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# **Residential property development and financial ratio analysis: a South African perspective**

*Peer reviewed*

## **Abstract**

Financial statements are read, analysed and interpreted by a diverse group of interested parties, among whom are owners, directors and managers who read financial statements to utilise the information for planning and control purposes. It is imperative that they uncover underlying or evolving trends and/or other salient features in order to assess the business' progress towards achieving its strategic goals (as determined through its planned objectives). Financial ratio analysis promises to be a simple but effective way of analysing financial statements for interpretation. It is, however, not a 'complete' method of analysis as it is directed at measuring financial objectives only.

The 'traditional' method of analysis and interpretation of financial statements evolved over a period of approximately a century (mainly due to major developments in management concepts). Thereafter industrious researchers explored the possibility of effecting changes to these existing methods, formulae and uses of financial ratios to explore their predictive abilities. It was assumed to be an inherent attribute of ratio analysis. Although there is no real consensus, the conclusion is that failure-or-success-prediction-models suffer from poor predictive abilities. Therefore this study was directed at the principles of applying the 'traditional' approach to financial ratio analysis. The references to the 'modern' models, techniques and their applications are made for contextual purposes only.

The aim of this study is twofold. The first aim is to determine whether residential property developers apply financial ratio analysis in analysing the financial information contained in their financial statements. Developers indicated that they do use ratio analysis for this purpose. The second aim is to illustrate how important the acquisition of knowledge and understanding of the basic principles and techniques of financial ratio analysis is to non-accountants (such as the average property developers and built environment professionals) in applying financial ratio analysis in their decision-making. Section 8 in this study serves as guideline to practitioners, based on results and conclusions of the empirical study of the article.

There is no internationally accepted theoretical framework or standard for applying and using financial ratio analysis to assist managers in the assessment of business performance. This should not create the perception that ratios are

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merely an accumulation of tools and techniques. Each ratio is an integral link in a chain of financial ratios.

Managers in the built environment should be encouraged to gain knowledge and apply financial management tools and techniques to enhance their financial management expertise. Non-financial managers and directors can no longer avoid financial management responsibilities by deferring these to the financial professionals. Rather, managers and directors need to adopt an attitude of the buck stops here.

Keywords: Property development, ratio analysis, South Africa

## Abstrak

Finansiële state word gelees, ontleed en vertolk deur 'n diverse groep belanghebbendes. Een groep is die eienaars, direkteure en bestuurders wat finansiële state bestudeer ten einde die inligting aan te wend vir beplanning- en kontrole-doeleindes. Dit is van uiterste belang om onderliggende of ontlukende tendense of ander kenmerkende eienskappe te identifiseer, ten einde te bepaal of 'n besigheid se strewe na bereiking van sy strategiese mylpale, soos vasgestel deur die onderneming se doelwitte, bereik word. Finansiële verhoudingsontleding belooft om 'n eenvoudige maar effektiewe metode te wees om ontledings vir die vertolking van finansiële state te doen. Dit is egter nie 'n volledige metode van prestasie meting, ontleding, interpretasie en bestuur nie, aangesien dit slegs meting van finansiële doelwitte aanspreek.

Oor die tydperk van ongeveer 'n eeu het die metode van ontleding genaamd 'tradisioneel' ontstaan (hoofsaaklik weens vooruitgang in bestuurstechnieke). Daarna het navorsers die moontlikheid ondersoek om die voorspellingsmoontlikhede van verhoudingsontleding te ontgin deur geringe veranderings aan die 'tradisionele' metodes aan te bring. Daar is nie algemene ooreenstemming nie, maar dit blyk die gevolgtrekking te wees dat mislukking-en-sukses-modelle min voorspellingswaarde inhou. Daarom was hierdie studie daarop gerig om die toepassing van die 'tradisionele' metode van ontleding van finansiële state te ondersoek. Verwysing na die 'moderne' modelle, tegnieke en hulle toepassing word slegs gemaak vir kontekstuele doeleindes.

Die doel van die studie is tweevoud. Eerstens om te bepaal of residensiële eiendomsontwikkelaars verhoudingsontleding gebruik in die vertolking van hulle ondernemings se resultate. Eiendomsontwikkelaars het aangetoon dat hulle inderdaad van finansiële verhoudingsontleding gebruik maak. Tweedens om te illustreer hoe belangrik kennis en begrip van finansiële verhoudingsontleding asook die basiese beginsels en tegnieke van verhoudingsontleding vir nie-finansiële bestuurders (soos die gemiddelde eiendomsontwikkelaar en bou-omgewing professionele persone) is in die toepassing van finansiële verhoudingsontleding met betrekking tot besluitneming. Punt 8 van die artikel word daaraan gewy om advies te verskaf aan gebruikers van verhoudingsontleding in die bou-omgewing.

Daar bestaan geen internasionaal aanvaarde teoretiese raamwerk of standaard vir die gebruik en toepassing van finansiële verhoudingsontleding om bestuurders te ondersteun in die evaluering van hulle ondernemings se resultate nie. Dit moet egter nie die indruk skep dat verhoudings bloot 'n versameling van verhoudings en tegnieke is nie; elke verhouding is 'n integrale skakel in 'n ketting van verhoudings.

Bestuurders in die bou-omgewing behoort aangemoedig te word om die nodige kennis in te win en toepassings van gebruike en tegnieke van verhoudingsontleding te beoefen aangesien dit die enigste manier van verkryging van ondervinding is. Nie-finansiële bestuurders durf nie langer die finansiële bestuursverantwoordelikhede vermy deur dit aan rekeningkundige persone oor te dra nie. Bestuurders en direkteure moet 'n houding van die verantwoordelikheid eindig hier inneem.

Sleutelwoorde: Eiendomsontwikkeling, ratio analise, Suid-Afrika

## 1. Introduction

Whittington(1980: 219) defined the basic assumption of ratio analysis as that of:

*proportionality, i.e. it is assumed that a proportionate relationship exists, or ought to exist, between the two variables whose ratio is calculated.*

McDonald & Morris(1984: 89) observed that:

*ratio analysis has been popularized not by its structural validity, but by its convenience.*

Coetzee, Stegmann, Van Schalkwyk, & Wesson (2002: 199) regard ratio analysis as:

*... the most noted and useful tool for analysers of financial statements. Even so, it is sometimes misunderstood and its importance underestimated.*

Ratio analysis lacks explicit theoretical structure and the user of ratios is required to rely upon the authority of an analyst's experience. Ratio analysis is replete with untested assertions about which ratios should be used and what their proper levels should be. In general, the expected relationships of various ratios have not been formulated. The major part of ratio analysis literature consists of instructions on how to compute ratios (Horrigan, 1968). This has not changed since Horrigan made the observation in 1968.

Horrigan(1968) indicated the basic ratio shortcoming and the need that exists for analytical devices which will enable analysts to compare financial statements between firms and over time periods. Ratio analysis is a simple, quick method of comparison. Available evidence suggests that ratios do have predictive value, even if only in respect of financial distress. Horrigan suggested that the shortcomings of ratio analysis be remedied and predicted that ratios would play an important role in the future. Ratios should at least be useful to the small firm for internal analyses and to most external analysts for investment and credit evaluations.

McKosker (1998) stated that when ratios are interpreted with care it allows managers to concentrate resources in the correct areas. Good management and appropriate accounting systems accompanied by relevant controls is needed to maintain direction or correct the lack thereof. Gitman (2003) cautioned that financial ratios should be meaningful and there should be a logical relationship between the units being used. According to Brigham & Gapenski (1996: 47), ratio analysis is useful as a starting point for planning actions that will influence the future course of events. Chabotar (1989) stated that by itself, a ratio almost never provides sufficient evidence for panic or pride and there is much about an organisation that cannot be quantified by means of ratio analysis, such as leadership and reputation. Ross (2005) pointed out that financial statement information is subject to legitimate estimates, timing decisions and illegitimate manipulation. Adrian (1979: 123) states that each firm and the industry in which it performs is unique as to its product, objectives and financial structure resulting in the fact that each firm is unique to the values of its financial ratios. This can result in a negative assessment of a specific firm, although it may have a sound financial structure.

This led to the question whether residential property developers apply financial ratio analysis in analysing the financial information contained in their financial statements? The hypothesis that residential property developers do apply financial ratio analysis in practice and decision-making will be tested. This article aims to illustrate the importance of knowledge regarding financial ratio analysis as applied by residential property developers. Ratio analysis evolution seems to move toward a structure as illustrated in Figure 1. This structure forms the basis of the empirical study discussed hereafter.

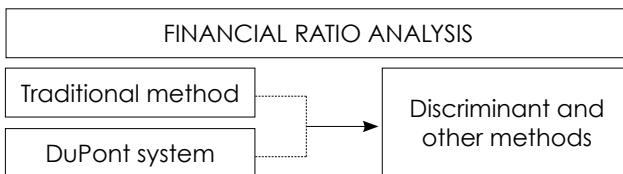


Figure 1: Spectrum of ratio analysis available

## 2. Traditional ratio analysis

According to Gitman (2003), financial ratios can be divided into five basic categories. Liquidity, activity and debt ratios primarily measure risk. Profitability ratios measure return. Market ratios capture both risk and return. Figure 2 illustrates this concept.

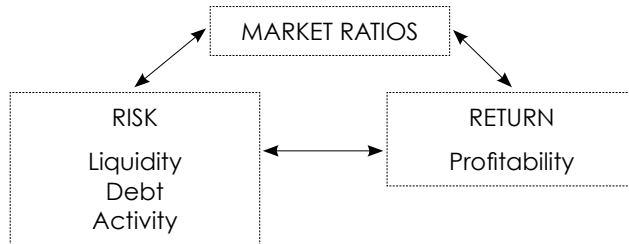


Figure 2: Traditional ratios

Liquidity refers to a firm's ability to meet its obligations over the short term. This means to have the necessary cash available to pay for costs and expenses and to make payments due to creditors. The availability of adequate levels of cash is measured by the Current Ratio and refined by the Quick (Acid-Test) Ratio.

A company's ability to survive over the long term is related to its debt position. The debt position of a firm indicates the amount of non-owner or non-self-generated funds used by the business. In general, the more debt a firm uses, the higher the risk. Due to the influence of financial leverage, debt could actually increase the return to owners, but at the risk of possible insolvency should the company be unable to service its debt. Debt or Solvency Ratios are the Debt Ratio, Times Interest Earned Ratio and Fixed-Payment Coverage Ratio.

Activity Ratios measure the speed (in terms of days or number of times per year) with which assets and liabilities are converted into cash. Activity ratios are Inventory Turnover Ratio, Average Collection and Payment Periods Ratios and Total Asset Turnover Ratio. This can be considered a measure of assurance for uncertain liquidity ratios.

Profitability ratios evaluate a firm's profits by expressing them in terms of level of income (turnover), certain levels of assets, as well as the owners' investment. Profitability Ratios are Gross Profit Margin, Operating Profit Margin, Net Profit Margin, Earnings per Share (EPS), Return on Total Assets (ROA) and Return on Common Equity (ROE).

Market Ratios relate the firm's market value measured by its current share price to certain accounting values. These ratios give an indication on what investors in the marketplace feel the firm is doing in terms of risk and return. Market Ratios are Price/Earnings (P/E) Ratio and Market/Book (M/B) Ratio.

According to Salmi, Virtanen & Yli-Olli (1990), financial ratios are widely used for modelling purposes by both practitioners and researchers. Many distinct areas of research involving financial ratios can be discerned. They stated that historically one can observe several major themes in the financial analysis literature. There is overlapping in the observable themes, and these do not necessarily coincide with what theoretically might be the best founded areas. Salmi & Martikainen (1994) developed the above theme concept further. Where both the numerator and the denominator are market based they suggested the use of the term 'market-based ratio' and the use of the term 'financial ratio' for ratios and other similar data derived from financial statements, with and without the market-based element.

Traditional ratios are part of a structure as illustrated in Figure 2. Financial ratios are not a random group of calculations. A clear and logic sequence, interdependence and reliability exist in their compilation. Figure 2 illustrates the structured concept of ratios.

### **3. A structure for traditional ratio analysis**

Gitman(2003: 53), Melicher (2006: 154), Coetzee *et al.* (2002: 199) and Faul, Pistorius, Van Vuuren, Vorster, & Swaneveldter (1997: 806-807) roughly agree on traditional ratios as illustrated in Figure 2. The most important and often overlooked wisdom contained within the diagram can be illustrated by comparing the diagram with a book. A book contains the complete story or message, so does the diagram. If each ratio is regarded as a chapter within the book, then without any one of them the message is not only different; but also incomplete. One ratio, like one chapter, cannot be expected to convey the full story or message that unfolds in the book as a whole.

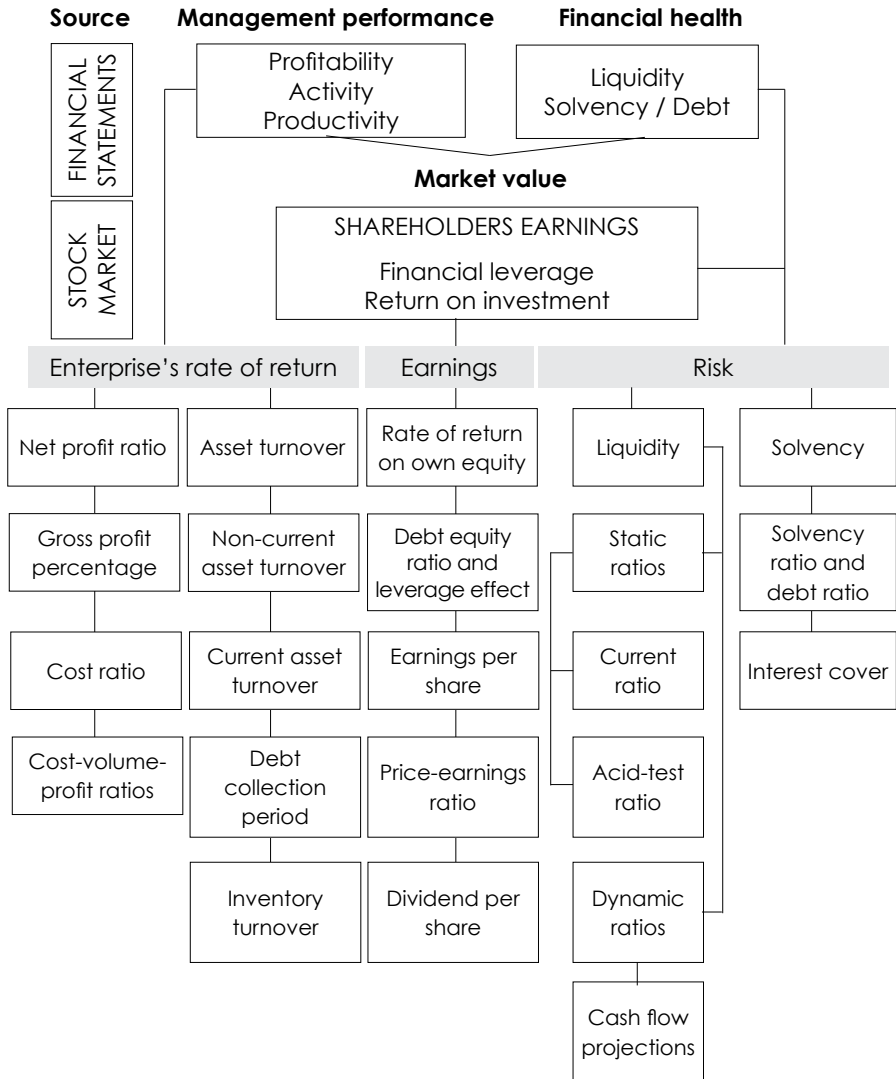


Figure 3: Illustration of ratios in groupings  
Source: Faul *et al.*, 1997: 807 adapted

#### 4. The DuPont method of analysis

The traditional method is better illustrated and understood alongside the DuPont method of analysis which includes the financial statements. The DuPont system evolved from the traditional method and, by focusing on certain key ratios, the DuPont method is in fact an alternative presentation of the traditional method. Melicher (2006: 175) defined DuPont as:

*The technique of breaking down return on total assets (ROA) and return on equity (ROE) into their component parts.*

ROA is calculated as:    Net profit margin X Total asset turnover

ROE is calculated as:     $\frac{\text{Net income}}{\text{Shareholders equity}}$     or ROA X FLM

The DuPont Corporation needed a method of performance measurement and the 'DuPont identity' method proved to be the answer. The distinguishing aspect of this analysis is that it results in a measure of an entity's profitability, namely, ROE. The DuPont model is a structured analytical technique often used in practice. The model assumes that the single aim of a business is to increase the return of shareholders' funds (thus maximise ROE). The model combines risk and return as both sides are linked to the ROE.

According to Gitman (2003), DuPont combines the net profit margin, which measures the firm's profitability in sales, with total asset turnover, which indicates how efficiently the firm has used its assets to generate sales. The product is return on total assets (ROA). The second step is the modified formula and relates the firm's return on total assets (ROA) to its return on common equity (ROE) which is calculated by multiplying the return on total assets (ROA) by the financial leverage multiplier (FLM), the ratio of total assets to common equity.

Angell & Brewer (2003: 1) commented on "the deficiency of the DuPont system of analysis in most textbooks and provides an alternative that more accurately aligns the analytical measures to the factors affecting a firm's return on equity". They added net profit available to the owners to the equation and labelled it "Net Leverage Multiplier".



Penman (1991) concluded that the ROE is best interpreted as an effective profitability measure, not a risk measure. By contrast, De Wet & Du Toit (2007: 59) determined as follows when the return on equity (ROE) is weighed up against the present favourite, economic value added (EVA): "it is clear that the debate about the effectiveness of traditional accounting performance measures, as well as the search for the real drivers of shareholder value, will continue and increase in intensity. Although ROE has some appeal because it links the income statement (earnings) to the balance sheet (equity), it has some serious flaws as a measure of performance".

Figure 4 illustrates that ROE (a gauge of profit-generating efficiency) is affected by:

- Operating efficiency (net profit margin, indicated as 1 in Figure 4)
- Asset use efficiency (total asset turnover, indicated as 2 in Figure 4), and
- Financial leverage (financial equity multiplier, indicated as 5 in Figure 4).

The DuPont method of analysis (illustrated in Figure 3) starts with the components of the financial statements and works towards the ROE. The upper portion of the diagram summarises the income statement in income and expense activities and the lower portion of the diagram summarises the balance sheet in net balance sheet activities. It is important to note that step one determines the Return on Total Assets (ROA) ([4] in Figure 4: calculated as [2] on the Figure divided by with [3] on the Figure) and the second step the multiplication of ROA with the Financial Leverage Multiplier (FLM) ([5] in Figure 4) to calculate Return on Equity (ROE) ([6] in Figure 4). It is otherwise calculated as Profit available to the Owners ([1] in Figure 4) divided by Owners' Equity.

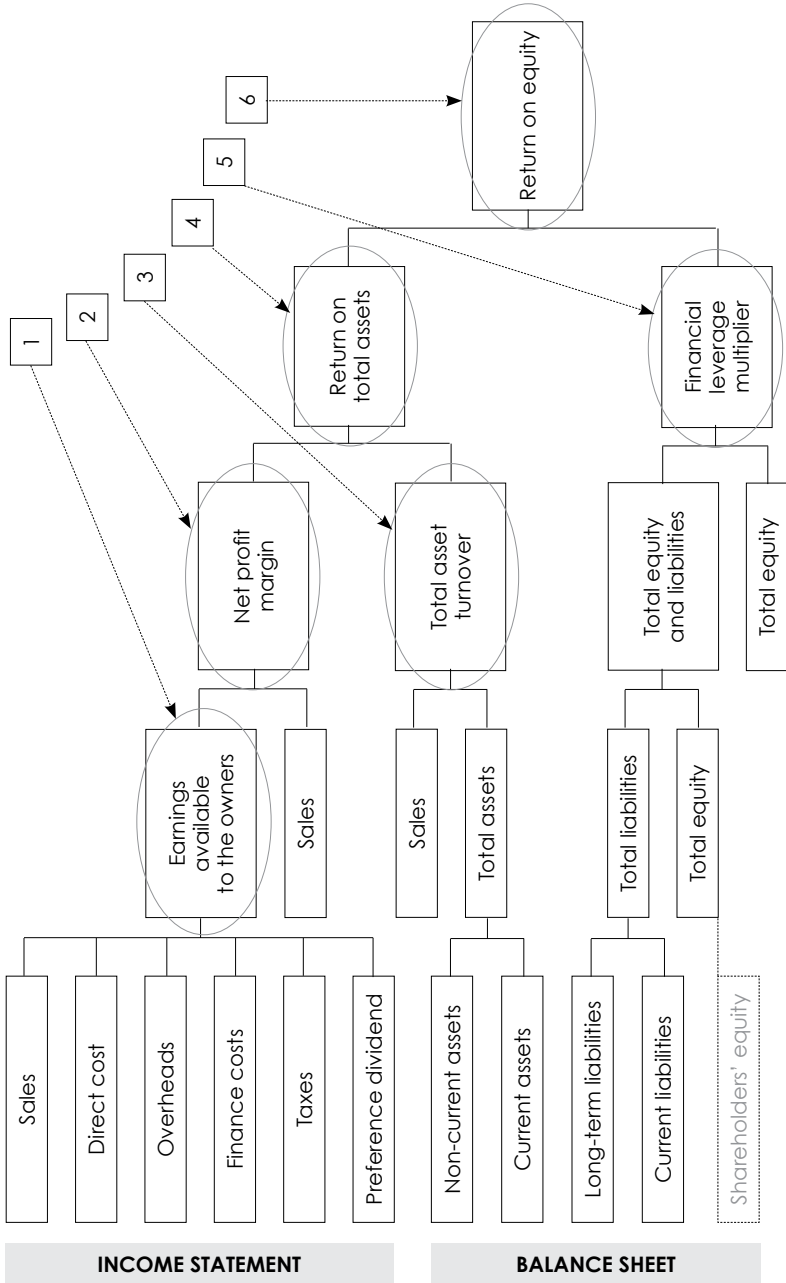


Figure 4: DuPont system of analysis  
Source: Meitner (2006: 176) & Gitman (2003: 140) Adapted

## 5. Discriminant and other methods of ratio analysis

According to Joy & Tollefson (1975: 723), discriminant analysis research has substantially increased; however, these studies have experienced problems with interpretation. They remarked that “the conclusions and generalizations that can be drawn from such studies are frequently tenuous and questionable.”

Kaufmann, Gadmer & Klett (2001: 1); Feroz, Kim, & Raab (2003); Gattoufi, Oral & Reisman (2004), and Thannasoulis, Boussofiame & Dyson (1996) researched the method of analysis called Dynamic Financial Analysis (DFA). Kaufmann *et al.* (2001: 1) remarked that DFA combines so many economic and mathematical concepts and methods that “it is almost impossible to identify and describe a unique DFA methodology.”

Gallizo & Salvador (2003: 267) contributed to “the understanding of the behaviour of financial ratios by means of a Hierarchical Bayesian Analysis of the partial adjustment model of financial ratios.” Seay, Pitts & Kamery (2004: 9), on the other hand, sought to “enhance the understanding of the ratio adjustment phenomenon by investigating the association between certain firm-specific factors and the rates of ratio adjustment and of expectation (target) adjustment.”

Chen & Shimerda (1981: 51) undertook an empirical analysis of useful financial ratios. They concluded that there is one recurring question in the use of financial ratios: “Which ratios, among the hundreds that can be computed easily from the available financial data, should be analyzed to obtain the information for the task at hand?”

The existing controversy and contradictions in the constant search for a fixed set of ratios and benchmarks are best explained by the following quotations. These clearly indicate a diverse but honest opinion of what financial ratios are and/or what they are not.

- According to Altman (1968: 589), academics appear to be moving toward the elimination of ratio analysis as an analytical technique in assessing the performance of the business enterprise, and theorists downgrade arbitrary rules of thumb, such as company ratio comparisons, widely used by practitioners. “Although attacks on the relevance of ratio analysis emanate from many esteemed members of the scholarly world, does it mean we bridge the gap between traditional ratio ‘analysis’ and the more rigorous statistical techniques or rather sever the link”.

- Deakin (1976: 90) stated that the recent application of advanced statistical techniques to the traditional financial ratio analysis of companies has raised some questions concerning the usefulness of these ratios for persons external to the firm.
- Eisenbeis (1977:895) stated that there exist pitfalls in the application of discriminant analysis in business, finance and economics. "The applied discriminant analysis papers that have appeared in the business, finance, and economics literature to date, most have suffered from methodological or statistical problems that have limited the practical usefulness of their results".
- Laínez & Callao (2000: 65) concluded that "Business activity has acquired an international dimension and financial information needs to be understood both inside and outside its country of origin".

Regarding property companies Barkham (1997: 441) remarked that they are a key group in the economy of the built environment: "The entrepreneurs that run property companies are responsible for initiating development projects and managing them. The risk incurred by participants in the development process, such as banks and construction firms, is related not only to the risk of the project being undertaken but also to the financial risk associated with the property company that initiates and manages the project."

Traditional ratio analysis, and therefore the DuPont method, that focus on the ROA and ROE are considered to be the basic route to be taken by non-accountants and non-financial managers and therefore formed the basis of the empirical study and research of this article. The area of discriminant methods is still unclear to the majority of analysers.

## **6. Methodology**

The property development industry in South Africa entails residential, commercial and industrial development. It was decided to limit the scope of this study to residential property developers to prevent the study from becoming too general, too time-consuming and too expensive. The aim of this study is to determine whether residential property developers in Gauteng apply financial ratio analysis in the development of property. This will be determined by using descriptive statistics based on data obtained by means of a questionnaire.

## **6.1 Development of the questionnaire**

The data needed to address the main research question was located with residential property developers and was secured by means of a questionnaire directed at residential property developers. The data was interpreted and correlations (if any) were drawn between the sizes of the selected property developers and the use of financial ratio analysis.

The questionnaire was designed to be as brief as practically possible in view of the amount of information needed for the study. The four questions posed were designed to obtain relevant information in terms of the use of financial ratio analysis. The questions were designed with the traditional approach to financial ratio analysis as basis by focusing on the relevant areas of liquidity, activity, solvency and profitability.

The aim of the questionnaire was to determine whether respondents used the method of financial ratio analysis in analysing and interpreting their financial statements (for the purpose of internal management) by applying the traditional approach.

## **6.2 Sample size**

All the registered residential property developers in Gauteng were initially included in the original sample. Only residential property developers registered with the Gauteng Home Builders Association were used in this study.

In deciding on the size of the sample, practical considerations such as reliability and accuracy, as well as time and cost constraints, had to be considered. A small sample of 20 residential property developers, registered at the Gauteng Home Builders Association was considered. The statistical relevance of the variables was tested by applying Fisher's exact test (See attachment 1).

## **6.3 Sampling method**

At the time of the sampling, a total of 33 residential property developers were registered at the Gauteng Home Builders Association. When an attempt was made to contact all these developers, it was found that a number of them were no longer operating. This limited the sample. In the end, only 20 registered residential property developers were selected from the remaining group. A questionnaire was presented telephonically to each residential property developer selected. A covering letter explained the purpose of the research.

## 6.4 Representative of the response

All 20 of the telephonic interviews conducted were satisfactorily completed. In addition, there is no reason to believe that the questions contained in the questionnaire would cause bias in the answers received, because every single respondent was asked the same questions in the same manner. The response was therefore considered to be acceptably representative of the sample.

## 7. Research results

Having explained the research method followed in the study, attention is now paid to the statistical analysis of the data collected, as well as the results obtained from the data. Special attention is paid to ascertaining the extent of the use of financial ratio analysis, as well as any relationship between the size of respondents' businesses and financial ratio analysis as business tool.

### 7.1 Number of years in the property development business in relation to the use of financial ratio analysis

Table 1: Number of years in the property development business in relation to the use of financial ratio analysis

Number of years	Use of financial ratio analysis		
	Yes (frequency)	No (frequency)	Total %
0-10 years	3	5	40.00
11-20 years	5	2	35.00
21+ years	5	0	25.00
Total	13	7	100

Fisher's exact test:  $p = 0.0934$

Table 1 places the number of years that the respondents have been in the residential property development business in relation to their use of financial ratio analysis in their businesses. The following trend is clear: developers who have been in the market for less than ten years tend not to use financial ratio analysis. A small percentage of developers who have been in business between 11 and 20 years still do not use financial ratio analysis but more of these developers do use financial ratio analysis. Developers who have been in the developing business for more than 20 years all use financial ratio analysis in their businesses. Fisher's exact test shows that there is no statistically significant relationship between the variables ( $p > 0.05$ ).

## 7.2 The use of liquidity ratios by residential property developers in relation to their applicability

Table 2: The use of liquidity ratios in relation to their applicability

Use of liquidity ratios	Applicability of liquidity ratios			
	Low	Medium	High	Total %
Never	3	1	2	31.58
Sometimes	0	1	3	21.05
Always	0	0	9	47.37
Total	3	2	14	100

Fisher's exact test:  $p = 0.0101$

Table 2 indicates that there is a relationship between how often residential property developers in Gauteng use the liquidity ratio and how applicable this ratio is to them. A total of nine of the 20 respondents (47.37%) always use liquidity ratios in their businesses. These respondents also have a high regard for the applicability of the liquidity ratio. In terms of Fisher's exact test of 0.0101, there is a statistically significant relationship between the two variables ( $p < 0.05$ ).

## 7.3 The use of solvency ratios by residential property developers in relation to their applicability

Table 3: The use of solvency ratios by residential property developers in relation to their applicability

Use of solvency ratios	Applicability of solvency ratios			
	Low	Medium	High	Total %
Never	3	3	0	31.58
Sometimes	0	3	4	36.84
Always	1	0	5	31.58
Total	4	6	9	100

Fisher's exact test:  $p = 0.0079$

Table 3 examines whether there is a relation between how often residential property developers in Gauteng use solvency ratios and how applicable this ratio is to them. Only four respondents said that they only sometimes use solvency ratios, but they regard these as highly applicable indicators of business performance. A total of five respondents always use solvency ratios and regard these as highly applicable. Fisher's exact test indicates that there is a definite statistically significant relationship between the two variables ( $p < 0.05$ ).

#### 7.4 The use of profitability ratios by residential property developers in relation to the applicability of the return on assets (ROA)

Table 4: The use of profitability ratios by residential property developers in relation to the applicability of the ROA

Use of profitability ratios	Applicability of ROA			
	Low	Medium	High	Total %
Never	2	1	1	21.05
Sometimes	1	1	0	10.53
Always	1	3	9	68.42
Total	4	5	10	100

Fisher's exact test:  $p = 0.077$

Table 4 shows information on the use of profitability ratios in relation to the applicability of the ROA of residential property developers in Gauteng. It clearly shows that nine respondents (47.37%) always use profitability ratios and have a high regard for the applicability of ROA, and that 68.42% of the respondents always apply profitability ratios as an indicator of business performance. Ten respondents regard the return on assets ratio as highly applicable, but Fisher's exact test shows that there is no statistically significant relationship between the variables, as  $p > 0.05$ .

#### 7.5 The use of profitability ratios by residential property developers in relation to the applicability of the return on equity (ROE)

Table 5: The use of profitability ratios by residential property developers in relation to the applicability of the ROE

Use of profitability ratios	Applicability of ROE			
	Low	Medium	High	Total %
Never	2	1	1	21.05
Sometimes	0	1	1	10.53
Always	1	2	10	68.42
Total	3	4	12	100

Fisher's exact test:  $p = 0.1429$

Table 5 examines whether there is any relationship between profitability ratios, as used by residential property developers, and



the ROE ratio. Ten respondents (52.63%) always use profitability ratios and regard the ROE ratio as highly applicable. Fisher's exact test shows that there is no statistically significant relationship between profitability ratios and the applicability of the ROE ratio as an indicator of business performance, as  $p > 0.05$ .

## **8. Challenges to the application of ratios analysis in the built environment**

Although there is no generally accepted theoretical framework for the use of financial ratio analysis, there seems to be agreement on the following: basic principles (underlying assumptions), simplicity of calculation and application, limitations to the analysis, and the intricacy (pitfalls) of the interpretations of the results of the analysis.

Non-accountants and non-financial managers who are still deciding whether or not to utilise ratio analysis should understand why they need to make certain choices and decisions regarding ratios. Figure 5 can serve as a start to this process.

## 8.1 Process of choices in the application of ratios

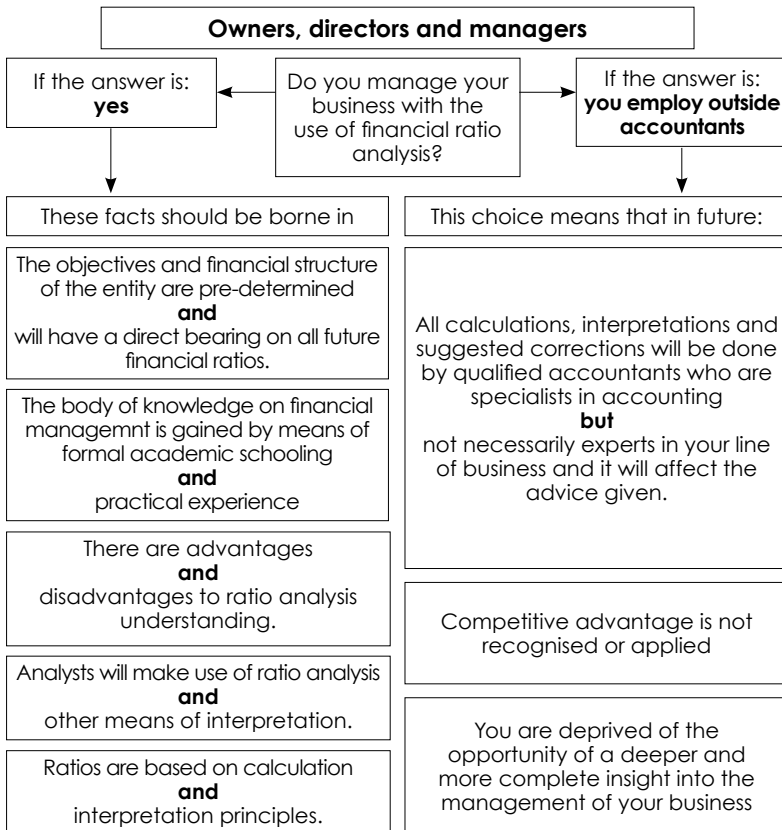


Figure 5: Decision structure to managers who decided to use ratio analysis

## 8.2 Examples of lesser known pitfalls in ratio analysis

All textbooks that include ratio analysis convey extensive examples of the more obvious pitfalls in ratio application. Lesser known pitfalls should also be borne in mind, such as:

- An isolated ratio could create a wrong impression. The liquidity ratio without the profitability ratio is incomplete information on the sustainability thereof.
- Company goals and objectives could be asset accumulation-based, profit realisation-based, human resource or infrastructure

development-based or social responsibility-directed. The progress towards its success requires different measurements.

- The objectives of the company should be expressed in the form of target ratios over the full spectrum of financial ratios to indicate the effect thereof on all the ratios. It must be expressed what effect one ratio will have on other important ratios. This might also explain why certain ratios can be considered to be positive although they might be lower than industry standards. Budgeted target ratios should equal the period of all other financial budgets.
- External influences on internal ratios are sometimes difficult to measure and can easily be over- or undervalued in explaining substantial ratio changes.
- Absolute amounts versus percentages are sometimes forgotten in the interpretation. The mere size of amounts can lead to decreased percentages.
- Ratio analysis is not merely the calculation of a given ratio. The interpretation of the ratio value is more important. A meaningful basis for comparison is needed, otherwise increases and decreases can be misleading.
- Comparison to industry averages is popular but can easily be misleading. It is important to investigate significant deviations to either side of the industry norm, as it might indicate other problems related to the specific ratio.
- Any year-to-year changes might not seem significant but might point to major problems if the cumulative effects over longer periods are investigated.
- Certain trends or expected occurrences cannot be detected by any single ratio or group of ratios, e.g. balances arising from contractual agreements in the construction industry.

### **8.3 Knowledge and skills required by any user of ratios**

The following is a short list of some of the more important background requirements to financial ratio analysis:

- The aspects of the Theoretical Framework of Accounting (AC000), such as:
  - the principles on which they are based (underlying assumptions);

- the qualitative characteristics of financial reports, and
- interaction between qualitative characteristics and constraints.
- The principles of Presentation of Financial Statements (AC101:IAS1), such as:
  - objective and components;
  - overall considerations, and
  - basic disclosure requirements.

The synergy achieved by the balance sheet, income statement, cash flow statement, the directors' report and the notes to the financial statements. According to Vorster, Koen, Koornhof, Oberholster & Koppeschaar (2003: 17):

*A close relationship exists between these statements that together form the annual financial statements, as each reflects different aspects of the same transactions and events... No single statement will, in itself, provide all the necessary information to the users of the statements.*

- The fact that financial statements are a report on historic events (it can or cannot assist in predicting future events).
- The traditional approach to financial ratio analysis is a simple but effective way of analysing and interpreting financial statements if correctly applied.

The knowledge and skills needed are summarised in Table 6.

Table 6: Summary of knowledge and skills needed when ratios are applied

No.	Discipline	Owners, directors and managers need to understand
1	<b>Accounting</b>	<ul style="list-style-type: none"> <li>• Director's report (Chairman's review)</li> <li>• Balance sheet</li> <li>• Income statement</li> <li>• Statement of changes in equity</li> <li>• Cash flow statement</li> </ul>
2	<b>Information systems</b>	The information system designed, implemented and maintained must supply such data that will enable the accountants to prepare the entity's financial statements according to the requirements of AC000 and AC101/IAS101, and enable the users of financial ratios to calculate fundamental ratios with reliable accuracy.
3	<b>Management</b>	<ul style="list-style-type: none"> <li>• Which parties are interested in the financial statements (and why).</li> <li>• How the financial statements will be analysed by both internal and external parties regarding various aspects of performance and how this will affect the value of the firm.</li> <li>• The cautions to be exercised in using financial ratios (and why).</li> </ul>

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4	<b>Marketing</b>	<ul style="list-style-type: none"> <li>• The effects their decisions will have on the financial statements, particularly the income statement and cash flow statement</li> <li>• How analysis of a ratio such as the Return on Equity (ROE) measures the return on shareholders' investment in the entity, and how this may affect the firm's decision on financing policies, selling prices or rental levels.</li> </ul>
5	<b>Operations</b>	<ul style="list-style-type: none"> <li>• How the cost of operations is reflected in the financial statements.</li> <li>• How the analysis of ratios such as return on total assets (ROA) measures the overall effectiveness of management in generating profits with the available assets. This may affect future decisions regarding assets and facilities.</li> </ul>
6	<b>Financial management</b>	<ul style="list-style-type: none"> <li>• How to read financial statements.</li> <li>• The types of financial ratios available.</li> <li>• How and when to use and rely on financial ratios.</li> <li>• Internal and external effects of financial ratios on long-term financing and planning.</li> </ul>

Source: Adapted from Gatman, 2003: 40

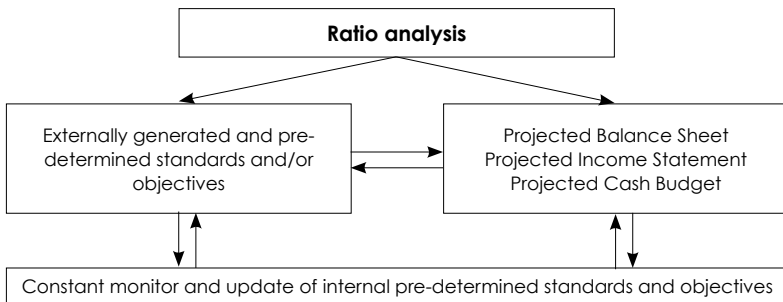


Figure 6: Available ratio analysis model to the property investment industry

### 8.4 Application – proceed with caution

Melicher (2006: 153) determined that “comparing a firm's ratios to other companies or to the average for the industry requires a degree of caution”. The following cautions are advised:

- **Caution one** - Managers need to learn to ‘read and understand’ financial statements. The moment that the information and message contained in the financial statements are understood no method of analysis can supply more information. Ratios (and the analysis and interpretation thereof) will assist in ‘zooming in’ on the problems and strengths identified.

- **Caution two** - Decide on a method of analysis, namely horizontal analysis (evaluating data on a whole series of statements over a period), vertical analysis (statement data expressed as a percentage of a base amount) or ratio analysis (identification, measurement and evaluation of financial relationships or ratios of the financial position and results). In the case of ratio analysis, a decision must be made whether to use trend or time-series analysis (evaluate a firm's performance over time), cross-sectional analysis (compare different companies at the same point in time), industry-comparative analysis (compare a firm's ratios against average ratios for other companies in the same industry) or any combination of the previous.
- **Caution three** - Obtain a basic textbook on the subject of financial analysis/ratio analysis and work through the calculations. Textbooks focusing on property are not freely available. In the authors' opinion it is advisable to work through a general financial management textbook first and then move on to industry-specific text. Management style is related to personality characteristics. Managers need to incorporate financial and other management principles into their evolving management style. Books available are (listed in order of 'user friendliness'): Faul *et al.* (1997: 806-807), Coetzee *et al.* (2002: 199), Melicher (2006: 154) and Gitman (2003: 53). A certificate course in financial management for non-financial managers is an excellent start.
- **Caution four** - Only proceed to methods such as DuPont style analysis and articles on the topic once a thorough understanding of ratios, their advantages and disadvantages are mastered.
- **Caution five** - Attempt ratios that are not generally accepted by practitioners and academics, such as discriminant or any other more advanced analysis method. Figure 6 illustrates the summarised route available to practitioners seeking benchmarks and comparable standards in the analysis process.

## 8.5 Available interpretation tools and comparative measures

Coetzee *et al.* (2002: 199) state that the analyser has a variety of tools at his disposal. Table 7 presents an evaluation in terms of availability to the practitioner.

Table 7: Available interpretation tools

	TOOLS	Available	Notes
1	Comparative financial statements	Seldom	A
2	Ratio analysis	Financial statements	B
3	Structural analysis	Financial statements	C
4	Index changes	Financial statements	D
5	Specialised analysis <ul style="list-style-type: none"> <li>• Cash budgets</li> <li>• Analysis and changes in financial position</li> <li>• Changes in gross profit percentage</li> <li>• Break even analysis</li> </ul>	Financial statements or Management statements	E

Coetzee (2002: 199) cautions that the evaluation of the above must always be considered against one or more of the comparative measures contained in Table 8.

Table 8: Comparative measures

	COMPARATIVE MEASURES	Available	Notes
1	<b>Objective, pre-determined standard or objective (budget)</b>	Management statements	F
2	<b>Historical data peculiar to the enterprise</b>  Corresponding analyses for previous periods of comparable and related figures	Management statements	G
3	<b>Data from outside the firm</b>  Corresponding analyses of the industry or other enterprises in the industry (Similar enterprises or similar industry)	Seldom	H
4	<b>Empirically accepted standards</b>  (including the experience and background of the analyst)	Yes, but be aware	I

### Notes to tables 7 and 8

- Comparative financial statements

Competitors' (private companies' and partnerships') statements are seldom available.

- Ratio analysis

Determined by availability and frequency of compilation of own financial statements.

- Structural analysis

The evaluation of movements in amounts is highlighted by interconnected ratios.

- Index changes

It is extremely difficult to find an adequate base amount to express all other amounts.

- Specialised analysis

This analysis would be crucial to management on a pre-determined period basis.

- Pre-determined standard or objective

When ratio calculations are based on projected statements and budgets it results in maximum management planning and control. Targets and their success are clear.

- Historical data peculiar to the enterprise

Although restricted by historical policies it is very helpful in performance measurements.

- Data from outside the firm

Information would not be specific but will constitute industry averages.

- Empirically accepted standards

Empirical standards are seldom accepted by practice due to specific characterisation qualities attached to every industry type, management team, finance policy, etc.

## **9. Conclusion**

### **9.1 The sample**

Residential property developers in Gauteng apply financial ratio analysis in the management of their property development entities. It is clear that there is a tendency to use components of financial ratio analysis, especially where developers have been in the property development business for more than ten years. Statistically significant relationships were found in terms of liquidity and solvency.

The analysis showed that the majority of the respondents (60%) have been in the residential property development business for more than ten years. Developers who have been in the business for less than ten years tend not to use financial ratio analysis as a financial technique.



There was no clear statistically significant relationship between the number of years spent in the residential property development business and the use of financial ratio analysis, but it was clear that developers who have been in the development business for more than ten years tend to a large extent to use financial ratio analysis in their businesses.

There is a statistically significant relationship between the use of liquidity ratios and their applicability within the residential property development business in Gauteng.. The majority of the respondents use liquidity ratios and regard them as highly applicable. As discussed above, liquidity refers to the company's ability to meet its short-term obligations. The same level of statistical significance was found in terms of the use of solvency ratios and their applicability. The company's solvency status refers to its use of debt financing. It can therefore be deduced that residential property developers regard both their short-term position and their debt position over the long term as important. Both these components of financial ratio analysis relate to the risk position of the business. With regard to the use of profitability ratios and the applicability of the ROA and the ROE, there was no statistically relevant relationship between the variables. Despite this, the majority of those respondents who use profitability ratios regard the ROA and ROE as highly applicable. These ratios refer to the use of own funds and assets to create profits and maximise the wealth of the owners of the company.

In terms of the research conducted it is clear that financial ratio analysis is used by residential property developers but not to the extent that it may be used.

## **9.2 Ratio analysis**

Financial ratio analysis is widely used by managers to monitor their firm's performance and to add substance to decisions. There is always the danger that the sheer volume of data can overwhelm managers. This is sometimes the reason why only a few key ratios are used to summarise the firm's liquidity, activity, solvability and profitability.

The fact that the financial ratio analysis can illustrate, in a way, what management techniques were applied emphasises its importance as a management aid in property development. Financial ratio analysis gives an indication of future financial trouble areas which can lead to corrective action and act as cornerstone for planning and control.

The built-environment professionals should take note that accountants differ on the success and reliability of discriminative ratio analysis. Rather adhere to what you know and make the transition at a time when it can be attempted with more assurance.

## 10. Recommendations

Although there is no internationally laid down standard for financial ratios, a company's financial position and performance must be assessed against some type of industry benchmark, and financial ratios assist management to ask the right questions (rather than provide the right answers).

Each time ratio analysis is attempted, the following illustration of a general misinterpretation should be borne in mind. According to Dewey (2007: online) "When the perceptual system forms a percept or gestalt, the whole thing has a reality of its own, independent of the parts. The Gestalt psychologist Kurt Koffka made a famous statement about this: 'The whole is other than the sum of its parts.' This statement is often translated into English as: 'The whole is greater than the sum of the parts.' Koffka did not like that translation. He firmly corrected students who substituted 'greater' for 'other' (Heider, 1977). 'This is not a principle of addition', he said."

Financial management skills enable managers to make educated decisions on all other management functions such as marketing, purchasing and human resources. Management need this fundamental skill which cannot be passed on to their accountants and be expected to contribute equally to their understanding of the challenges facing them in management. As all management decisions contain a financial component (which is frequently quite substantial), the concern arises: How is management expected to come to a decision if they only possess part of the skills required to perform the task competently?

Financial management competency assists managers in general to make decisions concerning their entities. Although the exact amount of financial management skill and knowledge required by general managers is unknown, what is known is its importance.

Remember the motto: *Avoid making correct decisions - based on wrong information.*

## Attachment 1: Fisher's exact test

*It is sometimes only possible to obtain limited amounts of data, especially if the sample tested is very small, as in this case. When the numbers in a table are small, it may be best to compute exact probabilities rather than one-sided alternatives for either probability models or a situation in which all marginal totals are fixed (Steel & Torrie, 1980: 504). The test used in such calculations is called Fisher's exact test. It determines whether the probabilities ( $p$ ) are statistically significant. In this kind of test we require a comparison or standard against which the answer ( $p$ ) can be tested.*

### 1. The process of performing Fisher's exact test

#### 1.1 Notation

For notation in the steps outlined below, let  $a$ ,  $b$ ,  $c$ , and  $d$  be cell entries; let  $r$  and  $c$  be row and column totals; and let  $n$  be sample size, as in the table below:

Table A: Notation

$a$	$b$	$r_1$
$c$	$d$	$r_2$
$c_1$	$c_2$	$N$

#### 1.2 Computation of Fisher's exact test

Fisher's exact test directly computes  $p$ , the probability of getting a table as strong as the observed table or stronger. This requires computing Fisher's formula below for the given table, as well as for all stronger tables, then summing the separate  $p$ 's to get the total probability of a table that is strong or stronger, as explained below.

#### 1.3 Specify the observed table and all stronger tables

Reduce the cell with the lowest count by one in steps to create the tables stronger than the observed table.

Table B: Computation

Observed Table			Next Stronger			Strongest Table		
7	2	9	8	1	9	9	0	9
5	6	11	4	7	11	3	8	11
12	8	20	12	8	20	12	8	20

#### 1.4 Computing the probability by means of Fisher's exact test:

$$p = (r_1!r_2!c_1!c_2!)/n!a!b!c!d!$$
$$p_{\text{observed}} = 9!11!12!8!/20!7!2!5!6! = .132$$
$$p_{\text{stronger}} = 9!11!12!8!/20!8!1!4!7! = .024$$
$$p_{\text{strongest}} = 9!11!12!8!/20!9!0!3!8! = .001$$
$$p_{\text{total}} = .157$$

Note that factoring is denoted by ! The arithmetic operation of multiplying 1 times 2 times 3, etc., up to n, is for the case of n!

#### 1.5 Interpreting Fisher's p

Interpreting Fisher's p is straightforward. In the example above, p is .157, meaning that there is a 15.7% chance that, given the sample size and distribution of the observed table, we would get a table as strong or stronger by chance sampling alone. Since scientists ordinarily consider .05 to be the cut-off point for the acceptability of significance levels, we would conclude that the distribution in the observed table cannot be said to be significantly different from chance.

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# **Knowledge management as a performance enhancing tool in construction project management in South Africa**

*Peer review*

## **Abstract**

Knowledge management is concerned with the development and exploitation of the knowledge assets of an organisation, with a view to furthering the organisation's objectives. The vital role that knowledge management processes play in the performance of business organisations has been the basis of several studies - a number of companies operating in various other industries have proven the need for, and performance enhancing benefits of, adopting knowledge management processes in one form or another. Taking these accounts into consideration, this article attempted to test the hypothesis that effective knowledge management use would constitute a performance enhancing tool in construction project management enterprise in South Africa. The research survey was thus carried out among registered professional construction project managers in South Africa.

The levels of awareness and use of knowledge management systems among construction project management professionals in South Africa was analysed. This revealed a mostly 'medium to high' level of awareness and use. However, the Project Efficiency Review (PER) approach to performance measurement showed limited correlation between knowledge management use and enhanced performance in construction project performance. Other performance measurement approaches such as Metrics, Economic and Market Value also showed limited correlation. Two causative factors for this situation are construction project scope changes and schedule delays, which are seemingly pervasive in contemporary South Africa. As such, further research is recommended to establish more appropriate 'objective' performance measurement approaches that would be able to accommodate these complexities. This would facilitate the making of a business case for knowledge management use in construction project management.

Keywords: Knowledge management, project management, performance measurement.

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## Abstrak

Kennisbestuur het ten doel om die kennisbata van 'n organisasie te ontwikkel en te benut ter bevordering van die organisasie se doelstellings. Die kardinale rol wat kennisbestuur speel in organisasies se prestasies vorm die basis van verskeie studies – 'n aantal besighede buite die konstruksiebedryf het getoon dat daar 'n behoefte is aan die aanvaarding van kennisbestuurprosesse aan die een kant, en die prestasieverbeteringsvoordele wat sodanige kennisbestuurprosesse bied, aan die ander kant. In die lig hiervan het hierdie studie onderneem om die hipotese dat effektiewe kennisbestuur 'n instrument tot prestasieverbetering in die konstruksiebedryf in Suid-Afrika daarsalstel, getoets. Die navorsingsondersoek is uitgevoer onder professionele konstruksie-projekbestuurders in Suid-Afrika.

Die bewustheidsvlakke en gebruik van kennisbestuursisteme onder professionele konstruksie-projekbestuurders in Suid-Afrika is ondersoek; die resultate het 'n 'medium tot hoë' bewustheidsvlak en gebruik getoon. Die Projekvaardigheidsoorsigbenadering tot prestasie meting is hoofsaaklik in hierdie studie gebruik. Dit het 'n beperkte korrelasie tussen kennisbestuur gebruik en verhoogde prestasie in konstruksieprojekte getoon. Ander prestasie metingbenaderings byvoorbeeld Metrieke, Ekonomiese en Markwaarde, het ook beperkte korrelasie getoon. Twee huidige wydverspreide bydraende faktore tot hierdie toedrag van sake in Suid-Afrika is die verandering aan projekbestek (omvang) en skedule vertraging. Verdere navorsing word dus aanbeveel om 'n meer toepaslike 'objektiewe' meetinstrument vir prestasie daar te stel wat hierdie kompleksiteit kan akkommodeer. So 'n instrument sou die ontwerp/skep van 'n besigheidsaak vir kennisbestuur gebruik in konstruksie-projekbestuur in die hand werk.

Slutelwoorde: Kennisbestuur, projekbestuur, prestasie meting

## 1. Introduction

Construction projects present varied and often complex scenarios, involving project teams consisting of a wide range of specialist professionals (architects, engineers, quantity surveyors, planners, project managers, etc.) collaborating in the achievement of its successful completion. Due to the flexible and transient nature of construction project activities, processes and associated resources - especially the human resource - the project teams thus formed are usually dismantled upon the completion of the project. The consequent risk of valuable empirical project-related knowledge being lost at the end of the project is therefore highly probable, unless a conscious effort is made to accumulate and manage such knowledge in a systematic manner.

The application of knowledge management practices has been shown to contribute to enhanced business performance in several business fields and industries, such as information technology, manufacturing and petrochemical (Despres & Chauvel, 2000; Robinson, Carrillo, Anumba & Al-Ghassani, 2005: 132-150). Construction project management is not an exception. The use

of knowledge management would enable project teams to have ready access to required knowledge; it would help establish success models, avoid the repetition of past mistakes, and form a basis for the development of better procedures. The end result would be enhanced performance and eventually, profitability. This article seeks to explore the correlation between knowledge management use and enhanced performance in construction project management in South Africa.

In a highly competitive business world of the 21<sup>st</sup> century, the need for continuous strategically driven knowledge creation and management is a necessity in any organisation that wishes to achieve and maintain a competitive edge, in order to improve its performance and profitability. Large Japanese companies have relied on knowledge creation to foster long-term innovation and strong business performance (Davenport & Marchand, 2000: 165-169; Despres & Chauvel, 2000: 170-176). This explains why an increasing number of companies are adopting knowledge management in one form or another. The construction industry should not be left behind in the use of knowledge management. There is therefore a need to explore possible avenues whereby appropriate knowledge management processes can be utilised in construction project management, in order to improve business processes, i.e. enhance performance, as well as increase productivity and profitability.

## **2. Knowledge management in construction project management**

### **2.1 Overview of knowledge management**

Various authors have defined knowledge management, highlighting different aspects. Knowledge management is mainly concerned with the development and exploitation of the knowledge assets of an organisation, with a view to furthering the organisation's objectives (Davenport & Prusak, 1998). The knowledge to be managed includes the explicit, documented, tacit as well as subjective knowledge. Management of this knowledge entails all the processes associated with the creation, identification and sharing of knowledge. Young (2003) views knowledge management in a different light, namely that the creation and subsequent management of certain environments encourage knowledge to be created, shared, learnt, enhanced, organised and utilised for the benefit of the organisation. This reveals a cultural aspect of the organisation. Recently a number of companies have proven the need and benefits of adopting

knowledge management processes, in one form or another. This argument proclaims that intellectual capital is essential to wealth generation, and is key to ensuring success in the future (Despres & Chauvel, 2000).

According to Quintas (2005: 10-30), knowledge in today's organisations exists mainly in two forms:

- Tacit knowledge - This knowledge is acquired through experience of human activity, and internal reflection, which often resides in peoples' minds without being stated openly, and
- Explicit or codified knowledge - This knowledge has been written down, and expresses all details and intended meaning in a clear and obvious manner. Once codified, it can be interpreted and understood by others.

Much of the knowledge generated in organisational processes is tacit knowledge (Quintas, 2005: 10-30); people are therefore the locus of much organisational knowledge. As such, a key challenge for understanding knowledge management would be to convert as much as possible valuable tacit knowledge to explicit knowledge.

## **2.2 The knowledge process**

Despres & Chauvel (2000: 170-176) propose six steps in the knowledge management process:

- Mapping - The individual, or even an organisation, is unable to embrace the entire universe of information available. Instead, people seek comprehensible nuggets of information with which they are familiar and comfortable, i.e. individuals and organisations map out information environments of their own making.
- Acquire/capture/create - From these information environments, people appropriate, and perhaps subsequently combine, the most valuable nuggets of information. This stage includes individual or organisational search activities and processes which locate the information appropriate for the given work.
- Bundle/collate - A variety of media are available to bundle (i.e. package) information, e.g. paper, email, and multimedia. The information must be given coherent meaning, usually by an author, in order to enable others to utilise the information.

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- Store - Individuals and organisations stockpile information in memory systems of various kinds. These range from brains to hard disks, filing cabinets, libraries and data warehouses.
- Apply/share/transfer - Knowledge management implicitly recognises that information is social and therefore it can only be recognised as knowledge within some kind of social context. The value of knowledge depends on the actions which result from it.
- Innovate/evolve/transform - In order to retain its value, knowledge must evolve to keep in step with changes in the environment. This necessitates research and development programmes that build on experiences in the marketplace, as well as creativity processes that broaden intellectual horizons.

## **2.3 Knowledge management tools**

The aforementioned knowledge process requires certain systems and tools for its operation. Knowledge management tools comprise both Information Technology (IT) and non-IT-based tools, required to support various processes and sub-processes of knowledge management. These processes include locating, sharing and codifying knowledge (i.e. converting 'tacit knowledge' to 'explicit knowledge') (Al-Ghassani, Anunba, Carrillo & Robinson, 2005: 83-102). A large number of tools are available to choose from in implementing a knowledge management strategy. Selecting appropriate knowledge management tools for individual companies needs to be carefully considered in order to ensure that the business issues and contexts are understood and that the company's goals are adequately addressed. Knowledge management tools can be broadly divided into two categories.

### **2.3.1 Knowledge management techniques**

Knowledge management techniques (non-IT-based tools) are generally affordable to most companies, as no sophisticated infrastructure is required to implement and maintain them, although some techniques may require more resources than others. These techniques are easy to implement as they incorporate relatively simple and straightforward features, and focus on retaining and increasing the organisational knowledge, which is a key asset to organisations. Along these lines, Al-Ghassani *et al.* (2005: 83-102) propose the following examples of knowledge management techniques:

- Brainstorming - This process involves a group of people who meet to focus on a problem, and then intentionally propose as many deliberate unusual solutions as possible.
- Communities of practice - These consist of a group of people of different sets of skills, development histories and experienced backgrounds who collaborate to achieve commonly shared goals. Examples would be associations of industry professionals/professional representative bodies or groups.
- Face-to-face interaction - This is a traditional, usually informal way of sharing tacit knowledge owned by an organisation and its employees. It also helps in increasing the organisation's memory, developing trust and encouraging effective learning.
- Post-project reviews - These are debriefing sessions used to highlight lessons learnt during the course of a project. These reviews are important to capture knowledge about causes or failures, how they were addressed, and the best practices identified in a given project. This increases the effectiveness of learning, as knowledge can be transferred to subsequent projects.
- Mentoring - This is a process where a trainee or junior member of staff is assigned to a senior member of an organisation for advice on career development; the mentor provides coaching to facilitate the career development of the trainee and checks progress by providing feedback.
- Recruitment - As a way to 'buy-in' knowledge, recruitment offers the opportunity for an organisation to acquire external tacit knowledge, especially of experts, thereby expanding the organisation's knowledge base.
- Training - This helps to improve staff skills and therefore increase knowledge. It usually takes place in a formal format, which can be internal or external, and could be used to ensure that employees' knowledge is continuously updated.
- Apprenticeship - This is a form of training in a particular trade carried out mainly *via* learning by doing; apprentices often work under their masters and learn through observation, imitation and practice, until they reach the required skill level.

### **2.3.2 Knowledge management technologies**

Technologies depend heavily on IT as the main platform for implementation, with many organisations considering them as important enablers to support the implementation of a knowledge management strategy (Anumba, Bloomfield, Faraj & Jarvis, 2000; Egbu, 2000; Storey & Barnett, 2000: 145-156). Knowledge management technologies are significant because they consume about one third of the time, effort and money required for a knowledge management system. The other two-thirds relate mainly to people and organisational culture (Davenport & Prusak, 1998). These technologies consist of a combination of hardware and software:

- Hardware technologies - These are very important because they provide the platform for the software technologies to perform, as well as the medium for the storage and transfer of knowledge. Some possible hardware considerations include the personal computer or workstation to facilitate access to required knowledge databases; powerful network servers to allow networking across an organisation as well as between organisations, and public network technology (e.g. the internet) and/or private network technology (e.g. intranet, extranet) to facilitate access to and/or sharing of knowledge.
- Software technologies - Several software packages are available from various vendors capable of performing different knowledge management tasks and functions. According to Manchester (2000: 185-186), some of the main threads of development, which have each spawned products that can be utilised in knowledge management, include information retrieval from the internet, corporate networks/intranets and other data sources; context-sensitive document management tools, and workflow processing software. Increasingly, vendors in these sectors are incorporating information retrieval engines into their products.

## **2.4 Knowledge management in the construction industry**

The importance and implications of knowledge management in the construction project management is extensive. The decision on what knowledge an organisation needs and the knowledge intensity depends on the context of the business environment, i.e. the key knowledge about the business processes and people, for the delivery of its products (Egbu & Robinson, 2005: 31-49). These context-based factors address issues of what is produced (products,

i.e. goods/services), how it is produced (i.e. processes) and by whom (i.e. people).

Currently construction industry demands results faster than ever – decisions must be made rapidly, placing considerable pressure on the individual. Construction industry professionals and personnel must be constantly aware of past experiences as well as present standards, and yet they must also seek to incorporate an ever-growing pool of new ideas in order to innovate faster than the competition (Sheehan, Poole, Lyttle, & Egbu, 2005: 50-64). In the face of such challenges, effective knowledge management offers construction organisations that seek to enhance their business performance real potential in key areas necessary for effective delivery of construction projects. In order to adequately address these challenges, construction professionals and organisations face economic imperatives that can move towards increased codification of knowledge. This enhances efficiency of exploitation and transparency of sharing, while reducing knowledge costs (Egbu & Robinson, 2005: 31-49).

## **2.5 Knowledge mapping in construction organisations**

Egbu & Robinson (2005: 31-49) posit that the point of departure for structuring construction project knowledge is to develop a knowledge map. This locates explicit knowledge and serves as a pointer to holders of tacit knowledge. Figure 1 shows a possible framework for developing a 'knowledge map' with multiple levels of detail. A skill and knowledge 'yellow pages'/database can also be used to provide a directory of experts. This can help in finding the right person to approach for advice and best practice. Such knowledge mapping tools are very important but need to be kept up to date to maintain its usefulness.

The knowledge map serves as a continuously evolving project memory, forming a link between different knowledge sources, and enabling the construction project team members to learn from past and current projects through the navigation of information and codified knowledge. It also assists in capturing and integrating tacit knowledge into the project knowledge base, as well as creating new knowledge by adding, refining and broadening the scope.

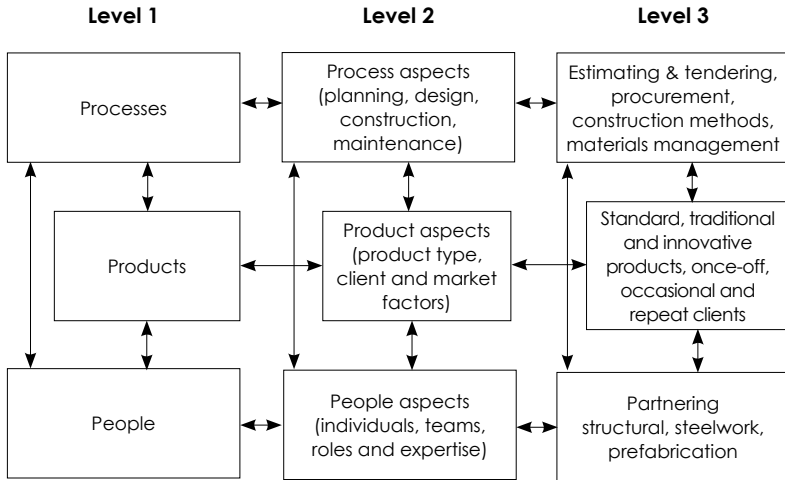


Figure 1: Knowledge mapping in construction organisation  
Source: Egbu & Robinson, 2005: 31-49

## 2.6 Potential benefits of knowledge management in construction project management

It is clear from the foregoing that knowledge management as a performance-enhancing tool has the potential to produce significant benefits when adopted by organisations in one form or another. Specific benefits achievable in construction project management may include:

- Increased innovation - It is recognised that innovation is the key to competitiveness, and depends on knowledge creation and application; in many sectors, competitive advantage is increasingly occurring through innovation, whether in products, processes or services (Quintas, 2005: 10-30). The management of innovation is essentially the management of the knowledge process – the creation, reformulation, sharing and packaging/bringing together of different types of knowledge. Knowledge is an input to, and is inseparable from, the innovation process. New knowledge is also an output of that process (Quintas, 2005: 10-30).
- Lower dependence on key individuals - Once the tacit knowledge from key individuals is 'harvested', codified and stored using the various knowledge management tools and systems discussed earlier, there will be less dependence on



individuals; their experience would now be available to all via the knowledge retrieval system. In addition, projects requiring such individuals' level of skill and knowledge could now run in tandem, reducing possible delays in waiting for one project to be completed before commencing another.

- Improved teamwork - In knowledge management-oriented companies, knowledge employees use contemporary advanced technologies to pave the way for knowledge flow via electronic networking. This, in turn, saves the time and cost of knowledge sharing, irrespective of distance and physical locations (Zou, McGeorge, & Lim, 2003: 233-250). Good communication and knowledge management practices also present a blueprint on where and how to access required project knowledge. These result in smooth and effective project teamwork, thereby increasing productivity.
- Quicker response - Firms that have adequate knowledge management systems in place are better able to quickly respond to queries from clients and other issues as and when they arise. The system's database can be configured along information retrieval lines (Manchester, 2000: 185-186); inputting a query request using a keyword would produce an array of scenarios similar to the current query context, enabling the organisation to respond quickly. The result would be a client with the overall impression of good customer service, and an increased possibility for repeat business.
- Reduced risks - The integration of knowledge management systems and strategies in construction project management enables the sharing of project risk knowledge via specific knowledge base, and has been advocated as an area of importance for day-to-day performance, with concomitant significance to a company's business success (Kahkonen & Kazi, 2003: 163-173). Specific risk knowledge management systems would readily inform decision pertaining to key issues in construction projects (such as health and safety as well as construction best-practices), thereby greatly reducing costs and down-time due to injury.
- Increased knowledge retention - Knowledge management processes and systems enable construction organisations to retain tacit knowledge that would otherwise be lost when valued employees leave or retire from the organisation. Knowledge losses due to reduction in personnel are also minimised throughout the project (Girmscheid & Borner, 2003: 137-149).

- Increased client satisfaction - Increased value can be provided to construction organisation's clients and customers through effective knowledge management. With the right tools and systems, the client will be given better service, as the project management essentials of time, cost and quality can be better delivered on a given project. This would be achieved using templates derived from well-designed knowledge management systems. Increased client satisfaction is a benefit that would result in improved business competitiveness and financial performance (Stewart, 1997).
- Non re-invention of the wheel - Effective knowledge management practices will greatly lessen the likelihood for 're-inventing the wheel' from project to project (Latham, 2005). Rediscovering tried and trusted solutions go hand-in-hand with losses of efficiency in finalising the project (Girmscheid & Borner, 2003: 137-149). Such situation would be avoided, along with the repetition of past mistakes, resulting in cost savings and financial gains.
- Interdisciplinary knowledge transfer - Knowledge management has the potential to promote knowledge transfer across a variety of project interfaces in organisations, disciplines and sectors. The construction industry may find knowledge from other sectors or disciplines useful in implementing innovative systems and processes specific to the sector.

## **2.7 Knowledge management and performance measurement**

There is the need to measure the performance benefits of utilising knowledge management systems and knowledge assets, in order to be able to demonstrate its business benefits, and to justify the commitment of required organisational resources to its activities and processes. Performance measurement of knowledge management is an evolving area - the degree whereby a project achieves its stated goals is one of the major ways of measuring its level of performance and success. Objective project goals are usually stated in terms of project time/schedule, cost/budget and quality/technical specifications (Liu & Walker, 1998: 209-219). Along these lines, Shenhar, Dvir, Levy & Maltz (2001: 699-725) identify the Project Efficiency Review (PER) as an 'objective' approach for measuring performance and success in project management. However, other researchers have argued that the use of solely objective measures (i.e. 'on time/schedule', 'within budget' and 'according to quality/

technical specification') is not sufficient for the assessment of project performance (Morris, 1986: 16-55; Baker, Murphy, & Fisher, 1983: 902-919). Accordingly, Robinson *et al.* (2005: 132-150) propose other performance measurement indices which are grouped into three approaches: namely,

- Metrics approach – This approach uses input and/or output indicators to monitor the performance of knowledge assets or knowledge management programmes. Input indicators reflect actions or enablers required to achieve required knowledge management objectives (e.g. staff training, experienced recruitments), while output indicators measure the performance or result of those actions (e.g. improved client satisfaction, reduced cost and time overruns). This approach is based on the assumption that there is a relationship or correlation between the indicators of business performance and profitability.
- Economic approach - This approach attempts to calculate the actual contributions or net improvements in business performance, while recognising that the costs associated with implementing knowledge management programmes are crucial. The objective is to assess whether the benefits exceed the costs.
- Market-value approach – This approach is based on the principle that the value of a company comes from both its hard financial capital (physical and monetary assets) and soft knowledge or intellectual capital. Knowledge or intellectual capital therefore constitutes the difference between the value assigned to an organisation by a buyer or the stock market in relation to its book-market value.

### **3 Research methodology**

#### **3.1 Overview**

Participants in the survey were registered professional construction project manager as members of the South African Council of Project and Construction Management Professions (SACPCMP). Theoretical frameworks discussed earlier were used in two parts, i.e. the analysis of the current levels of knowledge management among the surveyed construction project managers, and subsequently, measurement of construction project management performance. In the light of the need for practicality, coupled with a need to

exclude largely subjective measurement indices such as 'quality' and 'satisfaction', this research strategy adopted a balanced selection of elements of two of the earlier mentioned performance measurement approaches, namely:

- **Project Efficiency Review measurement approach (PER):** The elements utilised include:
  - Actual versus planned construction project schedule/ time - This relates to the extent to which the project actual construction/completion time achieved the project planned completion time.
  - Actual versus planned construction project budget/costs - This relates to the extent to which the project actual budget achieved the project planned budget
- **Economic Measurement Approach (EMA):** The elements utilised include:
  - Repeat client business - This relates to the amount of repeat business; previous research has shown this to be an indication of level of client/customer satisfaction, which ultimately affects business performance.
  - Employee productivity - This relates to the output/value contributed per employee, in terms of size/value of construction projects handled per professional employee, for a given period (i.e. per month).
  - Staff retention/staff turnover - This relates to the percentage of professional staff retained or leaving.

### **3.2 The research instrument**

An information gathering instrument, consisting of a detailed questionnaire incorporating the use of investigative questions, was adopted. The information required from the respondents was organised broadly into four sections. These addressed the demographic profiles of respondents, levels of recognition of possible benefits as well as actual use of knowledge management strategies and tools in construction project management by the respondents. In addition, project management performance measurement data, and general comments from the respondent concerning any aspect of the research, were included.

### **3.3 Data gathering**

The names and contact details of registered professional construction project managers were obtained from SACPCMP sources. The survey questionnaire, along with a covering letter introducing the research objectives and possible benefits, was subsequently sent (electronically via email) to over 150 registered members (these were selected by virtue of their email addresses being available and obtainable from SACPCMP sources). A total of 20 questionnaires were returned. Although a larger respondent sample would have been preferable, the time constraints surrounding the research programme necessitated the adoption of a time-definite cut-off point for the return of survey questionnaires. However, Goddard & Melville (2005) suggest that a sample of 20 is sufficient for a small-sample analysis, and is therefore considered appropriate for the purposes of the study. The fact that over 90% of the polled project managers reported having over 10 years of construction project management experience, coupled with the geographical spread of their locations of practice (i.e. cities spread across South Africa such as Johannesburg, Pretoria, Cape Town and Durban) further lends credibility to their feedback as well as the outcome of this research.

## **4. Results and analysis**

The data analysis was carried out on the information provided by the respondents via the survey questionnaire. It was assumed that the respondents have no bias and are sincere in their responses to questions in the questionnaire.

### **4.1 Broad levels of awareness of knowledge management and performance benefits**

Zou *et al.* (2003: 233-250) posit that effective implementation of knowledge management systems is dependent on management and employee awareness and perception of the possible benefits of the system. This is because, no matter how good the system might be, it will exist in name only if people are not using it. In order to broadly measure the present levels of knowledge management awareness, respondents were asked to rate both personal and organisational awareness levels of perceived performance benefits associated with the use of knowledge management in construction project management. To this end, respondents were asked four questions, which serve as awareness indices, i.e. 1) awareness levels of knowledge management practices/processes; 2) recognition of

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business benefits of knowledge management among management-level personnel; 3) recognition of business benefits of knowledge management use among project-level staff, and 4) perceived level of correlation between knowledge management and enhanced performance in construction project management. (It is noted that such responses would be somewhat subjective). A 4-point scale and associated coding (High = 3, Medium = 2, Low = 1, Nil = 0) was used to assess the relative awareness levels, as suggested by Goddard & Melville (2005). The results revealed that 60% of the survey respondents indicated awareness level indices ranging from 'medium to high'. This leads one to conclude that the respondent project management personnel in South Africa are likely to make use of knowledge management tools, provided they are appropriately resourced with such tools (see Tables 1 and 2).

Table 1: Broad levels of awareness of knowledge

No	Respondent	Knowledge Management Awareness Index Points (Ap)				Average $A_i = \sum A_p / 4$
		Index 1	Index 2	Index 3	Index 4	
1.	A	3	3	3	3	3
2.	B	0	0	0	0	0
3.	C	1	3	2	2	2
4.	D	3	3	3	3	3
5.	E	2	2	2	2	2
6.	F	3	3	2	2	2.5
7.	G	3	3	2	2	2.5
8.	H	3	3	3	2	2.75
9.	I	2	2	2	2	2
10.	J	2	3	3	2	2.5
11.	K	2	3	3	3	2.75
12.	L	1	3	2	2	2
13.	M	1	3	3	3	2.5
14.	N	3	3	2	3	2.75
15.	O	3	3	3	3	3
16.	P	3	3	2	2	2.5
17.	Q	1	1	1	1	1
18.	R	1	1	0	0	0.5
19.	S	3	2	1	1	1.75
20.	T	3	3	3	3	3

Table 2: Summary of knowledge management awareness levels

<i>Average Index (A)</i>	<i>Classification</i>	<i>Frequency</i>	<i>% (Total = 100%)</i>
Below 1	Low	2	10%
1 to 2	Low to Medium	6	30%
2.1 to 3	Medium to High	12	60%

## 4.2 General level of knowledge management use

Respondents were asked to rate general levels of use of the various categories and types of knowledge management tools discussed earlier in sections 2.3.1 and 2.3.2. Responses were also evaluated using a four-point ranking scale as described earlier in section 4.1. The respondents showed a relatively equal mix and use levels of the various knowledge management techniques and technologies, without any obvious preferences. The results showed that 90% of the respondents indicated that they use knowledge management at different levels, ranging from 'medium to high' average usage level, in different construction projects. This indicates that the majority of respondents are presently engaged in some form of knowledge management use in their various construction project management activities in South Africa (see Tables 3 and 4). ('High' usage represents above 70% average level of use, weight = 3 points; 'Medium' represents between 40% to 70%, weight = 2 points; 'Low' represents between 10% to 40%, weight = 1 point; while 'nil' represents less than 10%, weight = 0)

Table 3: General levels of use of knowledge management techniques and technologies

<i>No.</i>	<i>Respondent</i>	<i>Average level of use of knowledge management technique (U)</i>	<i>Average level of use of knowledge management technology (V)</i>	<i>Average (U + V) ÷ 2</i>
1.	A	1.88	2.67	2.28
2.	B	1.63	3	2.32
3.	C	2	2.33	2.17
4.	D	2.63	3	2.82
5.	E	2.75	1	1.88
6.	F	2.13	3	2.57
7.	G	1.88	3	2.44
8.	H	2.5	2.67	2.58
9.	I	1.63	2.67	2.15
10.	J	2.63	3	2.81
11.	K	1.88	3	2.44
12.	L	2	2.33	2.17

13.	M	1.88	2.67	2.27
14.	N	2	1.33	1.67
15.	O	2.63	3	2.82
16.	P	1.88	3	2.44
17.	Q	1.75	3	2.38
18.	R	1.75	3	2.38
19.	S	1.63	2.67	2.15
20.	T	1.38	3	2.19

Table 4: Summary levels of use of knowledge management tools

Average $(U + V) \div 2$	Classification	Frequency	% (Total = 100%)
Below 1	Low	0	0%
1 to 2	Low to Medium	2	10%
2.1 to 3	Medium to High	18	90%

### 4.3 Correlation between knowledge management use and enhanced construction project management performance in South Africa

In order to examine the possible correlation between knowledge management use and enhanced construction project management performance, it was necessary to first measure the performance levels of the various respondents/organisations participating in the research survey; the selected approaches for performance measurements have been discussed earlier in Section 3.1. With the use of these approaches, the following construction project management performance measures/indices were computed for the various respondents/organisations. Only eighteen respondents provided valid project performance data. Respondents 'S' and 'T' did not provide any project performance data in the returned questionnaires, and as such, both were excluded from further consideration in the data analysis.

#### 4.3.1 Primary performance indices

These performance indices are based on project time and budget considerations, 'objective' criteria whereby construction project performance may be readily evaluated (Liu & Walker, 1998; Shenhar *et al.*, 2001). These are:

**Schedule Performance Ratio (SPR):** This ratio represents the construction time overruns. It depicts a measure of the level of the respondent's ability to achieve the required time constraints in a



project, and as such is a measure of the respondent's construction project performance. Each respondent's SPR is given by:

$$\mathbf{SPR} = \text{Actual construction time} \div \text{Planned construction time (1)}$$

where 'i' represents each of the respondents. The ratio can be averaged over each respondent's total number of projects given to arrive at an Overall Schedule Performance Ratio (OSPR) for each respondent.

**Budget Performance Ratio (BPR):** Similar to the SPR above, this ratio represents the construction budget/cost overruns. It depicts a measure of the level of the respondent to achieve the required cost constraints in a project. As such, it is another measure of the respondent's construction project performance. Each respondent's BPR is given by:

$$\mathbf{BPRI} = \text{Final account} \div \text{Tender price (2)}$$

where 'i' represents each of the respondents. The ratio can also be averaged over each respondent's total number of projects given, to arrive at an Overall Budget Performance Ratio (OBPR) for each respondent.

Table 5: Primary performance measurement indices of respondents

No.	Respondent	Overall Schedule Performance Ratio (OSPR)	Overall Budget Performance Ratio (OBPR)	Overall Performance Ratio (OPR)
1.	A	1.01	1.12	1.07
2.	B	1.60	1.01	1.31
3.	C	1.06	1.25	1.56
4.	D	1.00	1.12	1.06
5.	E	1.08	1.13	1.11
6.	F	1.00	1.13	1.07
7.	G	1.56	1.08	1.32
8.	H	1.42	1.90	1.66
9.	I	1.00	0.96	0.98
10.	J	1.00	0.96	0.98
11.	K	1.10	1.00	1.05
12.	L	1.06	1.25	1.16
13.	M	0.71	0.86	0.79
14.	N	1.28	1.22	1.3
15.	O	1.03	0.96	1.00
16.	P	1.00	1.08	1.04
17.	Q	0.95	0.92	0.94
18.	R	1.31	0.96	1.14

**Overall Performance Ratio (OPR):** This is taken as the average of the Overall Schedule Performance Ratio (OSPR) and the Overall Budget Performance Ratio (OBPR) for each respondent, and is given by:

$$OPR_i = (OSPR_i + OBPR_i) \div 2 \quad (3)$$

where 'i' represents each respondent. The OPR is an attempt to measure the 'objective' overall project performance, considering the planned versus actual project fundamentals of schedule/time and budget/costs.

From equations (1), (2) and (3), it can be deduced that:

- If OPR = 1, then actual project performance was at par with the planned.
- If OPR is greater than 1, then actual project performance was below the planned.
- If OPR is less than 1, then actual project performance was better than the planned.

The interpretations also imply that the lower the value of OPR for any given respondent, the higher the level of performance; conversely, the higher the OPR, the lower the performance.

The Overall Performance Ratios (OPR) were computed and found to be as shown in Table 5 above. The OPR as calculated represent the primary performance measurement indices for the various respondents to the research survey. These indices are subsequently used to explore the possible correlation between the various levels of knowledge management use and construction project management performance levels of the respondents.

### 4.3.2 Secondary performance indices

These are based on the following indices, which also form part of the performance measurement approaches discussed earlier:

**Employee Productivity Ratio (EPR):** This relates to the output/value contributed per employee, in terms of the size/value of projects handled per professional employee. The use of this index is based on the consideration that a project personnel that is well knowledge-resourced via the use of knowledge management tools will exhibit enhanced productivity vis-à-vis one that is otherwise (Robinson et al., 2005). An EPR is obtained as follows:

**EPRI** = Project final account ÷ (Number of personnel x Actual project duration)

where 'i' represents each of the respondents. The ratio can be averaged over each respondent's total number of projects given, to arrive at an Overall Employee Productivity Ratio (OEPR) for each respondent. (For the purposes of this article, a 'Full-time' employee involvement is weighted as 1 personnel, a 'Part-time' employee as ½, and a 'Supervisory' employee involvement as 1½.). The classification of this index, as secondary, is informed by the consideration that certain projects, though large in size and associated budget, may only involve limited scope of work, and/or may run for a limited duration (e.g. an office building or residential development may comprise limited and/or repetitive construction work/activities). These would require lesser levels of project personnel involvement than more complex projects with broader scopes. However, the study made no attempt to engage with differing levels of scope of the respondents' projects. Neither did it consider the relative subjective methods of determining what constitutes 'full-time', 'part-time' and 'supervisory' level involvement of project management personnel.

Table 6: Secondary performance measurement indices of respondents

No.	Respondent	Overall Employee Productivity Ratio (OEPR) (R million/personnel month)	Repeat client ('Yes' or 'no')
1.	A	4.02	Yes
2.	B	1.95	No
3.	C	0.15	Yes
4.	D	0.39	No
5.	E	0.03	Yes
6.	F	1.50	Yes
7.	G	0.30	Yes
8.	H	0.11	Yes
9.	I	1.65	Yes
10.	J	0.12	Yes
11.	K	0.20	Yes
12.	L	0.10	Yes
13.	M	1.00	No
14.	N	0.48	No
15.	O	2.57	Yes
16.	P	2.26	Yes
17.	Q	1.98	No
18.	R	1.98	Yes

The Overall Employee Productivity Ratio (OEPR) of the various respondents was also computed and found to be as shown in Table

6. The 'Repeat client' measure is also depicted in the same table. It was noted that only 5 of the respondents (i.e. 25%) recorded any level of staff turnover data during the course of the projects provided for consideration. As such, this measure was excluded from further consideration by virtue of its limited usability.

#### 4.4 Examination of a possible correlation

In order to examine a possible correlation between knowledge management use and enhanced construction project management performance, a test for linear correlation was adopted. The Pearson's product-moment coefficient of linear correlation was utilised, as described in Goddard & Melville (2005). The coefficient was calculated using the following formula:

$$r = \frac{\{n\sum XiYi - (\sum Xi)(\sum Yi)\}}{\sqrt{\{n\sum Xi^2 - (\sum Xi)^2\}}\sqrt{\{n\sum Yi^2 - (\sum Yi)^2\}}}$$

This parameter 'r' lies between -1 and 1. A value of 1 indicates a perfect linear dependence with a positive slope. An increase in the value of knowledge management (variable X) was associated with a proportionate increase in the value project management performance (variable Y). A value of -1 indicates a perfect linear dependence with a negative slope (an increase in the value of variable X is associated with a proportionate decrease in the value of variable Y). A value of 0 or thereabouts indicates very little correlation.

Table 7: Levels of knowledge management use and overall performance ratio

No	Respondent	Average levels of knowledge management use (X)	Overall performance ratio (Y)
1.	D	2.82	1.06
2.	O	2.82	1.00
3.	J	2.81	0.98
4.	H	2.58	1.66
5.	F	2.57	1.07
6.	G	2.44	1.32
7.	K	2.44	1.05
8.	P	2.44	1.04
9.	Q	2.38	0.94
10.	R	2.38	1.14
11.	B	2.32	1.31
12.	A	2.28	1.07

13.	M	2.27	0.79
14.	C	2.17	1.56
15.	L	2.17	1.16
16.	I	2.15	0.98
17.	E	1.88	1.11
18.	N	1.67	1.13

The levels of knowledge management use indices computed earlier were set as variable X, and are juxtaposed with the primary performance measurement indices (obtained using the Project Efficiency Review measurement approach/Overall Performance Ratio) similarly computed for corresponding respondents, which are set as variable 'Y' (see Table 7; the respondents are listed in order of decreasing average knowledge management use levels). The purpose of adopting the test for linear correlation is to examine the possible dependence of levels of project management performance (as measured by the Overall Performance Ratio (OPR) indices) on the levels of knowledge management use (measured by the average levels of use of various knowledge management tools as indicated by the respondents). This would indeed help establish a possible correlation between the levels of use of knowledge management processes and enhanced construction project management performance (Goddard & Melville, 2005).

From the above (Table 7) calculations give the following:

$$n = 18, \sum X_i = 42.59, \sum Y_i = 20.37, \sum X_i Y_i = 48.12, \sum X_i^2 = 102.34 \text{ and } \sum Y_i^2 = 23.83.$$

Hence:

$$r = \frac{18 \times 48.12 - (42.59 \times 20.37)}{\sqrt{\{(18 \times 102.34) - 42.59^2\} \times \{(18 \times 23.83) - 20.37^2\}}} = -0.07$$

The coefficient of linear correlation 'r' was thus calculated to be of a value of - 0.07. The magnitude of 'r' shows very little correlation between the high levels of knowledge management use and high construction project management performance levels. This reveals that there are other significant factors which contribute to construction project management performance, and its measurement, within the South African context. It is therefore necessary to further explore possible contributory factors that could have resulted in this outcome. The following factors were identified within the context of the study.

#### **4.4.1 Performance measurement approaches**

The use of PER, based on 'objective' measure, was adopted for the purposes of the article. However, the inherent realities of the construction project environment in South Africa, particularly as indicated in the respondent survey, reveal its application to be inappropriate, for the following reasons:

- Changes in project scope - Over 55% of the respondents providing project performance data experienced significant changes in project scope, which they believed impacted on both the construction project schedule (i.e. the actual project construction duration), as well as the project budget (i.e. the project final account). The impacts of these scope changes were mostly negative and their extent usually unforeseeable at the planning phase of the construction project, during which the target/planned project schedule and budget are set. These scope changes usually originated from the client, or other project participant outside the direct influence of the construction project manager associated with the project. The resultant effect of this situation on the construction project management performance measurement, using the PER approach-derived indices, is to skew such measurement in an unpredictable manner.
- Delays in actual project schedules - This was a more prevalent occurrence, with over 88% (i.e. 16 out of the 18 respondents provided valid project performance data) of the respondents reporting some form of delay. These delays were also outside the control of the construction project management team. The reasons reported for unforeseen and uncontrollable delays included client financing (39%), contractor delays (22%), delays with procurement (33%) and electric power outages (6%), with some respondents reportedly experiencing a combination of delays. Again, such delays would negatively impact on the actual construction project schedule, thereby skewing performance measurement using the PER approach.

#### **4.4.2 Framework for enhanced performance assessment**

The assessment of enhanced performance, within the framework adopted for the study, attempted to compare the various current levels of knowledge management use of respondents with current levels of performance. This is done with a view to examining the

possible correlation between 'high' levels of knowledge management use and 'high' levels of construction project management performance. This approach therefore necessarily cuts across various organisations/respondents. An alternative framework is via detailed case studies of selected organisations, in order to establish 'before' and 'after' performance levels of individual organisations involved in construction project management, with respect to the adoption/implementation of knowledge management systems and processes. This approach has been suggested by other authors, and has seen some degree of success in its use (Sheehan *et al.*, 2005: 50-64; Zou *et al.*, 2003: 233-250). Such a framework would be able to accommodate, to an extent, the various scope-change and delay factors inherent in the industry, provided that the impact of such factors does not vary excessively with time, or such variations average out. However, such a framework requires a high degree of familiarity with the subject organisation's processes, in terms of both 'before' and 'after' the knowledge management system's implementation. It also requires luck to find such an organisation that is about to embark on a knowledge management implementation process. In addition, patience is needed in order to realise performance-enhancing benefits. As one can readily imagine, this option of research methodology could not be explored within the context of the study, due to considerations mentioned in section 3.3.

Liu & Walker (1998: 209-219) have noted that there are inherent complexities in project environments, which result in complex project goals. This, it seems, is being reflected in the construction project industry in South Africa, as elucidated in this article. The complexities in this instance are the result of changes in project scope and delays, which presently seem to be pervasive in the local industry.

An attempt is also made to utilise EMA indices to examine a possible correlation between knowledge management use and enhanced construction project performance. For respondents with knowledge management use levels classified as 'medium to high', the average overall employee productivity ratio (OEPR) was R1.27 million per employee-month; for respondents with knowledge management use levels classified as 'low to medium', the average OEPR was R 0.26 million per employee-month. Thus, the higher average OEPR for respondents with relatively higher knowledge management use levels suggests a measure of dependence of employee productivity levels on the levels of knowledge management use in construction project management in South Africa.

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Likewise, 83% of respondents with knowledge management use levels classified as 'medium to high' recorded patronage by repeat clients, compared with 50% of respondents with knowledge management use levels classified as 'low to medium'. This also suggests a measure of dependence of customer satisfaction (and hence, enhanced performance) on levels of knowledge management use.

#### **4.5 Respondents' general comments**

In order to achieve a holistic scope for the study, respondents were asked for comments on what, in their experiences, constitute key opportunities and threats regarding knowledge management use in construction project management in South Africa. They were also asked for comments on factors which informed their knowledge management use patterns.

##### **4.5.1 Opportunities and threats for knowledge management use**

Several opportunities were identified for increased knowledge management use. The primary being the need for readily available, relevant and reliable information/knowledge, coupled with the provision of appropriate database(s) and software to facilitate its storage and access when required, in order to inform the decision-making process. It was noted that only 20% of the respondents reported any conscious attempt at managing project knowledge via a knowledge process and/or knowledge database/map. Not surprisingly, the respondents indicated that a knowledge database was a key opportunity though they did not have any such system in place.

Identified threats to knowledge management use include primary issues of affordability such as limited resources available for construction project management teams, coupled with perceived high cost of entry-level knowledge management systems. Also mentioned was the limited commitment on the part of the respondent organisation's management, as well as limited skills and experience in the use of knowledge management processes among construction project personnel. These considerations are seemingly quite pervasive within the construction project management industry, and are not necessarily limited to the South African context as observed by Zou *et al.* (2003: 233-250) and Sheehan *et al.* (2005: 50-64).



#### **4.5.2 Knowledge management use patterns**

The type of knowledge management tool used was to a large extent informed by the respondents' perception of its suitability in achieving the desired project outcome, based on experience. Also considered were issues of value-for-money, as well as affordability, especially by respondents who considered their operations to be 'small'. There were no stated or observed apparent preferences in choice of particular tool. Few respondents indicated a choice for particular software used, such as Microsoft Projects.

#### **4.5.3 Other comments**

The majority of respondents also commented on the need for additional training for construction project-personnel in information and knowledge management use, in order to enhance their level of effectiveness in construction project management use.

These findings are to a large extent supported by previous research and discourse by other authors such as Egbu & Robinson (2005: 31-49), Prusak (2000: 182-186), Sheehan *et al.* (2005: 50-64) and Zou *et al.* (2003: 233-250).

### **5. Conclusions and recommendations**

This article has provided insight into the concept of knowledge management and its use as an efficiency-enhancing tool in construction project management, among various professional construction project managers in South Africa. The conclusions drawn from the discussion include the following:

- Most construction project management professionals show a significant level of awareness and appreciation of knowledge management use and possible associated performance-enhancing benefits in construction project management in South Africa.
- Most professionals are engaged in some form of knowledge management use in construction project management, and mostly at a high level.
- A minimal degree of correlation between the level of knowledge management use and the level of performance was observed. The possible causative factors considered for the lack of significant correlation are the apparent high incidence rates of scope changes and schedule delays, inherent in the construction industry in South Africa. These factors are

crucial to the evaluation of the 'objective' performance measurement indices utilised in the correlation analysis. The prevalence of these factors impacts on the indices in such a way as to skew these indices in an unpredictable manner. The use of economic performance measurement approaches, however, established a measure of dependence of enhanced construction project performance on knowledge management use.

Regarding possible opportunities and threats to effective knowledge management implementation in the construction project management profession in South Africa, two main opportunities were identified:

- The use of a knowledge database/map and associated software for accessing such, as a way to consciously manage construction knowledge, and also to serve as a key resource to inform subsequent construction project management-related decisions.
- Additional training for construction project management personnel in the value and use of knowledge management tools in order to alleviate perceived inadequacies in this regard.

The following threats were identified:

- Issues of affordability, *vis-à-vis* perceived high cost of entry-level knowledge management systems and tools suitable for use in construction project management.
- Limited commitment of organisational top-level management to the implementation and use of knowledge management processes and tools in construction project management.
- Inadequate levels of training of construction project personnel in the use of knowledge management processes and/or tools.

The article, however, has also shed some light on certain areas that require further studies:

- The deriving of appropriate assessment methods for measuring the performance benefits achieved *via* knowledge management use in construction project management. The use of the PER method, although based on 'objective' measures such as project schedule and budget, would be seriously impacted by factors such as changes in project scope and delays as indicated in the article. It is therefore necessary to devise performance measurement approaches

that can either isolate and exclude the effects of the changes in project scope and delays, or otherwise accurately compensate for them.

- The development of appropriate database systems and related application software, and/or the increase in awareness levels of the availability of such systems, for use in construction project management. Appropriate context-sensitive information retrieval software would also need to be developed.
- The development of strategies aimed at securing the commitment of top-level management of organisations to knowledge management implementation in construction project management. This can best be achieved by establishing a 'business case' for knowledge management use, i.e. by evaluating and measuring the concrete impact in terms of business value derivable from engaging in such knowledge management activity (Sheehan *et al.*, 2005: 50-64). One of the key challenges, in an attempt to evaluate this business case, has been identified as the "intangibility of some of the benefits of knowledge management". Also identified is the issue of appropriate methods of performance measurement, as indicated earlier in this article.

From the foregoing discussions and analysis, it is apparent that addressing the issue of the 'performance measurement paradox' would play a crucial role in further research in the field of knowledge management and its use in the construction project management industry (similar conclusions have been drawn by Zou *et al.* [2003: 233-250]). There is also the need to create greater awareness of the fact that knowledge management use in construction project management does not necessarily have to be expensive. Non-information technology-based knowledge management techniques are generally affordable, as they do not require expensive, sophisticated infrastructure and are relatively simple to implement and use. This would encourage entry-level and possibly smaller construction project management organisations to embrace the use of knowledge management processes and systems in their operations.

As the construction project management profession progresses into the future, it has been noted that knowledge will be a critical resource, will transfer more effortlessly than money, will make for incredible levels of competition, and will spread 'near-instantly' (Sheehan *et al.*, 2005: 50-64). Given these considerations, professional construction project managers in South Africa will have to actively

embrace the use of knowledge management. Achieving effective knowledge management use will be challenging, given the local South African context as elucidated in the findings of the study. Professionals and organisations will also have to create and maintain not only knowledge management systems, but also a culture that truly recognises the benefits of knowledge management, as well as encourages its members to seek and use such knowledge.

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Catherine Karusseit & Amanda Gibberd

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## Towards inclusion: a critical appraisal of legislation and the South African Standard, Part S

Peer reviewed

### Abstract

Since the demise of apartheid in 1994 South Africa has undergone tremendous transformation, both political and societal. Evidence of this is the constitution, which was adopted in 1996 and is considered to be one of the most progressive in the world. Its essence is rooted in the qualities of equality and diversity. Yet, despite the inclusive nature of changes made to the constitution and related legislation, the *South African Standard* (SABS 0400), in particular Part S 'Facilities for disabled persons', remains a discouragingly exclusive document. This article documents the inclusive nature of South Africa's new constitution and related legislation against which context Part S of SABS 0400 is critically appraised. Research is conducted by means of a literature review, an interview with the South African National Standard (SANS) technical advisor and questionnaires; thereafter, the pertinent documentation is critically analysed. Finally, recommendations are made in an endeavour to achieve a built environment that is rightly inclusive.

Keywords: South Africa, constitution, legislation, building standards, inclusive environments

### Abstrak

Sedert die opheffing van apartheid in 1994 het Suid-Afrika geweldige transformasie ondergaan. Die grondwet, wat in 1996 aangeneem is en wat as een van die mees progressiewe grondwette in die wêreld beskou word, is 'n bewys van hierdie transformasie. Die grondwet se essensie is gewortel in gelykheid en diversiteit. Ten spyte van die inklusiewe karakter van die veranderinge wat aan die grondwet en verwante wetgewing aangebring is, bly die *Suid-Afrikaanse Standaard* (SABS 0400), veral Deel S 'Fasiliteite vir gestremde persone', nietemin 'n ontmoedigend eksklusiewe dokument. Hierdie artikel dokumenteer die inklusiewe aard van Suid-Afrika se nuwe grondwet, asook verwante wetgewing. Deel S van die SABS 0400 word binne hierdie konteks krities beoordeel. Navorsing is gedoen deur middel van 'n literatuurstudie, vraelyste, en 'n onderhoud met die tegniese raadgewer van die Suid-Afrikaanse Nasionale Standaard (SANS); hierna is die pertinente dokumentasie geanaliseer. Laastens word aanbevelings gemaak in 'n poging om 'n bou-omgewing wat waarlik inklusief is, daar te stel.

Sleutelwoorde: Suid-Afrika, grondwet, wetgewing, boustandaarde, inklusiewe omgewings

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## 1. Introduction

South Africa's buildings, neighbourhoods and cities are cultural artefacts shaped by human intention and intervention, symbolically indicating to society the place held by each of its members. According to Weisman (1994: 1-2) access to space is fundamentally related to social status and power, and changing the allocation of space is inherently related to changing society. Space is, thus, a social construct; the spatial arrangements of our buildings and communities reflect and reinforce the nature of relations in society. This is particularly evident in South Africa which since the democratic elections in 1994 has undergone a number of political and social changes. Architecture is a means to express this change, from an exclusive society to an inclusive one. Deplorably, only a handful of the buildings designed and constructed since 1994 have truly embraced and reflect the inclusive nature of the constitution. This can be attributed to a number of factors, the most glaring being that the National Building Regulations (NBR) and Part S of the South African Standard (SABS 0400)<sup>1</sup> has taken this length of time to be revised. The result is a disjuncture between the new constitution (1996) and its associated Acts and the NBR and SABS 0400.

The notion of inclusive environments and a definition of disability are discussed in an effort to articulate their relevance to the built environment. The inclusive nature of South Africa's new constitution and related legislation is then briefly documented. Against this context, Part S of SABS 0400, both as it currently stands and the proposed revision is critically appraised. Finally, recommendations are made in an endeavour to achieve a built environment that is truly inclusive.

## 2. Research

Background for research was established by means of a literature review. A semi-structured interview with the SABS 0400 technical advisor, Ms D Geszler was conducted early in 2008. Questions posed to Geszler and subsequent discussion was concerned with:

- The current state of the SABS 0400 Part S.
- What does the process for the revision of any part of the building regulations entail?

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<sup>1</sup> While the title of the South African Standard (SABS 0400) has been changed to the South African National Standard (SANS 10400) the document has not yet been published. Currently the South African Bureau of Standards (SABS) is still issuing the SABS 0400 document.



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- Whether any of the various disability groups are involved in the process?
- Which other professionals are consulted?
- What are the stumbling blocks that have delayed the process?
- Whether international precedents, such as the United Kingdom and Australian standards, are considered as part of the revision process?

## 2.1 Questionnaire

A short questionnaire was compiled and distributed among permanent and part-time lecturing staff at the Department of Architecture, University of Pretoria, as well as a small sample of practitioners. Both lecturers (who are also practitioners) and practitioners are representative of the three disciplines of architecture, namely: architecture, landscape architecture and interior architecture. A total of twenty-nine questionnaires were distributed, of which nineteen were completed and returned.

The questionnaire posed the following questions:

- Whether the practitioner applies the recommended dimensions for facilities for people with disabilities as given in SABS 0400 Part S as maximum or minimum dimensions?
- Whether the practitioner is aware of the existence of the SABS 0246 and, if so, what do they understand by the reason for its existence?
- Whether the practitioner is aware of the *Promotion of Equality and Prevention of Unfair Discrimination Act* and, if so, what do they understand were its legal implications for him/her as designer?

The following findings were made from the completed questionnaire:

- 33% of the respondents apply the recommended dimensions for facilities for people with disabilities as minimums.
- 57% of the respondents apply the recommended dimensions for facilities for people with disabilities as maximums.
- 38% of the respondents are not aware of the existence of the SABS 0246.

- 52% of the respondents are aware of the existence of the SABS 0246.
- 73% of the respondents who are aware of the existence of the SABS 0246 actually use it in practice. One respondent pointed out that it is confusing to have more than one document dealing with the same issue, which is further compounded by the fact that the two do not correspond.
- 33% of the respondents are unaware of the *Promotion of Equality and Prevention of Unfair Discrimination Act*.
- 57% of the respondents are aware of the *Promotion of Equality and Prevention of Unfair Discrimination Act*.
- 83% of the respondents who are aware of the Act's existence admitted to not being familiar with the content of the Act and therefore are unaware of its legal implications for them as designers.

### **3. Inclusive environments and disability**

An inclusive environment refers to a built environment that takes into consideration the potential ability and needs of *all* users. An inclusive environment includes:

*... people who are physically disabled, people with sensory disabilities: both hearing and sight, people with learning disabilities, people with mental illnesses, elderly people, young children, people with heavy luggage, people with dexterity problems, people with neurological problems, women who are very pregnant, people who are in a hurry and not looking where they are going, people who have had an accident and are temporarily disabled, people who are not wearing their glasses that day, people who are distracted or concentrating on something else (Osman & Gibberd, 2000: 25).*

It is evident that all South Africans need an inclusive environment. However, certain groups of people can be identified as experiencing the greatest difficulties with the built environment, including people with disabilities, people with Acquired Immune Deficiency Syndrome (AIDS), children and elderly people. According to Osman & Gibberd (2000: 25), among these groups, people with disabilities have been singled out as having been significantly disadvantaged from using the built environment.

Disability is an evolving concept and contemporary approaches to disability adopt a more critical interpretation of disability. Disabled Peoples International (Priestley, 2006: 21) define disability as:

*... the loss or limitation of opportunities to take part in the normal life of the community on an equal level with others due to physical and social barriers.*

The United Nations (UN) Convention on the Rights of Persons with Disabilities (United Nations, 2006: online) defines disability as a result of:

*... the interaction between persons with impairments and attitudinal and environmental barriers that hinders full and effective participation in society on an equal basis with others. Furthermore, it states that people with disabilities ...include those who have long term physical, mental, intellectual or sensory impairments which in interaction with various barriers may hinder their full and effective participation in society on an equal basis with others.*

It is evident, from these definitions, that impairment is clearly set apart from disability and that disability has social and environmental causes rather than biological ones. Priestley (2006: 23) states that social relations and barriers prevent the full participation of people with disabilities, ie quality and citizenship. Thus, if the built environment is a cultural artefact, then it too plays a role in disability: it may either increase disability, through negligent or exclusive design, or decrease disability through considered and good design, allowing all people to move around and experience the environment as independently and freely as they would like.

#### **4. Legislative provisions in acts other than the National Building Regulations and Building Standards Act**

South Africa's constitution, 'one law for one nation' (South Africa, 1996), is considered to be one of the most progressive in the world. In essence it is rooted in the qualities of equality and diversity. People with disabilities are referred to specifically.

##### **4.1 Constitution of South Africa, 1996**

The *Constitution* was first adopted on 8 May 1996 and amended on 11 October of the same year by the Constitutional Assembly. It was signed into law on 10 December 1996. The process of drafting the *Constitution* involved as many South Africans as possible and took two years. The *Constitution* is, thus, an integration of ideas from ordinary citizens, civil society and political parties represented in and outside of the Constitutional Assembly (South Africa, 1996).

## 4.2 Bill of Rights and Legislative Acts

Chapter two of *the Constitution* contains the *Bill of Rights*. The sections of the *Bill of Rights* (South Africa, 1996), as well as legislative acts other than the NBR and *National Building Standards Act*, which pertain to the built environment, are listed in Table 1.

Table 1: Bill of Rights and Legislative Acts pertaining to the built environment

Legislation	Premise
Bill of Rights: Section 7 Rights (South Africa, 1996)	<ul style="list-style-type: none"> <li>enshrines the rights of 'all' South Africans, affirming the values of human dignity, equality and freedom.</li> </ul>
Bill of Rights: Section 9 Equality (South Africa, 1996)	<ul style="list-style-type: none"> <li>everyone is equal before the law.</li> <li>the state may not unfairly discriminate on one or more grounds, including disability.</li> </ul>
Bill of Rights: Section 10 Human Dignity (South Africa, 1996)	<ul style="list-style-type: none"> <li>everyone has inherent dignity and the right to have their dignity respected and protected.</li> </ul>
Bill of Rights: Section 24 Environment (South Africa, 1996)	<ul style="list-style-type: none"> <li>everyone has the right to an environment that is not harmful to their health or well-being.</li> </ul>
Occupational Health and Safety Act (Act No 85 of 1993) (South Africa, 1993)	<ul style="list-style-type: none"> <li>affects all employers, people in employment, and people not in employment but who are affected by the employer's undertakings, which includes people with disabilities.</li> <li>thus an employer's responsibilities are to provide and maintain a working environment that is safe and without risk to the health of his/her employees.</li> </ul>
Employment Equity Act (Act No 55 of 1998) (South Africa, 1998: 2, 12, 14)	<ul style="list-style-type: none"> <li>To achieve equity in the work place by:</li> <li>promoting equal opportunity and fair treatment in employment, and</li> <li>implementing affirmative action to redress the disadvantages in employment experienced by designated groups, including people with disabilities.</li> </ul>
Promotion of Equality and Prevention of Unfair Discrimination Act (Act No 4 of 2000) (South Africa, 2000: 1, 7)	<ul style="list-style-type: none"> <li>addresses the issue within which sites, complexes and buildings should be made usable by people with disabilities.</li> <li>No person may unfairly discriminate against any person on the ground of disability, including:</li> <li>denying or removing any supporting or enabling facility necessary for their functioning in society;</li> <li>contravening the code of practice or regulations of the SANS that govern environmental accessibility;</li> <li>failing to eliminate obstacles that unfairly limit or restrict persons with disabilities from enjoying equal opportunities, or failing to take steps to reasonably accommodate the needs of such persons.</li> </ul>

<p>White Paper on Integrated National Disability Strategy (South Africa, 1997: 23), commonly known as the INDS</p>	<ul style="list-style-type: none"> <li>• The White Paper is government's normative stance in terms of the development of people with disabilities and the promotion and protection of their rights:</li> <li>• Government's vision is "a society for all", in which people with disabilities form a natural and integral part, which is in line with the human rights vision of the UN.</li> <li>• Legislation is regarded as a crucial mechanism for action.</li> <li>• Government recognises the need for revision and amendment of existing legislation, so that it should comply with and give substance to constitutional requirements.</li> </ul>
<p>United Nations Convention on the Rights of People with Disabilities (United Nations, 2006: online)</p>	<ul style="list-style-type: none"> <li>• South Africa ratified the convention in 2007:</li> <li>• to promote, protect and ensure full and equal enjoyment of human rights and fundamental freedoms by all persons with disability</li> <li>• to promote respect for their inherent dignity</li> <li>• the convention is unique in that it is legally binding</li> </ul>

## 5. National Building Regulations and Part S

The purpose of Part S 'Facilities for disabled' of the NBR and its associated SABS 0400 deemed-to-satisfy rules is to serve as a document to be used by local, state or national government to control building practice, by way of a set of statements of acceptable minimum requirements of building performance (SABS stakeholders workshop 2007). The document is structured into Parts dealing with various aspects of a building. Each Part contains a section with the relevant regulations (stated in legal language), followed by deemed-to-satisfy rules.

The *White Paper on Integrated National Disability Strategy (INDS)*, compiled in 1997, already recognised then that the standards prescribed by the NBR require review. Yet, change has been slow to be realised due to a number of factors. In order to revise any Part of the NBR and SABS 0400 the following steps must be taken: stakeholders are consulted; feasibility and impact studies are conducted; the proposed amendments are published in the *Government Gazette*, and finally the amendment is legislated. Geszler (2008), technical advisor on building regulations at the SABS, commented that this process is cumbersome and hampers uniform implementation.

This is one of the reasons why the revision of Part S, which was initiated in 2000, is yet to be completed: it is a logistical one and has nothing to do with the changes in legislation. The building regulations were originally published as a total document; this entire document had

to be revised and changed in order to update a single part. It has taken this length of time within the SABS to agree to publish the different Parts separately so that they can be updated separately.

According to Geszler (2008), changes to NBR are also assessed in terms of financial implications to building costs with the stipulation that they should not increase building costs. Stated in the Preface of the SABS 0400 (1990: 3):

*... [as] these regulations were originally introduced as a long-term anti-inflationary measure it is obvious that they should not increase the overall cost of building.*

In this regard, it was inferred from comments by Geszler (2008) that a revised and more rigorous Part S would result in increased building costs. This misconception would certainly impede the drive for revision and change. Moreover, this is unfounded since the contrary is clearly stated in the *INDS* (South Africa, 1997: 30), namely that purposefully designing in an inclusive manner only increases overall building costs by 0.2%, which is regained in the long term.

The NBR, which has been amended within its current state but not revised, was approved by the Department of Trade and Industry (DTI) in May 2008 (South Africa, 2008: 45). Although the NBR itself is not being revised, the wording has been re-interpreted in the light of the new constitution. While this has enabled some change to the regulation, other suggested changes have been rejected, as they require a revision of the regulation, which did not form part of the scope of the changes. As a result a new version of the deemed-to-satisfy rules of Part S has been drafted (SANS 10400-S, 2008). This was due to be published in March 2009; however, this has been delayed because parts of SANS 10400 which refer to other standards need to be revised. This revised Part S will cancel and replace the corresponding parts of the first revision, SABS 0400 Part S, and absorb the SABS 0246. Even though the new Part S is yet to be published it is evaluated, in this article, by comparison to the old Part S in the critical appraisal that follows.

## **5.1 Part S**

Part S of the SABS 0400 and SANS 10400-S includes the regulations and deemed-to-satisfy rules, which are standards setting out national requirements for an accessible built environment. Part S is the construction industry's reference point on access for people with disabilities, whether adults or children.

## **5.2 0246**

The SABS 0246 'Accessibility of buildings to disabled persons' was compiled in 1993 as voluntary guidelines/standards to be consulted as a supplement to the SABS 0400 Part S. The SABS 0246 establishes the minimum design requirements for access to and circulation in buildings and related facilities.

## **6. Critical appraisal of SABS 0400 Part S and SANS 10400-S**

This section examines the SABS 0400 Part S<sup>2</sup> and SANS 10400-S in the light of the preceding discussion (c.f. 4 & 5), as they apply to people with disabilities, and explains legal anomalies.

### **6.1 Defining the population (S1)**

A common misconception is that Part S of the Building Regulations is the only part that affects people with disabilities. However, other parts also relate to environmental access for people with disabilities: Parts D (Public safety), Part J (Floors), Part K (Walls), Part M (Stairways), Part N (Glazing), Part O (Lighting and Ventilation), Part P (Drainage), and Part T (Fire Protection). Part T of the new SANS 10400, as approved by the DTI (cf. 5) addresses this issue. This part has been amended to include people with disabilities in regulation T(1)(a), the protection and safe evacuation of users/occupants (South Africa, 2008: 67).

The old Part S gives no direct definition of disability. It does not distinguish between adults and children. It is, thus, inferred that a disabled person is a person who falls into one of the following categories of people: people in wheelchairs, people who are able to walk but unable to use stairs, and people with impaired vision. South African statistics, from 1996 and 2001, demonstrate that while many people relate disability to wheelchair use, and commonly only to people with paraplegia who are only a fraction of the wheelchair-using population, this is inaccurate. The new Part S (SANS 10400-S 2008: 7), however, highlights the fact that other groups of people with disabilities have problems with the built environment, and includes a comprehensive and up-to-date definition of disability, making it clear that other groups of people with disability have just

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2 The old Part S (SABS 0400) and new Part S (SANS 10400-S) will be distinguished from one another on points difference; however, where Part S remains unchanged it is simply referred to as Part S. This is done purposefully to highlight the improvements in the new Part S, while simultaneously drawing attention to failings that remain unaddressed.

as much right to experience non-discrimination, according to the *Constitution*, as people with paraplegia.

## 6.2 The application of Part S (S1)

Part S applies to 79% of building occupancy categories. Changes to most building occupancy categories require a revision of the regulation. The following exceptions were allowed in the recent amendment:

A hotel with less than 25 beds (category H1) is not required, by the old Part S (SABS 0400 1990: 151), to make provision for wheelchair access. This exception has been amended in the new Part S. A hotel with less than 25 beds is exempt only if it can reasonably prove that it is not possible to include wheelchair access in certain aspects of the design (SANS 10400-S, 2008: 27).

The S1(d)(i and ii) (SABS 0400 1990: 151) is written in such a way that it is extremely nebulous:

Any building where

*... there is a difference between the level of the ground storey and the finished ground immediately outside any door giving access to such ground storey and such difference in levels or, where there is more than one such door, the smallest of such differences, expressed in millimetres, is more than the overall floor area of such a building expressed in square metres: provided that such overall floor area shall, in any building equipped with a lift, be deemed to be the total floor area of all storeys served by such a lift.*

This infers that if any type of building is designed to be high enough off the ground, and the relationship of its height from the ground with its surface area is calculated and found to be more than the total surface area, no facilities for people with disabilities need be included. This loophole contravenes section (c) of the *Promotion of Equality and Prevention of Unfair Discrimination Act* (Table 1). This ambiguity has been removed from the new Part S (SANS 10400-S, 2008: 27).

## 6.3 Facilities to be provided under Part S (S2)

Part S requires that certain facilities be provided to make a building accessible. Some of the significant gaps found in the old Part S are addressed by the new Part S.



### **6.3.1 Access, egress and lifts**

The old Part S (SABS 0400 1990: 151) provides scope to create access through any door, not necessarily the main entrance, thereby sanctioning segregated entrances to buildings. The new Part S (SANS 10400-S, 2008: 27) closes this gap by stipulating that people with disabilities are able to enter the building safely, by suitable means, from the main and ancillary approaches of the building to the ground storey; via the main entrance and any secondary entrance. It includes a provision for egress, that was previously absent. There must be a suitable means of egress for people with disabilities from any point in a building to a place of safety in the event of an emergency.

The old Part S is vague as far as the issue of lifts is concerned. It merely states that a lift must be provided (SABS 0400, 1990: 151). The new Part S (SANS 10400-S, 2008: 27) provides clear requirements: that any lift installed must serve the needs of people with disabilities, which is extended from people with paraplegia and mobility impairments to include a more comprehensive definition of disability (c.f 6.1).

### **6.3.2 Parking**

Parking facilities to be provided, as stated in Part S (SABS 0400, 1990: 151, SANS 10400-S, 2008: 27) is unclear and inadequate. It only makes provision for parking for people with disabilities if there are more than 50 parking spaces and if access is provided from the parking area to the ground storey. A more comprehensive requirement would be that in any parking lot an adequate number of the parking spaces be provided for people with disabilities and that the parking spaces be located within 50 metres of the accessible entrance.

### **6.3.3 Auditoria**

With regards to auditoria the old Part S (SABS 0400 1990: 151) indicates that space for access and space for seating must be provided for people in wheelchairs in an auditorium. The new Part S (SANS 10400-S 2008: 27) specifies that access and space for seating must accommodate both people in wheelchairs and other assistive devices. Both, however, fail to require that the person seated in the aforementioned space be able to see and hear what is taking place.

### **6.3.4 Water closets**

With regard to the provision of water closet (WC) facilities, Part S2 (SABS 0400, 1990: 151, SANS 10400-S, 2008: 28) exempts H3 (domestic residence) classification of building from providing a wheelchair accessible WC. However, the inclusion of wheelchair accessible facilities is relevant to this class of building, as it would allow a resident to remain in his/her home as s/he grows older or becomes disabled.

### **6.3.5 Commonly used routes**

The new Part S (SANS 10400-S, 2008: 27) extends the definition of obstacles in the path of travel. It states that commonly used paths of travel must be clear of obstacles which limit, restrict or endanger the movement of people with disabilities. It also includes obstacles which may prevent people with disabilities from accessing facilities provided in the building.

## **6.4 Deemed-to-satisfy rules**

The new Part S successfully omits a glaring loophole found in commentary provided at the beginning of the deemed-to-satisfy rules in the old Part S. The commentary states that even though people with disabilities should be able to play a full role in society, "... economic considerations may make it difficult to provide the facilities in all buildings. This fact has been acknowledged in the regulations in the form of an exemption from the requirements in the case of certain buildings ..." (SABS 0400, 1990: 152). This commentary provides designers with all the motivation they require to disregard environmental access whenever they choose to do so. This is also seen to validate the misconception that including access features into the design of a building increases the building costs (cf. 4).

The SABS 0246 provides practitioners with requirements or design principles on access for people with disabilities, which when applied are advantageous not only to the disabled user but also to the entire population of South Africa. However, the document is not widely used among practitioners. In addition, many of the requirements given do not correspond with the old Part S, which is confusing (cf. 2.1). The SABS 0246 provides a more comprehensive, detailed and illustrated document than the old Part S. A number of areas not covered by the old Part S are included: lighting; signage; controls for use by people with disabilities; signals and warnings for people with impaired sight or hearing, as well as additional notes and diagrams on the design and layout of a wheelchair-accessible water closet. In

the new Part S the old deemed-to-satisfy rules have been replaced with the more comprehensive and accessible SABS 0246, which will allow for both better practice and a better understanding of the needs of people with disabilities. However, it should be noted that even the SABS 0246 needs to be updated and brought in line with international standards of universal access.

## **6.5. Legal clarification and status of Human Rights legislation**

Prior to May 2008 (cf. 5) the State was exempted from the provisions of SABS 0400 if the Minister of Trade and Industry, in concurrence with the Ministers' of Defence, Law and Order, and Justice, were of the opinion that the erection of any building or class of building by or on behalf of the State is in the interest of the country's security (in accordance with the NBR and *Building Standards Act 103 of 1977*). The State was also exempted by virtue of economic considerations, necessity or expediency, either generally or in any specific case. However, because South Africa has since ratified the UN Convention (Table 1) and because of the *Promotion of Equality and Prevention of Unfair Discrimination Act*, the aforementioned exemption is no longer valid.

As the findings from the questionnaire indicated (cf. 2.1), while 57% of the respondents are aware of the *Promotion of Equality and Prevention of Unfair Discrimination Act*, the majority of practitioners are not familiar with its content and are, therefore, not aware of their legal obligations in ensuring an accessible built environment (Table 1). Although the legal status of this Act is still being tested, recent court cases, for example the case of the Kabega Park police station (Steyn, 2008) and the case of Meyerton Court buildings (De Bruin, 2003), heard in equity courts, have resulted in people with disabilities being awarded compensation for inaccessible buildings, and apologies being proffered by the offending party.

## **6.6 Enforcement**

Enforcement of the NBR is controlled at microlevel by the local building council and their inspectors. Geszler (2008), however, stated that these inspectors often lack the skills to make sound judgements. The *INDS* (South Africa, 1997: 30) concurs: "... unfortunately these regulations have been badly administered and monitored". In this regard the *INDS* (South Africa, 1997: 30) lists a number of specific problem areas that need to be addressed, including planning professionals who fail to understand and implement the specific

details required in providing an inclusive environment and developers who do not have clear policies on environmental access.

## **6.7 Standards: minimums or maximums**

The standards given in Part S and the SABS 0246 are minimums. However, practitioners typically apply them as maximums (optimum dimensions) (cf. 2.1). This is problematic in that the standards are grossly outdated and have seemingly been compiled with a lack of understanding of the problems encountered by people with disabilities in the built environment.

## **6.8 The new Part S**

While preceding sections discussed the new Part S compared to the old Part S, this section summarises the achievements and failures of the new Part S. First, it combines both the technical standards, the SABS 0400 and the SABS 0246, eliminating previous confusion. Secondly, the meaning of the standard is brought in line with the constitution and the *Promotion of Equality and the Prevention of Unfair Discrimination Act*. New standards, such as those pertaining to parking spaces have been added. Finally, it features clear explanatory notes, a comprehensive list of definitions, and includes all the legislative Acts and sections of the *Bill of Rights* related to disability.

However, it fails to achieve the following: requirements are not based on the latest ergonomic research and international standards, for example the required gradients for ramps are still out of date and dangerous. The requirements also do not provide for different environments, such as transport infrastructure or shopping malls, as opposed to office environments.

## **7. Recommendations**

It is evident from this study, and as stated in the *INDS* (South Africa, 1997: 30), that the old Part S (SABS 0400 Part S) is outdated, seemingly compiled with a lack of understanding of the real needs of people with disabilities and not in line with the inclusive nature of the constitution. Therefore, the new Part S (SANS 10400-S) urgently needs to be published and implemented. However, it should be borne in mind that it is in itself imperfect.

The following recommendations are made:

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- the regulations should be revised in terms of remaining ambiguities, thereby bringing them in line with the constitution and associated legislation;
- the regulation should be reviewed. A move towards a universal access regulation, including both people with disabilities and those without should be debated and considered;
- the new Part S (SANS 10400-S) should be updated in terms of the latest research in ergonomics, and other areas of universal design;
- the new Part S (SANS 10400-S) requirements should be extended to include a variety of built environments, such as city planning, transport infrastructure and different building types;
- the new Part S (SANS 10400-S) should be updated, by means of a comparative study, in terms of progressive international standards, such as those of the United Kingdom and Australia;
- any procedures of revision should include an intensive and thorough process of consultation with all the relevant organisations of and for people with disabilities;
- any process of revision should include the study of international precedents in terms of their processes and resultant standards;
- the public, local building council and their inspectors, professional practitioners, construction industry and developers should be made aware of the revised standards, the legal implications in terms of the constitution and be given an understanding of the real needs of people with disabilities;
- education and training is a means to achieve the aforementioned recommendation. Training in this regard needs to be formally implemented in tertiary diplomas and degrees relating to the built environment. Furthermore, training should be provided by the various professional bodies to practitioners.

## **8. Conclusion**

It is clear that all people need an inclusive built environment so that they can live and work comfortably. Moreover, certain groups in society, in particular people with disabilities, experience the greatest difficulties with the built environment. Thus, it is imperative that the new Part S (SANS 10400-S) be published and implemented if our built environment is to begin to reflect the political and social change it

is currently experiencing, and that these standards themselves be further updated.

In addition, the needs of people with disabilities ought to be understood and appreciated. Therefore, the standards should be aligned with the inclusive nature of our constitution, in particular the Bill of Rights. In this way our buildings, landscapes, neighbourhoods and cities might both physically and symbolically indicate that people with disabilities are an integral part of our society.

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## **Managing risks associated with the JBCC (principal building agreement) from the South African contractor's perspective**

*Peer review*

### **Abstract**

Construction is a complex and risky business. It is a time-consuming process involving a multitude of organisations with different objectives and skills. In addition, increasing client expectations coupled with the technological development of materials and equipment made the construction industry subject to more risks than any other industry. Contracts are essential tools for organising the relationship between involved parties and managing associated risk. For years the South African construction industry had a very poor reputation in managing construction risks. In order to improve the image of the South African construction industry and to assist contractors to develop their proper risk management strategy, this article aims to manage the risks associated with the Joint Building Contracts Committees (JBCC) Principal Building Agreement (PBA). A research methodology, consisting of literature review, questionnaires and interviews, is designed to achieve four objectives. First, to review the topics of contracts and risks in construction projects and the JBCC (PBA). Secondly, to develop an innovative framework to enable contractors to identify, quantify and classify risks associated with the JBCC (PBA). Thirdly, to evaluate the developed framework from industry's feedback in order to improve its performance. Finally, to create a correlation matrix of contractor's risk sources.

**Keywords:** Contracts, risk, JBCC (PBA), construction, framework, correlation matrix, contractor's risk source, South Africa.

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## Abstrak

Konstruksie is 'n komplekse en riskante bedryf. Dit is 'n tydrowende proses en sluit in 'n reeks organisasies met verskillende doelwitte en vaardighede. Hoër kliëntvereistes, gekoppeld aan die tegnologiese ontwikkeling van materiale en toerusting, het die konstruksiebedryf meer blootgestel aan risikos as enige ander bedryf. Kontrakte is die middele wat gebruik word om die regte en verpligtinge tussen die betrokke partye te bepaal en om die verwante risikos te bestuur. Die Suid-Afrikaanse konstruksiebedryf het vir 'n hele aantal jare 'n swak reputasie gehad rakende risiko-bestuur. Die doel van hierdie artikel is om die reputasie van die konstruksienywerheid te verbeter en om kontrakteurs by te staan met die ontwikkeling van hul vaardighede om die risikos soos uiteengesit in die Gesamentlike Boukontraktekomitee (GBK) se Hoofbouooreenkoms (HBO) beter te bestuur. Die navorsingsmetodologie bestaande uit 'n literatuurstudie, vraelys en onderhoude het vier doelwitte. Eerstens, om 'n oorsig te gee van die kontrak- en risiko-aspekte van konstruksie-projekte in die GBK HBO. Tweedens, om 'n innoverende raamwerk te ontwikkel om kontrakteurs te help om risikos in die GBK HBO te identifiseer, kwantifiseer en klassifiseer. Derdens, om die ontwikkelde raamwerk te evalueer deur middel van bedryfterugvoering om sodoende prestasie daarvan te bevorder. Laastens, om 'n korrelasie-matriks van die oorsprong van kontrakteursrisikos op te stel.

**Sleutelwoorde:** GBK PBA, konstruksie, kontrakte, kontrakteursrisikos-oorsprong, korrelasie-matriks, raamwerk, risikos, Suid-Afrika

## 1. Research background and rationale

Numerous contracts are signed daily in construction, which is one of the largest global industries and an integral part of economic growth and social development (Mthlale, Othman & Pearl, 2007; Anaman & Amponsah, 2007 cited in Khan, 2008). These contracts range from new construction, refurbishment to maintenance. Some projects are simple and worth a few thousands of Rands whereas others are complex and may cost hundreds of millions of Rands. Some projects may involve just two organisations, whereas others may involve a multitude of suppliers, subcontractors and consultants. Irrespective of how simple or complex the project is, all projects have something in common: they are exposed to risk and can go wrong (Edwards & Bowen, 2005).

In his report entitled "*Construction the Team*" Sir Michael Latham considered that no construction project is risk free. Risk can be

managed, minimized, shared, transferred or accepted. It cannot be ignored (Latham, 1994). According to Smith (1999); Finley, Deborah & Fisher (1994); Flanagan & Norman (1993) and Papageorge (1988), risk is a natural part of any construction project. The reason for this is that construction is a multifaceted process that has a wide variety of complex processes. In addition, construction projects involve hundreds if not thousands of interacting activities that have time, cost and quality constraints. These constraints inevitably cause the risks of delay, inflation, cost overruns, natural or physical damages on site, potential harm and/or loss to people, property, reputation, business and reduction in qualified personnel, bankruptcy as well as client dissatisfaction.

At present, the construction industry is facing a more challenging environment than previously. The increasing expectations of clients, the need to deliver higher quality products and services at tight-time scale and lowest cost; the development of new construction methods, procedures, materials and new types of buildings resulted in project stakeholders facing high risks towards attaining high standards of efficiency. It is therefore important to plan and make the right decisions, which will reduce risk on cost, time and quality of the building projects (Edwards & Bowen, 2005; Carter, Hancock, Morin & Robins, 1997; Flanagan & Norman, 1993).

Construction contracts organise the relationship between parties once the offer is accepted (Finsen, 2005). They are the tools for managing risks (Uff & Odams, 1995) and establishing the rights, duties, obligations, and responsibilities of the various contracting parties in order to allocate risk.

For years the South African construction industry had a poor reputation due to the lack of application of risk management. Currently, a contractor is often given a mass of information and data at the time of bidding, which may or may not be well coordinated and organised. The contractor is expected to assimilate all the information in a relatively short period of time and to provide the client with an intelligent but profitable bid (Smith, 1998; Harinarain & Othman, 2007).

Because of the importance to improve the image of the South African construction industry, coupled with the necessity to enable contractors to understand and develop their risk management strategy as well as the significance to overcome the limitation and the scant attention paid to this topic in construction literature, particularly in the South African context, this paper aims to manage

the risks associated with the Joint Building Contracts Committee (JBCC) Principal Building Agreement (PBA).

## **2. Research methodology**

In order to achieve the abovementioned aim, a research methodology, consisting of literature review, questionnaires and interviews, was designed to achieve the following objectives:

- Reviewing the topics of contracts and risks in construction projects and the JBCC (PBA).
- Developing an innovative framework to enable contractors to better understand and develop their risk management strategy.
- Evaluating the developed framework by means of the industry's feedback to improve its performance.
- Creating a correlation matrix of risk sources to the contractor.

A representative and non-biased sample of Durban-based construction companies was selected. This helped increase the validity and reliability of collected data and research findings. The Master Builders Association website (Master Builder Association, 2008) was accessed to obtain a list of Durban-based registered construction companies. The result was a list of 62 companies ranging from small, medium to large enterprises. All these companies were contacted to enquire whether they utilise the JBCC (PBA). Out of the 62 companies contacted, 23 stated that they utilise the JBCC (PBA). These companies were contacted and the scope of the study was introduced to them. Only 9 companies agreed to participate in the study. The survey questionnaires were faxed to these companies and respondents were then interviewed to gain thorough insight and feedback.

## **3. Contracts in construction**

### **3.1 Definition and obligations**

A contract is an exchange relationship created by oral or written agreement between two or more persons, containing at least one promise, and recognised in law as enforceable (Blum, 2007). Such an agreement gives rise to personal rights and corresponding obligations. For a contract to be legally enforceable, an agreement should have legal purpose and form, offer and acceptance,

consideration and competent parties (Athearn & Pritchett, 1984). In construction, a building contract is an agreement between two parties, the contractor who agrees to erect a building and the employer who agrees to pay for it. This agreement creates personal rights and obligations, and the right of one party is the obligation of the other. The contractor has the obligation to erect the building and the right to be paid for it, while the employer has the right to have the building erected and the obligation to pay for it. A contract comes into existence on the acceptance of an offer. If either party defaults on his/her obligation, the other party may invoke the assistance of the law to enforce his rights (Finsen, 2005).

### **3.2 The contract documents**

Construction contracts differ substantially from the usual commercial ones. The commodity concerned is not a standard one but a structure that is unique in its nature and involves considerable time, cost, and risk. The usual construction contract consists of a number of different documents such as general conditions, supplementary conditions, drawings, bills of quantities and addendums. All contract articles should be carefully read before rather than after the contract is signed. After execution of the contract, the contractor is bound by all its provisions, whether one has read them or not (Finsen, 2005; Clough, 1975). A building contract is a trade-off between the contractor's price for undertaking the work and his willingness to accept both controllable and uncontrollable risks. Hence, the price for doing the work partly reflects the contractor's perception of the risk involved (Flanagan & Norman, 1993).

### **3.3 The Joint Building Contracts Committee (Principal Building Agreement)**

The Joint Building Contracts Committee (JBCC) represents the variety of interests in the South African construction industry. It has six constituent member organisations: the Association of South African Quantity Surveyors; the South African Institute of Architects; the South African Association of Consulting Engineers; the South African Property Owners' Association; the Specialist Engineering Contractors Committee, and the Building Industries Federation of South Africa (Van Deventer, 1993). The JBCC Series 2000 is a suite of documents comprising the Principal Building Agreement, the Nominated/Selected Subcontract Agreement and the Preliminaries, which together constitute the terms and conditions of the agreement between the parties. In addition, there are sundry documents that

do not add to the rights and obligations of the parties but merely facilitate the administration of the contract. These include the Contract Price Adjustment Provisions, the Construction Guarantee, the Payment Guarantee, the Payment Certificate, the Completion Certificate, etc. (Finsen, 2005).

### **3.3.1 Parties to the JBCC contract**

The parties to a building contract are the employer and the contractor. In the JBCC Series 2000 edition no mention is made either of the architect or of the quantity surveyor or of any of the engineers. Instead, a principal agent assumes all these roles. He may be an architect, a quantity surveyor, an engineer or a project manager. He is not expected to fulfil all of these roles as provision is made for the employer to appoint other agents to play their traditional roles. However, only the principal agent can issue instructions, receive notices on behalf of the employer and bind to him. The principal agent is not a party to the contract and does not acquire any contractual rights and obligations. He acts on behalf of the employer in respect of a great number of his obligations which, for lack of training and expertise, the employer cannot perform himself. The duties of the principal agent and the other agents to the employer under a construction contract are: carrying out their duties with reasonable skill and care, independently exercising reasonable professional judgment, and protecting the employer's interests (Finsen, 2005; Murdoch, 1996; Van Deventer, 1993).

## **4. Risks in construction**

### **4.1 Overview and definition**

The future is largely unknown and most business decisions are taken on the basis of expectation, assumption, estimates and forecasts which involve taking risks. Due to its nature, the construction industry is considered to be subject to more risk than any other industry. The reason is that getting the project from the initial investment appraisal stage through to completion and into use involves a complex and time-consuming design and construction process. The construction process involves a large number of people, from different organisations, with different skills and interests, and a great deal of effort is required to co-ordinate the wide range of activities undertaken. In addition, the increasing expectations of clients, technological advancement and development of complex facilities that involve multiple interacting systems increase the probability of

occurrence of unexpected events during the process of building procurement (Murdoch, 1996). Such events are called risks (Shen, 1999). Risk can travel in two directions: the outcome may be better or worse than expected. Taking this into account, risk could be defined as the exposure to the possibility of economic or financial loss or gain, physical danger or injury, or delay as a consequence of the uncertainty associated with pursuing a particular course of action (Chapman, 1995; Raftery, 1994).

## **4.2 Types of risk in construction projects**

Risks in construction projects can be classified under many categories:

- According to the events, outcome risk can be classified as (a) upside risk when the outcome of the event is better than the original forecast and (b) downside risk when the outcome of the event is worse than the original forecast.
- According to the possibility of occurrence, there are two kinds of risks: (a) pure risk, which arises from the possibility of accident or technical failure and (b) speculative risk, possibility of loss and gain, which may be financial, or physical.
- According to the possibility of reduction, there are two kinds of risk: (a) diversifiable risk, if it is possible to reduce risk through pooling or risk-sharing agreement, and (b) non-diversifiable risk, if pooling agreement is ineffective in reducing risk for the participants in the pool (Williams, Smith & Young, 1995).
- Flanagan & Norman (1993) classified construction risks as political, economic, technical, external relations, management, design, environmental, legal and operational.
- Perry & Hayes (1985 cited in Shen, 1999) classified risks in construction projects as physical, construction, design, political, financial, legal-contractual, and environmental.
- Santoso, Ogunlana & Minato (2003) classified risk as physical, personal, technical, safety-accident, construction design causes, political and regulation, financial, contractual, and environmental regulations risks.

### **4.3 Risk management process**

Risk management is the process of identifying, analysing and responding to project risks. It includes maximising the results of positive events and minimising the consequences of adverse ones (PMBOK, 2004). It is the process of protecting the organisation, its people, assets, and profits, against the physical and financial consequences of risk. It involves planning, co-ordinating and directing the risk control and the risk financing activities in the organisation (Greene & Serbein, 1983; Valsamakis, Vivian & du Toit, 1999). Edwards & Bowen (2005) stated that risk is important for most project stakeholders as it affects their business and success. Hence, risk cannot be disregarded or dealt with haphazardly. Modern society's expectations of corporate behaviour and public accountability demand that organisations consider the risks they face or create for others. The process of Risk Management can be classified as follows:

#### **4.3.1 Risk identification**

Risk identification is considered to be the most important element of risk management. Many of the major decisions with the greatest impact on the project are made during its early feasibility and design development stages. During these stages changes can be made with the least disruption. In addition, the information, upon which such decisions are made, is most likely to be incomplete or inaccurate. Therefore, to ensure that the right decisions are made, all the important risks and their sources must be identified and assessed at the earliest possible point in the project's life cycle (Valsamakis, *et al.*, 1999; Laxtons, 1996). Different tools and techniques can be used for risk identification, including experienced experts' judgement; standard questionnaires and checklists; structured interviews; expert computer-based systems; outside specialists; brainstorming sessions; Delphi technique, and the combined approach (Valsamakis, *et al.*, 1999; Laxtons, 1996; Papageorge, 1988)

#### **4.3.2 Risk analysis**

Risk analysis is used to evaluate risks and ascertain the importance of each risk to the project, based on an assessment of the probability of occurrence (Likelihood) and the possible consequence of its occurrence (Severity). Risk = Likelihood X Severity Loss/Gain (Balfour Beatty, 2000; Rafferty, 1994). Risk analysis assesses both the effects of individual risks and the combined consequences of all risks on the project objectives. Risk analysis enables decision-makers to improve the quality of their judgments by providing more realistic information

on which to base decisions. This is clearly summarised by Tony Ryan, Chairman of Guinness Peat Aviation Ltd, as quoted in Raftery (1994) "This is not a speculative game at all. Our objective is not to avoid risk but to recognise it, price it and sell it." There are many techniques used for risk analysis such as sensitivity analysis, probability analysis, simulation techniques, risk premium, expected monetary value (EMV), expected net present value (ENPV), EMV using a Delphi peer group, risk-adjusted discount rate (RADR), detailed analysis and simulation, and stochastic dominance (Shen, 1999; Smith, 1999; Raftery, 1994). There is no 'best' single technique, as every project will almost certainly have individual characteristics, which make it unique (Amos & Dent, 1997).

### **4.3.3 Risk response and mitigation**

Risk response and mitigation is the action that is required to reduce, eradicate or avoid the potential impact of risks on a project. The main aim of any response and mitigation strategy is to initiate and implement the appropriate action to prevent risks from occurring or, at minimum, limit the potential damage they may cause. This should ensure that the overall project objectives of time, cost and quality are not jeopardised. The information gained from the identification and analysis of the risks gives an understanding of their likely impact on the project if they are realised. This, in turn, enables an appropriate response to be chosen (Laxtons, 1996). The general guiding principle of risk response is that the parties to the project should seek a collaborative and mutually beneficial distribution of risk (Raftery, 1994). Furthermore, risks need to be allocated to those parties best placed to influence both the likelihood of the risk occurring and its potential impact should it occur. The methods used for risk response and mitigation are risk avoidance, risk transfer, risk reduction and residual retention, risk retention, combination of two or more of these responses to risk (Shen, 1999; Smith, 1999; Laxtons, 1996; Flanagan & Norman, 1993).

## **4.4 Benefits of implementing risk management**

Raftery (1994); Godfrey (1996); Mootanah (1998) and Hiley & Paliokostas (2001) mentioned that many benefits could be gained from applying systematic risk management process as follows:

- Better understanding of project objectives and uncertainty.
- Better responding to unexpected events.



- Effective team building and better use of skills and experience of project personnel.
- Promoting effective communication.
- Improving project management.
- Improving decision-making.
- Establishing the justification of contingencies.
- Reducing project costs.
- Providing value for money.
- Protecting the balance sheet by transferring or avoiding unaffordable risks.
- Eliminating unnecessary risks.
- Concentrating resources on what matters.

## **5. The Identification, Quantification and Classification Framework (IQCF)**

Framework is defined as the basic and logical structure for classifying and organising complex information (FEAF, 1999). It is a structure for describing a set of concepts, methods and technologies required to complete a product process and design (EDMS, 2007). The Identification, Quantification and Classification Framework (IQCF) (hereinafter referred as 'the framework' or the IQCF) is the set of functions, activities, procedures as well as the tools and techniques required to assist construction contractors to better understand the risks associated with the clauses of the JBCC (PBA). It is a decision-making tool designed to enable contractors to identify, quantify and classify the risks of the JBCC (PBA) clauses. The IQCF will help the contractors draw the appropriate risk management plan to mitigate the adverse effects of these risks (Harinarain & Othman, 2007).

### **5.1 The need, aim and objectives of the IQCF**

The construction industry is one of the largest booming industries in South Africa. It contributes 8% of the total employment of the country with 1,024,000 people in 2006 (South Africa. Department of Housing, 2007). This involves hundreds of consultants, contractors and suppliers, as well as the establishment of contracts, especially since the rise in construction work for the 2010 Soccer World Cup. The need for the IQCF stems from the importance to improve the image

of the South African construction industry, the necessity to assist contractors to better understand the risks pertaining to the JBCC (PBA) as well as the importance to overcome the scant attention paid to this topic in construction literature. To achieve this aim, the following objectives must be achieved:

- Identifying the risks associated with the JBCC (PBA) contract clauses from the contractor's perspective.
- Quantifying the identified risks to draw a complete picture of the most serious risks.
- Classifying the identified and quantified risks to collect them in groups in order to allow contractors to distinguish those risks that originate from within the contractor's organisation and those that are external to the contractor's organisation.

## **5.2 The conceptual description of the IQCF**

The IQCF was developed in a systematic process consisting of three steps: identification, quantification and classification of the risks associated with the JBCC (PBA).

### **5.2.1 Identification of the JBCC (PBA) risks**

Since the framework adopts the contractor's perspective, the first step of risk identification was to identify all potential risks that could possibly affect the contractor. This entailed carrying out in-depth literature review based on textbooks, academic journals, professional magazines, conference proceedings, seminars, dissertations and theses, organisation and government publications as well as internet and related web sites. First, literature review resulted in identifying (270) risks. Secondly, these risks were reviewed and refined on a regular basis to omit repeated risks and merge similar ones. The end result was a list of 136 risks. Thirdly, these risks were then compared with the clauses of the JBCC (PBA) in order to ensure that the most important risks were covered in the JBCC (PBA). Finally, the criteria that will be used to state the risks associated with JBCC (PBA) clauses were developed. In order to establish these criteria, it is essential to initiate a link between the identified risks and the factors that lead to an organisation's success or failure. Corporate analysis shows that every organisation has internal and external environments. Each one of them has its effect on the success or failure of the organisation. Internal environment consists of strength factors and weakness factors, whereas external environment consists of opportunities factors and threat factors. These factors are adopted to design the

criteria for identifying the risks associated with the clauses of the JBCC (PBA). Within this research, the following criteria are established in order to identify the risks associated with the JBCC (PBA) from the contractor's perspective: reducing organisations' strengths, increasing organisations' weakness, reducing organisations' opportunities and increasing organisations' threats, see Figure 1.

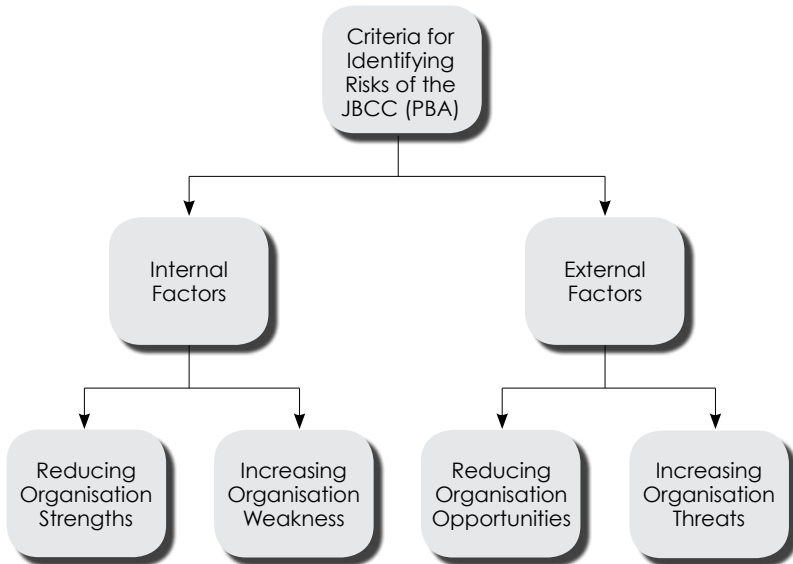


Figure 1: Risk identification criteria.  
Source: Harinarain & Othman, 2007: 147

### 5.2.2 Quantification of the JBCC (PBA) risks

Once the identification criteria were established, the next step of the framework development was to quantify the risk associated with the JBCC (PBA) clauses from the contractor's perspective in order to identify the most influential ones. Risks were quantified based on the probability of occurrence (P) and its severity (S), where the result is  $R = P * S$ . This quantification was carried out by interviewing a selected number of managers of construction companies. The Likert scale of 1 to 5 was used to quantify the probability and severity of these risks. The numerical scores from the interview provided an indication of the varying degree of influence that each risk has on the contractor. To further investigate the data, the relative importance index (RII) was used to rank the risks according to their influences using the

following equation:  $RII = \sum W / AN$ , where W=weighting given to each driver by the respondents and range from 1 to 5, A= highest weight (5 in our case); and N= total number of sample (Kometa & Olomolaiye, 1997; Olomolaiye, Price, & Wahab, 1987; Shash, 1993).

### 5.2.3 Classification of the JBCC (PBA) risks

The last step of the framework development was the classification of the risks identified and quantified. Classifying risks enables the contractor to consider them within a more coherent framework. It provides the construction professionals, in general, and the contractor, in particular, with a more uniform risk language, specifically in fields where risk needs to be communicated to a wide variety of project stakeholders. It allows the contractor to establish a common understanding of different risks, and provides an essential basis for effective knowledge transfer within an organisation and from one project to another (Edwards & Bowen, 2005). In order to comply with the risk identification criteria developed by the authors, this research classified risks affecting the contractor as internal risks and external risks:

- **Internal risks** emerge from within the contractor's organisation or are within the control of the contractor.
- **External risks** emerge from outside the contractor's organisation, or are out of the control of the contractor.

Table 1 shows the overall format of the IQCF that hosts all the information gleaned in the previous steps.

Table 1: The Identification, Quantification and Classification Framework

JBCC (PBA) Clause	Risk Identification Criteria				Risk Quantification			Risk Classification	
Description of clause	Reducing organisation strengths	Increasing organisation weakness	Reducing organisation opportunities	Increasing organisation threats	Probability (P)	Severity (S)	Result = P*S	Internal risk	External risk

Source: Harinarain & Othman, 2007: 148

## **5.3 Models and the modelling process**

### **5.3.1 Modelling the IQCF**

Modelling is the process of developing an accurate description of a system. As technology grows, accurate system description becomes more vital. Modelling helps to regulate the unplanned day-to-day administrative procedures and it is therefore a powerful framework for solving problems (Marca & McGowan, 1988). The IQCF is designed to be performed in a series of interrelated steps in order to enable contractors to adopt the appropriate risk management strategy when utilising the JBCC (PBA). When the procedures to identify, quantify and classify risk cannot be reduced to the activities of a simple model, they could lead to complications. In general, modelling the IQCF will facilitate effective management and risk identification, quantification and classification, diminish confusion, enhance building contractors' reputation, maintain focus on project completion and achieve better decisions. Modelling requires determining the sequence of events and their relationship to each other so that this information can be presented in a network (Othman, 2005). Based on the properties of the IQCF, the process model was selected to be the appropriate model to represent the activities of the IQCF because it is concerned with representing consecutive steps or activities with the delivery of an end product or service.

### **5.3.2 Reviewing the modelling tools**

A number of modelling tools were reviewed in order to select the most appropriate one to represent the IQCF. The criteria for representing the framework included the ability to analyse each clause of the JBCC (PBA) in terms of risk identification, quantification and classification; ease of use and understanding by contractors, as well as applicability and relevance to the construction industry. Some of these models were not suitable for representing the IQCF either because they are still in their infancy and are not widely used in construction like the Unified Modelling Language (Noran, 2005) and Role Activity Diagrams (Abeyasinghe & Phalp, 1997) or because they are difficult to read like the Data Flow Diagrams (Chung, 1989; Ranky, 1994; Anumba, Cutting-Decelle, Baldwin, Dufau, Mommessin & Bouchlaghem, 1998) as well as the Hierarchy plus Input-Process-Output which has limited ability to show detailed information about a system (Chung, 1989).

### 5.3.3 The Integrated DEfinition (IDEF-0)

This is a requirement specification tool based on the concept of system modelling of Input, Control, Output and Mechanism (see Figure 2). It uses natural and graphic languages to convey meaning about a system. This methodology defines functions and their interfaces, and facilitates hierarchy decomposition of detail in a system (Chung, 1989). The two primary modelling components are functions (represented on the diagram by boxes) and the data and objects that interrelate those functions (represented by arrows) (National Institute of Standards and Technology, 1993).

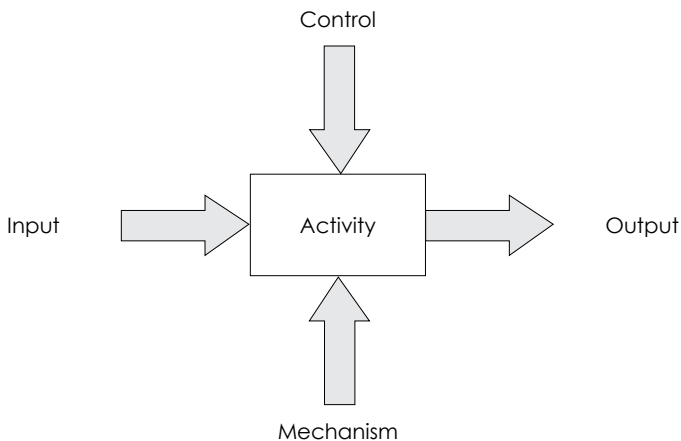


Figure 2: IDEF-0 Diagram  
Source: Renssen, 2001: online

IDEF-0 was chosen as the most appropriate method to represent the IQCF because it:

- uses function and activity modelling which is ideal to model the IQCF by describing its functions and activities step-by-step;
- is comprehensive (due to the elaborated information required);
- is generic (for analysis of systems and subject areas of varying purpose);

- is rigorous and precise (for production of correct, usable models);
- is concise (to facilitate identifying, quantifying and classifying risks in the JBCC [PBA]);
- is conceptual (for representation of functional requirements);
- allows for decomposition of a function into a number of smaller sub-functions, and
- is flexible (to support several phases of the life cycle of a project) (National Institute of Standards and Technology, 1993: ii).

### 5.3.4 The functional representation of the IQCF

Table 2 shows the contents of the IQCF. A top level (IQCF/A-0) presentation of the framework is presented in Figure 3. They are: Identifying risk associated with the JBCC (PBA) (IQCF/A1), Quantifying risk associated with the JBCC (PBA) (IQCF/A2), and Classifying risk associated with the JBCC (PBA) (IQCF/A3), shown in Figure 4.

Table 2: Table of contents for the IQCF

<i>Diagram Reference</i>	<i>Description</i>
IQCF/A0	Investigating risks associated with the JBCC (PBA) from the contractor's perspective.
IQCF/A1	Identifying risks associated with the JBCC (PBA) from the contractor's perspective.
IQCF/A2	Quantifying risks associated with the JBCC (PBA) from the contractor's perspective.
IQCF/A3	Classifying risks associated with the JBCC (PBA) from the contractor's perspective.

Source: Harinarain, 2008: 85

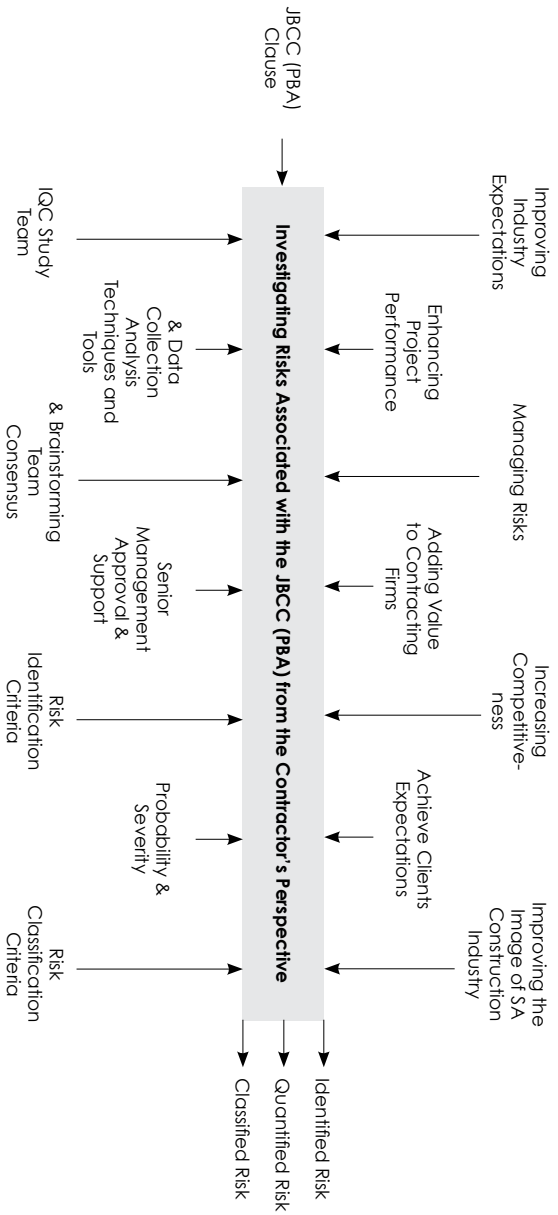


Figure 3: Investigating risks associated with the JBCC (PBA) from the contractor's perspective  
 Source: Harinarain, 2008: 87



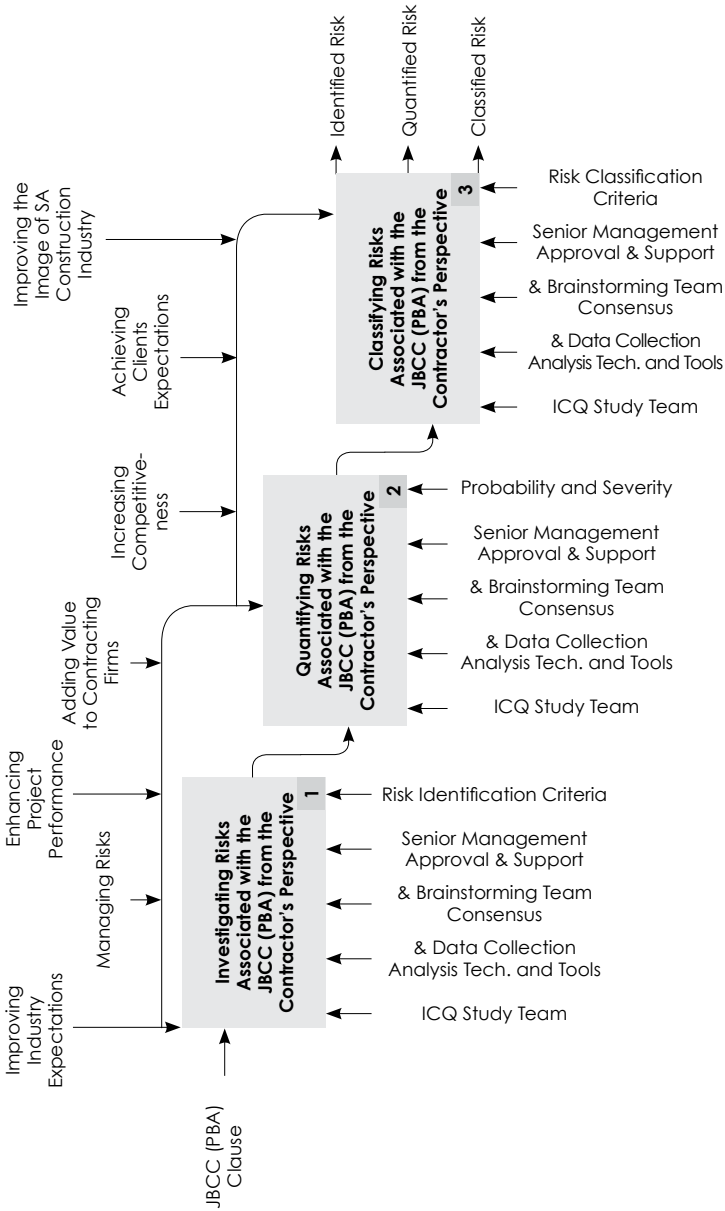


Figure 4: Investigating risks associated with the JBCC (PBA) - The three levels of the IQCF  
Source: Harinarain, 2008: 88

#### **5.3.4.a Identifying risks associated with the JBCC (PBA) from the contractor's perspective**

This function aims to identify the risks associated with the JBCC (PBA) from the contractor's perspective (Figure 5). It is a decomposition of box (1) in the IQCF/A0 diagram (Figure 4). The input to this function is the JBCC (PBA) clauses. The identification function has to be carried out in an endeavour to improve the industry expectations, enhance project performance, manage risks, add value to contracting firms and increase their compositeness, achieve client expectations as well as improve the image of the South African industry. Hence, gaining the approval and support of senior management is required to facilitate the acceptance and implementation of the study results. A study team has to be formulated to conduct the study. In addition, an orientation meeting prior to the study is essential to plan for the study and state its objectives, location and duration. Selecting the right team members is crucial to the success of the identification study. The criteria developed by the authors for risk identification must be utilised. Different data collection and analysis techniques and tools have to be used for risk identification. Furthermore, team members have to be encouraged to generate as many risks as possible during the brainstorming session. The output of this process is the identified risks. Once the risks have been identified and approved, the team can proceed to the next step.

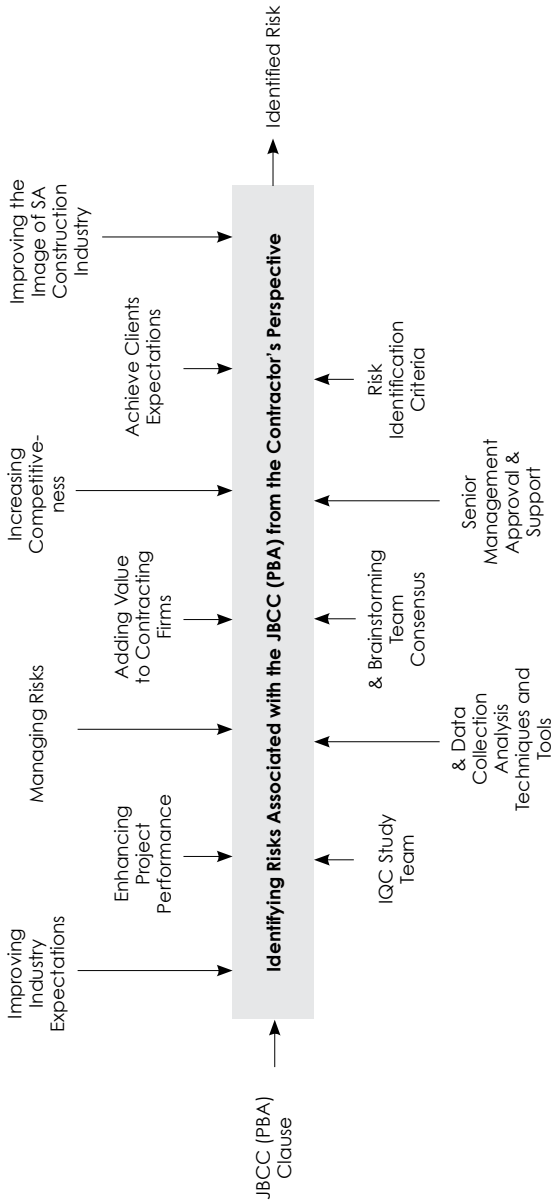


Figure 5: Identifying risks associated with the JBCC (PBA)  
Source: Harrincrain, 2008: 89

#### **5.3.4.b Quantifying risks associated with the JBCC (PBA) from the contractor's perspective**

This function aims to quantify the risks associated with the JBCC (PBA) from the contractor's perspective (Figure 6). It is a decomposition of box (2) in the IQCF/A0 diagram (Figure 4). The Input to this function is the risks identified in the previous function. The quantification function has to be carried out in order to improve the industry expectations, enhance project performance, manage risks, add value to contracting firms and increase their compositeness, achieve client expectations as well as improve the image of the South African industry. In addition to the mechanisms used to carry out this function such as approval and support of senior management, study team, data collection techniques and tools, the probability and severity analysis must be used to quantify identified risks through brainstorming and team consensus. Furthermore, the Relative Importance Index (RII) is vital for ranking risks according to their influences. The output of this stage is the quantified risk.

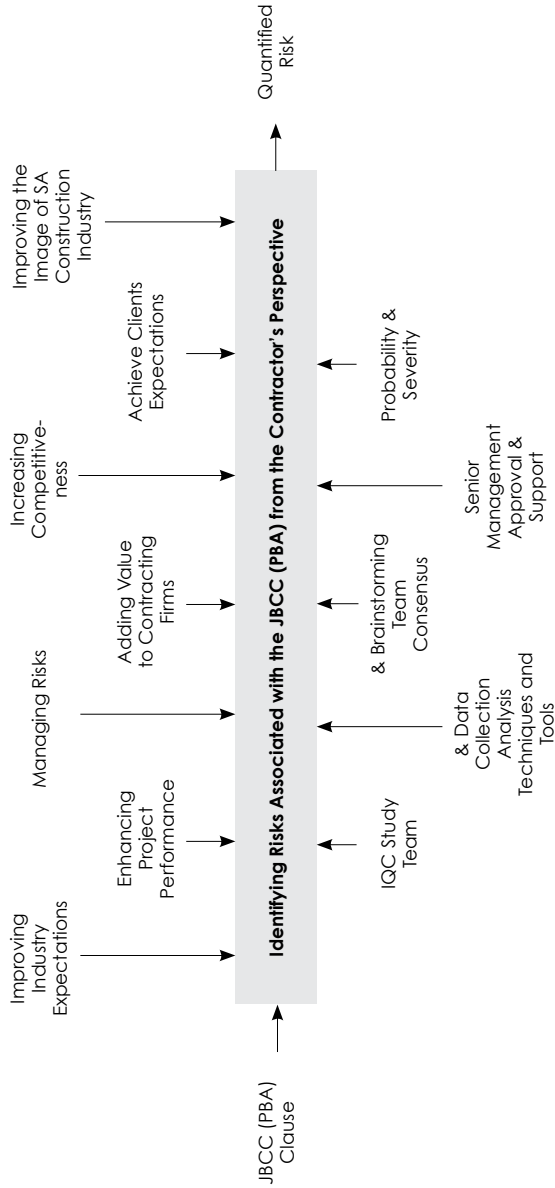


Figure 6: Quantifying risks associated with the JBCC (PBA)  
Source: Harinarain, 2008: 90

#### **5.3.4.c Classifying risks associated with the JBCC (PBA) from the contractor's perspective**

Within this function the risks identified and quantified in the previous two functions will be classified from the contractors' perspective (Figure 7). This function is a decomposition of box (3) in the IQCF/A0 diagram (Figure 4). The input to this process is the output of the previous function. Classifying risks will help improve the industry expectations, enhance project performance, manage risks, add value to contracting firms and increase their compositeness, achieve client expectations as well as improve the image of the South African industry. The developed criteria for risk classification developed by the author which classify risks as internal and external risks will be applied. Other mechanisms such as approval and support of senior management, study team, data collection and analysis techniques and tools, brainstorming and team consensus have to be used to achieve the function objectives. The output of this stage is the classified risk.

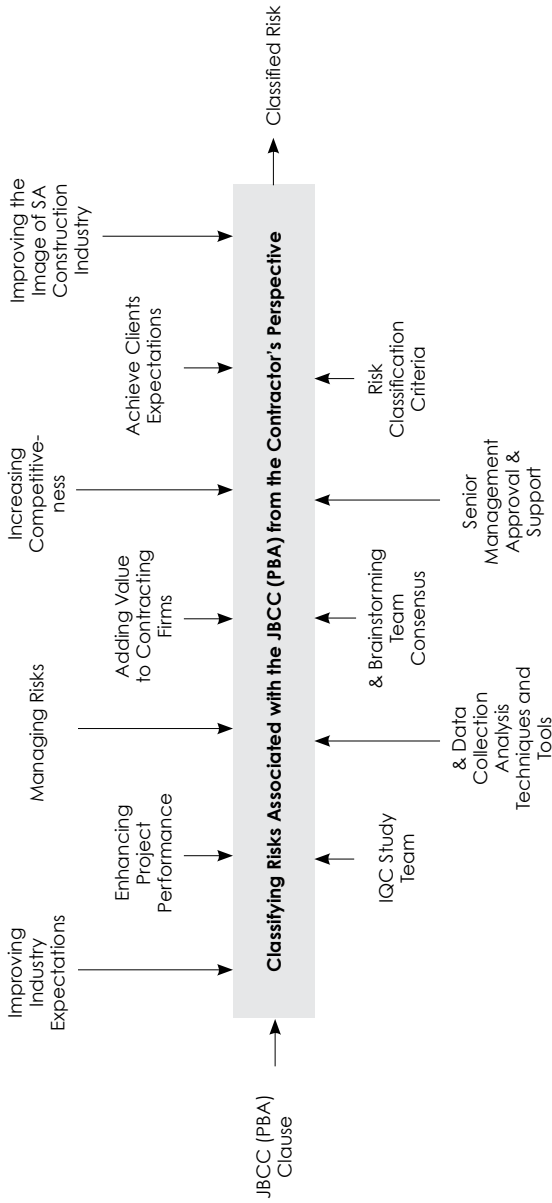


Figure 7: Classifying risks associated with the JBCC (PBA)  
Source: Harinarain, 2008: 91

### **5.3.5 Evaluation of the IQCF**

In order to evaluate the framework and to get feedback from the industry, 26 survey questionnaires were sent to construction firms. Out of these, 9 were completed and returned, providing a response rate of 47%. According to Babbie (1992), as a rule of thumb 50% is adequate while Mcneil & Chapman (2005); Saunders, Lewis & Thornhill. (2003); Gillham (2000); Tashakkori & Teddlie (1998) and Fellows & Liu (1997) state that 30-40% is acceptable because few people respond to questionnaires. The questionnaire was divided into three sections based on the three components of the framework. The questions asked the construction company to rate the suitability and acceptance of the identification, quantification and classification criteria developed by the authors in the framework on a scale of 1 to 5 (where 1=Poor and 5 =Excellent). Room for suggestion of improvement is provided. For the first section 67% of the respondents rated the risk identification criteria of reducing the company's strengths, increasing its weaknesses, reducing its opportunities or increasing its threats as 4 out of 5, while 33% rated it 3 out of 5. For the second section, 45% of the respondents rated the quantification method of probability and severity 4 out of 5, where 44% rated it 3 out of 5 and 11% rated it 2 out of 5. For the third section, 67% of the respondents rated the risk classification system of internal and external risks 4 out of 4, while 33% rated it as 3 out of 5. None of the respondents made any suggestions as to how these three areas could be improved. As general comments of the respondents, 56% of the respondents considered the framework a very good tool, while 44% rated it as good. One respondent did suggest that the framework could be elaborated on in further studies, by incorporating health and safety as well as quality aspects.

### **5.3.6 Benefits of the IQCF**

The IQCF developed by this research is an innovative decision-making tool designed to enable contractors to identify, quantify and classify the risks of the JBCC (PBA) clauses. The IQCF will help the contractors draw the appropriate risk management plan to mitigate the adverse effects of these risks. Proper implementation and understanding of the IQCF will provide the following benefits:

- Enhance risk identification;
- Improve risk quantification;
- Advance risk classification;



- Reduce disputes and disagreements as well as improve project performance;
- Increase contractors' reputation and their competitiveness;
- Improve the image of the South African construction industry and achieve client expectations;
- Make decisions on an informed basis, and
- Develop better risk management plans.

### **5.3.7 Limitations of the IQCF**

Due to the current boom in the South African industry because of the Soccer World Cup 2010, there are some limitations that impede the adoption and application of the IQCF: time constraints, work commitment as well as lack of qualified and trained personnel. To overcome these obstacles and facilitate the use of the IQCF, the benefits of the framework have to be clearly presented to the senior management of contracting companies in order to win over their confidence and ensure their commitment to adopt the framework and offer the training necessary to the successful application of the framework.

## **5.4 The correlation matrix of contractor's risk sources associated with the JBCC (PBA)**

### **5.4.1 Identification of contractor's risk sources associated with the JBCC (PBA)**

Based on the criteria of identifying risks associated with the JBCC (PBA) developed by the authors, risk sources to the contractor could be defined as the person, authority or event that either reduces the strength of the company, increases its weakness, reduces its opportunities and increases its threats, thus ultimately affecting the achievement of the project objectives and client satisfaction (Harinarain, Othman & Pearl, 2008). In this research, survey questionnaires and interviews were utilised to identify and quantify the contractor's risk sources associated with the JBCC (PBA). Respondents to the questionnaires and interviews were asked to select the risk source from a list of project participants. These were (1) client, (2) principal agent, (3) architect, (4) quantity surveyor, (5) engineer, (6) supplier, (7) subcontractor and (8) government authority. The outcome of the questionnaires and the interviews is described below.

#### **5.4.1.a The client as a risk source to the contractor**

Data analysis showed that clients are the risk source to the contractor in 72.5% of the JBCC (PBA) clauses. All respondents stated that the client is the main risk source to the contractor in clauses 3, 9, 10, 11, 12, 19, 31, 37, 38 & 39. The client represents a considerable risk source because s/he makes the decision to build, specifies the design requirements, states the ultimate budget, commencement and completion dates and if there are to be any variations. Clients are risk sources to the contractor with varying degrees with regard to other clauses (see Table 3).

#### **5.4.1.b The principal agent as a risk source to the contractor**

Analysis of responses showed that the principal agent represents the risk source to the contractor in 25% of the JBCC (PBA) clauses with varying degrees. Lack of leadership and experience of the principal agent to issue instructions to project teams, receive notices on behalf of the employer or represent him may cause many decisions to be suspended which, in turn, affect the daily work of the project and the contractor's progress.

#### **5.4.1.c The architect as a risk source to the contractor**

Data analysis showed that architects are the risk source to the contractor in 25% of the JBCC (PBA) clauses with varying degrees. Design errors, unco-ordinated tender documents, design changes due to, for instance, incomplete project brief, lack of understanding client requirements, lack of design experience are risks the contractor confronts during the construction process.

#### **5.4.1.d The quantity surveyor as a risk source to the contractor**

Respondents mentioned that quantity surveyors are the risk source to the contractor in 32.5% of the JBCC (PBA) clauses. 50% of the respondents mentioned that incorrect and late completion of the contract account (clauses 33 and 34) delays the contractor's cash flow and impedes him from starting new projects. Other risks that the quantity surveyors can cause to the contractor are adjustment to the contract value, delaying payment and dispute settlement (see Table 3).

#### **5.4.1.e The engineer as a risk source to the contractor**

Respondents mentioned that in 10 out of 40 clauses of the JBCC (PBA) the engineer is considered the risk source to the contractor. Complexity of building design, lack of expertise, design error, missing information, unco-ordinated documents and resolving disputes represent risk sources to the contractor. Engineers are risk sources to contractors with varying degrees in other clauses (see Table 3).

#### **5.4.1.f The supplier as a risk source to the contractor**

In 3 out of 40 clauses of the JBCC (PBA) suppliers represent risk to the contractors. Lack of access of the supplier to the work, revising the completion date and dispute settlement will hinder the supplier from delivering requirement materials and equipment on time which delays the contractor and prevents him from meeting the project requirements.

#### **5.4.1.g The subcontractor as a risk source to the contractor**

In 37.5% of the JBCC (PBA) clauses, subcontractors represent the risk source to the contractor. 22.2% of the respondents stated that in clauses 21 and 23, subcontractors were the main source of risk to contractors. This is because any delay caused by the subcontractor due to incompleteness of his job will hinder the contractor to meet the project deadline and could cause penalties and client dissatisfaction. Subcontractors are risk sources to contractors with varying degrees in other clauses (see Table 3).

#### **5.4.1.h The government authority as a risk source to the contractor**

In 12.5% of the JBCC (PBA) clauses, government authorities represent the risk source to the contractor. 83% of the respondents stated that changing government regulations during the construction process are considered a risk that affects the contractor's progress on site. Government authorities are risk sources to contractors with varying degrees in other clauses (see Table 3).

It is worth mentioning that 21% of the clauses are not applicable because they either do not contain any words or are explaining various aspects of the contract.

Table 3: Correlation matrix of risk sources to the contractor

Clauses	Sources of Risk to the Contractor							
	Client	Principal Agent	Architect	Quantity Surveyor	Engineer	Supplier	Sub-contractor	Government Authority
3.0 Documents	100%							
9.0 Indemnities	100%							
10.0 Works insurances	100%							
11.0 Liability insurances	100%							
12.0 Effecting insurances	100%							
19.0 Assignment	100%							
31.0 Interim payment	100%							
37.0 Cancellation by employer - loss and damage	100%							
38.0 Cancellation by contractor - employer's default	100%							
39.0 Cancellation - cessation of works	100%							
<hr/>								
21.0 Selected subcontractors							100%	
23.0 Domestic subcontractors							100%	
<hr/>								
22.0 Direct contractors	67%						33%	
27.0 Latent defects	67%						33%	
20.0 Nominated subcontractors	50%						50%	
33.0 Recovery of expense and loss	50%			50%				
34.0 Final account and final payment	50%			50%				
7.0 Regulations	17%							83%

Clauses	Sources of Risk to the Contractor							
	Client	Principal Agent	Architect	Quantity Surveyor	Engineer	Supplier	Sub-contractor	Government Authority
32.0	44.44%		11.1%	44.44%				
15.0	44.44%			44.44%			11.11%	
35.0	33%	17%		33%			17%	
18.0	33%				50%			17%
4.0	8%	8%	42%		42%			
17.0	18.89%	18.89%	18.89%	18.89%	18.89%		5.56%	
5.0	17.78%	17.78%	17.78%	17.78%	17.78%		11.11%	
24.0	17.78%	17.78%	17.78%	11.11%	17.78%		17.78%	
25.0	17.78%	17.78%	17.78%	11.11%	17.78%		17.78%	
26.0	17.78%	17.78%	17.78%	11.11%	17.78%		17.78%	
16.0	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%
29.0	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%
40.0	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%	12.50%
1.0						N/A		
2.0						N/A		
6.0						N/A		
8.0						N/A		
13.0						N/A		
14.0						N/A		
30.0						N/A		
36.0						N/A		

Source: Harinarain, 2008: 133

### 5.4.2 Quantification of contractor’s risk sources associated with the JBCC (PBA)

Data analysis showed that clients are ranked the highest risk source facing contractors when using the JBCC (PBA) with (mean 4.8, median 4.7 and mode 4.8 out of 5). Subcontractors were ranked the second risk source to the contractor with (mean 4.5, median 4.4 and mode of 4.3 out of 5). Suppliers were ranked the least risk source to the contractor with (mean of 2.7, median 2.6 and mode 2.5 out of 5). Figure 8 shows the quantification of the contractor's risk sources.

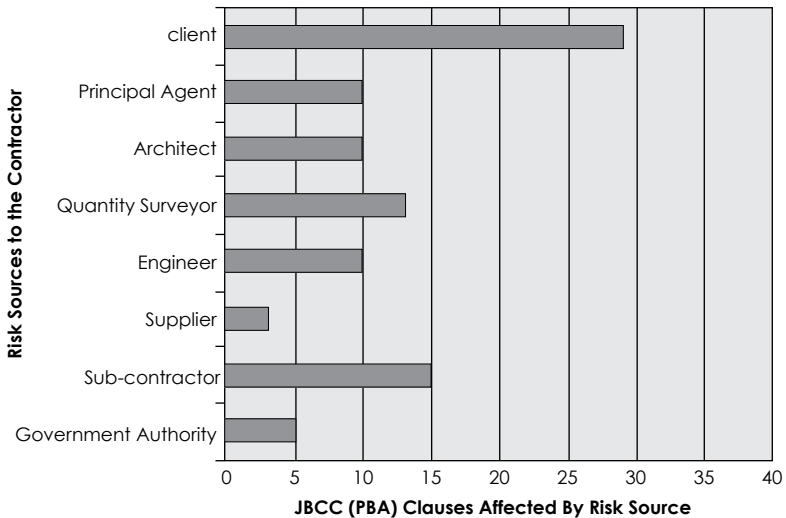


Figure 8: Risk sources to contractor using the JBCC (PBA).

## 6. Conclusions and recommendations

Having reviewed the topics of contracts and risks in construction and bearing in mind the developed framework and the contractor's risk source correlation matrix, the research may reach the following conclusions and recommendations:

- The construction industry is facing a more challenging environment than previously. Client expectations have increased and clients are in need of better quality products and services that use new developed materials and equipment at lower cost and tight time scales, which eventually leads to risk.

- Contracts are essential tools for organising the relationship between different parties involved in the construction project and managing associated risks. The JBCC is a committee consisting of six constituent organisations that represent the variety of interests in the South African Construction industry. The Principal Building Agreement records the terms of agreement between the employer and contract. For many years the South African building industry had a very bad reputation due to the lack of implementing risk management in construction projects.
- In order to improve the image of the industry, this research developed an innovative framework to enable contractors to identify, quantify and classify risks associated with the JBCC (PBA). This will help contractors improve their performance, increase their competitiveness, add more value and achieve the industry's and client's expectations. In addition, the research developed a correlation matrix that identifies and quantifies the risk sources to contractors. Clients, subcontractors and quantity surveyors were ranked the highest risk sources to contractors, respectively.
- Benefits of the developed framework and the correlation matrix must be presented to senior management in construction companies to facilitate their adoption and application as an approach for improving the global construction industry and, in particular, in South Africa.

## **Acknowledgement**

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## **Education, training and mentorship in pursuit of maturity in quantity surveying**

*Peer review*

### **Abstract**

The aim of this article is to determine whether professional quantity surveying firms are ready to meet the challenges facing them in respect of their responsibility towards the changing professional environment in terms of standards, education, professional development and training. Analysing the maturity of firms may assist the quantity surveying profession to establish its position and strategies. Results on project management maturity in South Africa, based on a research project conducted by the University of the Free State, in conjunction with the Wirtschafts Universität in Vienna in 2006 forms the basis of the article as well as the development of an education, training, mentorship and Continuing Professional Development (CPD) model to promote quantity surveying professional maturity.

Training in the quantity surveying profession in pursuit of maturity and excellence should focus on core functions of the quantity surveyor; competence required for registration; the expected services or outcomes that the profession believes it should be able to offer the market, and narrowing the gap between academic and experiential learning components by encouraging professionals to enhance their skills through CPD.

Generating standards, following the accreditation policy of the South African Council for the Quantity Surveying Profession (SACQSP) and research facilitation were found to be important aspects for education in the quantity surveying profession in pursuit of maturity and excellence.

A structured mentorship programme that addresses proactive development towards maturity should be introduced for the profession.

The Education, Training, Mentorship and CPD model to achieve quantity surveying professional maturity, developed by one of the authors, may assist in bridging the gap between the providers of formal education and the providers of quantity surveying service to clients towards professional maturity.

Keywords: Education, training, development, maturity, quantity surveying profession

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## **Abstrak**

Die doel van hierdie artikel is om vas te stel of professionele bourekenaarfirmas gereed is om die uitdagings aan te pak in terme van die verantwoordelikheid wat hulle het teenoor die veranderende professionele omgewing van standarde, onderrig, professionele ontwikkeling en opleiding. Analisering in die bourekenaarprofessie mag firmas help om hul posisie en strategieë in terme van volwassenheid vas te stel. Resultate verkry van 'n studie oor projékbestuurvolwassenheid gedoen deur die Universiteit van die Vrystaat in samewerking met die Wirtschafts Universität in Vienna in 2006 vorm die basis van die artikel asook die ontwikkeling van 'n onderrig, opleiding, mentorskap en voortgesette ontwikkeling model om bourekenaar professionele volwassenheid te bevorder.

Opleiding in die bourekenaarprofessie in die strewende na volwassenheid en uitnemendheid behoort te fokus op kernfunksies van die bourekenaar; bevoegdheid vereis vir registrasie; die verwagte dienste en uitkomst wat die professe glo hulle aan die mark behoort te lewer en die vernouing van die gaping tussen akademiese en indiensopleiding komponente deur professionele persone aan te moedig om hulle vaardighede deur voorgesette professionele ontwikkeling te verhoog.

Generering van standarde, gevolg deur die akkreditasie beleid van die Suid-Afrikaanse Raad vir die Bourekenaarsprofessie en navorsing fasiliteite is belangrike aspekte vir onderrig in die bourekenaarsprofessie in die strewende na volwassenheid en uitnemendheid.

'n Gestruktureerde mentorskapprogram wat proaktiewe ontwikkeling teenoor volwassenheid aanspreek, behoort aan die professe bekendgestel te word.

Die Onderrig, Opleiding, Mentorskap en VPO model om bourekenaar professionele volwassenheid te behaal, wat deur een van die outeurs ontwikkel is, mag help om die gaping tussen die verskaffers van formele onderrig en die verskaffers van bourekenaar dienste aan kliënte te vernou.

Slutelwoorde: Onderrig, opleiding, ontwikkeling, volwassenheid, bourekenaarprofessie

## **1. Introduction**

The Quantity Surveying profession in South Africa is currently experiencing change related to structure, required services offered and infrastructure products to members. Continuous professional development and improving standards, education, research and training are therefore relevant.

The problem addressed is whether professional firms are ready to meet the challenges facing them in respect of their responsibility towards development and the changing professional environment. The study investigated how maturity models may be applied as a quantitative tool. Maturity measurement may indicate the development levels of the profession. It is proposed that maturity analysis and measurement should be based on current project

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management maturity research which could contribute to solutions in respect of the profession's role in developing standards.

Research conducted by the University of the Free State, South Africa, has shown positive results in respect of professional mentoring aimed at small- and medium-sized construction contractors (Hauptfleisch, 2006). It is therefore hypothetically stated that a mentorship programme may play an important role in the continuing development of the quantity surveying profession. The success achieved with the above programme also suggests possible applicability of membership principles in respect of professions.

Conclusions and recommendations emphasise the need for education and training in the profession, supported by tools previously under- or not utilised adequately, in particular, maturity models and mentoring tools in the continuing professional development of quantity surveyors.

## **2. The quantity surveyor's perceived position**

It is often held that the education of young people for the construction professions is not sufficiently effective and that a more practical approach is needed. The question may then be asked whether professions and firms are ready or mature in respect of developing the professions and young entrants. This was stated in debates at congresses and meetings at the 2007 Association of Schools of Construction of Southern Africa (ASOCSA) congress.

It seems reasonable to accept that while members of the profession are critical about the performance of academic institutions, the majority are themselves not paying due attention to their own development in a very competitive, constantly changing market. The question may then be asked whether professional maturity is at an acceptable level and do the members of the profession grasp the importance of their role in the development of the profession, its standards and training?

## **3. Maturity of a project-orientated nation, profession and enterprises**

### **3.1 Maturity (level of development) of nations and professions**

Fuessinger (2006: 3-4) proposes that the maturity of a project-orientated nation also includes the following additional project-management-related services:

- Project management education: Formal education programmes are provided;
- Project management research: Research projects, publications and events are typical activities, and
- Project management marketing: A national project management association (Fuessinger, 2006: 3-4) is in place.

Although the above services refer to project management orientation, they may equally be relevant to other construction professions. It is submitted that based on the above, the following elements should prevail in the development of a profession:

- Education: Understanding the knowledge, science and skills needed for the profession, using known technical, management and mentorship instruments;
- Research: This relates to the development of the profession as a learned society, and
- Association: An association of professionals with effective communication systems and instruments pursuing CPD.

Gruber (2004: CD-ROM) states that maturity implies growth over time as well as understanding why success occurs, and ways to correct or prevent problems.

The advantages for enterprises to be part of such an analysis are, according to Gruber (2004: CD-ROM), that they determine where they stand and can identify certain strengths and weaknesses in processes, implement certain methods for effective improvement, and set up improvement programmes. Enterprises may also be led by way of maturity identification to total product, marketing and service delivery improvement, using the principles of the project management maturity model.

### **3.2 A maturity model and dimensions**

*"A Maturity Model is a framework describing a process whereby something desirable can be developed or achieved"*  
(Gruber, 2004: CD-ROM).

It is proposed that a maturity model used to analyse the project management maturity of firms, companies and nations may assist the quantity surveying profession to understand the maturity of the profession, particularly in the domains of education, training and mentorship.



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Figure 1 illustrates an overview of project management maturity in South Africa, based on a research project conducted by the University of the Free State, in conjunction with the Wirtschaftsuniversität in Vienna in 2006. This overview of average maturities of respondent companies / firms in South Africa expresses the dimensions (elements) of maturity (levels of development) as percentages.

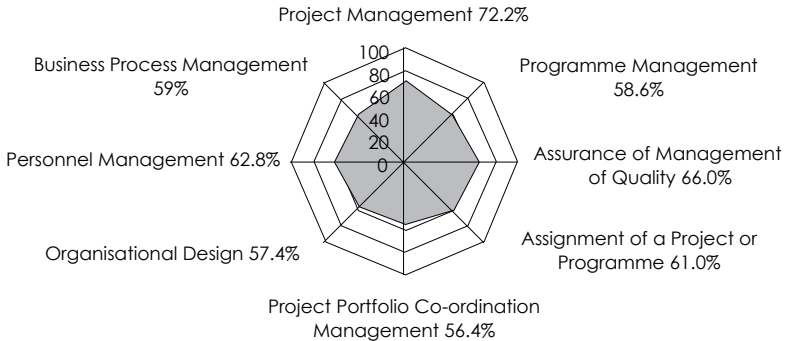


Figure 1: Average maturities of respondent companies / firms in South Africa  
Source: (Project Management Group, 2006)

The average maturity rating (score out of five) for the analysed project-orientated companies in South Africa is 3.12 (see Table 1) or 62.4%. These South African companies / firms show a high maturity ratio in project management with 3.61 points or 72.2%. Organisational design of the project-orientated company / firm shows the lowest results with 2.87 points or a 57.4% maturity ratio (Verster & Hauptfleisch, 2007).

Table 1 presents the average maturities of South Africa based on four project-orientated groups (POG) analysed. The sum of the four averages gives the average for the 21 project-orientated companies (POC) in South Africa. The maturity ratio of quantity surveyors as project managers is shown in column 4 at 58.6%.

Table 1: Average maturities of the South African Project-Orientated Groups (POG) (Table descriptions expanded on by the authors)

<b>Maturity ratio: 5-point scale</b>					
1	2	3	4	5	6
<i>Dimensions</i>	POG in South Africa	POG building & civil construction	POG QS consulting	POG engineering consulting	POG education, government & non-profit
<b>Maturity Ratio Averages</b>	<b>3.12</b>	<b>3.37</b>	<b>2.93</b>	<b>3.35</b>	<b>2.82</b>
Project Management	3.61	3.77	3.52	3.90	3.30
Programme Management	2.93	2.73	3.14	3.02	2.93
Assurance of Management Quality of a Project or Programme	3.30	3.71	2.98	3.25	3.12
Assignment of a Project or Programme	3.05	3.50	2.81	3.48	2.38
Project Portfolio Co-ordination and Networking Between Projects	2.82	3.07	2.80	3.24	2.29
Organisational Design of the Project-oriented Company	2.87	3.10	2.57	3.10	2.66
Personnel Management in the Project-oriented Company	3.14	3.51	2.60	3.29	2.95
Process Management in the Project-oriented Company	2.95	3.25	2.66	3.02	2.74

Source: (Oosthuizen, Kotzé & Hauptfleisch, 2007)

### 3.3 The importance of procurement as a dimension of maturity

In terms of the above project management research, the products delivered to the market by quantity surveyors may be identified as dimensions that could be weighed and then measured for maturity in order to establish benchmarks and development areas.

Procurement is discussed to illustrate the importance of this quantity surveying function, i.e. an important element of maturity. A quantity surveyor is expected to possess a high level of maturity related to procurement. In Table 2 the results from recent studies in the United

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Kingdom (UK) and South Africa (SA) show procurement preferences (QS to client or contractor).

Table 2: Comparison between procurement systems in the UK and SA

<i>Procurement and measurement method</i>	<i>UK %</i>	<i>SA %</i>
Measurement as part of procurement (% of project where used)	57%	84%
Approximate quantities where measurement is not carried out (% of project where this was done)	55%	56%
Method of measurement SMM 7 and SSM 6 (% where these systems were used)	77%	90%
Computer systems for bill production	67%	73%

Source: UFS, 2004; RICS, 2002

Some practitioners tend to emphasise the role of measurement skills, a very practical skill to new entrants. Table 2 shows the requirement for these skills in the market. The difference in the UK and SA responses is clear. It is observed that measuring skills are considered less important in the UK than in SA. However, procurement as a QS function is still preferred. The difference in preferences may help to understand the maturity rating of measurement as part of procurement.

### **3.4 Importance of communication instruments as a dimension of maturity**

Instruments used by the quantity surveyor to communicate with clients may equally be relevant to maturity and may serve as examples to establish a maturity model for the profession.

Figure 2 shows the communication instruments that quantity surveyors normally use for projects in the construction industry. The importance of estimates, cost reports, final accounts and contract conditions documents as communication instruments were identified as positive. Estimates, cost reports and final accounts are viewed as important communication instruments for projects.

The cost plans, payment advice, and escalation costing presentation were also experienced in a positive manner. The importance of the standard system of measurement (SSM), preliminaries, preambles for trades, although highly rated, were considered by the respondents to

be least important. Figure 2 illustrates the most important instruments indicating what communication instruments may be most important in establishing the level of quantity surveying maturity.

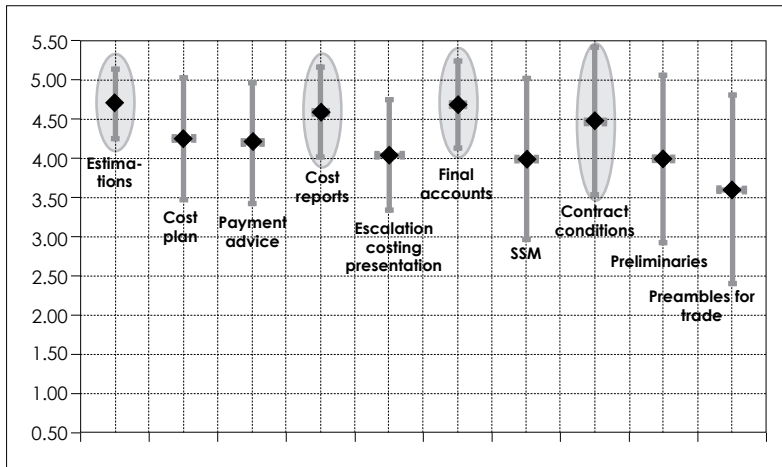


Figure 2: Importance of communication instruments used for projects by professional quantity surveyors in private practice.

Source: Berry, Verster & Kotzé, 2006

#### 4. Training in the quantity surveying profession in pursuit of maturity and excellence

##### 4.1 Identification of work for professional quantity surveyors

In terms of the *Quantity Surveying Profession Act 49 of 2000*, the South African Council for the Quantity Surveying Profession (SACQSP) has developed a draft of core functions of the quantity surveyor, published in 2002. This document highlighted the most important activities and functions inherent in delivering professional services:

- Cost advice and planning;
- Project procurement and documentation;
- Tendering and contractual relationships;
- Contract services;
- Specialist skills related to quantity surveying services;

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- Quantity surveying related to engineering services, and
- Building and construction/property development. This category includes construction management, project management, principal agency, project monitoring, quality inspections, and value management (SACQSP, 2002).

This document is now being revised to adhere to the requirements of the Council for the Built Environment (CBE) and to address the duplication or overlaps that may be evident between the various professions active under the authority of the CBE.

## **4.2 Skills clusters and competence**

The SACQSP accepted an assessment criteria related to competence required for registration as a professional quantity surveyor. The skills clusters and competence requirements are:

- Cost advice and cost planning. This category includes preparing and using cost data, estimates, financial viability, comparative design studies, budgets and cost plans, whole life appraisals, turnover and cash flows, cost management and reporting, applying fee scales, and implementing conditions of engagement.
- Project procurement and documentation. This includes procurement, contract documentation, bid analysis, price determination, documentation for subcontractors, cost value statements, specifications and schedule of rates.
- Post contract services. This includes cost advice, final cost estimation, variation accounting, cost benefit analyses, alternative construction methods, recording and assessing records, report on on-site requirements, and cost management.
- Engineering. This includes earthworks, roads, sewerage and water facilities, plant, structural steelwork, process and manufacturing plant, transformers, cabling, communication systems, fire detection, heating, air-conditioning and ventilation, and installations (SACQSP, 2007a).

Figure 3 lists the functions, elements and maturity outcomes (dimensions) of a possible model with the expected services or outcomes which the Quantity Surveying profession believe it can offer the market (PAQS, 2003a). These outcomes are regarded as important elements of a maturity model although small differences

on the basic competencies at entry level that a quantity surveyor should possess by South Africa and by the Pacific Association of Quantity Surveyors (PAQS) are shown in Table 3.

Table 3: A comparison between the South African situation and the PAQS on the basic competencies at entry level that a quantity surveyor should possess.

<i>SOUTH AFRICA</i>	<i>PACIFIC ASSOCIATION</i>
Quantification	Quantification
Numeracy	Numeracy
Communication	Communication skills
Interdisciplinary and interpersonal teamwork	Personal and interpersonal skills
Commerce, entrepreneurship and management	Business and management
Professional practice	Professional practice
Information technology	Construction technology
Technology	Construction technology
Law	Construction law and regulations
Research	

Source: (Verster, 2004)

Comparative analysis, presented in Table 3, shows the most important services or expected outcomes of the profession. These could be interpreted in this instance as the technical and professional skills where maturity should be at an expert level. The profession is expected to provide ample development opportunities to its young people to become experts in respect of these services. The reason why the PAQS study is included is to show the similar view of the professions of different worlds regarding basic outcomes and competencies.

### **4.3 Continuing Professional Development (CPD)**

Haupt (2003: 31) states that it is evident that all the co-operative partners, academics, students and employers need to narrow the gap between academic and experiential learning components.

Following from this statement one of the questions that needs to be asked is: what role do or should the profession and its members play in making quality training available to young people entering the profession?

The ASAQS implemented a CPD programme on behalf of the SACQSP as early as 1999 in an effort to develop the profession towards a dynamic pro-active learned society. The categories to achieve 200 points per five year cycle of development activities were:

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Category 1: Conferences, seminars, workshops.

Category 2: Small group activities, journal clubs, training sessions and committee work for the profession.

Category 3: Individual activities, self-study, lecturing.

For Category one, two points were allowed per one hour of activities to a minimum of 80 points over a period of five years, for the others only one point per hour was allowed.

The five-year cycle was later extended to the end of 2006 (SACQSP, 2006).

In 2006 a new system was introduced to be implemented as from 2007. A yearly cycle was introduced and registered. Professional Quantity Surveyors are now required to undertake 25 hours of CPD activities in one year. Only two categories of activities are now accepted:

Category 1: Fifteen hours minimum of formal external training (including research output, congresses), and

Category 2: Ten hours maximum of informal training and other acceptable activities (SACQSP, 2007b).

Guest (2007: 28), consultant to the Institute of Continuing Professional Development, believes that keeping up to date by means of continual learning should become a natural habit and that professional people have the duty to update their working knowledge.

The activities within the professions driven by the ASAQS and the SACQSP are pro-active and internationally relevant. The correct implementation of all the requirements and policies should lead to the development of the profession and its people to the highest possible level, a true learned society.

However, members of the profession and registered Quantity Surveyors do not seem to have a sufficiently high appreciation of the integrated education and development model currently being developed. The lack of CPD activities illustrates this unfortunate fact (Cruywagen, 2007: 99). It is accepted that CPD activities will be important in respect of firms or individual development to maturity.

## **5. Education in the quantity surveying profession in pursuit of maturity and excellence**

### **5.1 Generating standards**

Over the past four years the quantity surveying Standards Generating Body (SGB) has developed standards for the profession on both a full qualification basis and a comprehensive set of unit standards for all the relative quantity surveying qualification levels and outcomes. The unit standards are soon to be gazetted. Education providers will have to adhere to these standards within the next few years (SAQA, 2005-2007).

Table 4 shows a summary of exit level outcomes, critical evidence for assessment purposes and assessment criteria of the quantity surveying qualification at Honours degree level. Typically, a programme leading to awarding an Honours degree in Quantity Surveying aims to develop graduates who will possess demonstrable, specialised skills and competencies to:

- analyse and solve problems related to the built environment;
- deal with commercial, entrepreneurial and management issues;
- communicate effectively on all matters to which their skills and competencies have been applied;
- use and apply information technology;
- interpret and apply legal principles within the context of the built environment;
- execute tasks requiring numerical and quantification expertise;
- conduct research within the context of the built environment, including consideration of interdisciplinary aspects, and
- apply knowledge of technology within the context of the built environment (SAQA, 2005-2007)



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Table 4: Outcomes, evidence and assessment of quantity surveying qualifications level 7

<b>Honours degree in Quantity Surveying Qualifying learners are competent to:</b>	<b>Critical evidence for assessment purposes Analysis and problem-solving</b>	<b>Assessment criteria</b>
<ul style="list-style-type: none"> <li>• Demonstrate familiarity with and display knowledge and understanding of the quantity surveying practice and procedure</li> <li>• Well-rounded knowledge and an ability to critically question core theory, practice and methodology</li> <li>• Competence in modes of inquiry employed in practice disciplines</li> <li>• Analyse and locate the principles and perform own work within current practice</li> </ul>	<ul style="list-style-type: none"> <li>• Create and innovate systems of identification, assessment</li> <li>• Formulation and solving of convergent and divergent problems</li> <li>• Assess the impact, risks and benefits of design proposals</li> <li>• Exercise judgment</li> <li>• Perform management tasks</li> <li>• Alternative solutions to problems or queries</li> <li>• Apply techniques and principles of quantity surveying analysis, financial management and risk management</li> </ul>	<ul style="list-style-type: none"> <li>• Clear identification</li> <li>• Planning approaches</li> <li>• Choice of optimal solution</li> <li>• Division of tasks</li> <li>• Prioritisation</li> <li>• Logical structures</li> <li>• Establishment of reasons</li> <li>• Co-operation</li> <li>• Identification, evaluation and reporting</li> <li>• Planning and managing project and construction processes</li> <li>• Performing management tasks, including analyses</li> <li>• Exercising judgement</li> <li>• Communicating project development</li> </ul>
	<p><b>Commerce, entrepreneurship and management</b></p>	
	<ul style="list-style-type: none"> <li>• Understand management skills</li> <li>• Cost-effective use of appropriate resources</li> <li>• Quality control and health and safety</li> <li>• Client needs</li> <li>• Understand environmental, social and community issues</li> <li>• Accounting</li> <li>• Budgets and cash flows</li> </ul>	
	<p><b>Economics</b></p> <ul style="list-style-type: none"> <li>• Application of economics, concepts and principles</li> </ul>	

Source: (SAQA, 2005-2007)

The descriptions in Table 5, relating to quantity surveying, comply with the National Qualifications Framework (NQF) where ladders of opportunity are provided for learners to progress (within their

capabilities) from the lowest to the highest levels of competence. It also facilitates recognition of prior learning (RPL) in that it allows learners entry at various levels. In addition, it consistently ignores the work environment of the learner.

Table 5: Descriptions Level 7 for Quantity Surveying

Level 7	Learners are required to demonstrate competence in the application of advanced quantity surveying expertise (theory and practice) related to the built environment. Graduates work under the guidance of a Professional Quantity Surveyor.
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Note: These level descriptors were developed during the QS SGB Scoping Exercise held on 15<sup>th</sup> October 2004 which was approved by the SACQSP in October 2006.

## 5.2 Accreditation policy

The accreditation policy document was accepted at the SACQSP meeting of 23 March 2007. Education providers will have to adhere to this document for future accreditation. Although the policy is not regarded as a guillotine to cut providers off, the seriousness of quality education and training provision is accepted. The policy document, submitted to the SACQSP by the Education Standards and Research Committee, based the policy on the following criteria for Honours levels:

- Entry requirements level at 17 unweighted matric points where a higher grade A symbol constitutes 5 points and an E symbol 1 point. (Standard grade at -1 in each instance);
- Research output should be at a publication output of 8 per permanent staff member per year;
- Senior lecturer equivalent (SLE) to full-time student equivalent (FTE) should not be more than 1:40 (SACQSP, 2007a) ;
- Employability of graduates, and
- Qualification levels of full-time academic staff - 75% at Masters level or higher (RICS, 2005; SACQSP, 2007a).

The policy document is aligned with the accreditation policy of the Royal Institution of Chartered Surveyors (RICS) and the Pacific Association of Quantity Surveyors (PAQS) accreditation policy documentation (RICS, 2005; RICS, 2007; PAQS, 2003b).

Apart from the above, education providers must adhere to the 19 criteria for accreditation by the SACQSP (SACQSP, 2007b).

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The above illustrates international tendencies to improve standards of research, education, training and services to the profession.

### **5.3 Research**

Research is viewed as one of the most important determinants and dimensions of the maturity of a profession and a nation.

The Education Standards and Research Committee of the SACQSP submitted a research facilitation plan to the SACQSP in 2006. This plan was accepted at the Council's meeting in October 2006.

The aim of the SACQSP is to promote research as a pro-active dynamic and interactive process to ensure that the profession remains in the vanguard of its business and knowledge environment. To this end the South African accredited journal *Acta Structilia*, published by the University of the Free State, is endorsed by the Council to promote research.

The main strategy is therefore to establish a firm research focus for development of the profession and the mission is to achieve the strategy through a research journal, an interactive seminar or mini-congress series, and by commissioning research projects. Ultimately, this will establish a strong development focus in the profession (SACQSP, 2006).

## **6. Mentorship in the quantity surveying profession in pursuit of maturity and excellence**

From the above overview, which describes various interventions to uphold and promote improvement in standards regarding education in quantity surveying, it is noteworthy that experiential training, supported by active mentoring, is not emphasised adequately. As with other professions such as medicine, accounting, engineering, and law, it is an obvious imperative that the scientific use of mentoring in developing a learned quantity surveying profession should be mandatory.

The generally accepted meaning of mentorship is that it is a process of transferring knowledge and skill. Typically this entails that an older knowledgeable person imparts knowledge and skills to a younger *protégé*. In a developed world environment this typically takes place in a closed environment such as a specific enterprise, family structure or other organised endeavour.

Over the past five years the University of the Free State has achieved success with its mentorship programme for small- and medium-sized construction contractors. This mentorship programme resulted from concerns of the financial sector regarding security when lending into the emerging market. Government initiatives and legislation to create an enabling environment post-1994 for previously disadvantaged individuals (PDIs) made construction contracting opportunities available to PDIs.

The main challenge that faced both the financial sector and government agencies was how to provide support to the development of the PDIs as so-called emerging contractors. Mentorship was identified as an important component of such support. A comprehensive Integrated Emerging Construction Development Model (IECDM) was structured and introduced as a development programme. The important aspect of identifying suitable mentors was addressed by the establishment of an accreditation programme, currently located at the University of the Free State. In essence, recognition of prior learning and psychometric evaluation of prospective mentors developed.

The identification and creation of an accreditation programme for construction mentors in South Africa is believed to be the first attempt of its kind in the world. In a joint survey undertaken for a statutory body, the panel could not uncover a similar initiative anywhere else in the world. Mentorship in other forms is common, but none could be found that reflected a specific intervention to support small independent construction contractors, who operate for their own account. In this context, mentoring has grown into a complex professional support service, growing towards coaching and a business advisory intervention.

Without a weighted analysis having been done, several categories of mentorship are recognisable:

- Category a: mentorship in a closed working environment;
- Category b: as interventions by organs of state and academic institutions to establish support structures, and
- Category c: as a paid professional service, mainly in category (b).

It is clear that mentoring generally takes place or should take place in a structured and controlled environment. Although it is common that mentoring in category (a) tends to be less formal, it is still significant, if taken seriously.

When considering categories (a), (b) and (c) above, it seems logical that young people undergoing a professional learnership / article period during formal professional, or on completion of education, fall into category (a). The problem at hand is to structure mentoring for young professional trainees in such a way that it becomes a reliable development tool, operating from a consistent platform in professional practices where young quantity surveyors are mentored. It seems logical that, while a period of practical experience is a pre-requisite to register as a professional practitioner, the practical experience should be structured as a measurable, mentoring programme.

The question that arises is to what extent senior practising quantity surveyors are capable of providing young people with state-of-the-art mentoring, if they themselves do not meet their own profession's CPD requirements.

Wilkinson (2004: 9-10) states that supervisors and counsellors of Assessment of Professional Competence (APC) candidates are in a role of advice and support but also assess the candidate's competence. However, they are not expected to train. The RICS regards the supervisor as a person with day-to-day responsibility for a candidate's knowledge of his/her work, and the counsellor as a person with a more strategic role, as two persons. The South African situation may present difficulties for firms to find two people for the above roles. The RICS, however, also allows for the fact that smaller firms cannot always appoint two people (Wilkinson, 2004: 10).

Wilkinson (2004: 10-11) stipulates the following duties of the supervisor or counsellor:

- Ensure that the candidate receives training in line with the competency requirements;
- Sign off the candidate at three-monthly and six-monthly intervals, and at the interim and final assessment stages;
- Ensure that all records and reviews are completed accurately;
- Assist the candidate with the preparation and submission of documents for the final assessment;
- Liaise regularly with the supervisor / counsellor, and
- Provide support and encouragement.

He further reminds supervisors and / or counsellors that they are required to maintain high levels of involvement: "You will not simply be 'dipping in and out' of the process" (Wilkinson, 2004: 11).

The question remains: Are supervisors or counsellors in the UK or in South Africa actually performing the duties as they should and do young people receive the due attention they deserve or should receive? It may be prudent to consider that a structured mentorship programme that addresses proactive development towards maturity should be introduced for the profession in South Africa and perhaps internationally.

## **7. Conclusion**

For the growth of a professional society and for such a society to be world class and a real learned society, research, education, training and professional development are fundamental elements to future survival, development and prosperity. It is proposed that the Quantity Surveying profession in South Africa is becoming a proactive learned society. This is evident from the numerous activities, documentation, policies and structures implemented by the official institutions and associations of the professions, on behalf of the profession and the public that use its services.

However, it is equally evident that many members of the profession are not sensitive or active enough in building the profession's knowledge, skills and attitudes towards development and growth. CPD activities clearly show this unfortunate tendency. Professional maturity models can assist with the establishment of benchmarks, prompting professional practitioners to concentrate on their particular maturity dimensions that require enhancement. In this regard CPD can make an important contribution. An integrated research, education, training and development process is needed to achieve the goals of the profession. A model which includes education, training, mentorship and CPD may assist in bridging the gap between the providers of formal education and the providers of the quantity surveying services to clients towards professional maturity. Such a model is diagrammatically presented in Figure 3.

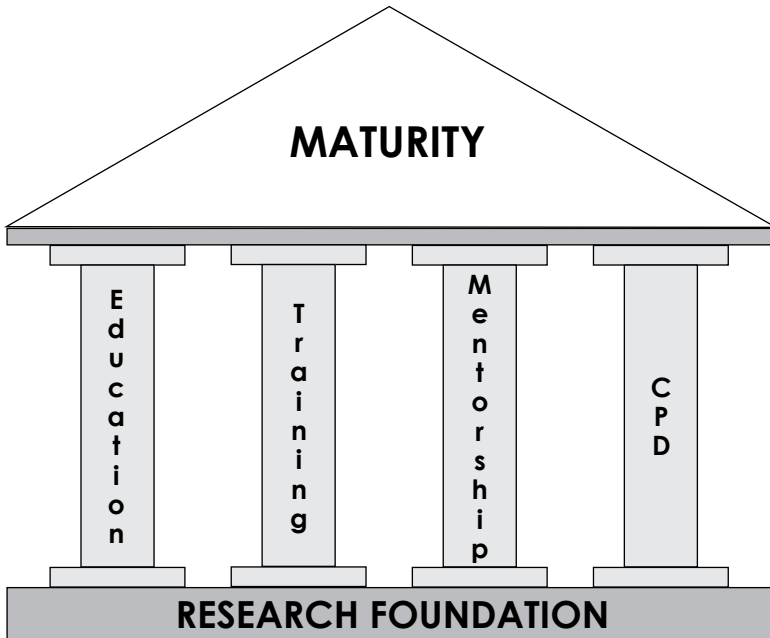


Figure 3: Education, training, mentorship and CPD model to achieve quantity surveying professional maturity

It is recognised that the candidateship system of the SACQSP goes a long way in assisting newly qualified entrants into the profession. The position is held that training the trainers and a mentorship approach will further enhance the development of new entrants and promote the continuing development of all professionals. However, until a professional quantity surveying maturity model is introduced, it will remain difficult to establish scientifically whether all the proposed objectives (dimensions of maturity) have been achieved.

## 8. Recommendations

Maturity levels of the profession need to be established in respect of the total integrated development of the profession and its people in terms of all the dimensions typical of a mature profession.

The following elements or dimensions should be included in an integrated system:

- Pursue sustained communication with the profession regarding standards and education;

- Educate the profession in respect of CPD and its role;
- Train and develop mentors;
- Render continuing support to develop knowledge by means of research;
- Design, develop and integrate a mentorship system as part of the total development activity that also adheres to all the principles laid down in the policy documents;
- Establish the maturity levels of role-players first and then those of the profession;
- Establish stronger links between education institutions and the profession, and
- Communicate to the profession what the role of education providers is and what the role of training and membership entails.

For the Quantity Surveying profession in South Africa to continue to grow / develop towards a pro-active learned society it is proposed that identified important aspects of education, training and mentorship in pursuit of maturity be addressed by professionals in the industry.

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**Dienie Steenkamp**

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## **The impact of storm water on Langenhoven Park: an integrated approach can make a difference**

*Peer review*

### **Abstract**

Langenhoven Park is a suburb situated north-west of Bloemfontein, Mangaung. It started as a garden suburb but is increasingly characterised by town house developments. The increase in impervious surfaces contributes to the amount and speed of storm water runoff.

The storm water runoff negatively affects the groundwater levels. As an arid country, South Africa cannot afford to lose water, albeit on the surface or as groundwater. Recent literature regards the treatment of storm water at source as the best solution.

This article examines the role of legislation in dealing with storm water and how to treat storm water as an asset, and not as a problem. Storm water in Langenhoven Park needs special attention with regard to all the hard surfaces in recent residential developments.

Keywords: Storm water, town houses, drainage channels, amenity, asset

### **Abstrak**

Langenhovenpark is 'n woonbuurt aan die westekant van Mangaung. Dit is begin as 'n "tuinstad", maar tans word dit oorheers deur meenthuisontwikkelings. Die harde oppervlakte het toegeneem wat geen water dreineer nie en dit vermeerder die hoeveelheid en spoed van stormwater.

Die wegvoer van stormwater het 'n negatiewe effek op grondwatervlakke. Suid-Afrika as 'n water-skaars gebied kan nie bekostig om water so te verloor nie. Die nuutste gevolgtrekking is dat stormwater by die oorsprong hanteer moet word.

In hierdie artikel word gekyk na maniere om stormwater vanaf vanaf wetgewing tot die optrede van ontwikkelaars, huisbewoners en besighede te hanteer. Stormwater word beoordeel as 'n bate vir die gemeenskap en nie as 'n probleem nie. Stormwater in Langenhovenpark moet aandag geniet weens al die harde oppervlakte geskep deur die nuutste residensiële ontwikkelings.

Sleutelwoorde: Stormwater, meenthuise, dreineringskanale, bate

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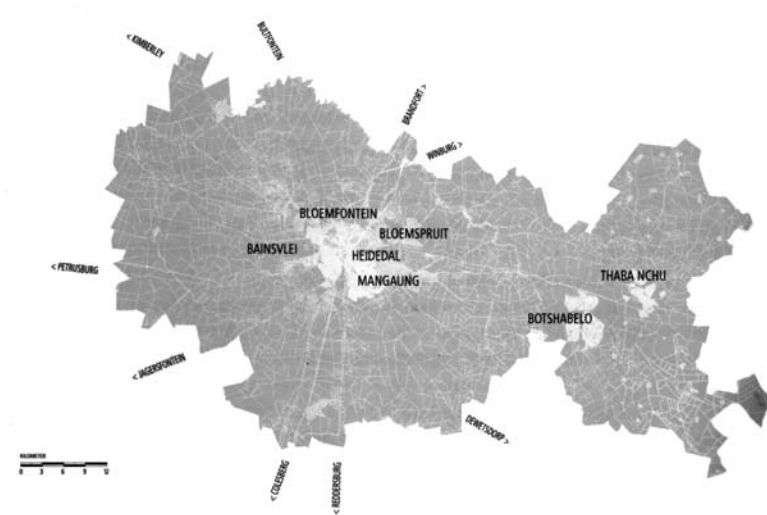


Figure 1: Locality plan of Mangaung Local Municipality with Bainsvlei (Langenhoven Park) to the west  
Source: MLM, 2004: 8

## 1. Introduction

Langenhoven Park is situated to the west of Bloemfontein. This suburb was originally the farm of Andrew Hudson Baines and Bainsvlei served as homestead from 1905<sup>1</sup>. In the 1980s Langenhoven Park was designed as a garden suburb, but it has since developed to include numerous town house complexes and duet houses. This area is relatively flat and interspersed with small koppies. The drainage of storm water is no problem under normal circumstances but with all the town house developments and the increase in hard surfaces the storm water could become a problem in this area. On 26 January 2006 a rainstorm in Langenhoven Park flooded the area. There was so much surface water that the children played with boats in the streets. These floods resulted in substantial damage to infrastructure and private property (Sauer, 2006:1).

The objective of this article is to consider all the legislation pertaining to storm water and to find cost-effective solutions for storm water

1 On 24 August 1860 the biggest hunt was conducted on this farm that when Prince Albert (Queen Victoria's son) and Sir George Grey and others shot more than a thousand buck within an hour (Steyn & Wessels, 1999: 65).

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management in Langenhoven Park that will be financially, socially and ecologically acceptable.

## **2. The causes of the amplification of storm water**

Storm water and floods are natural phenomena that occur from time to time, while inundation is generally promoted by man and urbanisation. One of the most famous and earliest mentioned floods occurred when Noah and his family survived in the Ark. All life forms depend on water and soil; and they should thus receive priority in any development context (CSIR, 2000: 6, 9). Some floods are not natural disasters, but are man-made inundations, for instance in the case of developments in floodplains (Olivier, 2006: 7).

The actions of man, such as urbanisation, deforestation and agricultural drainage, aggravate problems relating to storm water (Turner, 1998: 280). Urbanisation increases the prevalence of impermeable surfaces such as roofs, streets, sidewalks and other paved areas, resulting in more runoff and less infiltration, which must be drained (Gaspar, Tavares & Azevedo, 2005: 275). Development, coupled with a lack of vegetation, causes an increase in the quantity and peak flow rate of the runoff (CSIR, 2000: 6, 6). The velocity and the level of the water determine the degree of flooding and the resultant damage. In a study conducted in Iran, Hosseinzadeh (2005: 427) found, that the length of time during which the concentration of urban floods is at full force doubled, and that urbanisation increased flood frequencies by up to 100%. The actions of man are causing increases in storm water.

## **3. Increased density and storm water**

Sustainable development requires a dense urban form to prevent urban sprawl and loss of biodiversity; and mixed uses to reduce travel costs, energy and resource consumption (Beisi, 2001: 26).

“Compact cities bring a kind of ambivalence, as high densities are not always compatible with the natural environment and green cities” (Stapelberg, 2006: 2, 3). Compact cities, however, mean more hard surfaces and runoff and hence increased storm water. All the town house developments in Langenhoven Park could make it a compact city if it were not for the homogeneous residential land use (see Figure 2).

*... it is now largely a car dependant suburb where inhabitants have to reach schools, jobs and to a large extent recreational*

*facilities by car as the only modern of transport (Steyn & Schoeman, 2006: 9, 15).*

If we regard compact cities as sustainable, the issue of storm water has to be considered and mitigated.



Figure 2: Homogeneous residential developments  
Source: Steyn & Schoeman, 2006: CD- ROM

#### 4. Recent handling of storm water

Engineers calculated the runoff and planned to discharge it by means of an underground drainage system or concrete channels (Turner, 1998: 286). Purseglove (1988: 2) considers such drainage channel as 'strait-jackets of steel and concrete'. Turner (1998: 285) condemns the use of public funds to destroy public assets such as streams, wetlands and floodplains. Accommodating this rapid runoff and discharging it into the storm water system causes flooding downstream, if the stream is not widened to accommodate the additional volumes of water. To compensate, upstream landowners should contribute to river works downstream (Turner, 1998: 286, 287). Many streams in urban areas are dangerous and enclosed by barbed wire. The incorrect handling of storm water in urban areas can exacerbate desertification in rural areas. Problems in this regard include storm water drainage, destruction of wetlands and floodplains, and the planting of alien vegetation (Olivier, 2006:

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5). Usually the 'improvement' of rivers means increasing their flow capacity (Turner, 1998: 295) (see Figure 3). According to these authors, the handling of storm water creates problems for the environment, not solutions.

Draining most of the rain away from an area diminishes the groundwater table with a detrimental effect on all vegetation. Boreholes will dry up, and people who are dependent on water from boreholes will be affected.

The practice of channelling storm water and draining it as fast as possible has serious effects on the environment and other ways to handle storm water should be investigated.



Figure 3: Storm water channels which increase the speed of the storm water  
Source: Steenkamp, 2008: own picture

#### 4.1 Calculation of flood lines

Heavy rainfall causes floods, especially in urban areas. Engineers classify the size of floods in terms of the probability of such a flood occurring again within a certain period of time. The storm water system should be able to handle floods up to the five-year level. When a ten-yearly or 100-yearly flood occurs, buildings and roads

are flooded, resulting in inconvenience and injuries and damage to people and property. Building flood-defence works is expensive, depleting public funds; there are also environmental consequences including exacerbation of flood-related problems downstream. This problem could be addressed by managed flooding; for example, certain facilities, called multifunctional landscapes such as playing fields, parks and gardens, could be built below the flood lines. Pervious pavements could improve infiltration, vegetated channels could slow down the velocity of the flow, and grass buffer strips could remove pollutants.

An annual flood could be accommodated by means of non-essential car parks and roads, whereas 100-yearly floods could be accommodated in some urban areas with non-essential services (though not in areas comprising hospitals, for example). If people wish to build under the prescribed flood lines they should know that extra costs are involved, and that they should not lay any claim to public funds (Turner, 1998: 299-300). This is illegal in South Africa in terms of the Water Act and the National Building Regulations.

Buildings could be made 'flood-tolerant' or flood-proof by:

- Sealing electrical services;
- Using water-sealed doors;
- Raising buildings on stilts, and
- Waterproof concrete or extra foundations.

Traditionally, the storm water drainage system accommodated frequent storms and associated runoff. Current property values have increased to such an extent that engineers must take the possibility of more severe storms into account (CSIR 2000). Global warming is changing our weather, with increased severity of storms. *Guidelines for Human Settlement Planning and Design*, commonly referred to as the red book, discusses a dual system which makes provision for both of these eventualities. The frequent storms are accommodated by the normal storm water drainage system, referred to as a minor system. The severe storms are accommodated in terms of a major system, which includes conduits, channels and the road system, so that the water can be conducted to suitable points of discharge, such as parks and sports fields (CSIR, 2000: 6, 3).

#### **4.2 Present regulations and policies**

The *National Water Act* (Act 36 of 1998) requires a 100-year recurrence interval flood line for all development plans. Municipal authorities may also require other flood lines (CSIR, 2000: 6, 6).



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Many property deeds have a built-in requirement that the lower land must receive the runoff from higher properties along the natural course of the land (CSIR, 2000: 6, 1).

Prevention of water pollution is regulated by the Departments of Water Affairs and Forestry, Environmental Affairs and Tourism, and Health (CSIR, 2000: 6, 7).

The *National Environmental Management Act (NEMA)*, Act 107 of 1998 (South Africa, 1998) and regulations in terms of Chapter 5, Government Notice regulations 385, 386 and 387 regulate developments and determine when Environmental Impact Assessments (EIA's) are necessary.

Township establishments are done according to the legislation of the different provinces where the 1:50- and 1:100-year flood lines are required on layout plans; authorities usually do not permit construction under these flood lines. Storm water forms part of the services reports compiled by engineers.

### **3.3 Stormwater and the Mangaung Municipality**

The Integrated Development Plan of the Mangaung Local Municipality states that roads and storm water infrastructure services are expensive to construct and maintain, and it is not an income-generating service. It is funded by property tax income, property developers or grants for lower income areas (MLM, 2004: 127).

According to an official (who wishes to remain anonymous) of the Mangaung Municipality, the municipality caters for 1:5-year floods in the underground system. More severe floods should be handled by means of the roads. The layout is handled by the town planners, who try to handle storm water *via* the streets, and avoid allowing the storm water to flood property from the streets.

Lower-lying properties should accommodate water. Problems usually occur when walls and structures are built in water courses and drainage channels, or when underground systems are blocked. Blockages are caused by overgrowth of vegetation, or littering in the streets or at building sites.

The legal department is responsible for handling claims after flooding. The municipality does not become involved in disputes between neighbours regarding storm water issues.

Storm water is not a major issue for the Mangaung Local Municipality. In 2006, after exceptionally high rainfall, numerous complaints were

received. People normally tend to forget storm water until the next storm occurs. A lack of capacity makes it impossible to implement measures to handle storm water in a more sustainable way.

#### 4.4 Storm water in Langenhoven Park

Langenhoven Park was established as a garden city in the 1980s. The character of the suburb changed from 1991 with the development of sectional title town houses on general residential sites of two to 11.28 hectares. Approximately 200 sectional titles were registered from 1981 to 1985 while this grew to approximately 1200 from 2001 to 2005. The area of town house development expressed in hectares was less than 10 hectares from 1981 to 1985 but from 2001 to 2005 it grew to nearly 60 hectares. The density increased with 30 town house units per hectare as the norm (Steyn & Schoeman, 2006: 5, 6). According to Steyn & Schoeman (2006: 12), the high density of the town houses in Langenhoven Park has a negative impact on civil municipal services such as storm water and sewerage due to increased surface water drainage.



Figure 4: Open spaces as a trench for storm water  
Source: Steyn & Schoeman, 2006: CD- ROM



Figure 5: Storm water canal used as a dumpsite  
Source: Steyn & Schoeman, 2006: CD-ROM

Open spaces are used to handle storm water in Langenhoven Park. Some of these open spaces are canals for storm water (see Figure 4). This could be an amenity to the community with the correct methods like swales and vegetation. At present it is an eyesore and used as a dump for rubbish and building rubble (see Figure 5). The surfaces of many other parks are also impervious. Swales and indigenous vegetation could help to slow down storm water.

Walls around town house developments can aggravate the damage during floods when it is built in water courses or in floodplains and if it cannot drain or if blockages occur. During the construction of the town houses many storm water channels were blocked by builder's rubble or broken by heavy vehicles.

In Langenhoven Park a public participation process was started to implement measures to inform the residents of ways to reduce storm water and to use the storm water channel in a more sustainable manner. Through ownership of the area the neighbours to these trenches could help to reform this area. Swales could slow down the water and help with water harvesting for trees and shrubs. Garden waste could be dumped in an organised manner to be used as

compost and mulch. A wetland could be developed if a wall with an overflow could be constructed at the lowest point of the trench.

## **5. Storm water as a resource**

If storm water is regarded as a resource and not as something to drain as quickly as possible, there are many options to handle storm water, as demonstrated in the following paragraphs.

In future, river catchment management should refer to "multi-purpose schemes designed to improve the capacity of each river valley to function as a visual amenity, a recreation area, a fishery, a nature reserve, a water supply, a storm detention area, a drainage network and a movement corridor for boats, walkers, cyclists and equestrians" (Turner, 1998: 295). This can be achieved through multi-purpose planning, managed flooding, storm detention basins, infiltration facilities, vegetated roofs, porous pavements and natural river works (Turner, 1998: 295). Purseglove (1988:164) suggests that one side of the channel should be kept untouched. Water management planning should be conducted on a catchments basis, and the handling of storm water should form part of the bigger picture. Policies could restrict post-development runoff to pre-development runoff levels (CSIR, 2000: 6, 6). Developers should pay a large retention fee which the Local Authority should retain for approximately 18 months after 50% of the area is developed to ensure that they do not disappear, leaving home owners to manage storm water from poor design and construction.

Rainwater is free of charge; and it should be handled as a resource. The best way to handle storm water is at its source; runoff should be detained where it occurs, and released as slowly as possible. Rainwater should infiltrate the ground where it falls. Water infiltration has several advantages: enhanced soil moisture levels; river flow can be regenerated, and improved water quality. Retention of storm water helps with evaporation through the soil and plants, groundwater recharge and the remainder could be drained off after a delay (Göbel, Stubbe, Weinert, Zimmerman, Fach, Dierkes, Kories, Messer, Mertsch, Geiger, & Coldeway, 2004: 270).

If one uses swales as retention basins, they should be integrated with the landform design (Hosseinzadeh, 2005: 431). A drainage levy can be imposed on landowners who discharge water. The amount of drainage from an area can be calculated, and developers who exceed the maximum stipulated rate of runoff should pay compensation, or carry out work in order to detain the water

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and prevent more problems from occurring downstream, or use a retention fee. Other land uses, such as forestry and wetlands, contribute towards retaining storm water and floods.

In South Africa, runoff usually has a high clay content; thus it is not economically viable to filter out the products of erosion (silts and clays). This would take too long, and would require large portions of land. Retention facilities should be used as water bodies and should allow natural processes to occur, for example in the case of wetlands (CSIR, 2000: 6, 21).

Edmond (2005: 215) describes the following uses for urban storm water:

- Irrigation of nearby parks;
- Navigation and transport;
- Aquaculture and the breeding of ducks and fish, as well as the cultivation of water plants;
- Using the fish population to get rid of mosquitoes;
- Fire-fighting;
- Washing down;
- Industrial use;
- Toilet flushing

In 1981, a survey on the handling of storm water was conducted in the USA and Canada. Nearly half of the 12 683 facilities were dry basins; 25% were car parks; nearly 20% were ponds; while 5.5% consisted of rooftop areas. It was determined that the detaining of storm water, and releasing it at a regulated rate, comprised the fundamental principle of storm water management (Turner, 1998: 303).

## **6. How to handle storm water in a more sustainable manner**

Roofs are steeply inclined and smooth, and thus comprise the fastest rainwater discharge points of all urban surfaces. Turner (1998: 304) and Hosseinzadeh (2005: 427) advocate the use of vegetated roofs. Vegetated roofs could help with insulation in very hot or cold climates.

Porous pavements and streets could be used in areas where the roads are not so busy. The street could be used by pedestrians, cyclists and children; and the roughness of natural surfaces could ease the traffic (Turner, 1998: 306).

Structures that are built to control floods should have many purposes, including water storage, flood protection, aeration, storm detention, etc. Many structures could be used for recreation, such as canoeing, fishing, swimming, camping, etc. (Turner, 1998: 309). The Willamette

River Water Treatment Plant in Wilsonville, Oregon was planned in order to accommodate a park, as well as community facilities including a meeting room, a laboratory and an administrative building. Picnic pavilions, attractive scenery across the river, access to the river, and trails connecting the river to other open spaces in the city, all form part of this scheme. The water is pumped to the top, and waterfalls and ponds form an artificial water feature (Sensenig, 2004: 8).

Parks - It is better for ecosystem services if small areas are connected to form corridors, rather than isolated islands (Olivier, 2006: 6). Smaller parks could form part of the drainage system for the purposes of treatment and storage (Edmond, 2005: 212, 213).

Wetlands play an important natural role in the handling of storm water. Wetlands are those areas that are inundated or saturated by surface or groundwater, at a frequency and duration that are sufficient to support - and which, under normal circumstances, actually do support - an abundance of vegetation and animal life typically adapted to life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas. The advantages of wetlands include the filtering of pollution, the purification of our drinking water, the recharging of groundwater aquifers, and the absorption of floodwaters (Maret & Blakeman, 2005: 454; Olivier, 2006: 7). Soft-edged wetlands provide storage for the purposes of flood control, drainage, and the treatment of water for re-use (Edmond, 2005: 210). Building up to the edge of the wetland does not destroy the wetland itself; but over time, it becomes uninhabitable for fauna and flora. Wetlands contain unique birdlife, medicinal plants and grass that can be used for making mats, hats and other artefacts. They also help to contain fires (Olivier, 2006: 8). Wetlands create environments for microbial populations, which alter contaminating substances by using the nutrients or energy contained therein. Other advantages of wetlands (constructed or natural) include low maintenance levels, as well as the fact that they provide habitats for plants and animals. Wetlands can be regarded as an asset, offering opportunities for recreation and education (CSIR, 2000: 6, 21). Reed-bed systems purify water, and should form part of the water-management system (Turner, 1998: 301). Water quality could be improved by the installation of litter- and oil-traps before the water enters the wetland. Water could be cleaned by using natural ultra-violet light, and nutrients could be absorbed by macrophytes.

In Norway, the construction costs of an open drainage system are 30% lower than the cost of a conventional pipe system. Operational

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costs were approximately the same (Astebol, Hvitved-Jacobson & Simonsen, 2004: 247).

Handling storm water naturally holds benefits for the environment and the population, and is also beneficial from a financial point of view.

## 7. Management of storm water

Management of storm water is important and should include enforceable regulations for settlement development in order to encourage water savings and groundwater recharging. A programme for infrastructure repair and maintenance is the task of the local government (Du Plessis & Landman, 2002: 79). The funding of storm water management is important. In Canada, the system of payment by property owners for the use and benefit they derive from storm water management and on estimates of impervious property area is popular, because it is fair and equitable. An equitable system of payment can serve as an incentive to adopt on-site best practices (Cameron, J. & Cincar, C. & Trudeau, M. & Marsalek, J. & Schaefer, 1999: 255).

The following measures could help to reduce and handle runoff:

- Detention/retention ponds or rooftop detention;
- Overland flow in open channels should be planned at the outset in collaboration with the road layout planners;
- Preference should be given to pervious surfaces;
- The maintenance of vegetation and alternative fuel sources should be developed to retain the vegetation (burning plant material for heat and cooking). Trees and plant beds can use storm water if they are not enclosed (see Figure 6)



Figure 6: Verge around the tree that catches the water  
Source: Joubert, 2007a: own drawing

- The use of contour planning and swales to retain runoff water;
- Soak-ways could be used to detain runoff water in wetlands (CSIR, 2000: 6, 8).

All the measures for handling storm water could be implemented if they are included in guidelines and enforced by the Local Authority. According to legislation, storm water

is not important until a storm turns into a flood that causes damage. The following measures can be taken, namely the developers could use pervious paving; the residents could use less paving and more soak-aways and water tanks; the construction teams could ensure that the storm water drainage systems are not blocked. The handling of storm water should be part of integrated planning. From the layout of the township, the construction of the houses and infrastructure and the residents' gardening habits to the municipality's management of open spaces, all parties involved have a role to play.

## **8. Recommendations**

Storm water must be handled in an integrated manner from the inception of the township, including the construction of the services and buildings and the maintenance of the open spaces and the individual properties.

### **8.1 Planners**

- Water management should be done for the entire catchment area, including rain, surface and groundwater. Cognisance should be taken of water reticulation, sewage and storm water. The Department of Water Affairs and Forestry has legislation in this regard.
- The regulations for EIA should require the developer to determine the runoff before development and calculate the runoff after development. The measures to minimise and detain storm water should be stated in the report as part of the EMS and must form part of the Record of Decision.
- Planning according to contours helps to minimise storm water and reduce the speed of the runoff. From the onset the drainage should be planned especially before paving (see Figure 6). Examine alternatives for hard surfaces.
- Development should not occur in drainage areas, floodplains or wetlands.



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- Open spaces should be connected and planted with indigenous vegetation (vegetated channels). Trees should be planted but also ground cover in beds to help with the drainage of storm water.
- Multi-purpose planning of open spaces could help to create amenities for the entire community. Such spaces could be used for recreation, water detention (grass buffer strips), relaxation, exercise and biodiversity.
- Wetlands and artificial wetlands should be created in open spaces to contribute towards water purification.

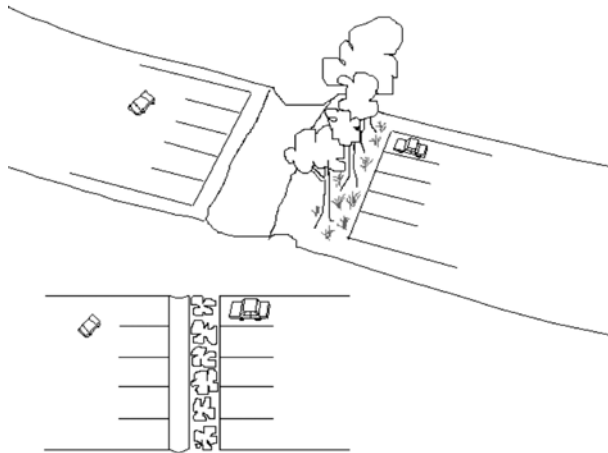


Figure 7: Schematic view of the use of swales in parking areas  
Source: Joubert, 2007b: own drawing

## 8.2 At home

- Plant an indigenous garden with swales to harvest water and prevent runoff.
- Install rainwater tanks.
- Refrain from paving large areas with impervious material, seek alternatives.

### **8.3 Communities**

- Communities can work together and take ownership of the parks and storm water drainage channels in their area and create an amenity.

### **8.4 Local authority**

- Ensure that the initial design of the township minimises or retains storm water and that that the construction of the area complies with the Record of Decision of the EIA.
- Restrict the construction of impervious surfaces. Parking areas could also be designed to minimise storm water. The use of plant beds and swales could help with the retention of storm water.
- Incentives and/or penalties could help to motivate developers to use appropriate surfaces and designs to minimise and detain storm water. Levies could be imposed for developments that increase runoff.
- Incentives could be used for residents who install water tanks and who use less paving material.
- A balance between housing densification and decreased storm water runoff should be pursued as an important objective.
- Infrastructure should include multi-purpose assets in the community. Storm water drainage and detention could be achieved by means of wetlands and parks. A wetland needs a dam wall with an overflow to contain the water.
- Streets with low traffic volumes could be constructed with pervious surfaces, with the dual purpose of easing traffic and draining storm water.
- Jobs could be created for entrepreneurs to produce pervious paving blocks.
- Public participation could help to change the storm water canals in something for the community to enjoy.

The Environmental Impact Assessment (EIA) process should inform all stakeholders on how to handle storm water in a sustainable manner. While the EIA process focuses on individual projects, the Strategic Environmental Plans could help with the bigger picture.

*Water is a unique commodity. Let us treat rain as the true blessing that it is.*

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