# TO WHAT EXTENT IS THE CONSTRUCTION INDUSTRY UTILIZING THE BENEFITS OFFERED BY DATA ANALYSIS?

BONGANI MASHELE

# TO WHAT EXTENT IS THE CONSTRUCTION INDUSTRY UTILIZING THE BENEFITS OFFERED BY DATA ANALYSIS?

By: Bongani Titus Mashele
22036386

Submitted in fulfilment of part of the requirements for the Degree of BSc (Hons) (Construction Management)

In the faculty of Engineering, Built Environment of Information Technology

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA
Denkleiers • Leading Minds • Dikgopolo tša Dihlalefi

Study Leader

Mr. J.H. Cruywagen

October 2010

## Declaration by student

I, the undersigned, hereby confirm that the attached treatise is my own work and that any sources are adequately acknowledged in the text and listed in the bibliography.

……

Signature of acceptance and confirmation by student

## Abstract

| | |
|---|---|
| Title of treatise | : To what extent is the construction industry utilizing the benefits offered by data analysis? |
| Name of author | : Mr BT Mashele |
| Name of study leader | : Mr J H Cruywagen |

Institution : Faculty of Engineering, Built Environment and Information Technology

Date : 28 October 2010

Data trend analysis refers to the concept of collecting information and data to attempt to spot a pattern, or prevailing trend, in the information which occurs over time. Trend and data analysis provides adequate insight to learn from past performance, facilitate an accurate picture of current conditions, and provide a proper perspective to guide action and future performance for each project and the company. ( Henderson, 2004; Bausman, 2003 ) Failure of construction companies is common, for large and small companies alike it's a challenge to survive, let alone thrive.

The objective of this treatise is to investigate to what extent is the construction industry utilizing the benefits offered by data analysis? The research will achieve this by first understanding the concept of data analysis, then proceed with studying the manner in which construction entities utilize data analysis and finally how it is used by the whole Built Environment.

# Table of contents

**Chapter two: What is data trend analysis?**

**Chapter three: What processes are involved in data trend analysis?**



**Chapter four: Data analysis used as key indicator of management and financial performance for construction companies.**

**Chapter five: What's the Data trend analysis for the whole built environment sector?**

**Chapter six: summary and conclusion**

# List of figures

# List of abbreviations

| | |
|---|---|
| Built Environment Professions | (BEP) |
| Construction Industry Development Board's | (CIDB) |
| Construction Industry Indicator | (CII) |
| Council for the Built Environment | (CBE) |
| Construction Education and Training Authority | (CETA) |
| Cost Performance Index | (CPI) |
| Free State | (UFS) |
| Information Technology Trend | (ITT) |
| Return on Equity | (ROE) |
| Policy Council | (PC) |
| South African Institute of Architects | (SAIA) |
| Schedule Performance Index | (SPI) |
| Statistics South Africa | (Stats SA) |

# Chapter one

## To what extent is the construction industry utilizing the benefits offered by data analysis?

### 1.1 Background / introduction

Data trend analysis refers to the concept of collecting information and data to attempt to spot a pattern, or prevailing trend, in the information which occurs over time. Construction is unquestionably one of the most significant industry contributors to the economy. However, globalization, advances in technology, environmental factors and changes in the economy are presenting new challenges in today's competitive market conditions. To increase its contribution to wellbeing and to exploit new opportunities, the industry must respond positively and quickly to the impact of current trends.

Contractors operate in complex and ever changing marketplace where competition is high and profit margins are slim. Due to the nature of construction having tight delivery programmes and involving temporary teams, disputes are commonplace. External influences also play a role, such as material and labour cost fluctuations and Governmental regulations. Most projects have a majority of the construction activities exposed to the elements during production and/or performed in unconditioned space variables that have a significant impact on labour productivity, installation quality, and schedule performance (Bausman, 2001). Within such a harsh environment contractors are still expected to predict cost and time of completion and guarantee performance. It is no wonder contractors are susceptible to bankruptcy. About thirteen percent (13%) of all failures are construction companies (Roper and Mclin, 2005) and failure is not limited to small companies. For large and small companies alike “it’s a challenge to survive, let alone thrive”. Effective management is essential for the success of the company. Data must provide adequate insight to learn from past performance, facilitate an accurate picture of current conditions, and provide a proper perspective to guide action and future performance for each project and company. (Henderson, 2004; Bausman, 2003).

The analysis of data will enable management to identify key indicators that drive and effectively measure project and company performance. (Roper K, 2010). These indicators must be evaluated against the companies’ expectations and the performance benchmarked against the industry. Management must also be in a position to understand the factors and operational forces that drive these indicators (RMA, 2006). Data is the lifeblood of an organisation. It is pivotal to how most companies make money in today’s marketplace, but it is not as yet being treated as the crucial asset it clearly is (Catlin, 2005).

## 1.2 Stating the problem

To what extent is the construction industry utilizing the benefits offered by data analysis?

The purpose of this study is to research how the construction industry and built environment use data analysis for business decisions. And to further look at what data analysis means in the construction context and the processes involved in its administration.

## 1.3 The sub problems

### 1.3.1 What is Data trend analysis?

The concept of collecting data and information on a specific subject over time, to be used to spot a trend or a prevailing pattern, is what statisticians refer to as trend analysis. Trends are usually defined as progressive changes in a particular subject.

*Hypotheses*

Trend analysis is about using information and data collected to spot a trend that occurs over time to help guide future organizational plans.

### 1.3.2 What processes are involved in data trend analysis?

Data is a set or grouping of information about a particular issue or population that has been gathered through structured and consistent methods over a period of time in a particular pattern.

*Hypotheses*

Data analysis involves collecting, arranging and investigating data with the purpose to seek underlying information contained in the data.

### 1.3.3 How is Data analysis used as key indicator of management and financial performance for construction companies?

Many professionals have realized the importance of harnessing the power of data for competitive advantage. Statistical thinking and financial management methods are the keys to unleashing the powerful information contained in the data. When data analysis is done and interpreted with care it allows managers to concentrate on issues that have more impact on the core business of the company.

*Hypotheses*

Construction professionals utilize trend analysis to plan, forecast and to measure and understand performance.

### 1.3.4 What's the Data trend analysis for the whole built environment sector?

Companies, professional bodies and associations analyze the industries' data In order to enhance the industries competitive edge, deliver cost effective services and resolve industry problems. Universities, professional bodies, government and research institutions use data analysis as a light to their path as they move forward in their efforts to understand the changes in society and in the industry.

*Hypotheses*

Built environment undertake data analysis to benefit industry participants with information indicating prevalent trends in the sector.

## 1.4 Delimitations

The research is done with certain limitations to how it is going to be conducted. The research relies on findings conducted by other researches. Due to the amount of time available to conduct the research it was not feasible for the researcher to initiate a survey data analysis processes from scratch. The analysis of trends takes place over a very long period of time, and a year's data is not long enough to prove a reliable prevailing trend. A fact regarding data that has been analysed by others to whom the research makes reference to is deemed to have been proven as correct and reliable. It also not easy for the research to use personal technical knowledge as the subject matter is a specialized one. Data analysis is a subject based in the field of statistics hence the research does not go deep into the statistical models involved. The number and nature of available research data on trend analysis specifically for the construction industry is not enough to offer variety. It is not possible to interview a large number of construction industry companies without the authority to do so.

## 1.5 Definition of terms

Trend analysis is a mathematical technique that uses historical results to predict future outcome.

## 1.6 Assumptions

The assumption the research makes is that all the trends which the research makes reference to were comprehensive enough, appropriately analyzed and the findings adequately proven. The methods of statistical data analysis have already been proven.

## 1.7 Importance of the study

Given today's competitive market conditions most companies do not use industry data collected over long periods of time to be able to make safe predictions. Many problems that arise in construction companies may be avoided provided that a trend of failure is known. Most often problems are global to the industry and simple observation of data about other companies' performance in the industry collected

over long periods of time can help with anticipating and remedial strategies. Data also collected internally can help show the prevailing trend in that organization in order to help management control, lead and organize more effectively. Data analysis can help the manager identify problems before they become a crisis. These problems may be life threatening to the company (such as realizing that the company will not be able to pay its bills in the upcoming months) or simple planning issues (such as identifying that the company's equipment is aging and that funds need to be set aside to replace this equipment in the next few years).

It is important to analyze business data in order to understand where the company is making its profit. This can allow managers to focus on those areas that are most profitable, identify those that need improvement, and identify work that does not bring in profit and eliminated.

In the recent economic downturn among many other companies that suffered, construction companies where the most severely affected. The research wants to find out if construction companies utilize data trend analysis to help them understand historical performance to guide organizational action and forecast outcome. The impact of the economic downturn inspired the inquiry about the analysis of economic indicators to prepare for the future. The research wants to learn how the application of data trend analysis is specially modelled for use in construction companies. Lastly the research wants to investigate how data trend analysis can be used as a management system for construction companies.

### 1.8 Research methodology

The approach that will be taken to solve the problem will involve consulting books dealing with the subject of trend analysis located in the statistics section of the University of Pretoria main library. The research will also consult books written specifically about trends analyzed in the South African construction industry also located in the library. The research will also consult academic articles found on the internet published by various built environment councils and bodies. The research will also look at media articles where current construction industry trends are analyzed, which are more common now in the wake of the recent economic downturn. Actual questionnaires produced by bodies seeking industry data from its members will also be presented.

# Chapter two

## What is data trend analysis?

### 2.1Introduction

The construction industry is one of the longest serving industries in the history of mankind. Thus it carries with it a lot of history and records of how it performed in the past. These historical recordings serve to form the basis for data that can be tapped into to find out the performance of the industry in previous years. Having all of this data at ones disposal can make it possible to spot a trend in the data when analysed through statistical tools. This concept of collecting data and information on a specific subject over time, to be used to spot a trend or a prevailing pattern, is what statisticians refer to as trend analysis.

The definition of trend analysis becomes more appropriate when defined in terms of statistical and mathematical references. This chapter will discuss in full what trend analysis is. In the chapter the research will uncover the actual definition of trend analysis as it is defined in statistical terms. This topic or concept is also best explained by using examples and studies where trend analysis was employed. Often trends are based on qualitative considerations and subjective assumptions. This chapter will not dwell much on the calculations involved in this subject.

Trends are usually defined as progressive changes in a particular subject. If the subject that is being studied can be described by a variable or variables that occur over time. An example of such a variable in construction can be annual revenue for instance, and then placed over time, like years, to form a trend that can be analyzed. The term trend analysis refers to the concept of collecting information and to attempt to spot a pattern, or trend, in the information. In the field of statistics trend analysis is classified under the time series model. (Steyn, 1996)

### 2.2 The time series model

A time series is a set of observations on a variable which one has an interest to investigate that has been collected in a time order. Time series is mostly used in two instances, firstly to obtain an understanding of the underlying reasons and structures that produced the observed data. Secondly to be able to forecast, monitor and even for having feedback and forward control on observations which are of interest. If forecasting of the observed variable is the main objective, the simplest model of the observed series will be used and the required forecasts made on the basis of this model. (Stoodley, 1980)

Time Series Analysis is used for many applications such as: (Steyn, 1996)

- Economic Forecasting

- Sales Forecasting
- Budgetary Analysis
- Stock Market Analysis
- Yield Projections
- Process and Quality Control
- Inventory Studies
- Workload Projections
- Utility Studies
- Census Analysis

In time series analysis the measurement of the variable of interest may be made continuously or at equally spaced intervals. With continuous measurement, examples of variables which could be treated in this manner are for instance the temperature in a cement plant reactor or wind speeds on a particular site for a high rise building. Alternatively equally spaced measurement are done for the accumulation of data over a period as for example, monthly sales, daily rainfall or batch yields in a cement production process.

Time series as a statistical forecasting technique finds its widest application in the economics field. Many Government departments are also involved in the use and the production of forecasts; examples are forecasts of unemployment, rates of inflation, growth of the economy, prices of goods, and demand for commodities and so on. Statistics South Africa (Stats SA) is also a central body from which data forecasts may be obtained. Forecasting techniques are widely used in the industrial and commercial context. In the commercial sector, for example sales forecasts are required to plan the production, holding and distribution strategic policies of goods being manufactured by companies. In the Industrial context long-term forecasts are required for such purposes as man power planning, building of new plant or extra capacity or to determine the future national demand for a product. (Steyn, 1996)

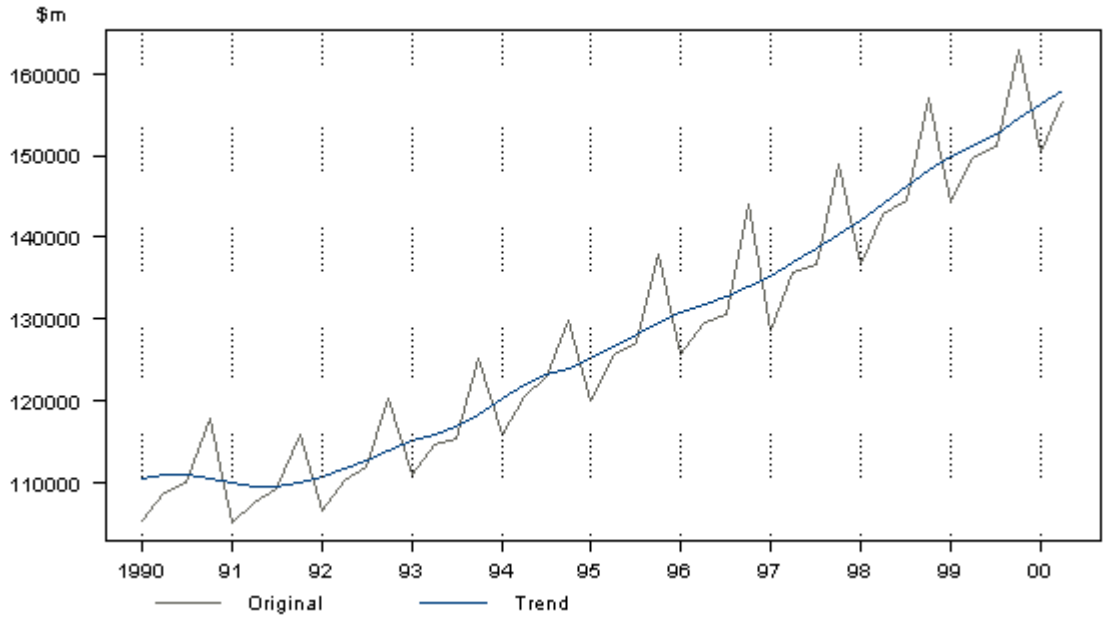
### 2.3 Time series trend analysis variations

The research has so far clarified that a data set that is dependent on the time at which the data was collected is called a time series. Forecasts based on observed data are usually the main objective of time series analysis. An observed time series will usually contain one or more of four kinds of variations or so called movement components. They are the long-term movement, seasonal fluctuations, cyclical movements and irregular movements. Each of these movement components can be attributed to a particular cause. A brief description of each movement component now follows.

### 2.3.1 The long-term movement

This is time series data that show a general trend or tendency which can be observed only in the long-term. The trend may show some gradual increase/decrease or remain constant in the long-term. For example (see figure 1) (courtesy of the Australian Bureau of statistics). The Types of possible trend curves found in long-term movement will be discussed later in the chapter.

Figure 1: Long-term movement

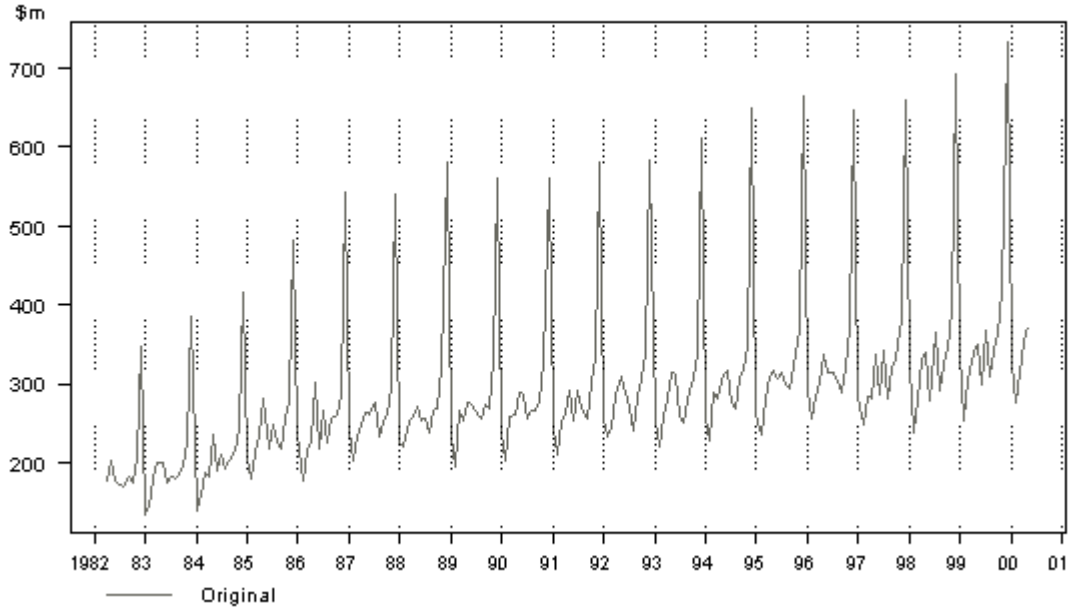



Source: the Australian Bureau of statistics

### 2.3.2 Seasonal fluctuations

This is time series that shows identical variation patterns that are repeated, for example on a monthly or annual basis. (See figure 2) (courtesy of the Australian Bureau of statistics). Seasonal fluctuations are usually caused by factors such as weather and customs. For example, the number of monthly housing starts might have a seasonal pattern due to changes in the weather. There might be a high level of housing that begins in spring and early summer because of good weather in future months. These might then decline through the late summer and autumn, reaching a low point during the coldest months of winter and then increase rapidly again in early spring.

Figure 2: Seasonal fluctuations



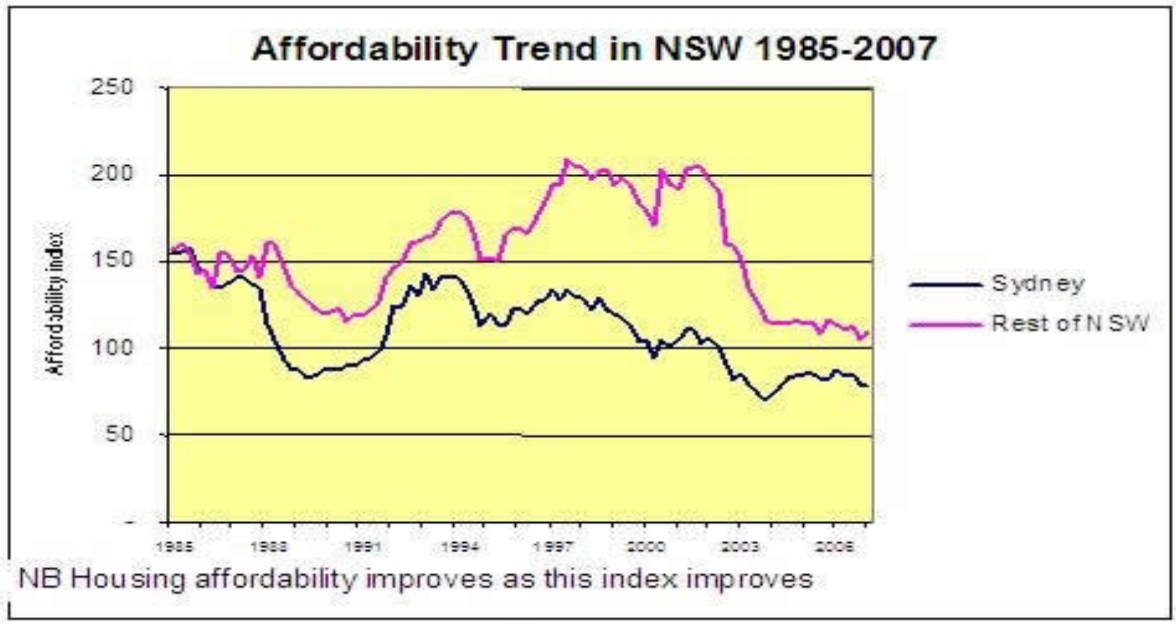

Source : the Australian Bureau of statistics

Seasonality in a time series can be identified by regularly spaced peaks and troughs which have a consistent direction and approximately the same magnitude every year, relative to the trend. The following diagram depicts a strongly seasonal series. In this example, the magnitude of the seasonal component increases over time, as does the trend.

### 2.3.3 Cyclical movements or business cycle

This is time series that shows a long-term swing above and below the general trend. The period of this component is not necessarily constant, but usually varies from a few years to several decades. In the case of economic data which has been observed over many years, the cyclical movement can be identified as a so-called business cycle. There are four phases in a business cycle namely, prosperity recession, depression and recovery. However when an observed time series extends over a period of less than five years, it is difficult to distinguish between the trend and the business cycle. Cyclical fluctuations need not be caused by changes in economic factors. For example cyclical fluctuations in housing demand might reflect changes in the number of couples who decide to marry and settle down. Take cyclical fluctuations in sales of a fashionable item of clothing might reflect changes in the clothing styles, which are determined by Paris fashion designers who might feel a creative inspiration in a certain direction.

Figure 3: Cyclical movements




Source: HIA/Commonwealth Bank Affordability Index 1985-2007

Other examples of cyclic trends (see figure 3)

a) Property development trends. They tend be short-term usually lasting one or two seasons. Generally, they're completely unpredictable. These may also include design trends by designers.

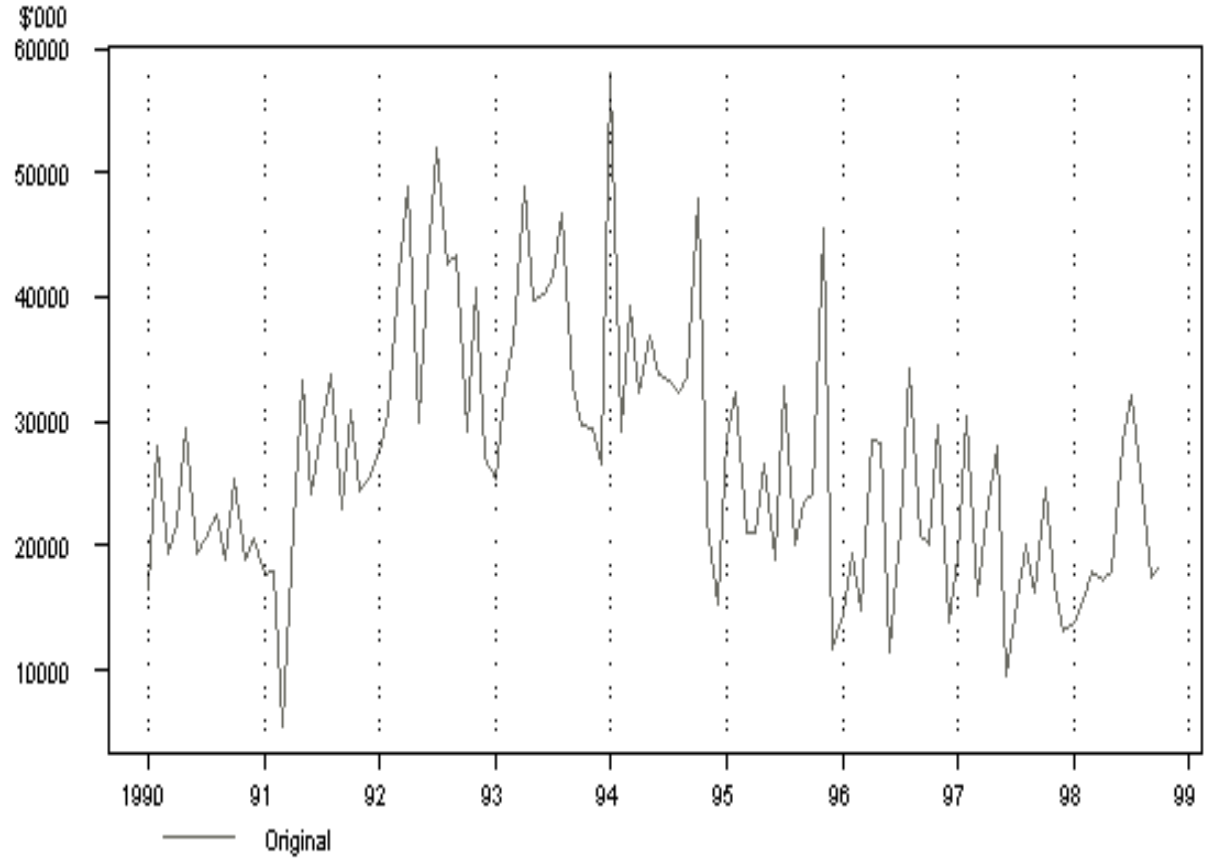
b) Political trends. They are usually cyclic, like elections and president terms of ruling.

c) Economic trends. They can be cyclic. For example, is an economic downturn that occurs every ten years in a particular industry or market.

### 2.3.4 Irregular variation

This is time series that when plotted on a graph, the sequence is often irregular and it resembles unevenly distributed saw-teeth. (See figure 4) (courtesy of the Australian Bureau of statistics). This irregular movement can be ascribed to observation errors and to incidental phenomena such as hail damage, earthquakes, strikes, hurricanes, elections or wars.

Figure 4: Irregular variation




Source: the Australian Bureau of statistics

The irregular component is what remains after the seasonal and trend components of a time series have been estimated and removed. It results from short term fluctuations in the series which are neither systematic nor predictable. The above graph depicts a highly irregular time series.

**2.4 Types of possible trend curves in long-term forecasting**

Furthermore within long-term forecasting there are various possible trend curves through which trend analysis can be done. They are; the straight line trend, simple exponential curve, parabola, log parabola, modified exponential curve, logistic curve and Gompertz curve. An example of each is illustrated in the annexure chapter.

**2.5 What is trend or data analysis in internal operations of organizations?**

All the variations and trend graphs mentioned above have mathematical equations that derive them. For the purpose of this research it will not be discussing the

mathematical formulas and equations; instead it will continue focusing on the literature and application side. Trend analysis in time series is useful to give business firms required forecasts of many events and conditions in all phases of their operations. Examples of these are as follows.

### 2.5.1 Marketing departments

Reliable forecasts of demand must be available so that sales strategies can be planned. For example, total demand for products must be forecast in order to plan the total effort to be put on promotions.

### 2.5.2 Finance

The interest rates must be predicted so that new capital acquisitions can be planned and financed. Income and expenses can be forecast in order to predict cash flows and maintain liquidity.

### 2.5.3 Human resource management

Forecasts of the number of workers required in different job categories are required, in order to plan job recruiting and training programmes. It is also used to predict the supply of labour into the market, the amount of absenteeism and the rate of labour turnover to be expected.

### 2.5.4 Production

Predictions of demand for each product line are required. These forecasts help the company to plan production schedules and inventory maintenance. Forecasts made of the demand of a particular product may be used to then make forecasts of raw material requirements so that purchases can be planned. The predictions about the availability of resources and prices are essential for planning of resource purchases.

### 2.5.5 Process control

Predictions and forecasts can also be used to understand the behavior of a production process. For example a cement batching plant can understand the increasing number of defective batches by studying the records of their mixing ratios.

### 2.5.6 Strategic management

Strategic management requires forecasts of general economic conditions, price and cost changes, technological change and market growth in order to plan the long-term future of the company. For example a forecast may be used to determine whether investing in new plant will be necessary in the future.

### 2.5.7 Project management

In project management trend analysis is a mathematical technique that uses historical results to predict future outcome. This is achieved by tracking figures in

cost and schedule performance. In this context, it is employed as project management and quality control tool

### 2.5.8 Other

Although trend analysis is often used to predict future events, it could be used to estimate uncertain events in the past, such as how many ancient kings probably ruled between two dates, based on data such as the average years which other known kings reigned. (Steyn, 1996) Today trend analysis often refers to the science of studying changes in social patterns, including fashion, technology and the consumer behavior.

## 2.6 Explaining trend analysis through investing techniques

Trend analysis is a form of comparative analysis that is often used to identify current and future movements of an investment or group of investments. The process mostly involves comparing past and current financial ratios in order to project how long the current trend will continue. This type of information can be extremely helpful to investors who want to make the most from their investments.

The process of a trend analysis begins with identifying the category of the investments that are being considered. For example, if the investor wishes to get an idea on the potential for making a profit with premix concrete the focus will be on the performance of premix concrete in a products market. The trend analysis will include more than one supplier for the product, in order to get a more accurate picture of the current status of premix concrete on the market.

Once the focus is established, the investor takes a long look at the general performance for the category over the last couple of years. This helps to identify key factors that led to the current trend of performance for the investment under consideration. By understanding how a given investment reached the current level of performance, it is then possible to determine if all or most of those factors are still having an influence.

After identifying past and present factors that are maintaining a current trend in performance, the investor can analyze each factor and then project which of these factors is likely to continue having an influence on the direction of the investment. Assuming that all or most of the factors will continue to have an influence for the foreseeable future, the investor can make an informed decision on whether to buy or sell a given asset.

## 2.7 Summary

The research has introduced the concept of trend or data analysis as a derivative of time series data. Trend analysis refers to the concept of collecting information over a period of time and to attempt to spot a pattern, or trend, in the information. In the field of statistics trend analysis is classified under the time series model. A time

series is a set of observations on a variable which one has an interest to investigate that has been collected in a time order. The research shows that the objectives of investigating a time series are to gain understanding of the process underlying the manner in which the time series was developed, and/or to forecast future values of the observed value. An observed time series will usually contain one or more of four kinds of variations or so called movement components. They are the long-term movement, seasonal fluctuations, cyclical movements and irregular movements. Furthermore the possible trend curves in long-term movement where listed as; the straight line trend, simple exponential curve, parabola, log parabola, modified exponential, logistic curve and Gompertz curve. These are used as tools through which data analysis is done. Time series analysis is used for many applications such as: Economic Forecasting, Sales Forecasting, Budgetary Analysis, Stock Market Analysis, Yield Projections, Process and Quality Control, Inventory Studies, Workload Projections, Utility Studies and Census Analysis. Trend analysis in time series is useful to give business firms required forecasts of many events and conditions in all phases of their operations. Examples of these are in marketing departments, in finance, in human resource management, in production, Process control, strategic management and project management. Information obtained through a data analysis is also helpful to investors who want to make the most of their investment.

### 2.8 Conclusion

The research has looked into the theory and definition of data and trend analysis. In statistics data and trend analysis are discussed as a part of time series analysis. Although this chapter of the research was more mathematically inclined, however the objective was to illustrate how the final information obtained from the models gets applied practically. Today data trend analysis often refers to the science of studying changes in social and socio economic patterns.

### 2.9 Testing of hypothesis

The hypothesis stated in chapter one stated.

*"Trend analysis is about using information and data collected to spot a trend that occurs over time."*

The findings of the research agree with the stated hypothesis in full. However the research goes more in debt explaining the manner in which the data which is of interest gets recorded, processed and then analysed in a chronological order. The research also mentions the different methods which are used in statistics to do the analysis and these include the four movement components, which are the trend curves that are used in data analysis. The hypothesis was correct entirely, but it was short for the amount of information available on the subject.

# Chapter Three

**What processes are involved in data trend analysis?**

## 3.1 Introduction

Data trend analysis refers to the concept of collecting information and data to attempt to spot a pattern, or prevailing trend, in the information which occurs over time. (Wikipedia). It is very obvious that analyzing data can provide strategic benefits to businesses. Effective decision support systems depend upon management's ability to understand an organization's underlying data. Key business activities including sales, marketing activities, financial, human resource and planning are improved when key decision makers have access to informative data.

Data and trend analysis is the process of taking the data you have collected (e.g., the responses on a surveys or questionnaires) and organizing the information in such a way as to be able to draw conclusions from it. There are various ways to look at the data in order to draw conclusions. We examine, define, conceptualize, and quantify data in order to answer questions about who, what, when, where, why, how and how much. We use it as a light to guide our path as we move forward. First, you must determine the type of analysis appropriate for the data collected and determine the strategy to manage the data. You need to implement the data analysis processes in four phases. Being the planning the process, gathering data, analyzing and evaluating data, and formulate recommendations. (Anne E, 2010)

Raw data can take a variety of forms, including measurements, survey responses, and observations. In its raw form the information can be incredibly useful, but also overwhelming. Over the course of the data analysis process, raw data is ordered in a way which will be useful and possible to draw important conclusions from.

## 3.2 Data Management

Before you decide what to wear in the morning, you collect a variety of data: the season of the year, what the forecast says the weather is going to be like, which clothes are clean and which are dirty, and what you will be doing during the day. You then analyze that data. Perhaps you think, "It's summer, so it's usually warm." That analysis helps you determine the best course of action, and you base your apparel decision on your interpretation of the information. (Anne E, 2010) Data comes from many places and a variety of formats. It is important to take a logical approach and think about the following questions before starting with the analysis

1. How will you keep track of all the data?
2. How will you make the data available to several members of your team?
3. How will you collect and integrate data over a period of time?

4. How can you set up the system so that others can step in if your job responsibilities change?

Choices about which data to include in your analysis is highly dependent on both the availability and the quality of the data. (AED/TAC-12 Spring 2006). The quality of the data should be checked as early as possible. Data quality can be assessed in several ways, using different types of statistical analyses: frequency counts, descriptive statistics (mean, standard deviation, median), normality (frequency histograms, normal probability plots). (Wikipedia) The data analysis processes is subdivided into four phases

### 3.3 The data analysis phases

#### 3.3.1 Plan the process.

- Formulate Recommendations
- Objectives
- Scope/Resource Allocation
- Methodology
- Communication Strategy

#### 3.3.2 Gather data

- Questionnaires
- Interviews
- Observation

#### 3.3.3 Analyze and evaluate data

- Observation
- Options
- Preparation & processing
- Recording & presenting
- Evaluation

#### 3.3.4 Formulate recommendations

- Communicating recommendations
- Implementing recommendations

### 3.4 Data Analysis Plan

Data analysis usually starts with developing a plan that reviews each question on an instrument. This plan will map out the manner how to analyze the data to get useful information. A data analysis plan will provide a consistent structure for the analysis. You can use a blank questionnaire or interview guide to outline the plan. After each question, note the analytic technique you plan to use.

Once you have determined which analytical technique will provide you with the most meaningful information, assign a code to each answer. The codes will allow you to tabulate and analyze the data in an organized fashion. It is often helpful to enter the data into a database or word processing program that can assist in the data analysis, an example is the common Microsoft excel programme Another option is to summarize or register the data on paper.

Use only data that are collected consistently and thoroughly. Data should be "cleaned" to remove incomplete or incorrect data. While these data will not be included in the analysis, they should be stored with a record of the analysis for future reference. Data cleaning will be discussed later. (Niles R. 2010)

#### 3.4.1 Key Points to remember about planning

- As part of your plan a strategy for keeping the key players updated regarding the progress of the data analysis process must be included.
- Identify in advance the resources that you will need to implement the process. Some
- Consult with the Policy Council (PC) regarding information being derived from the data analysis process as well as decisions that are being made as a result of the process.
- Get ideas and assistance from Policy Council (PC) members regarding the proposed data analysis process.
- Ensure that all data analysis team members are oriented and trained to understand the importance of the data analysis and its impact. ( AED/TAC-12 Spring 2006.)

### 3.5 Gathering data

The method of choice to gather data is depended upon the type of data involved. For qualitative data Open ended questions are required to gather data from participants. Closed ended questions are required for data surveying of quantitative data. The common survey methods used for gathering data are questionnaires, observations, personal interviews and focus group interviews.

### 3.5.1 Questionnaires

Questionnaires can be used to collect both qualitative and quantitative data they are convenient because they: can be distributed manually or electronically,

Can reach a vast number of people regardless of physical location or geographical di spersion, Can be distributed quickly and cheaply, and can be used when human and financial resources are not available to conduct interviews. For an example of a questionnaire used by professional bodies in the construction industry see figure 13 in annexure.

### 3.5.2 Personal Interviews

Personal interviews can be used for evaluating information needs, staff responsiveness, attitudes and perceptions. Personal interviews can be used for tracking the flow of information within the company.

### 3.5.3 Focus Group interviews

Focus group interviews are most useful when interaction of participants will generate ideas and can be used to survey participants on the same level in the company. It can be used to survey departments or teams with a common goal or interest.

### 3.5.4 Observations

An observation involves watching, following and recording activities as they are performed, then interpret these and draw conclusions. It is about selecting the representative group you will observe and silently observing work routine and following up with verbal questions. Observation works well when you are more interested in behaviour rather than perceptions of the users and when you require a qualitative view of how information fits into work processes.

## 3.6 Data analysis

When starting with the data analysis phase you need to investigate what data analysis options you have. The options include manual recording, spreadsheets, survey software programmes and statistical packages. Data processing involves interviews, observation findings, data cleaning, coding and editing response.

### 3.6.1 Data cleaning

Data cleaning is an important procedure during which the data are inspected, and erroneous data are -if necessary, preferable, and possible- corrected. Data cleaning can be done during the stage of data entry. If this is done, it is important that no subjective decisions are made about the choice of data. It is important not to throw information away at any stage in the data cleaning phase. All information should be saved (i.e., when you are altering variables, both the original values and the new values should be kept,), and all alterations to the data set should carefully and

clearly written down or documented. It is necessary to check that the cleaning process of the data has not had an influence in the outcome of the data arrangement. Also check if there are data observations that are missing and the extent, to determine the necessity to feel missing data with assumed data. (Wikipedia)

### 3.6.2 Data analysis techniques for Qualitative and Quantitative Data.

Data that is collected and made available for analysis may either be qualitative data or quantitative data. Therefore the analysis techniques used are different for the different types of data. Some of the techniques for qualitative data include content and case study analysis. For quantitative data, the most common techniques are frequencies, percentages, and averages.

#### a) Qualitative Data

The most useful analytical techniques for qualitative data will probably be content and case study analysis.

**Content analysis** consists of reviewing written documents (journals, observation notes, open-ended survey questions) or the text of spoken data (interviews or focus groups). As the evaluator reviews the material, he or she assigns codes to pieces of text that represent either important concepts, common patterns between respondents, or distinct responses by different subgroups. Isolate text associated with each code and then group it together by category. Categories can be predetermined (chosen at the time the instrument is developed) or emergent (chosen after examining the data). (Coolican, 1994).

**Case study analysis** requires the collection of identical sets of data on individuals or groups (e.g., demographic profiles, family relationships, and responses to specific events). You can use each case as a data point or a comparison with one another. Conclusions from both types of analysis can be presented in text or table format. It may be possible to use data analysis that is already occurring, particularly when you are using existing data. For example, school offices may track and report on attendance of chronically absent youth on a regular basis. Other community-based organizations may have systems in place to provide reports on clients. When planning your data analysis, take time to find out what analysis is already being conducted and avoid duplicating efforts when possible. Some institutions like the Department of public works may have data regarding various issues in the construction industry available from their many previously conducted studies.

#### b) Quantitative Data

For quantitative data, the most common type of analysis techniques will be frequencies, means, and percentage distributions. Frequencies refer to the number of instances a specific response was given. After calculating a frequency, you could also identify the mode or the response that occurs most frequently. A mean (or

average) is the sum of the responses to the item divided by the total number of all responses. A percentage distribution tells you what proportion of the respondents chose a specific answer.

### 3.7 Formulate recommendations

#### 3.7.1 Writing

Last it is important to write your key findings and interpretations as related to your study. A well written report must proceed from your findings and interpretations to recommendations that are clear and concise. Make sure that your recommendations are derived from your data and not “random” stand alone assumptions. Look out for poor graphical and tabular presentations as they often lead both readers and writers to draw erroneous conclusions from their data and obscure facts that better presentations would reveal. Some of these practices involve deliberate distortions of data, but more commonly they involve either unintentional distortions or simply ineffective approaches to presenting numerical evidence. (Edward R. Tufte’s,)

### 3.8 Summary

Data and trend analysis is the process of taking the data you have collected (e.g., the responses on a surveys or questionnaires) and organizing the information in such a way as to be able to draw conclusions from it. Raw data can take a variety of forms, including measurements, survey responses, and observations. The quality of the data should be checked as early as possible. The data analysis processes is subdivided into four phases: the planning the process, gathering data, analyzing and evaluating data, and formulate recommendations. Data analysis starts with developing a data analysis plan that will provide a consistent structure for the analysis. The method of choice to gather data is depended upon the type of data involved. For qualitative data Open ended questions are required to gather data from participants. Closed ended questions are required for data surveying of quantitative data. The common survey methods used for gathering data are questionnaires, observations, personal interviews and focus group interviews. A data analysis options include manual recording, spreadsheets, survey software programmes and statistical packages. Data processing involves interviews, observation findings, data cleaning, coding and editing response. Last it is important to write your key findings and interpretations as related to your study in a well structured report format.

### 3.9 Conclusion

The data analysis procedure is a well thought through and organized process that is guided by a plan. It is important to have a data management plan to help facilitate any data analysis that might be implemented in an organization. In the course of organizing the data, trends often emerge, and these trends can be highlighted in the written recommendations about the data. Charts, graphs, and textual write-ups of data are all forms of data analysis. These methods are designed to refine and

condense the data so that readers can bring together interesting information without needing to sort through all of the data on their own. These methods reflect what is later manifested as a key indicator for results of a data analysis.

### 3.10 Testing of hypothesis

The hypothesis stated in chapter one stated.

*“Data analysis involves collecting, arranging and investigating data with the purpose to seek underlying information contained in the data.”*

The hypothesis was partially correct in addressing the problem to understand the process of conducting a data analysis. The research discovered a comprehensive guiding process which might require certain technical skill and knowledge, especially statistical, as data analysis leans towards it.

# Chapter Four

**Data analysis used as key indicator of management and financial performance for construction companies.**

## 4.1 Introduction

Running a profitable construction company is a difficult business. Faced with a number of external pressures such as thinning profit margins, higher owner expectations and changing technologies, only contractors who follow best practices will not experience failure.

Much about the business world has changed in recent years, largely due to the developments and influence of information technology and global competition. In the Built environment other factors such as: the increase of new more complex projects, demanding clients, integration of multiple disciplines and knowledge explosion contribute as well.(Steyn, 2008: 2) Indeed many businesses today find themselves knee deep in data. Industries like the construction produce thousands of data through normal daily operations. Many professionals have realized the importance of harnessing the power of data for competitive advantage. Statistical thinking and financial management methods are the keys to unleashing the powerful information contained in the data. The typical business executive has access to large quantities of data obtained from a variety of sources. This data may contain information that is useful to make decisions.

The built environment experiences a big flow of data. This has led to the question whether construction companies utilize data analysis to measure performance and opportunities contained in data. The hypothesis that business data is analyzed to measure and understand performance will be investigated. Construction professionals should be encouraged to gain knowledge and apply data analysis management tools and techniques to enhance their information management expertise. Non statistician managers and directors should not avoid statistical management responsibilities by pushing these to the statistician and financial professionals.

When data analysis is done and interpreted with care it allows managers to concentrate on issues that have more impact on the core business of the company. It is a useful starting point for planning actions that will influence the future course of events. This report will address the question posed by firstly presenting ways that data analysis is used in business. The research will also show the importance of data analysis under the following topics. How is data analysis used to derive Key financial indicators for construction companies? How to analyze centres of profit in construction data? How is data analysis used as a tool for good construction financial management? How is data analyzed for the purpose of monitoring and

controlling construction costs? And what is the role of data analysis the project closeout phase and audit?

### 4.2 How is data analysis used as key financial indicators for construction companies?

Managing a successful construction company is a risky and challenging task. Contractors operate in a complex and ever changing market place where competition is keen and margins are slim. Production schedules are constantly being compressed while employer's expectations escalate. Disputes associated with contracts in construction are commonplace. Labour and material costs fluctuate, and government regulations are forever on the rise. The team assembled for design and construction is temporary, and comprises of individuals and organizations with diverse educational backgrounds and experience that often have differing project objectives. Most projects are performed in unconditioned areas that have great impact on labour productivity, installation quality and schedule performance (Bausman 2001). Within the context of these challenging industry and project forces, contractors are expected to competitively predict construction cost and time of completion and also guarantee performance. They are also expected to have good house keeping its financial matters. Financial data is always available to provide adequate insight to learn from past performance, to facilitate an accurate picture of current conditions, and to provide a proper perspective to guide action and future performance for each project and company (Henderson, 2004; Bausman, 2003).

What companies analyze in financial data is what is referred to as indicators. Indicators vary and they serve as effective measures of organizational performance. In the case of financial data they are financial performance indicators. In a construction business there is no shortage of data; in fact many companies might be suffering from too much data and subsequently utilizing the wrong one for measurement. Analyzed performance indicators must be evaluated against the company's expectations, tactical objectives, annual business plan and strategic goals. Performance should be benchmarked against the industry and not just the average performers but the best.

The key financial indicators that emerged to be derivative of data analysis fall in five categories: profitability, cash-flow, leverage, liquidity and forecasting. Successful companies analyze performance for each project, sector, team or business unit, service group, and the overall company. They also have well defined processes to collect, organize, and format current and relevant data for each management team. (Roper K, 2010)

#### 4.2.1 Profitability

The profitability of a company is measured using two key financial indicators. These are the Return on Equity (ROE) and also the percentage of profit based upon revenue both gross and net profit. The Return on Equity is normally used analyze the

performance of the overall company. The percentage of profitability serves as a key financial indicator for the project, business unit, profit center and the company. The best companies analyze performance on a regular basis.

### 4.2.2 Cash flow analysis

Cash flow is essential to a construction company. Also of high importance for a contractor is its ability to fund operations and meet general company obligations. The contractor must have enough cash to meet payroll, pay for materials and supplies, reimburse subcontractors, meet general company expenses and satisfy the minimum liquidity requirements by financial partners. Top performing companies realize that not only is effective cash management and analysis essential for an organization's financial health, but it ca also enhance the profitability of the company.

### 4.2.3 Leverage

Financial leverage indicates the degree to which a company has leveraged its equity relative to creditor debt or company volume. Leverage is measurement is for the company rather than for a specific project. Leverage indicators are also important to the company's' financial partner and its creditors because they are associated with the companies ability to repay its debts and the risk of the company.

### 4.2.4 Liquidity

Liquidity is a measurement of company instead of project performance in a construction company. What it measures and indicates is the company's ability to meet its short term obligations and the ability to pay its own bills. Financial partners and creditors are keen in the analysis of a contractor's liquidity.

### 4.2.5 Forecasting

To plan a successful path forward, one must understand and learn from the past. Company organizations and project teams that fail to effectively analyze past performance and use that insight to guide future actions are preparing for mediocrity or possible failure. Top performing company's are progressive and forward looking, but they respect the lessons and perspective provided by effective evaluation and analysis of past performance. They realize that this insight is invaluable for making prudent real-time decisions and to accurately forecast outcomes.

To effectively manage workflow and the company's resources the best performers track work as it is evolving in the pipeline, typically starting early in the development and design phase. They investigate all the parameters to assess the viability of the project and the probability of their success. They project sales and revenue at least a year out. Business development teams meet regularly to evaluate each opportunity and proactively position organizational resources to maximize success. The most successful construction companies develop comprehensive accounting practices to effectively identify all the direct and indirect costs required to service a client and/or

market niche. They slice and dice this data by project type, size, location, client, delivery method and other major variables influencing cost and profitability to determine the most effective and profitable allocation of organizational resources. The top performers don't go after every segment of the market but always looking for fresh opportunities in existing markets and are willing to explore new areas that show promise.

Top performers analyze organizational performance at every level to determine current status, project outcomes, and to gain insight to guide future decisions and actions. The best track performance of their project teams. They compare estimated and projected with actual profitability. Performance data is collected and evaluated on a regular basis to isolate variances requiring corrective action. Financial performance drives tactical decisions and actions. They evaluate both snapshots of organizational performance and operational trends. Data is collected to develop performance trends that provide important insight to guide tactical and strategic decisions regarding organizational strengths, weaknesses, market niches, client and individual project selection.

The organization also tracks the financial performance on all service and product lines in order to understand the returns on each. Financial data is collected, organized, and formatted to reveal performance of each group, business unit, service sector, and profit centre. Profit centre analysis will be discussed in full detail later. This data is used in operational and business planning to realign or reposition resources on existing work and guide business development activities. They are continually attempting to learn from past performance and use the insight gained to position the organization to maximize future success. (Adrian, J.J and Adrian, D.J. 1999)

### 4.3 Analyzing centres of profit in construction data

It is important for financial managers to identify where the company's profit is generated. Profit centre analysis is where management looks at different activities of the company as profit centres that generate company's profits. Profit centre analysis helps management determine if certain activities of the company are meeting its goals, identifies places for change, and provides a quantitative analysis that helps management make decisions, such as whether the company will perform its own work or subcontract it out. To be able to allocate profits two things must be understood. First, we must understand the sources of profit on the company's core business: building construction projects. Second, we must understand how to allocate general overheads to the different profit centres.

#### 4.3.1 Analyzing sources of profit

It is accepted that there are up to four sources of profit on a construction project. They are as follows: minimum profit and overhead mark-up required by the

company, profit from the bidding and buying process, profit from individual crews, and profit from project management.

The first source of profit is the minimum profit and overhead mark-up. Each company should establish a minimum profit and overhead mark-up that each project needs to meet to make lucrative for the company to construct the project. The profit and overhead mark-up may be different for the different cost categories; labour, material, subcontractor, equipment and other. This profit and overhead mark-up is used to cover the costs of the general overhead and provide a minimum profit for the company's shareholders. The profit from the minimum profit and overhead mark-up is easily determined by multiplying the project budget by the minimum profit and overhead mark-up.

The second source of profit or loss is profit or loss generated during the bidding and buying process by the estimator. The estimator is any person who prepares the estimate regardless of their job title. This profit in addition to the minimum profit and overhead mark-up and is result of skilful bidding, subcontracting and purchasing. One way to increase the mark-up is to identify those times when the market will allow contractors to charge higher than normal prices for their work.

The profit generated by the bidding and buyout process equals the price charged the owner, which is the bid accepted by the owner or the contract sum, less the budget for the project less the minimum profit and overhead mark-up. Estimators and buyer's performance data should be measured in terms of their performance in finding subcontractors and suppliers who understand, are committed to, and have regard for quality and schedule standard required for the project. Evaluating estimators and buyer's data is important as it allows management to get the most appropriate estimators assigned to the projects, identify areas where more training is needed, and take corrective action.

The third source of profit is profit from the management of labour and equipment used by the foreman's team. The profit earned by the foreman as part of management of teams is the difference between the budget for the work performed by the team and the cost to perform the work. The profit earned by the management of the construction teams derived from analyzing the number of hours for the labour and equipment it takes to complete the task, and the hourly rates for the labour and equipment. Profit occurs when labour and equipment is used efficiently and this requires good planning and scheduling of activities. Therefore the foreman needs an understanding of performance analysis by looking at data.

The profit data of teams may be analyzed and evaluated against a company standard or against the cost of replacing the crew with a subcontractor. When comparing teams to a company standard, their performance may be determined by comparing their performance data to the performance data of other teams. The ability of teams to meet deadline may be evaluated against determined success rate

in meeting scheduled milestones. Quality performance may be measured by collecting data in standardized quality inspections and by using the results of these inspections to determine how the team did to a set standard. Financial performance may be measured against the budget for that work. Management must look at schedule, quality, and financial performance when comparing in-house teams to subcontracting the work out. Analyzing data of construction teams is important not only so that management can hold the foreman accountable or determine if the team should continue to exist but also to know the strength and weakness of each team so that the most appropriate team can assigned to the projects.

The fourth and final source of profit is profit from management of the project. Equipment is included as part of the management of the project when the equipment is used by the entire project and is managed by the projects management team. The profit earned by the project's management team is the difference between the budget and the cost for the entire project, except for the work performed by the foremen's teams. Profit can be made by good project management in the form of controlling material waste and reducing overhead costs. One way to reduce overhead costs is to reduce the duration of the project. On the other hand, poor management can reduce profit by poor scheduling and excessive material waste.

Project management teams may be evaluated buy comparing their performance data to other project management teams, a minimum standard, or to an individual goal for the team what is analyzed must include data on scheduling, quality and financial performance. The project management team's performance data may be measured in the same way that the construction teams are measured. This performance may be measured on a single project or a group of projects taking place over time. Evaluating project management team's data is important as it allows management to get the most appropriate team assigned to the projects, identify areas where more training is needed, and take corrective action. (Petersen, S.J. 2005)

### 4.4 How is data analysis used as a tool for good construction financial management?

Managers in construction companies need to be able to know what elements are to be analyzed from data contained in financial statements. The balance sheet and the income state are very important tools to be used to track and measure a company's financial health. The financial health of a company can not only be determined by the data values shown on the financial statements, but also the relationships among these data values. These relationships are the elements that are being analyzed from the financial statements and these are known as financial ratios. Good construction financial management includes monitoring the critical financial ratios and comparing them to other companies in the industry. This is a method that searches for prevailing trends in the financial data. When doing an analysis of financial statements, data of one category or group is divided by data of another category or group. This calculation brings about a ratio that can be compared with

that of other companies in the industry. These ratios represent the relationship of the categories being analyzed. Ratios may provide insights into a company's ability to pay bills, or how efficiently it uses its financial resources, profitability, and the capital structure of the company. (Petersen, S.J. 2005)

### 4.4.1 Comparing data

As data are discussed, when data are available, typical ratios for construction companies in the single family residence, commercial, heavy and highway and specialty trades sectors are given. These data based from data from financial statements from thousands of companies from over a long period and reported by auditing companies. When comparing ratios to industrial averages, companies should obtain current data for their sector of the construction industry.

Single family residential includes constructions of new single family homes, refurbishments, repairs, and additions to single family homes performed by construction companies. Commercial construction includes the construction of multifamily housing, hotels, industrial buildings, warehouses, and other commercial construction by construction companies. Commercial constructions exclude construction projects performed by developers. Heavy and highway construction includes the construction of streets, highways, elevated highways, bridges, tunnels, waterlines, sewers, pipelines, communications, and power lines. Specialty trades include most subcontractor work and include the following special trades: plumbing, heating, and air-conditioning; paint and paperhanging, electrical work; stone work; plastering; drywall; acoustical; terrazzo; tile; carpentry; structural steel; roofing; glazing and all specialist trades not listed.

What ratios are being analyzed in financial data and how are they interpreted? (Dun & Bradstreet, 2005)

### 4.4.2 Quick ratio

The quick ratio is analyzed to measure a company's ability to pay current liabilities with cash or other cash assets (assets that can be turned into cash). The quick ratio may also be referred to as the acid test ratio. Quick ratio equals cash plus accounts receivable divided by current liabilities. A company with a quick ratio of 1 to1 or greater is considered liquid. A company with a ratio below 1 to 1 will need to convert inventory and other current or long term assets to cash through equity financing to pay its liabilities. A ratio greater than 1.5 to 1 may be a sign that a company has too much cash and should be investing it elsewhere.

### 4.4.3 Current ratio

The current ratio is a measurement of a company's ability to use current assets to pay for current liabilities. Current ratio is calculated from current assets divided by current liabilities. A current ratio of 2 to 1 is considered a strong indication that accompany is able to pay its current liabilities. If a company' current ratio is below 1

to 1 it is an indication that the company does not expect to receive enough revenue over the next year to pay its current liabilities. If the ratio is below 1.5 to 1 the company is undercapitalized and may run into financial problems during the next year. If a company's current ratio is over 2.5 to 1, the company may have too much of its assets tied up in current assets and should be investing long term.

### 4.4.4 Current liability to Net Worth ratio

The current liabilities to Net Worth ratio is a measurement of the risk that short term creditors are taking by extending credit to the company compared to the risk the company's owners are taking in the company. In a construction company with current liabilities greater than the company's net worth, the short-term creditors would have more capital risk than the owners. Short term creditors include suppliers and subcontractors who provide materials, labour, equipment and plant hire on credit. Current liabilities to Net Worth equal current liabilities divided by Net Worth. The Current liability to Net Worth is expressed as a percentage. For most industries it is recommended the percentage be less than 67%. Most commercial construction companies have a higher current liability to Net worth ratio because of their extensive use of suppliers and subcontractors to perform work.

### 4.4.5 Debt to equity ratio

The debt to equity ratio measures the risk in the company all the creditors are taking compared to the risk the company's owners are taking. Debt to equity equals total liabilities divided by net worth. The range the manager desires is one which is less than 2 to 1. If the debt to equity ratio exceeds 2 to 1 the manager must question whether the company will be able to repay its debt, particularly in an economic downturn. A debt to equity ratio that is less than 1 to1 may indicate that the company is not utilizing debt to expand the business.

### 4.4.6 Fixed assets to net worth ratio

The fixed asset to net worth ratio is a measurement of the amount of the owner's equity that is tied up in fixed assets, such as construction equipment and plant. Fixed assets to net worth equals net fixed assets divided by net worth. A high number indicates a company has invested substantially on fixed assets. During a downturn in the industry, companies with a large investment in construction equipment usually suffer the most.

### 4.4.7 Current assets to total assets ratio.

The Current assets to total assets ratio measure how liquid a construction company's assets are. It is derived by dividing current assets by total assets. A company with a high ratio would have most of its assets in the form of current assets and it would be very liquid. A company with a low ratio would have most of its assets tied up in long-term assets such as fixed and other assets. The latter is usually the case with construction companies that have substantial investments in plant and

equipment. Such companies have to keep a regular flow of work especially during a downturn in the industry, to avoid problems.

### 4.4.8 Collection period.

The collection period measures the average time it takes a company to collect payment from clients. In most construction companies working under contracts, the payment periods are contractually determined. This contractually a payment agreement helps with facilitating the collection period for contractors. A company's collection period should be less than 45 days. A collection period of more than 45 days indicates that the company has poor collection policies or has very generous payment terms to its clients. Generous payment terms and slow collection often increase a company's reliance on debt, which increases its interest expenses and thereby reduces its profitability.

### 4.4.9 Average age of accounts payable.

The average age of accounts payable represents the average time it takes a company to pay its bills and is a measure of how extensively accompany is using financing. When the average age of accounts payable is greater than 45 days this is an indication that the construction company is slow to pay its bills and may receive less favourable credit terms and pricing from its suppliers and subcontractors. When the average age of accounts payable is shorter than 20 days, unless a construction company is taking advantage of trade discounts, it may be an indication that the company is underutilizing trade financing. If the average age of accounts payable is equal to or slightly greater than the collection period is an indication that the company is using its suppliers and subcontractors to fund the construction work. If the accounts payable is much greater than the collection period than the contractor is withholding payments from its suppliers and subcontractors even after it has received payment for the work. If it is less than the collection period, it indicates that the company is in the habit of using its working capital to pay bills before it has received payment from the employer. The desire position is to have the average age of accounts payable equal or slightly greater than the collection period.

### 4.4.10 Assets to revenues ratio.

This ratio measures how efficiently the company is using its assets. It is also referred to as the assets to sales ratio. It is calculated by dividing the total assets by revenues. Companies with a high ratio may be performing too much work for their assets and a low ratio indicates that the company is not working enough for the assets at disposal.

### 4.4.11 Working capital turns.

Working capital returns measures how efficiently a company is using its working capital. Working capital is determined by subtracting current liabilities from current assets. The working capital represents funds that will be available for future work.

### 4.4.12 Accounts payable to revenues ratio.

The accounts payable to revenues ratio measures how much a company is using its suppliers and subcontractors as a source of funds. It is calculated by dividing the accounts payable by revenues. The higher the ratio or percentage the greater the funding the company is receiving from its suppliers and subcontractors.

### 4.4.13 Gross profit margin.

The gross profit margin is the percentage of the revenues left after paying construction costs and equipment costs. The gross profit margin is calculated by dividing the gross profit by revenues.

### 4.4.14 Return on revenue.

Return of revenue measures how well a construction company can withstand changes in the construction market, such as reduced prices, higher costs, and less demand. It is determined by dividing the net profit before taxes by the revenues.

### 4.4.15 Return on assets.

Return on assets is a measurement of how efficiently a construction company is using its assets and is often given as a percentage. A company that is run efficiently will have a high percentage, whereas a company which is poorly run will have a low return on assets. It is the net profit after tax divided by total assets.

## 4.5 How is data analyzed for the purpose of monitoring and controlling construction costs?

In order for managers of construction companies to control costs they must actively monitor costs. They need to look for potential problems and proactively address the problems. The success of a project's ability to control costs is measured by the Schedule Performance Index (SPI) and the Cost Performance Index (CPI). The Schedule Performance Index (SPI) measures the success of a project's management to complete work on time. The Cost Performance Index (CPI) measures the success of the projects management to complete under the set budget. The target levels being analyzed for the cost and the schedule performance indices are two things. They need to look for the value of the indices and then analyze the trend in these values over time.

## 4.6 What is the role of data analysis the project closeout phase and audit?

At the completion of every project after all the costs and revenues have been recorded, it is important to perform a project closeout audit. The purpose of the project closeout audit is to identify those things that may be implemented in future projects, and to identify problems that were encountered so that management can find ways to avoid them in future. The project closeout audit is an analysis of data and it consists of three steps. The first step is to validate the project costing data.

The validation of project costing data includes looking at the data in detail and verifying that the costs were charged to the appropriate project and category and that all costs are included. Second management must look at those areas of the project where they performed better than expected and analyze what factors led to their success. Third management must look at those areas of the project where they encountered problems.

### 4.7 Summary

Key financial indicators measuring profitability, cash flow, company leverage and liquidity are regularly assessed and the results communicated to the organization. The report indicates how the analysis of data contained in financial statements of construction companies helps management to identify problems before they become a crisis. These problems may be life threatening to the company, such as realizing that the company will not be able to pay its bills in coming months, or simple planning issues, such as identifying that the company's equipment is aging and that the funds need to be set aside to replace this equipment in the next few years. The best performers are big consumers of performance data in order to forecast outcomes and gain insight to guide current activities and the future direction of the company. Even though the top performers are already the most profitable and the best in their class, they are obsessed with operational excellence. They are constantly evaluating performance in an attempt to identify areas for improvement. The best utilize key financial indicators to reinforce the key drivers of company success.

### 4.7 Conclusion

Most projects construction companies undertake are exposed to the elements during production and performed in unconditioned spaces with a lot of variables that can have a significant impact on labour productivity, installation quality, and schedule performance (Bausman, 2001). It is within the context of these challenging industry and project forces, contractors are expected to competitively predict construction cost and time of completion and then contractually guarantee performance. Top performers utilize Key Financial Indicators to establish company focus and objectives, align organizational action, benchmark results, and reward performance. Key financial indicators measuring profitability, cash flow, company leverage and liquidity are regularly assessed and the results communicated to the organization. Performance data is analyzed to guide organizational action and forecast outcomes.

The report has indicated the analysis of data contained in financial statements of a construction company help the manager to identify problems before they become a crisis. These problems may be life threatening to the company (such as realizing that the company will not be able to pay its bills in coming months) or simple planning issues ( such as identifying that the company's equipment is aging and that the funds need to be set aside to replace this equipment in the next few years). The best

performers are big consumers of performance data in order to forecast outcomes and gain insight to guide current activities and the future direction of the company. Even though the top performers are already the most profitable and the best in their class, they are obsessed with operational excellence. They are constantly evaluating performance in an attempt to identify areas for improvement. The best utilize key financial indicators to reinforce the key drivers of company success.

The importance of management to know where the company is making its profit was discussed. The reason for it was that it allows them to focus on those areas which are most profitable. Analyzing cost data is important to monitor and help control construction cost. The project closeout audit is an analysis of data to identify those things that may be implemented in future projects, and to identify problems that were encountered so that management can find ways to avoid them in future.

### 4.8 Testing of hypothesis

The hypothesis stated in chapter one stated.

*"Business data is analyzed to measure and understand performance"*

In testing this hypothesis, it can be said that the hypothesis is partially correct in that companies analyze data to measure and understand performance. However the hypothesis does not explain what type of data is being analyzed? Where business data is found? How to process the data to key financial and performance indicators? The hypothesis only touched on the surface and lacked depth. The research uncovered more about data analysis as a means of diagnosing the financial health of a company based on the statistics and financial management techniques.

# Chapter Five

### What's the Data trend analysis for the whole built environment sector?

## 5.1 Introduction

The Built Environment professions as defined by the Council for the Built Environment (CBE) namely; architects, engineers, landscape architects, project and construction managers, valuers and quantity surveyors are crucial to the industry's ability to deliver this infrastructure. Generally there is a shortage of in depth research in the built environment ( Davis Langdon 2010). Companies, professional bodies and associations analyze the industries' data In order to enhance the industries competitive edge, deliver cost effective services and resolve industry problems. Universities, professional bodies, government and research institutions use data analysis as a light to their path as they move forward in their efforts to understand the changes in society and in the industry. They examine, define, conceptualize and quantify the data in order to answer their questions about who, what, when, why, how and how much. Data analysis tells them something they need to know about the whole industry. Through data trend analysis there are many trends that are observed in the built environment. These trends involve growth, reform and improvement of the construction sector.

The manner in which institutions in the built environment conduct data analysis, follows a process similar to the one employed by companies, as discussed in the previous chapter. The previous chapter looked at data analysis at construction company level and this chapter will look at data analysis in a much broader view, at sector level. The chapter will look at the findings of these professional bodies on the trends analyzed from data and indicators regarding the built environment.

## 5.2 Professional bodies using data analysis in the Built Environment

The Construction Industry Development Board (CIDB), The Council for the Built Environment (CBE), CSIR Boutek, and Construction Education and Training Authority (CETA) are the most prominent bodies constantly conducting research on the state of the Built Environment. A discussion of their findings on key impacts in the industry which include, capacity, knowledge intensity, skills development, business performance and service, information technology, transformation, changing regulatory and policy environment, sustainable development imperatives, innovation, education and training outcomes, globalization, international trends and HIV/Aids.

The Construction Industry Development Board (CIDB) was established to provide leadership to stakeholders and to stimulate sustainable growth, reform and improvement of the construction sector for effective delivery and the industry's enhanced role in the country's economy.

The Council for the Built Environment (CBE) aims to improve stakeholder relations and create partnerships to improve service delivery; intervene in improving the performance of the skills delivery pipeline; and ensure alignment of the activities of

the Council for the Built Environment CBE and the BE professional councils with national imperatives and initiatives

CSIR Boutek produces publications of relevance to professionals in the building and construction industry, decision-makers in central, provincial and local government, as well as students.

### 5.3 Construction Industry Indicators analyzed from industry data

The Construction Industry Development Board's (CIDB) Construction Industry Indicators are measures of performance of the industry, focusing on clients, the clients agents/ consultant and contractors. The Construction Industry Indicators CIIs have been captured annually since 2003, and are currently being captured by the Construction Industry Development Board (CIDB) in partnership with the Department of Quantity Surveying and Construction Management of the University of the Free State.

Jade Davenport (2010) reports that the Construction Industry Development Board's (CIDB's) Construction Industry Indicators (CII) survey for 2009 contains an analysis of the state of South Africa's construction industry in 2009. Highlighted trends are concerning issues of payment delays, reduced profitability of projects, contractor and client satisfaction, and project delays.

The Construction Industry Indicator (CII) survey, undertaken by the Construction Industry Development Board CIDB in partnership with the Department of Quantity Surveying and Construction Management at the University of the Free State (UFS), essentially measures the performance of the South African construction industry, focusing on clients, the clients' consultants and contractors. An example of a questionnaire being used to survey professionals can be found in the (Annexure figure13.)

The survey is based on a database of 3 441 projects completed in 2009 as well as responses drawn from 1 169 contractors and 332 client departments from across all nine provinces. Head of the Department of Quantity Surveying and Construction Management at University of Free State (UFS) Dr Hendrik Marx explains that the survey essentially examines client satisfaction, contractor satisfaction, profitability and payment delays, procurement indicators, and health and safety. Survey letter (see Annexure figure 14)

### 5.4 The state of the construction industry.

According to the Construction Industry Development Board (CIDB) report. The survey's most significant disclosure highlights significant payment delays in the industry. The survey indicates that only 42% of contractors were paid on time and 58% of payments to contractors were made 30 days or more after invoicing. Payment delays in 2009 show quite a significant deterioration compared with the payment delays in 2007 and 2008. Significantly, payment delays recorded in the 2009 survey were higher in the private sector and national departments. The survey suggests that metropolitan councils and public–private partnerships were the best payers. The Western Cape has the highest percentage of projects paid within 30 days, while the Northern Cape has the lowest number of projects paid on time. Construction Industry Development Board's (CIDB's) Chief Executive Office (CEO)

states that the issue of payment delays is a very serious matter. The delays could be the result of a poor quality of invoices or corruption within government departments. Such payment delays are killing small and medium-sized enterprises.

In terms of profitability, 74% of all the projects examined in the survey made a profit above 6%, while 23% of projects were undertaken at profit margins of 5% or less. Only 4% of projects made a loss.

The survey also indicates that 52%, 51% and 35% of special work, mechanical work and electrical work projects respectively achieved profit margins higher than 10%. Residential and non-residential building projects have been revealed to be the least profitable.

It has been revealed that 40% of Grade 2 contractors achieved a profit margin higher than 10% for projects undertaken in 2009, while only 27%, 32% and 35% of Grades 7, 8 and 9 contractors respectively achieved a profit margin higher than 10%.

In terms of client and contractor satisfaction, the survey indicates that clients were satisfied with the performance of contractors in 2009. Clients were neutral or dissatisfied with contractors' performance on 18% of the projects surveyed. Significantly, clients were least satisfied with the performance of contractors in the residential building sector, followed by civil works and special works. Contractors were satisfied with employers and agents, expressing an overall employer satisfaction level of 75%.

The survey suggests that the worst overall performing employer is the Gauteng national and provincial departments, as well as the Northern Cape metropolitan councils.

Another aspect that the survey highlights is the fact that only 85% of projects started on time and 84% were completed on schedule. All projects undertaken within the Free State and North West provinces were started and completed on time, while Limpopo province contractors were the worst performers, according to the survey.

### 5.5 Trends and impacts that require addressing in the Built Environment

CSIR Boutek undertakes a review of the South African construction industry to evaluate the industry against global standards and local demands and making a critical assessment of the current performance of the built environment professions measured against international and national expectations. The CSIR document focuses on the following Built Environment Professions (BEP) sector issues: Capacity; knowledge intensity, skills development, business performance and service, information technology, transformation, the changing legislative environment, sustainable development imperatives, innovation, education and training outcomes, globalization, international trends and HIV/Aids.

#### 5.5.1 Capacity

All indications are that the capacity of the professional sector within the industry is declining. (CSIR Boutek, 2009)

### 5.5.2 Knowledge intensity

Problem solving and maximising opportunities despite the constraints of the project are among the Built Environment Professions skills most admired by customers. (CSIR Boutek, 2009)

### 5.5.3 Skills development

According to a report by the Construction Education and Training Authority (CETA), it reveals that professionals that are very experienced were retiring or nearing retirement. In assessing the demand for future skills, the CETA report concludes that the poor growth forecasts for the near future will not demand additional skill capacity. However, it does note that there is a need emanating from a demand for higher skills, and for training for productivity increase. (CSIR Boutek, 2009)

### 5.5.4 Business performance and service

The construction sector has shown a continuous decline in its percentage contribution in GDP of 59, 3% percent since 1980, reaching its lowest level in 20 years during 2001 and 2002. Professional fee income has decreased in a similar trend. A survey undertaken by the South African Institute of Architects (SAIA) confirmed that more and more architects are deriving their income from non-architectural sources. (CSIR Boutek, 2009)

### 5.5.5 Information technology

Information Technology Trends (ITTs), such as widespread use of simulation including modelling and virtual reality offer far more robust design and specification opportunities. (CSIR Boutek, 2009)

### 5.5.6 Transformation

The number of students from previously disadvantaged communities enrolling in Built Environment courses is low Of those individuals from previously disadvantaged communities entering the profession, women constitute a greater proportion. (CSIR Boutek, 2009).

### 5.5.7 The changing legislative environment

Current legislation governing the built environment professions is separating the role of the professions into distinct and separate categories, contrary to emerging international demands for collaboration and integration. (CSIR Boutek, 2009)

### 5.5.8 Sustainable development imperatives

In response to the effects of the built environment on the environment, builders are increasingly seeking to design and implement green practices Frost & Sullivan programme manager David Winter state that the South African market for green buildings still faces small problems. These include a common misconception of the costs involved in green design and construction, as well as an overload of green information, (CSIR Boutek, 2009)

### 5.5.9 Innovation

Innovation is slowly rising in the Built Environment, mostly perpetuated by sustainable development imperatives. (CSIR Boutek, 2009)

### 5.5.10 Education and Training Outcomes

Surveys indicate that generally practitioners complain that the courses do not adequately qualify students for the practical aspects of the job. (CSIR Boutek, 2009)

### 5.5.11 Globalisation;

Given the decline in local market conditions, many consultancies are exploring regional, sub-Saharan and other global business opportunities. (CSIR Boutek, 2009)

### 5.5.12 International trends

There is dwindling number of professional interns, and the need for the industry and the professionals to be globally competitive. The reports all over the world stress the need for greater integration of processes within the industry. (CSIR Boutek, 2009)

### 5.5.13 HIV/Aids

The impact of HIV/Aids on the building industry could be devastating simply because the sector employs large numbers of semi-skilled and unskilled workers. It is anticipated that in general there will be 1335 deaths a day in 2008 29: that is one funeral a minute. It is estimated that 18 percent of South Africa's workforce could be infected by 2005: industry, an additional 40 000 workers might need to be trained to maintain a similar level of production. This represents a formidable level of funding on future training needs. (CSIR Boutek)

## 5.6 Summary

Through data trend analysis there are many trends that are observed in the built environment. These trends involve growth, reform and improvement of the construction sector. The Construction Industry Development Board (CIDB), The Council for the Built Environment (CBE), CSIR Boutek, and Construction Education and Training Authority (CETA) are the most prominent bodies constantly conducting research on the state of the Built Environment. The Construction Industry Development Board's (CIDB) Construction Industry Indicators are measures of performance of the industry, focusing on clients, the clients' agents/ consultant and contractors. The survey's most significant disclosure highlights significant payment delays in the industry. Trends and impacts that require addressing in the Built Environment involved the following Built Environment Professions (BEP) sector issues: Capacity; knowledge intensity, skills development, business performance and service, information technology, transformation, the changing legislative environment, sustainable development imperatives, innovation, education and training outcomes, globalization, international trends and HIV/Aids.

## 5.7 Conclusion

Improving the quality of life is the most important objective of the built environment. For the built environment professionals to have a future, they need to tune into real cultural values and to understand the way that the environment has an impact on them. To measure the impacts of the ever changing world, there is demand for the understanding and analysis of data. Data collected and produced by bodies in the sector serve as a light that show the direction the industry is moving. The chapter highlighted trends which can be seen from data made available by professional bodies and institutions to help members understand and to foresee the movement of the built environment as a whole. International trends and national objectives are combining to put extraordinary pressures on the construction industry. In the process, the industry will have to reinvent itself if it wishes to remain competitive, deliver acceptable products to an increasingly demanding customer, and deliver the required financial returns to its shareholders. The built environment professions will not remain untouched by this transformation. Significant changes will be required with regard to education, training, skills development, knowledge enhancement and service delivery.

## 5.8 Testing of hypothesis

The hypothesis stated in chapter one stated:

*"Built environment undertake data analysis to benefit industry participants with information indicating prevalent trends in the sector."*

In testing this hypothesis, it can be said that the hypothesis was partially correct as it only addressed the use of data trend analysis undertaken by construction companies. The report shows that many professional bodies and institutions are also responsible for production and analysis of industry data, to evaluate the industry against global standards and local demands To understand trends in the industry it was necessary to obtain data analysed by professional bodies because their findings encompass the entire industry and not limited to subject matters only of interest to specific companies.

# Chapter Six

## Summary and conclusion

### 6.1 Summary

Managing a successful construction company is a risky and challenging proposal. Contractors operate in a complex and ever-changing market place with though competition and slim profit margins. Production schedules are continually being compressed while owner expectations escalate. Disputes are commonplace, material and labour costs fluctuate, and governmental regulations are constantly on the rise. ( Bausman, 2008 ). Teams on projects are from diverse experience and educational backgrounds, usually having differing project objectives. It is little wonder that in this operating environment financial failure is quite commonplace. In the recent economic downturn among many other companies that suffered, construction companies where the most severely affected. The research wanted to find out if construction companies utilize data trend analysis to help them understand historical performance to guide organizational action and forecast outcome. The impact of the economic downturn inspired the inquiry about the analysis of economic indicators to prepare for the future. The research wanted to learn how the application of data trend analysis is specially modelled for use in construction companies. Lastly the research wanted to investigate how data trend analysis can be used as a management system for construction companies. The research follows this logical sequence to answer the main problem, first it's the Introduction to the reader the concept and subject of discussion, second examine processes involving the subject and its relation to business, third address the application of the subject in the construction industry, and fourth and final show a holistic view of the subject in terms of the whole Built Environment.

The main problem was broken down into four sub-problems. The first sub-problem the research addresses is the theory and definition of data trend analysis. Data analysis is defined as a part of time series data, which is a model in the studies of statistics. The research gives a formal definition of data analysis to acquaint the reader with the concept of data analysis as it is discussed.

The second sub-problem addresses the process of data trend analysis as a business model or system. This is necessary to articulate the relevance of data analysis to business, and the subsequent link to construction companies.

The third sub-problem discusses data analysis in more detail as driver and key indicator of general management and financial performance for construction companies. This sub- problem addresses the actual application of data trend analysis in construction management functions. This sub problem is key to the success of the research because it reveals the truth about the uses of data analysis in construction companies.

The last sub-problem deals with the concept of data collected and produced by bodies in the construction sector as a data base for comparative analysis with other companies of similar trades. Data collected and processed by professional bodies in the built environment is also used to mine historical trend analysis performance of thousands of companies in the last years. This offers an explanation about the contribution of professional bodies in managing information data required by construction companies to perform successful data analysis. This is discussed to indicate how serious the management of data is viewed as an important management support system for the entire industry. The final intention is to illustrate the use of data analysis as a system for the Built Environment as a whole

The research introduced the concept of trend and data analysis as a derivative of time series data. Trend analysis refers to the concept of collecting information over a period of time and to attempt to spot a pattern, or trend in the information. In the field of statistics trend analysis is classified under the statistical model of time series. A time series is explained as a set of observations on a variable which is being investigating in a time order. The research shows that the objectives of investigating a time series data are to gain understanding of the process underlying the manner in which the time series was developed, and/or to forecast future values of the observed value. An observed time series will usually contain one or more of four kinds of variations or so called movement components. They are long term movement, seasonal fluctuations, cyclical movements and irregular movements. Furthermore the possible trend curves in long-term movement where mentioned as: the straight line trend, simple exponential curve, parabola, log parabola, modified exponential, logistic curve and the Gompertz curve. These are used as tools through which data analysis is performed. Time series is used for many applications such as: economic forecasting, sales forecasting, budgetary analysis, stock market analysis, yield projections, process and quality control, inventory studies, workload projections, utility studies and census analysis. Trends analyzed in time series are useful to give companies foresight of events and performance levels. Examples of functions in companies utilizing data to analysis include: marketing departments, finance, human resource management, production, process control, strategic management and project management. Information obtained through a data analysis is also very useful the point of view of an investor.

Data and trend analysis is the process of taking the data one has collected (e.g., the responses on a surveys or questionnaires) and organizing the information in such a way as to be able to draw conclusions from it. Raw data can take a variety of forms, including measurements, survey responses, and observations. The quality of the data should be checked as early as possible. The data analysis processes is subdivided into four phases: the planning the process, gathering data, analyzing and evaluating data, and formulate recommendations. Data analysis starts with developing a data analysis plan that will provide a consistent structure for the analysis. The method of choice to gather data is depended upon the type of data

involved. For qualitative data Open ended questions are required to gather data from participants. Closed ended questions are required for data surveying of quantitative data. The common survey methods used for gathering data are questionnaires, observations, personal interviews and focus group interviews. A data analysis options include manual recording, spreadsheets, survey software programmes and statistical packages. Data processing involves interviews, observation findings, data cleaning, coding and editing response. The most common strategy for analyzing qualitative data is constant- comparison, but there are many other techniques from which to choose. All these depend on the type of information one is looking to extract from the data. Last it is important to write your key findings and interpretations as related to your study in a well structured report format

Most projects construction companies undertake are exposed to the elements during production and performed in unconditioned spaces with a lot of variables that can have a significant impact on labour productivity, installation quality, and schedule performance (Bausman, 2001). It is within the context of these challenging industry and project forces, contractors are expected to competitively predict construction cost and time of completion and then contractually guarantee performance. Key financial indicators measuring profitability, cash flow, company leverage and liquidity are regularly assessed and the results communicated to the organization. The report indicates how the analysis of data contained in financial statements of construction companies helps management to identify problems before they become a crisis. These problems may be life threatening to the company, such as realizing that the company will not be able to pay its bills in coming months, or simple planning issues, such as identifying that the company's equipment is aging and that the funds need to be set aside to replace this equipment in the next few years. The best performers are big consumers of performance data in order to forecast outcomes and gain insight to guide current activities and the future direction of the company. Even though the top performers are already the most profitable and the best in their class, they are obsessed with operational excellence. They are constantly evaluating performance in an attempt to identify areas for improvement. The best utilize key financial indicators to reinforce the key drivers of company success.

The importance of management to know where the company is making its profit was discussed. The research found that it allows them to focus on those areas which are most profitable in the business. Analyzing cost data is important to monitor and help control construction cost. The project closeout audit is an analysis of data to identify those things that may be implemented in future projects, and to identify problems that were encountered so that management can find ways to avoid them in future.

Built Environment professional Bodies play a big role to collect, mine, interpret data and to publish statistics regarding various topics that Construction Industry Indicators (CII) are based on. They function to keep professionals abreast with everything that affects the sector. The involvement of the bodies is an indication of the backing given to data analysis studies. Data analyzed about the Built Environment was discussed

under the following topics or indicators: trends within the Built Environment Professions, trends regarding capacity, knowledge and skills, education and training, student enrolments and graduates, profile of graduates, gender of professionals, age of professionals, remuneration, integration, business performances, practice and good governance, globalization, information technology developments, innovation, demand for quality, value and sustainable development imperatives. Construction Industry Indicators are measures of performance of the industry, focusing on clients, the clients' agents/ consultant and contractors. The idea is that the managers of companies in the built environment will utilize this data, to integrate the knowledge in the planning and comparative data analysis of the company information. Through data trend analysis there are many trends that are observed in the built environment. These trends involve growth, reform and improvement of the construction sector. The Construction Industry Development Board (CIDB), The Council for the Built Environment (CBE), CSIR Boutek, and Construction Education and Training Authority (CETA) are the most prominent bodies constantly conducting research on the state of the Built Environment.

### 6.2 Conclusion

Failure of construction companies is not limited to small companies, for large and small companies alike "it's a challenge to survive, let alone thrive". By evaluating a company's qualitative performance data, problems can be identified earlier. Failure can be avoided by studying the past, and learning about the present to foresee the future. Trend and data analysis provides adequate insight to learn from past performance, facilitate an accurate picture of current conditions, and provide a proper perspective to guide action and future performance for each project and the company. ( Henderson, 2004; Bausman, 2003 ) Trend analysis refers to the concept of collecting information and data to attempt to spot a pattern, or prevailing trend, in the information which occurs over time. Its application in business include: Economic Forecasting, Sales Forecasting, Budgetary Analysis, Stock Market Analysis, Yield Projections, Process and Quality Control, Inventory Studies, Workload Projections, Utility Studies, Census Analysis

Performance data is analyzed to guide organizational action and forecast outcomes. Top performers utilize Key Financial Indicators to establish company focus and objectives, align organizational action, benchmark results, and reward performance

Improving the quality of life is the most important objective of the built environment. The built environment professionals to have a future, they need to tune into real cultural values and to understand the way that the environment has operated and impacted on them. To measure the impacts of the ever changing world there is demand for the understanding and analysis of data. Data is also collected and produced by bodies in the construction sector to create data bases for comparative analysis with other companies of similar trades. Data collected and processed by professional bodies in the built environment is also used to compute historical trends

of the performance of thousands of companies analyzed in the last years to map socio economic trends affecting the industry. This offers their members a place where they can go to for such information to assist with understanding, doing comparisons and foresight with regards to the movement of the sector. The research has fully dealt with the topic of data analysis in construction companies and the Built Environment. It uncovered a deep well of knowledge on this topic that shows data analysis as a synthesis between statistics and financial management.

The research is rounded up by presenting the holistic view of data analysis in the Built Environment. International trends and national objectives are combining to put extraordinary pressures on the construction industry. In the process, the industry will have to reinvent itself if it wishes to remain competitive, deliver acceptable products to an increasingly demanding customer, and deliver the required financial returns to its shareholders. The built environment professions will not remain untouched by this transformation. Significant changes will be required with regard to education, training, skills development, knowledge enhancement and service delivery.

### 6.3 Testing the Hypothesis

The hypothesis stated in chapter one stated.

*"There are many uses and benefits of data and trend analysis and plays a significant role in the management of construction companies."*

The research resulted in a formal definition of data trend analysis. Today data trend analysis often refers to the science of studying changes in social and socio economic patterns, having a significant effect on business. The research discovered a comprehensive guiding process which might require certain technical skill and knowledge, especially statistical, as data analysis leans towards it. The research uncovered more about data analysis as a means of diagnosing the financial health of a company based on the statistics and financial management techniques. The research also revealed that many professional bodies and institutions are also responsible for production and analysis of industry data, to evaluate the industry against global standards and local demands

The hypothesis was vague and this suggests lack of in depth knowledge at the time the hypothesis was formulated. Although it is part correct the hypothesis was not specific about the uses and benefits it was referring to. Nonetheless the research was successful in proving the hypothesis. The entire report served as a more detailed breakdown of the hypothesis. The supporting information exceeded expectation and was on point in addressing the main problem.

### 6.4 Recommendation

Although the construction industry is a science, the research has revealed the importance of business management studies in the construction management field of study. Tertiary institutions must encourage graduates in each discipline to learn

about related disciplines. It has been suggested that teachers at tertiary institutions are not sufficiently comfortable with their own knowledge of related disciplines and therefore rarely encourage students to pursue multi-disciplinary paths. The reports all over the world stress the need for greater integration of processes within the industry. (CSIR Boutek, 2009) For the future more research will be conducted on, “The synthesis of statistics and financial management as an essential ability for the construction manager?”

# Bibliography


www.ameinfo.com

www.coolsurveys.com

www.robertniles.com

www.qualisresearch.com

www.wikipedia.org

Adrian, J.J and Adrian, D.J. 1999. Construction Accounting. Stipes Publishing L.L.C. Illinois, USA.

Albertus J. Trends in the construction of dwelling units in PE, University of Pretoria.

Annual Report 2005/2006 of the Construction Industry Development Board Construction Industry Development Board (CIDB) Construction Industry Indicators (CII) survey for 2009.

Australian project time-cost analysis: statistical analysis of intertemporal trends.

Cryer, Jonathan D. Time series analysis: with applications. New York: Springer 2008 2nd edition

Colorado State University. Writing@CSU survey research writing guide. (http://writing.colostate.edu/guides/research/survey/

Construction Education and Training Authority (CETA) sector skills plan 2007 – 2008

Dononhue, E. Survey techniques and tactics. PowerPoint Presentation, 2004 ( http://www.nysfirm.org/documents/pdf/wmg/survey.pdf)

Dun & Bradstreet, Inc. Industrial Norms and Key Business Ratio, years 1997 through 2005

Hong-Minh S.M. Barker R. and Naim M.M. Construction supply chain trend analysis, 26-28 July 1999, University of California, Berkeley, CA, USA

Lucas W.H. and Morrison T.L. 1981 "Management Accounting for Construction Contracts," Management Accounting,

Richard F, and David L. 2002. Construction management in practice.

Roper K and Mclin M. 2010. “Key Performance Indicators drive best for general contractors”

Petersen, S.J.2005. Construction Accounting and Financial Accounting .U.S.A: Pearson Prentice Hall.

School of Construction Management and Property, Queensland University of Technology

Smallwood. J PhD (Constr Man) Pr CM FCIOB MACPM MESSA MICOH MIoSM Researcher and Partner, CREATE, 2010

Steyn H. 2008. Project management, a multi disciplinary approach, 2nd Edition. Funda Project Management. (Pty) Ltd.

The Construction Industry Development Board (CIDB) Construction Industry Indicators Summary Results: 2009.

van Wyk L.2004, A Review of the South African Construction Industry Part 3: CSIR Boutek The Built Environment Professions.

van Wyk L. CSIR Building and Construction Technology. Current trends impacting on construction Industry participants internationally

# Annexure 1. Types of possible trend curves in long-term forecasting

**Figure 5. Straight line trend**

Source: wikipedia

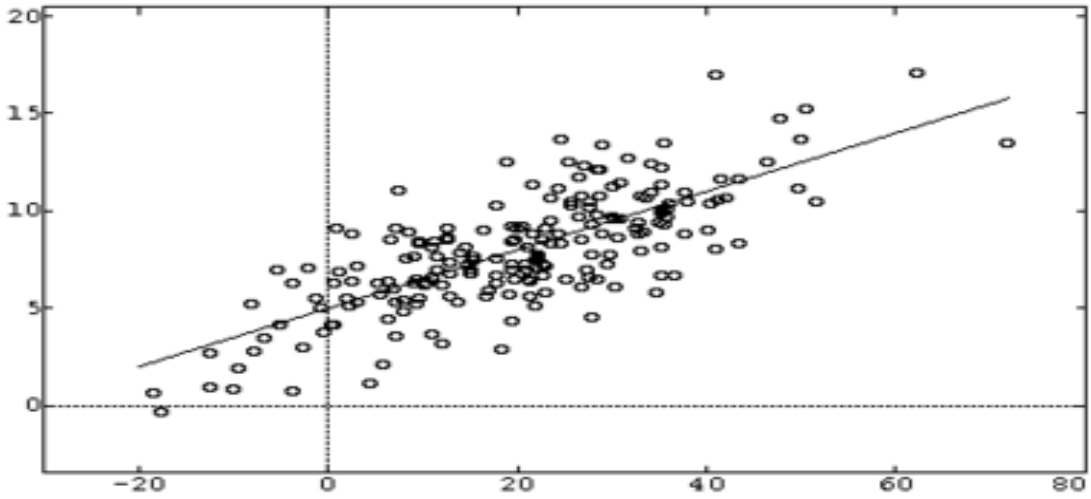



**Figure 6, Simple exponential curve**

Source: wikipedia

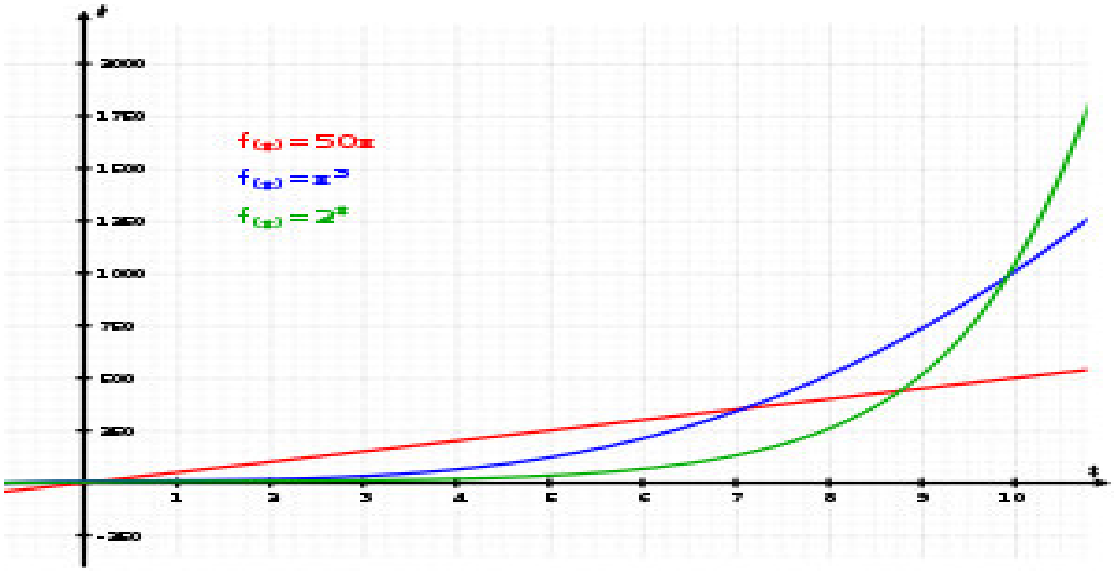


**Figure 7. Parabola**

Source: wikipedia

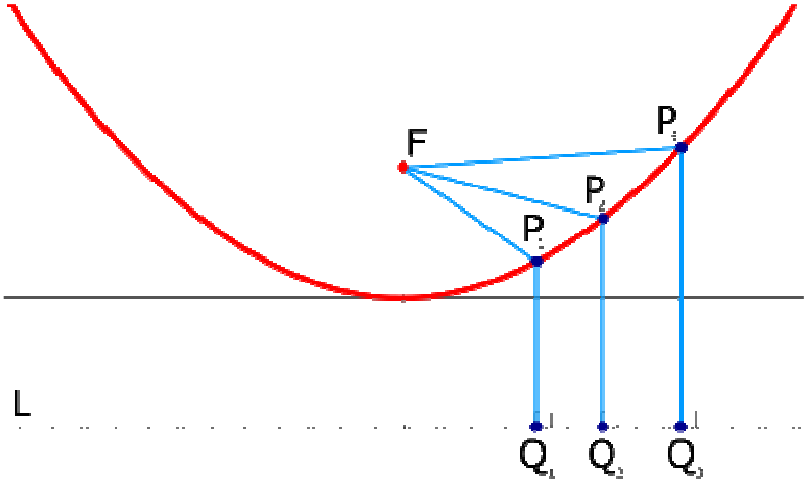



**Figure 8. Log parabola**

Source: wikipedia

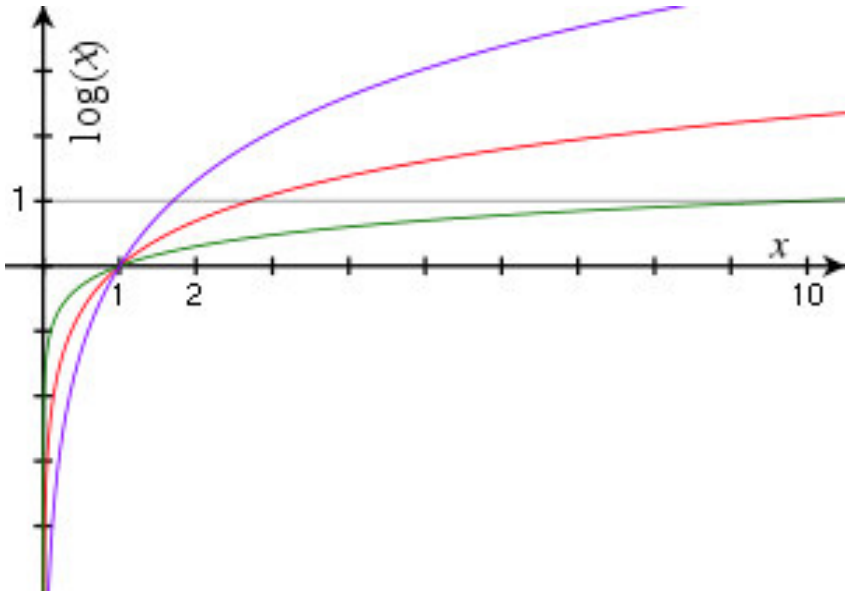


**Figure 9. Modified exponential**

Source: www.cpc.unc.edu

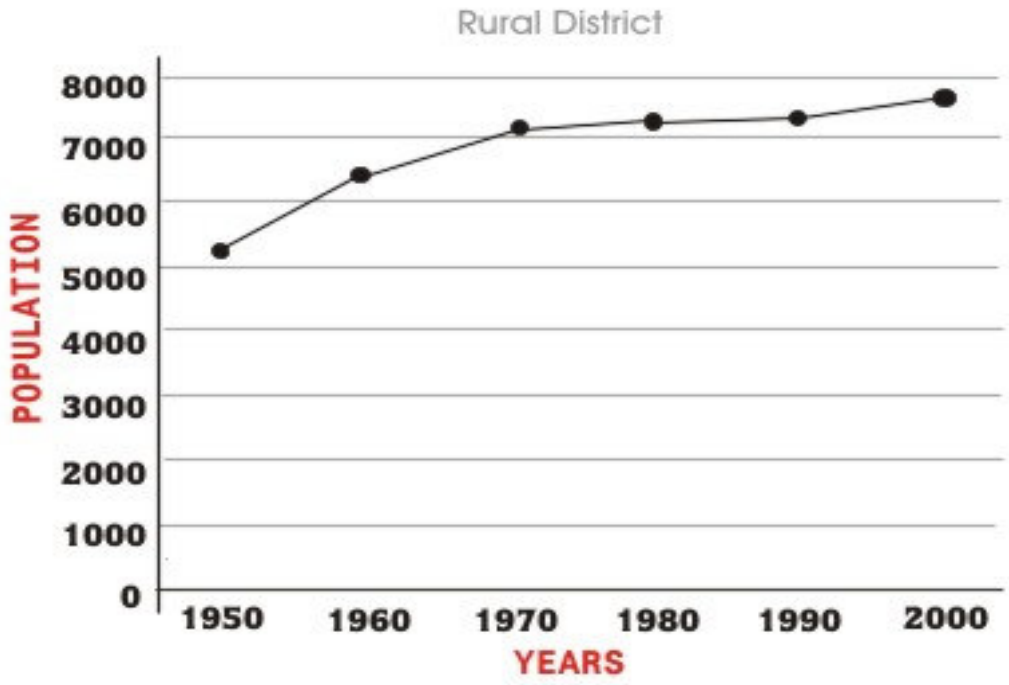



**Figure 10. Logistic curve**

Source: frontier economy

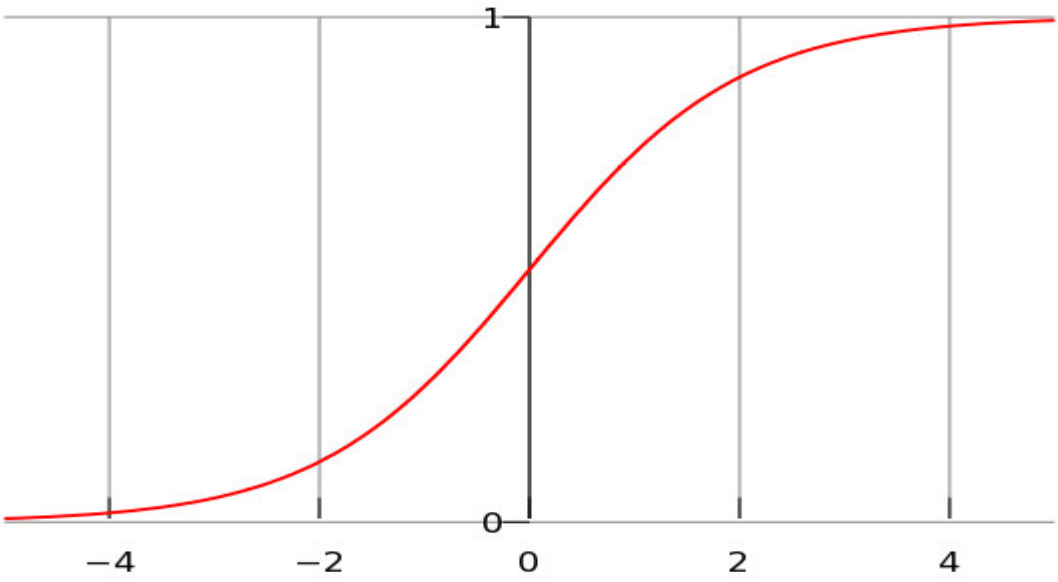
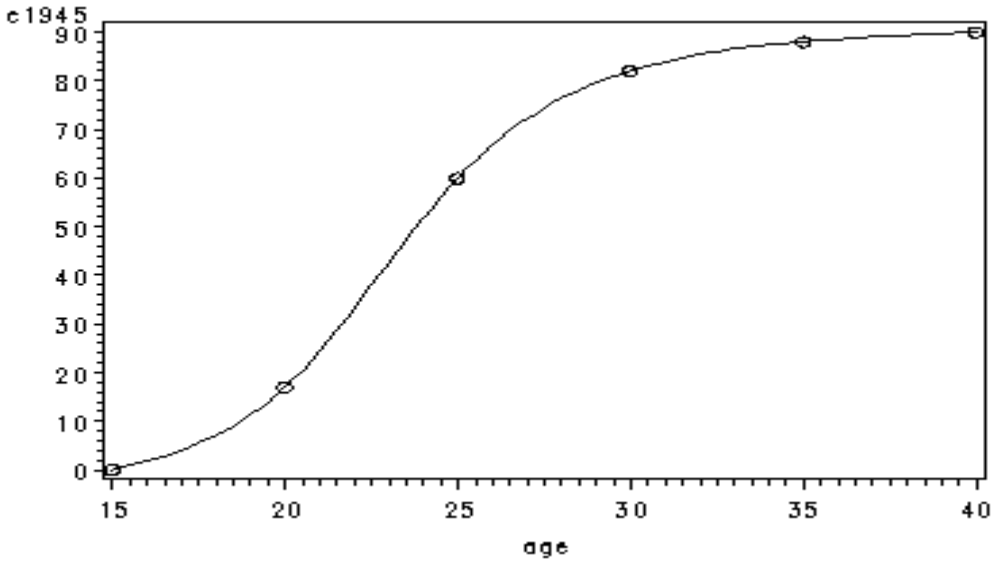
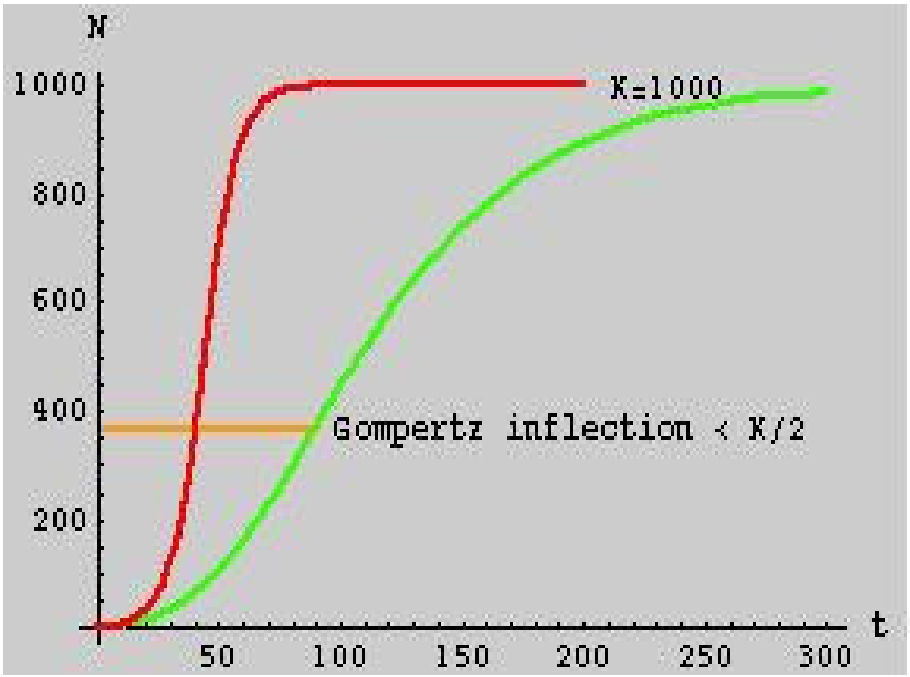


**Figure 11. Gompertz curves**

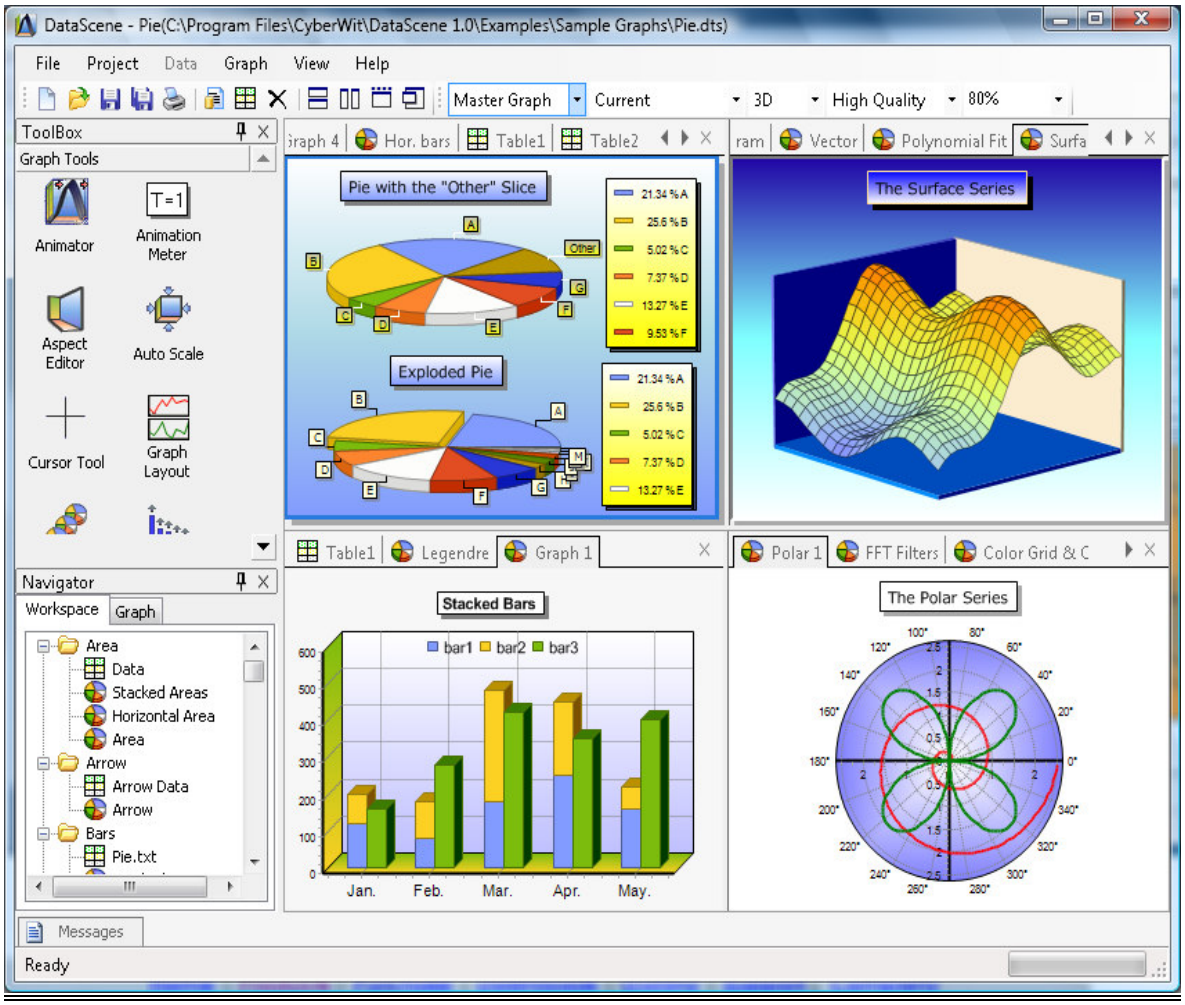



Source: of UCLA




Source: UWYO

**Figure 12. Other graphs illustrated on data survey software programme**



# Annexure 2.

## Example of survey questionnaire of a study being undertaken for the CIDB to determine the status of construction quality.

### Figure 13. Example of survey questionnaire

---

**QUALITY IN SOUTH AFRICAN CONSTRUCTION (PROJECT MANAGERS)**

1. On a scale of **1 (totally disagree)** to **5 (totally agree),** to what extent do you agree with the following definitions of quality **(please**

**note the 'unsure' option)**?

| | **Definition** | **Unsure** | **Totally disagree……Totally agree** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 1.1 | Best practice | U | 1 | 2 | 3 | 4 | 5 |
| 1.2 | Conformance to customer requirements | U | 1 | 2 | 3 | 4 | 5 |
| 1.3 | Conformance to requirements | U | 1 | 2 | 3 | 4 | 5 |
| 1.4 | Customer satisfaction | U | 1 | 2 | 3 | 4 | 5 |
| 1.5 | Durability | U | 1 | 2 | 3 | 4 | 5 |
| 1.6 | Excellence | U | 1 | 2 | 3 | 4 | 5 |
| 1.7 | Doing things right in every part and level of the organisation | U | 1 | 2 | 3 | 4 | 5 |

2. On a scale of **1 (not important)** to **5 (very important),** how important are the following parameters to **your organisation (please note the 'unsure' option)**?

| | Parameter | Unsure | Not ……..…… Very | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 2.1 | Cost | U | 1 | 2 | 3 | 4 | 5 |
| 2.2 | Environment | U | 1 | 2 | 3 | 4 | 5 |
| 2.3 | Health and safety (H&S) | U | 1 | 2 | 3 | 4 | 5 |
| 2.4 | Quality | U | 1 | 2 | 3 | 4 | 5 |
| 2.5 | Time | U | 1 | 2 | 3 | 4 | 5 |

3. On a scale of **1 (not important)** to **5 (very important),** how important are the following parameters to **built environment practitioners and stakeholders (please note the 'unsure' option)**?

| | Parameter | Unsure | Not ……..…… Very | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 3.1 | Cost | U | 1 | 2 | 3 | 4 | 5 |
| 3.2 | Environment | U | 1 | 2 | 3 | 4 | 5 |
| 3.3 | Health and safety (H&S) | U | 1 | 2 | 3 | 4 | 5 |
| 3.4 | Quality | U | 1 | 2 | 3 | 4 | 5 |
| 3.5 | Time | U | 1 | 2 | 3 | 4 | 5 |

4. On a scale of **1 (not important)** to **5 (very important),** how important is **quality** to the following **built environment practitioners / stakeholders (please note the 'unsure' option)**?

| | Practitioner / Stakeholder | Unsure | Not ……..…… Very | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 4.1 | Architects | U | 1 | 2 | 3 | 4 | 5 |
| 4.2 | Contractors: | | | | | | |
| 4.2.1 | • General (cidb grades 2-4) | U | 1 | 2 | 3 | 4 | 5 |
| 4.2.2 | • General (cidb grades 5-9) | U | 1 | 2 | 3 | 4 | 5 |
| 4.2.3 | • Trade | U | 1 | 2 | 3 | 4 | 5 |
| 4.2.4 | • Labour only | U | 1 | 2 | 3 | 4 | 5 |
| 4.3 | Engineering designers: | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 4.3.1 | • Civil | U | 1 | 2 | 3 | 4 | 5 |
| 4.3.2 | • Electrical | U | 1 | 2 | 3 | 4 | 5 |
| 4.3.3 | • Mechanical | U | 1 | 2 | 3 | 4 | 5 |
| 4.3.4 | • Structural | U | 1 | 2 | 3 | 4 | 5 |
| 4.4 | Project managers | U | 1 | 2 | 3 | 4 | 5 |
| 4.5 | Quantity surveyors | U | 1 | 2 | 3 | 4 | 5 |
| 4.6 | Materials manufacturers | U | 1 | 2 | 3 | 4 | 5 |

5. On a scale of **1 (very poor)** to **5 (very good)**, rate the following built environment practitioners in terms of their performance relative to quality **(please note the 'unsure' option)**?

| | **Practitioner / Stakeholder** | **Unsure** | **Very poor ……..……..Very good** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 5.1 | Architects | U | 1 | 2 | 3 | 4 | 5 |
| 5.2 | Contractors: | | | | | | |
| 5.2.1 | • General (cidb grades 2-4) | U | 1 | 2 | 3 | 4 | 5 |
| 5.2.2 | • General (cidb grades 5-9) | U | 1 | 2 | 3 | 4 | 5 |
| 5.2.3 | • Trade | U | 1 | 2 | 3 | 4 | 5 |
| 5.2.4 | • Labour only | U | 1 | 2 | 3 | 4 | 5 |
| 5.3 | Engineering designers: | | | | | | |
| 5.3.1 | • Civil | U | 1 | 2 | 3 | 4 | 5 |
| 5.3.2 | • Electrical | U | 1 | 2 | 3 | 4 | 5 |
| 5.3.3 | • Mechanical | U | 1 | 2 | 3 | 4 | 5 |
| 5.3.4 | • Structural | U | 1 | 2 | 3 | 4 | 5 |
| 5.4 | Project managers | U | 1 | 2 | 3 | 4 | 5 |
| 5.5 | Quantity surveyors | U | 1 | 2 | 3 | 4 | 5 |
| 5.6 | Materials manufacturers | U | 1 | 2 | 3 | 4 | 5 |

6. On a scale of **1 (minor)** to **5 (major)**, rate the following stakeholders in terms of their **contribution** to construction quality **(please note the 'unsure' option)**?

| | Stakeholder | Unsure | Minor…… ……Major | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 6.1 | Clients | U | 1 | 2 | 3 | 4 | 5 |
| 6.2 | Financiers | U | 1 | 2 | 3 | 4 | 5 |
| 6.3 | Materials suppliers | U | 1 | 2 | 3 | 4 | 5 |
| 6.4 | Plant and equipment manufacturers | U | 1 | 2 | 3 | 4 | 5 |
| 6.5 | Dept. of Public Works | U | 1 | 2 | 3 | 4 | 5 |
| 6.6 | Dept. of Human Settlements (Housing) | U | 1 | 2 | 3 | 4 | 5 |
| 6.7 | Local authorities (Municipalities) | U | 1 | 2 | 3 | 4 | 5 |
| 6.8 | cidb | U | 1 | 2 | 3 | 4 | 5 |
| 6.9 | South African Bureau of Standards | U | 1 | 2 | 3 | 4 | 5 |
| 6.10 | MBSA | U | 1 | 2 | 3 | 4 | 5 |
| 6.11 | MBAs | U | 1 | 2 | 3 | 4 | 5 |
| 6.12 | SAFCEC | U | 1 | 2 | 3 | 4 | 5 |
| 6.13 | Unions | U | 1 | 2 | 3 | 4 | 5 |
| 6.14 | CETA | U | 1 | 2 | 3 | 4 | 5 |
| 6.15 | NHBRC | U | 1 | 2 | 3 | 4 | 5 |
| 6.16 | SAPOA | U | 1 | 2 | 3 | 4 | 5 |
| 6.17 | Council for the Built Environment | U | 1 | 2 | 3 | 4 | 5 |
| 6.18 | Built Environment Councils e.g. ECSA | U | 1 | 2 | 3 | 4 | 5 |
| 6.19 | Built Environment Professional Associations / Institutes e.g. ASAQS | U | 1 | 2 | 3 | 4 | 5 |
| 6.20 | Industry associations e.g. Concrete Manufacturers Association (CMA) | U | 1 | 2 | 3 | 4 | 5 |
| 6.21 | Tertiary Education Institutions | U | 1 | 2 | 3 | 4 | 5 |
| 6.22 | Further Education Training Colleges | U | 1 | 2 | 3 | 4 | 5 |
| 6.23 | Construction Industry Media | U | 1 | 2 | 3 | 4 | 5 |

7. On a scale of **1 (very poor)** to **5 (very good)**, rate **South African** construction quality **(please note the 'unsure' option)**?

| Unsure | Very poor ……..… Very good | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |

8. On a scale of **1 (very poor)** to **5 (very good)**, rate the various sectors of the **South African** construction industry relative to quality **(please note the 'unsure' option)**?

| | Sector | Unsure | Very poor ……Very good | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| 8.1 | Commercial | U | 1 | 2 | 3 | 4 | 5 |
| 8.2 | Industrial | U | 1 | 2 | 3 | 4 | 5 |
| 8.3 | Infrastructure | U | 1 | 2 | 3 | 4 | 5 |
| 8.4 | Residential: | | | | | | |
| 8.4.1 | • Low-income | U | 1 | 2 | 3 | 4 | 5 |
| 8.4.2 | • Middle-income | U | 1 | 2 | 3 | 4 | 5 |
| 8.4.3 | • Upper-income | U | 1 | 2 | 3 | 4 | 5 |

9. On a scale of **1 (not)** to **5 (very)**, how important are the following interventions / systems relative to the achievement of quality **(please note the 'unsure' response)**?

| | Intervention / System | Unsure | Not …….…… Very | | | | |
|---|---|---|---|---|---|---|---|
| | | | 1 | 2 | 3 | 4 | 5 |
| 9.1 | Quality assurance | U | 1 | 2 | 3 | 4 | 5 |
| 9.2 | Quality control | U | 1 | 2 | 3 | 4 | 5 |
| 9.3 | Quality improvement | U | 1 | 2 | 3 | 4 | 5 |
| 9.4 | Quality management system | U | 1 | 2 | 3 | 4 | 5 |
| 9.5 | Total quality management | U | 1 | 2 | 3 | 4 | 5 |

10. On a scale of **1 (hardly)** to **5 (definitely)**, to what extent is quality and quality management regarded as …… **(please note the 'unsure' and 'not' responses)**?

| | Approach | Unsure | Not | Hardly……Definitely | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 |
| 10.1 | Operational | U | N | 1 | 2 | 3 | 4 | 5 |
| 10.2 | Administrative | U | N | 1 | 2 | 3 | 4 | 5 |
| 10.3 | Strategic | U | N | 1 | 2 | 3 | 4 | 5 |
| 10.4 | Normative | U | N | 1 | 2 | 3 | 4 | 5 |

11. On a scale of **1 (minor)** to **5 (major)**, to what extent is quality and quality management driven by the following drivers **(please note the 'unsure' and 'is not' options, and that i.t.o. = in terms of)**?

| | Driver | Unsure | Is not | Minor…… Major | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | 1 | 2 | 3 | 4 | 5 |
| 11.1 | Short-term view | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.2 | Profitability | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.3 | Levels of output or productivity | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.4 | Quality circles | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.5 | Work improvement teams | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.6 | Allocation, use and control of operational resources | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.7 | Data and information | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.8 | Recorded outcomes and achievements i.t.o. volume / output | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.9 | Recorded outcomes and achievements i.t.o. quality | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.10 | Recorded outcomes and achievements i.t.o. training | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.11 | Recorded outcomes and achievements i.t.o. reward systems / incentives | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.12 | Recorded outcomes and achievements i.t.o. procurement of equipment and material | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.1 | Desirable results | U | IN | 1 | 2 | 3 | 4 | 5 |

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 3 | | | | | | | | |
| 11.14 | Probable outcomes | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.15 | Benchmarking | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.16 | Innovation and creativity | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.17 | Management commitment and involvement | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.18 | Customer expectations | U | IN | 1 | 2 | 3 | 4 | 5 |
| 11.19 | Mission statement, vision and values | U | IN | 1 | 2 | 3 | 4 | 5 |

12. Does your organisation have a documented Quality Management System?

| **Unsure** | **No** | **Yes** |
|---|---|---|
| | | |

12.1 If 'Yes', is your organisation ISO 9000 series certified?

| **Unsure** | **No** | **Yes** |
|---|---|---|
| | | |

12.2 If 'No', to ISO 9000 series certification, does it intend to acquire such certification?

| **Unsure** | **No** | **Yes** |
|---|---|---|
| | | |

13. On a scale of **1 (minor) to 5 (major)**, to what extent does **your organisation** make use of the following practices / systems to achieve quality **(please note the 'unsure' response)**?

| | **Practices / System** | **Unsure** | **Minor …… Major** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 13.1 | Documented Quality Management System | U | 1 | 2 | 3 | 4 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 13.2 | Checklists | U | 1 | 2 | 3 | 4 | 5 |
| 13.3 | Client briefing | U | 1 | 2 | 3 | 4 | 5 |
| 13.4 | Value management | U | 1 | 2 | 3 | 4 | 5 |
| 13.5 | Constructability reviews | U | 1 | 2 | 3 | 4 | 5 |
| 13.6 | Coordination meetings | U | 1 | 2 | 3 | 4 | 5 |
| 13.7 | Samples / References | U | 1 | 2 | 3 | 4 | 5 |
| 13.8 | Inspections / Visual checks | U | 1 | 2 | 3 | 4 | 5 |
| 13.9 | Tests | U | 1 | 2 | 3 | 4 | 5 |
| 13.10 | Close out report | U | 1 | 2 | 3 | 4 | 5 |

14. On a scale of **1 (minor)** to **5 (major)**, to what extent do the following perspectives / practices / situations contribute to the achievement of quality in **your organisation / in your organisation relative to projects, and on projects (please note the 'unsure' response)**?

| | **Perspective / Practice / Situation** | **Unsure** | **Minor……Major** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 14.1 | Management commitment: | | | | | | |
| 14.1.1 | • Top | U | 1 | 2 | 3 | 4 | 5 |
| 14.1.2 | • Middle | U | 1 | 2 | 3 | 4 | 5 |
| 14.1.3 | • Project | U | 1 | 2 | 3 | 4 | 5 |
| 14.2 | Thorough understanding of quality | U | 1 | 2 | 3 | 4 | 5 |
| 14.3 | Commitment to certification | U | 1 | 2 | 3 | 4 | 5 |
| 14.4 | Holistic understanding of the role of quality | U | 1 | 2 | 3 | 4 | 5 |
| 14.5 | Wish to improve work processes | U | 1 | 2 | 3 | 4 | 5 |
| 14.6 | Focus on assurance to achieve quality | U | 1 | 2 | 3 | 4 | 5 |
| 14.7 | Optimum quality assurance | U | 1 | 2 | 3 | 4 | 5 |
| 14.8 | Experienced project supervision (project manager) | U | 1 | 2 | 3 | 4 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.9 | Completion of paper work | U | 1 | 2 | 3 | 4 | 5 |
| 14.10 | Adequate supervision | U | 1 | 2 | 3 | 4 | 5 |
| 14.11 | Adequate generic training | U | 1 | 2 | 3 | 4 | 5 |
| 14.12 | Adequate quality training | U | 1 | 2 | 3 | 4 | 5 |
| 14.13 | Adequate project manager skills | U | 1 | 2 | 3 | 4 | 5 |
| 14.14 | Adequate resources | U | 1 | 2 | 3 | 4 | 5 |
| 14.15 | Adequate planning in general | U | 1 | 2 | 3 | 4 | 5 |
| 14.16 | Adequate work organisation | U | 1 | 2 | 3 | 4 | 5 |
| 14.17 | Appropriate selection of design team | U | 1 | 2 | 3 | 4 | 5 |
| 14.18 | Adequate project duration | U | 1 | 2 | 3 | 4 | 5 |
| 14.19 | Appropriate design fee | U | 1 | 2 | 3 | 4 | 5 |
| 14.20 | Appropriate rates paid to consultants | U | 1 | 2 | 3 | 4 | 5 |
| 14.21 | Reporting on non-conformances | U | 1 | 2 | 3 | 4 | 5 |
| 14.22 | Consideration for health and safety (construction) | U | 1 | 2 | 3 | 4 | 5 |
| 14.23 | Optimum weather | U | 1 | 2 | 3 | 4 | 5 |
| 14.24 | Appropriate specifications | U | 1 | 2 | 3 | 4 | 5 |
| 14.25 | Appropriate details | U | 1 | 2 | 3 | 4 | 5 |
| 14.26 | Constructability of design | U | 1 | 2 | 3 | 4 | 5 |
| 14.27 | Limited variations | U | 1 | 2 | 3 | 4 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 14.28 | Conformance to standards | U | 1 | 2 | 3 | 4 | 5 |

15. On a scale of **1 (minor) to 5 (major)**, to what extent could the following perspectives / practices / situations improve or contribute to an improvement in quality in **South African** construction **(please note the 'unsure' response)**?

| | **Perspectives / Practices / Situations** | **Unsure** | **Minor ……..……..…… Major** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 15.1 | Reengineering | U | 1 | 2 | 3 | 4 | 5 |
| 15.2 | Integration of design and construction | U | 1 | 2 | 3 | 4 | 5 |
| 15.3 | Partnering | U | 1 | 2 | 3 | 4 | 5 |
| 15.4 | Client actions | U | 1 | 2 | 3 | 4 | 5 |
| 15.5 | Designer Quality Management Systems | U | 1 | 2 | 3 | 4 | 5 |
| 15.6 | Designer ISO 9000 series certification | U | 1 | 2 | 3 | 4 | 5 |
| 15.7 | Design (Appropriate) | U | 1 | 2 | 3 | 4 | 5 |
| 15.8 | Details (Appropriate) | U | 1 | 2 | 3 | 4 | 5 |
| 15.9 | Specification (Appropriate) | U | 1 | 2 | 3 | 4 | 5 |
| 15.10 | Optimum project duration | U | 1 | 2 | 3 | 4 | 5 |
| 15.11 | Contract documentation | U | 1 | 2 | 3 | 4 | 5 |
| 15.12 | Quality prequalification | U | 1 | 2 | 3 | 4 | 5 |
| 15.13 | Contractor project quality plans | U | 1 | 2 | 3 | 4 | 5 |
| 15.14 | Contractor Quality Management Systems | U | 1 | 2 | 3 | 4 | 5 |
| 15.15 | Contractor ISO 9000 series certification | U | 1 | 2 | 3 | 4 | 5 |
| 15.16 | Organisation culture | U | 1 | 2 | 3 | 4 | 5 |
| 15.17 | Management commitment (all stakeholders) | U | 1 | 2 | 3 | 4 | 5 |
| 15.18 | Goal setting | U | 1 | 2 | 3 | 4 | 5 |
| 15.19 | Measurement: | | | | | | |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15.19.1 | • Performance e.g. percentage of workers trained in quality | U | 1 | 2 | 3 | 4 | 5 |
| 15.19.2 | • Outcome e.g. No. of defects, cost of rework | U | 1 | 2 | 3 | 4 | 5 |
| 15.20 | Benchmarking | U | 1 | 2 | 3 | 4 | 5 |
| 15.21 | Education in quality | U | 1 | 2 | 3 | 4 | 5 |
| 15.22 | Training in quality | U | 1 | 2 | 3 | 4 | 5 |
| 15.23 | Standard operating procedures (SOPs) | U | 1 | 2 | 3 | 4 | 5 |
| 15.24 | Safe work procedures (SWPs) | U | 1 | 2 | 3 | 4 | 5 |
| 15.25 | Quality improvement processes | U | 1 | 2 | 3 | 4 | 5 |
| 15.26 | Worker participation | U | 1 | 2 | 3 | 4 | 5 |
| 15.27 | Quality circles / forums | U | 1 | 2 | 3 | 4 | 5 |
| 15.28 | Union prioritisation | U | 1 | 2 | 3 | 4 | 5 |

16. On a scale of **1 (minor) to 5 (major)**, to what extent do the following interventions / situations negatively affect quality / constitute a barrier to the achievement of quality in **South African** construction **(please note the 'unsure' response)**?

| | **Interventions / Situations** | **Unsure** | **Minor ……. Major** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 16.1 | Cyclical industry | U | 1 | 2 | 3 | 4 | 5 |
| 16.2 | Corruption | U | 1 | 2 | 3 | 4 | 5 |
| 16.3 | Archaic processes (design and construction) | U | 1 | 2 | 3 | 4 | 5 |
| 16.4 | Separation of design and construction | U | 1 | 2 | 3 | 4 | 5 |
| 16.5 | Lack of partnering | U | 1 | 2 | 3 | 4 | 5 |
| 16.6 | Lack of understanding of quality | U | 1 | 2 | 3 | 4 | 5 |
| 16.7 | Lack of insight relative to the role of quality | U | 1 | 2 | 3 | 4 | 5 |
| 16.8 | Lack of 'design team' management commitment | U | 1 | 2 | 3 | 4 | 5 |
| 16.9 | Lack of Quality Management Systems in design | U | 1 | 2 | 3 | 4 | 5 |
| 16.10 | Lack of designer quality expertise | U | 1 | 2 | 3 | 4 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.11 | Design | U | 1 | 2 | 3 | 4 | 5 |
| 16.12 | Detail | U | 1 | 2 | 3 | 4 | 5 |
| 16.13 | Specification | U | 1 | 2 | 3 | 4 | 5 |
| 16.14 | Poor constructability | U | 1 | 2 | 3 | 4 | 5 |
| 16.15 | Inadequate information | U | 1 | 2 | 3 | 4 | 5 |
| 16.16 | Inappropriate project durations | U | 1 | 2 | 3 | 4 | 5 |
| 16.17 | Contract documentation | U | 1 | 2 | 3 | 4 | 5 |
| 16.18 | Lack of pre-qualification on quality | U | 1 | 2 | 3 | 4 | 5 |
| 16.19 | Competitive tendering | U | 1 | 2 | 3 | 4 | 5 |
| 16.20 | Focus on cost by clients | U | 1 | 2 | 3 | 4 | 5 |
| 16.21 | Focus on time by clients | U | 1 | 2 | 3 | 4 | 5 |
| 16.22 | Focus on cost by contractors | U | 1 | 2 | 3 | 4 | 5 |
| 16.23 | Focus on time by contractors | U | 1 | 2 | 3 | 4 | 5 |
| 16.24 | Ineffective contractor registration | U | 1 | 2 | 3 | 4 | 5 |
| 16.25 | Lack of minimum requirement to contract | U | 1 | 2 | 3 | 4 | 5 |
| 16.26 | Focus on quality control | U | 1 | 2 | 3 | 4 | 5 |
| 16.27 | Reliance on inspections | U | 1 | 2 | 3 | 4 | 5 |
| 16.28 | Lack of ‘construction’ management commitment | U | 1 | 2 | 3 | 4 | 5 |
| 16.29 | Lack of Quality Management Systems in construction | U | 1 | 2 | 3 | 4 | 5 |
| 16.30 | Poor site management (planning, organising, leading, controlling, and coordinating) | U | 1 | 2 | 3 | 4 | 5 |
| 16.31 | Inadequate resourcing by contractors | U | 1 | 2 | 3 | 4 | 5 |
| 16.32 | Lack of contractor quality expertise | U | 1 | 2 | 3 | 4 | 5 |
| 16.33 | Level of subcontracting | U | 1 | 2 | 3 | 4 | 5 |
| 16.34 | Variations | U | 1 | 2 | 3 | 4 | 5 |
| 16.35 | Inadequate quality related tertiary education: | | | | | | |
| 16.35.1 | • Construction manager | U | 1 | 2 | 3 | 4 | 5 |
| 16.35.2 | • Architect | U | 1 | 2 | 3 | 4 | 5 |
| 16.35.3 | • Engineer | U | 1 | 2 | 3 | 4 | 5 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 16.35.4 | • Project manager | U | 1 | 2 | 3 | 4 | 5 |
| 16.35.5 | • Quantity surveyor | U | 1 | 2 | 3 | 4 | 5 |
| 16.36 | Inadequate generic skills training | U | 1 | 2 | 3 | 4 | 5 |
| 16.37 | Inadequate skills quality training | U | 1 | 2 | 3 | 4 | 5 |
| 16.38 | Inadequate production skills | U | 1 | 2 | 3 | 4 | 5 |
| 16.39 | Lack of worker participation | U | 1 | 2 | 3 | 4 | 5 |
| 16.40 | Lack of quality improvement processes | U | 1 | 2 | 3 | 4 | 5 |

17. Measurement:

17.1 Which of the following quality related measures does **your organisation** undertake **(please note the 'unsure' response)**?

| | **Measure** | **Unsure** | **No** | **Yes** |
|---|---|---|---|---|
| 17.1.1 | No. of defects | U | No | Yes |
| 17.1.2 | No. of test failures | U | No | Yes |
| 17.1.3 | Cost of rework | U | No | Yes |
| 17.1.4 | Other: | | | Yes |
| 17.1.5 | Other: | | | Yes |

**If 'Other', please record adjacent to 'Other' in the matrix above.**

17.2 If your organisation measures rework, what percentage does it constitute of:

17.2.1 Project / Fee cost: _____%

17.2.2 Project / Fee value: _____%

18. On a scale of **1 (limited)** to **5 (extensive)**, how would you rate your knowledge of quality **(please note the 'unsure' option)**?

| Unsure | Limited ……. Extensive | | | | |
|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 |

19. On a scale of **1 (minor)** to **5 (major)**, to what extent did the following contribute to **your** acquisition of quality related knowledge **(please note the 'unsure' option)**?

| | Source | Unsure | Minor …… Major | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 19.1 | Conference papers | U | 1 | 2 | 3 | 4 | 5 |
| 19.2 | CPD seminars / workshops | U | 1 | 2 | 3 | 4 | 5 |
| 19.3 | Experience | U | 1 | 2 | 3 | 4 | 5 |
| 19.4 | Journal papers | U | 1 | 2 | 3 | 4 | 5 |
| 19.5 | Magazine articles | U | 1 | 2 | 3 | 4 | 5 |
| 19.6 | Post-graduate qualifications | U | 1 | 2 | 3 | 4 | 5 |
| 19.7 | Practice notes | U | 1 | 2 | 3 | 4 | 5 |
| 19.8 | University /Technikon (University of Technology) / College education | U | 1 | 2 | 3 | 4 | 5 |
| 19.9 | In-house training | U | 1 | 2 | 3 | 4 | 5 |
| 19.10 | External training | U | 1 | 2 | 3 | 4 | 5 |
| 19.11 | Workshops | U | 1 | 2 | 3 | 4 | 5 |
| 19.12 | Short courses | U | 1 | 2 | 3 | 4 | 5 |
| 19.13 | Other: | | 1 | 2 | 3 | 4 | 5 |
| 19.14 | Other: | | 1 | 2 | 3 | 4 | 5 |

**If 'Other', please record adjacent to 'Other' in the matrix above.**

20. On a scale of **1 (minor) to 5 (major)**, to what extent does rework (work required to rectify / improve partially complete or complete work to conform to requirements or standards) negatively affect the following parameters **(please note the 'unsure' response)**?

| | **Parameter** | **Unsure** | **Minor…… ……Major** | | | | |
|---|---|---|---|---|---|---|---|
| | | | **1** | **2** | **3** | **4** | **5** |
| 20.1 | Cost of construction | U | 1 | 2 | 3 | 4 | 5 |
| 20.2 | Environment | U | 1 | 2 | 3 | 4 | 5 |
| 20.3 | Health and safety | U | 1 | 2 | 3 | 4 | 5 |
| 20.4 | Productivity | U | 1 | 2 | 3 | 4 | 5 |
| 20.5 | Quality | U | 1 | 2 | 3 | 4 | 5 |
| 20.6 | Time | U | 1 | 2 | 3 | 4 | 5 |
| 20.7 | Client satisfaction | U | 1 | 2 | 3 | 4 | 5 |
| 20.8 | Contractor satisfaction | U | 1 | 2 | 3 | 4 | 5 |
| 20.9 | Designer satisfaction | U | 1 | 2 | 3 | 4 | 5 |
| 20.10 | Worker satisfaction | U | 1 | 2 | 3 | 4 | 5 |
| 20.11 | Other: | | 1 | 2 | 3 | 4 | 5 |
| 20.12 | Other: | | 1 | 2 | 3 | 4 | 5 |

**If 'Other', please record adjacent to 'Other' in the matrix above.**

21. What percentage **(approximate)** of your project managers have received training in quality **(please note the 'unsure' response)**?

_____%

22. Business volume:

22.1 What was your annual business volume in 2009: _____

22.2 What is your average business volume based upon the last three years (2007, 2008, and 2009): _____

23. Please indicate the percentage of your annual business volume (approximate) that your organisation undertakes relative to the provinces and outside of South Africa **(please note the outside South Africa option and that the percentages must total 100%)**:

| | Province | Percentage |
|---|---|---|
| 23.1 | Eastern Cape | |
| 23.2 | Free State | |
| 23.3 | Gauteng | |
| 23.4 | Kwazulu-Natal | |
| 23.5 | Limpopo | |
| 23.6 | Mpumalanga | |
| 23.7 | Northern Cape | |
| 23.8 | North West | |
| 23.9 | Western Cape | |
| 23.10 | Outside South Africa | |
| 23.11 | **Total** | |

24. Is your organisation a member of an association?

| Unsure | No | Yes |
|---|---|---|
| | | |

24.1 If 'Yes', please state: _____

25. What categories of construction did your organisation provide project management services for during 2009 – please state the approximate percentage contributions **(please note the percentages must total 100%)**?

| | Category | % |
|---|---|---|
| 25.1 | Commercial | |
| 25.2 | Industrial | |
| 25.3 | Infrastructure | |
| 25.4 | Residential | |
| 25.5 | Other: | |
| 25.6 | **Total** | |

If 'Other', please state: _____

26. What level of work did your organisation provide project management services for during 2009 - please state the approximate percentage contributions **(please note the percentages must total 100%)**?

| | Category | % |
|---|---|---|
| 26.1 | Below ground | |
| 26.2 | Ground | |
| 26.3 | Single storey | |
| 26.4 | Double storey | |
| 26.5 | 0-10 Floors | |
| 26.6 | 0-20 Floors | |
| 26.7 | Other | |
| 26.8 | **Total** | |

If 'Other', please state: _____

27. On average, how many project managers did your organisation employ in 2009:

_____ No.

28. Do you have any comments in general regarding quality in **South African** construction?

Please record your details below to facilitate contacting you, in the event that a query should arise. **Please note that the data provided in this questionnaire will be treated in the strictest confidence.**

NAME: _____ PHONE: ( ) _____

ADDRESS: _____ FAX: ( ) _____

MOBILE:

E-MAIL:

# Annexure 3. survey letter

## Figure 14. Example of survey letter for a questionnaire

---


27
May 2010

Dear Madam / Sir

**Re: Status Report on Construction Quality in South Africa**

The enclosed survey 'Quality in South African Construction (Project Managers)' constitutes part of a study being undertaken for the cidb to determine the status of construction quality.

**Please note that your response will be treated in confidence, and your anonymity is assured.**

The sample frame consists of members of the Association of Construction Project Managers (ACPM).

We would be grateful if you would complete the questionnaire and **return it by the 11 June 2010** to:

createfae@yahoo.co.uk

or per facsimile to 086 629 0274 **(preferably per facsimile).**

Should you have any queries please do not hesitate to contact Professor Smallwood at:

083 659 2492 or per e-mail: createjs@yahoo.co.uk

**Thanking you in anticipation of your response.**

**Professor John Smallwood, PhD (Constr Man) Pr CM FCIOB MACPM MESSA MICOH MIoSM**

**Researcher and Partner, CREATE**