

## **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 besighheidsbestuur 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
<b>Planning:</b>						
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
<b>Organising:</b>						
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 =
<b>Leading:</b>						
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 =
<b>Controlling:</b>						
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

Subject areas	Successful		Unsuccessful		Mean	
	MS	Rank	MS	Rank	MS	Rank
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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