves identification of the initiator of a variation order. Arain & Pheng (2006) identified four origin agents of variation orders. These included 'client', 'consultant', 'contractor' and 'others'. It is also important to know what could be the reason for a variation order to be issued. A classification of categories/types rework (Love & Sohal, 2003) revealed the following causes or the circumstances under which variation orders could be initiated, namely:

- Design changes which arise from the client/consultant, contractor, occupier and supplier/manufacturer or change initiated for improvement purpose.
- Design errors which are mistakes made in the design.
- Design omissions which arise when an item or component is omitted from the design.

- Construction changes which are initiated to improve constructability or due to site conditions. Change may be made by the client, the consultant or the occupier after some work has been performed on site. Change may be made if the process or product needs to be altered/rectified or if there is a need to improve quality.
- Construction errors which are the result of erroneous construction methods procedures.
- Construction omission which are those activities that occur due to omission of some activities during the construction.
- Damage caused by accident or inclement weather.

5. Scope of the study

The study is being undertaken in South Africa that is currently experiencing an unprecedented construction boom. While existing infrastructure and buildings are upgraded the backlog in housing and infrastructure delivery, the deficit of skills, the high construction delivery costs and quality standards related problems are current challenges faced by the construction industry. There is growing concern about rising construction delivery costs. Recently, studies have been done in Sweden to investigate the existence of non value-adding (waste) activities in all phases of construction that resultantly give rise to increases in construction costs. The study reported in this article is similar given that it seeks to uncover waste within various activities/practice in construction projects. The study is confined to variation orders, an area that has not been widely researched.

6. Methodology

In order to identify waste formation zones, the framework suggested under the literature review was considered. Each variation order was audited in terms of three parameters, namely value of the loss, root causes and factors causing loss. This was made possible by designing an origin-causes matrix as illustrated in Table 1. Row A, B, C, etc. contain the costs of variation orders as per origin agent and column 1, 2, 3, etc. contain the costs of variation orders as per causes. The shaded areas represent the variation orders that are prone to waste. For example, by assuming that column 2 represents construction error and column 5 represents damage, the magnitude of waste is then calculated as follows: (A;2) + (C;2) + (C;5).

Table 1: Illustration of waste zones of variation orders

(Origin - cause)		Causes					Total
		1	2	3	4	5	
Origin agents	A		Xx	Xx	Xx		XX
	B	xx		Xx			XX
	C	xx	Xx			Xx	XX
	...	xx			Xx		XX
Total		XX	XX	XX	XX	XX	XX

7. Findings and discussions

7.1 Projects particulars

Primary data was obtained from a reputable cost consultant company in South Africa. A comparative analysis of cost of variation orders was done on two completed apartment complexes; a residential apartment hereby known as project A and shopping apartment hereby known as project B. Records including short descriptions, monetary values, the initiator and reasons for the variation were captured from the variation order files. The occurrence of variation orders were first grouped by number and secondly by value. Variation orders were recorded in a table according to the four origin agents and seven causes of variations identified from the literature. The origin agents included the 'client', the 'consultant', the 'contractor' and 'others'. In this context, 'client' included the development initiator and occupiers/tenants who financed the projects. 'Consultant' included the whole professional team that represented the client. 'Contractor' included the main contractor and his subcontractors. 'Others' included weather conditions, state regulations or any other conditions beyond control of either party to the contract. The seven causes included design change, design error, design omission, construction change, construction error, construction omission and damage. Additional preliminaries costs were added as an eighth column.

The tender sum for project A was R28,315,000 and the original planned works duration was 9 months. The tender sum for project B was R61,617,996 and the original planned works duration was 11 months. In total, 75 and 118 variation orders occurred on respective projects A and B. On project A, there were numerous additional works associated with the continuously revised electrical works. The reinforcement for concrete slabs changed from post-tensioned to conventional rebar. As the contractor could not finish on agreed

time, the extension of time of 25 days was granted. Unfortunately, due to a further failure to complete works during the revised completion period, the contractor was charged a penalty of R13,000 per day totaling R923,000 in 71 days above the extended period. Penalty charge amount was 3% of the contract sum and the actual completion period was 12 months with an escalation of 33% above the original time schedule. While there could be other factors that contributed to time escalation, it is argued that numerous changes to electrical works contributed to delays where the contractor might have failed to justify at which extend his productivity and progress were effected. On project B, the contractor was granted an extension of time of 26 days which is a time overrun of 9% over the planned works duration. No penalty was charged to the contractor and the consultant's records did not show in detail the reason behind such an extension.

7.1.1 Variation order occurrence

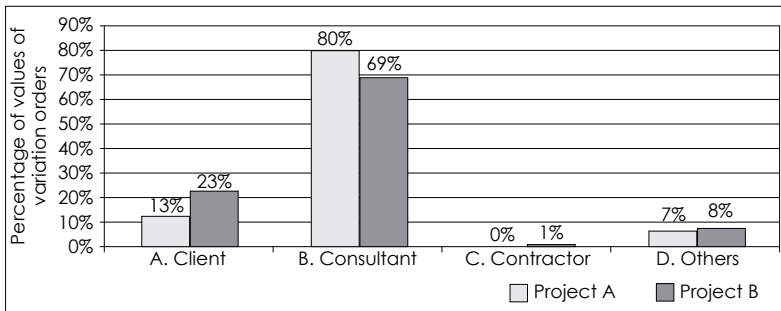


Figure 1: Origin agents of variation orders

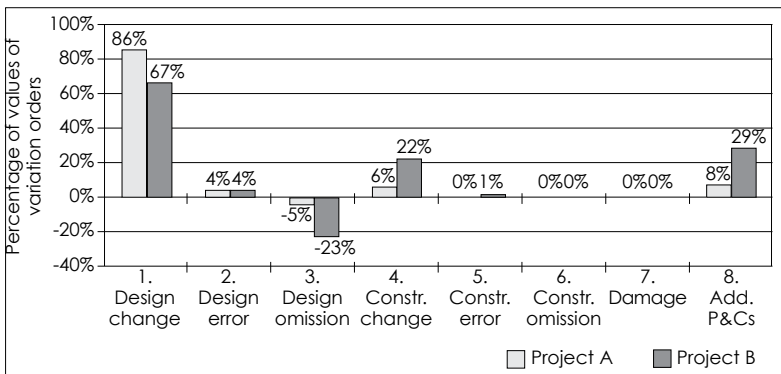


Figure 2: Causes of variation orders

Figure 1 shows the percentage of the value of origin agents of variation orders. For example, on both projects A and B, the consultant was the most predominant origin agent who produced 80% (R1,658,589) and 69% (R1,404,500) of the net total sum of variation orders. Figure 2 shows the percentage of the value of causes of variation orders. On both projects A and B, the design change was the most predominant cause of variation orders that amounted to 86% (R1,784,634) and 67% (R1,363,394) of the net total sum of variation orders. The value of errors and damage is provided for both respective projects are clearly shown. Unfortunately, the chart does not reveal the exact originating agent. Therefore, this will be possible by means of tables that clearly show at the same time parameters including monetary value, origin agent and causes of variation orders.

7.2 Identification of waste zones

Table 2 and 3 record the variation orders that occurred on projects A and B. The origin-cause matrix clearly shows the number and value corresponding at each couple origin-cause. It was possible to identify variation orders that were likely to generate waste. On project A, the cost of the design errors resulting from the consultant (B;2) was 4% (R83,360) of the net total sum. These were costs for remedial works to imported joinery as a result of inefficiency in design co-ordination and repair that was done on electrical cables and conduits damaged. It is argued that costs for demolition of erected works due to design error constitute waste of resources. The construction cost for construction error resulting from the contractor (C;5) was 0.18% (R3,738). Instruction was issued to repair damage done by the contractor (C;7) to neighbouring building during demolition works; but the works were not yet executed and subsequent cost was not provided. On project B, the cost of design errors resulting from the consultant (B;2) was 4% (R82,135) of the net total sum of variation orders and the cost resulting from the construction error of the contractor (C;5) was 1% (R12,395). The combination of the cost of errors originating from the consultant and the contractor amounted to 5% (R94,530) of the net total sum of variation orders. It was revealed that the consultant and the contractor had generated situations that yielded waste. No waste arose from unspecified 'others'. The question is to know who pays for such costs. In most cases, these are transferred to the account of the client and as a consequence, construction delivery cost increased.

Table 2: Origin-Cause matrix of variation orders - Project A

Origin agent	Causes								Total	%	
	1	2	3	4	5	6	7	8			
A. Client	No								1	3	4
	Amount	R98,327							R171,825	R270,152	13
B. Consultant	No	44	13	4						64	85
	Amount	R1,596,768	R83,360	-R101,208	R79,669					R1,658,589	80
C. Contractor	No							1		2	3
	Amount							R3,738	?	R3,738	0
D. Others	No	3		3						6	8
	Amount	R89,593			R54,582					R144,121	7
Total	No	49	3	13	7	1	0	1	1	75	100
	Amount	R1,784,634	R83,360	-R101,208	R134,251	R3,738	R0	R0	R171,825	R2,076,600	100

Keys: 1. Design change, 2. Design error, 3. Design omission, 4. Construction change, 5. Construction error, 6. Construction omission, 7. Damage, 8. Additional Preliminaries

Table 3: Origin-Cause matrix of variation orders - Project B

Origin agent	Causes								Total	%
	1	2	3	4	5	6	7	8		
A. Client	No 28		10			1		2	41	35
	Amount R314,385		-R444,661			R1,640		590,000	R461,364	23
B. Consultant	No 53	4	3	11					71	60
	Amount R1,049,009	R82,135	-R17,100	R290,456					R1,404,500	69
C. Contractor	No				1				1	1
	Amount				R12,395				R12,395	1
D. Others	No			4		1			5	4
	Amount			R154,660					R154,660	7
Total	No 81	4	13	15	1	2	0	2	118	100
	Amount R1,363,394	R82,135	-R461,761	R445,116	R12,395	R1,640	R0	R590,000	R2,032,919	100

Keys: 1. Design change, 2. Design error, 3. Design omission, 4. Construction change, 5. Construction error, 6. Construction omission, 7. Damage, 8. Additional Preliminaries

8. Conclusions

The review of the literature revealed that variation orders were likely to occur on construction projects since these are permitted under contractual agreements. Variation orders cannot be avoided completely since construction works involve complex operations that cannot be accurately determined in advance. It was argued that whenever a variation order is issued unnecessary costs could likely occur. These constituted waste of resources and as a result they contributed to higher construction delivery costs.

A comparative study was done on two apartment complexes. A total number of 75 and 118 variation orders averaging 8% (R2,076,600) and 4% (R2,032,919) of the contract sum (R28,315,000 and R61,617,996) occurred on respective projects A and B. It is argued that numerous variation orders on both projects contributed to time overruns and had potentially contributed to waste. Both projects A and B incurred delays and time for completion escalated at 33% and 9% over the original completion time. On project A, a contractor was charge a penalty of 3% (R923,000) of the original contract sum. Arguably, the numerous variation orders contributed to delays where the contractor might have failed to properly justify at which extent his productivity and progress were affected. However, there might be other factors beyond the scope of this study that contributed to delays.

By auditing each variation order in terms of the value, origin agent and the cause, it was possible to identify that variation orders were likely to generate waste. On project A, the cost of the error originating from the consultant and the client was 4% (R87,098) of the total net sum (R2,076,600). On project B, the combination of the cost of error originating from the consultant and the contractor was 5% (R94,530) of the net total sum of variation orders (R2,032,919). The origin-cause matrix proved to be an efficient tool that provided a breakdown of uncovering the probable magnitude of waste associated with variation orders.

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