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TOWARDS THE ESTABLISHMENT OF A RELEVANT TENDER-PRICE INDEX FOR THE SOUTH AFRICAN BUILDING INDUSTRY

By

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Declaration by student

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

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Signature of acceptance and confirmation by student

ABSTRACT

Title of treatise : Towards the establishment of a relevant tender-price index for the South African building industry

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Different types of building cost-related indices are used on a regular basis by quantity surveyors, developers, contractors, etc. in the South African building industry. Currently there is only one tender price index that is being published on a regular basis in the country, namely the Stellenbosch's Bureau of Economic Research Building Cost Index. As this index was already developed in the early 1960's, this research was prompted by the question whether the relative "age" of the index plays a role in the accuracy thereof. Another question flowed from the above, namely whether a new tender price index (TPI), based on a basket of indicator items derived from recently completed building projects, would yield different results that reflect a more accurate movement of tender prices.

The research findings suggest firstly that by following accepted practices related to the compilation of indices, a new TPT can be developed for use in the South African building industry. Secondly, it was found that the perception of quantity surveyors in South Africa is that a TPI is a useful tool that can and is used on a daily basis by South African quantity surveyors. They would also welcome the regular publication of a new TPI, even if only used

as a checking mechanism against the current BER index. It was also found in the research that a number of selected overseas countries that was investigated make use of TPI's that are similar in nature to that examined in this study. Although the approach towards the construction of such indices may differ in some aspects from country to country, the major issues related to index theory remain largely consistent.

The study resulted in a model for a new TPI for the South African building industry that in future may be published. If sufficient information can be gathered on a regular basis from quantity surveyors, the index can be expanded in the form of separate indices for different building types.

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- My father and late mother for their support throughout all my studies
- My wife Nerine and children for love, support and missed time
- To the highest power of all

Ephesians 3:20, 21: *"Glory to God, who is able to do far beyond all that we could ask or imagine by his power at work within us; glory to him in the church and in Christ Jesus for all generations, for ever and always"*

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CHAPTER 1

INTRODUCTION, BACKGROUND AND PROBLEM STATEMENT TO THE STUDY

1.1 INTRODUCTION AND BACKGROUND

According to Marx (2005), an index measures the changes in the cost of an item or a group of items, as time passes; it is a statistical aid for determining cost trends and forecasting any possible future costs.

In the building industry, two kinds of indices are generally used. The first are the so-called input indices based on the costs incurred by contractors and they are used mainly to determine contract-price adjustments on contracts, after a tender has been awarded. The second kind of indices is output indices, based on the accepted tender prices of contracts; and they are called contract-price indices, or more accurately, tender-price indices.

The difficulties of estimating building costs have increased significantly over the last number of years because of the growing uncertainty to accurately predict changes in market conditions. The cost of any building is determined by the cost of the labour and the materials in its erection. Seeley (1996) stated that variation in either of these basic factors would influence the cost of an item of work - both in absolute terms and relative to the cost of the entire building. The detailed labour and material content differ between buildings; and these variations must be taken into account by adjusting the cost of the data used for cost planning.

Seeley (1996) was of the opinion that the compilation of indices of building costs is the most satisfactory method of approach. The system of competition that exists in the South African building industry is such that the supply of, and demand for, services in the industry can influence prices to the client to a far greater extent than any fluctuations in the basic cost of items. It was stated by Miners (1969) that a client is, therefore, more interested in the prices that he will have to pay for a building; and an index based on "consumer" costs becomes important to him. The latter opinion is also supported by Ferry, Brandon and Ferry (2003), who report that quantity surveyors are particularly interested in the price their clients have to pay for a building. If an index measures the market price, as opposed to the change in the cost of resources, then a measure of current market conditions can be obtained, which is of great benefit in updating and forecasting costs.

Any historical cost records and the comparison of annual building industry outputs in terms of money are worthless - unless an acceptable building cost index is available for cost-adjustment purposes. Regarding the history of construction indices in South Africa, it was reported by Miners (1969) that a number of construction companies, and some of the larger quantity surveying firms in South Africa, have from time to time processed historical cost data with a view to establishing an *ad hoc* aid for estimating purposes, sometimes in the form of an index suitable for their own specific needs.

In a similar fashion, public sector departments have kept cost records, in order to facilitate the estimation of new projects, and to compare tender prices from the point of view of both a time and regional difference. Nevertheless, little was done in the past to remedy the need for a formal cost index on a national level. According to Miners (1969) the possibility that a reliable building cost index might become available for general use in South Africa has been investigated at some length by several people and organisations; but progress has unfortunately been very slow.

Miners (1969) speculated on the possible reasons for this situation, e.g. that it would require full information as to the purpose of the index, as well as precise details of a formula that could be used in preparing it.

Apart from the building industry, many other sectors of the economy are concerned, either directly or indirectly, with fluctuations in the cost of building. Akintoye (1991) stated that the construction cycle is closely linked with the general business cycle; and therefore, there is a relationship between construction demand and growth in the gross national product (GDP). Entrepreneurs in the industrial world are constantly faced with the problems of how to expand their activities; and the demand for construction capital, in relation to current market conditions, might be a key factor.

The above notion is supported by Yusof (2001) who states that demand for construction continuously rise or fall. If the demand continues to rise, the industry will ultimately reach its capacity. However, once the business atmosphere changes and the prospects for the country's economy look less bright, demand for construction would begin to wane.

Akintoye (1991) was also of the opinion that a period of economic prosperity tends to raise the consumer demand for goods and services which, in turn, triggers the demand for construction space. Historical data in the form of a building cost index could be a useful tool in the planning and programming of future developments. Similarly, such information could be invaluable to investors, when they wish to access trends in building costs with regard to present and future investment opportunities. On the other hand, as reported by Rawlinson and Raftery (1997), traumatic economic events, and in particular severe periods of recessions, have a resounding impact on the tendering strategy of contractors. This leads to contractors undercutting their competition with substantial discounts on an already low market rate. Such tendencies will be reflected in a TPI.

In the public sector there is also a need for analysing the trends in building costs for forward planning at top level, especially when it comes to estimating the capital needed to carry out any future building programmes. Miners (1969) was of the opinion that a building cost index could assist in this regard, as it provides a better idea of the effect that increased tender prices would have on building costs in the future.

The building professions are continuously faced with the problem of advising clients on trends in building costs. Such advice could have an influence on the client's decision on when and where to build, or on whether to build at all. According to Seeley (1996), a building cost index is ideal for this purpose, as the main function of such building-cost indices is to assess the differences in the levels of tenders at varying dates. Future trends in price levels could also be assessed *via* a study of cost indices (Seeley, 1996).

Currently tender price indices are being used by quantity surveyors, estimators, developers, building contractors, in order to adjust historical tender tariffs to present and future values. One of the first indices of tender prices in South Africa was developed by Brook, a quantity surveyor with the then Public Works Department in Pretoria, in the early 1960s. (Brook: 1974).

This index is based on 22 representative items of a 100m^2 single storey building. In the early 1970s, this index was taken over by the University of Stellenbosch's Bureau of Economic Research (BER), and expanded to include private sector building projects. Until today, the BER compiles the index on a quarterly basis from the priced bills of quantities of completed projects supplied voluntarily by members of the quantity surveying profession in South Africa.

1.2 RESEARCH PROBLEM, OBJECTIVES AND QUESTIONS

1.2.1 Research problem

As mentioned before, the BER Building Cost Index is currently the only tender-price index (TPI) available for the South African building industry. This index will be discussed in detail in Chapter 3; but in terms of identifying a problem statement for the study, the following guiding questions can be asked regarding the BER index in particular and the availability of indices in general in South Africa:

- Are the 22 items that are used to make up the BER index still representative of the current building industry to determine the index accurately?
- Is the relative "age" of the index playing a role in the accuracy of the index?
- What are the perceptions of South African quantity surveyors regarding the current relevance of the index?
- Are quantity surveyors reluctant to provide information in the form of priced bills of quantities to the BER?

From the above, it is clear that a critical review of the BER Building Cost Index in terms of composition and information gathering is necessary, in order to determine whether a new tender index, based on current information, can and should be established. It would also be prudent to determine the usage of the BER index in the South African building industry, especially among quantity surveyors, as well as their perception regarding the correctness thereof. The significance of this problem is that quantity surveyors are currently updating all cost information such as estimates, or doing cost forecasting into the future, using information based on the BER index. If such information comes from a wrong or outdated basis, all work based on that can be skewed. Hence, the main problem of such a study can be formulated as follows:

"What is needed for the establishment of a relevant tender-price index for the South African building industry?"

1.2.2 Research aim and objectives

The aim of the study is to establish the requirements of a new TPI for the South African building industry. To achieve this, the study has the following objectives:

- To understand the theory of indices;
- To investigate the history of indices used in the past, as well as those currently used in South Africa;
- To look at selected overseas countries in order to understand if and how indices are being used in such countries;
- To understand the use and perception of South African quantity surveyors regarding tender price indices;
- The development of an appropriate (and improved) method to establish a new TPI for the South African building industry

1.2.3 Research questions

In order to resolve the main problem, the following sub-questions have been identified:

Question 1: Why should it be necessary to establish a new TPI for the South African building industry?

Question 2: What methodology should be used, in order to establish a new TPI?

Question 3: What are the uses and perceptions regarding TPIs in the quantity surveying profession in South Africa?

Question 4: How do overseas countries, such as Australia and the UK, compare with South Africa regarding similar types of indices?

1.3 PRIMARY PROPOSITION

The primary proposition states that it would be possible to establish a new tender price index with a wider range of indicator items, based on buildings that represent current building methods.

1.4 SECONDARY PROPOSITIONS

The following secondary propositions can be formulated in terms of the identified research questions:

- Secondary proposition one: South Africa's building industry needs a new TPI because of the age of the current index.
- Secondary proposition two: The methodology for constructing a new index must be based on the general index theory, as well as recent information, such as that provided in recently priced bills of quantities.
- Secondary proposition three: The perception among quantity surveyors in South Africa is that a TPI is a useful tool; but that there is a need for a new, recently constructed TPI for the South African building industry.
- Secondary proposition four: Different countries use different approaches to calculate indices; although there are broad areas of consensus among these countries, as well as within South Africa, such as weighting, the type of index, the rates sources, the publication thereof, etc.

1.5 LIMITATIONS

The study is limited to the South African building industry; therefore, no civil engineering projects, such as roads, dams, mines, etc. will be included in the research. The time span of the investigation will cover the period of January 2006 to June 2012. The questionnaires will only be distributed to quantity surveying firms registered with the Association of South African Quantity Surveyors (ASAQS).

Although a TPI would be useful to quantity surveyors, contractors, developers and other role-players in the built environment, information in the form of questionnaires and priced bills of quantities will only be sought from South African quantity surveyors.

Only price bills of quantities of new projects will be used. The reason for this is that projects where the majority of the work comprises alterations and additions work contains a lot of "once-off" items that cannot be used in the compilation of an index.

1.6 ASSUMPTIONS

It may be assumed that most registered quantity surveyors in South Africa are familiar with the BER index. Another assumption is that most quantity surveying firms procure most, or all of their projects, *via* the traditional procurement route viz. through the use of bills of quantities. This is important because the success of a TPI is dependent on one having access to a large number of priced bills of quantities on a regular basis, from across the country.

1.7 DEFINITIONS

- **The building industry** is defined by Hauptfleisch and Siglé (2000) as that operational sector, which constructs buildings, according to the requirements of an employer, by making use of the built environment professions, the main contractors, the subcontractors, and a variety of other allied resources.

- **Professional quantity surveyor:** A person registered with the South African Council for the Quantity Surveying Profession in terms of the Quantity Surveying Act (No. 49 of 2000)
- **Priced bills of quantities.** According to the Construction Industry Development Board (2010), priced bills of quantities are documents prepared by registered quantity surveyors, according to a standard method, and priced by contractors, in order to compete for a building project. The priced bills of quantities of an accepted project comprise the document of the successful tenderer that is used for various functions during the administration phase of a contract.

1.8 EXPECTED CONTRIBUTION / IMPORTANCE OF THE STUDY

As mentioned before, the BER index is widely used in the building and property industries in South Africa. If the index is found to be outdated and, therefore no longer accurate, it could have a negative influence on a number of activities of these industries. On the other hand, if the BER index is still accurate, a new index would still be useful, as this could then be used by quantity surveyors and other users of the index, as a checking mechanism in conjunction with the BER index. A new index would, therefore, make an important contribution to the quantity surveying profession in South Africa.

Mouton (2001) states that some of the reasons for undertaking postgraduate studies are:

- To increase knowledge in a certain area; and
- To become an expert in a specific field.

As mentioned, this is an important topic in the context of its contribution to the South African building industry. Therefore, by increasing the knowledge and expertise of the researcher in the field of index theory, and by following accepted approaches to the development of a new index, this study can be justified to be on a PhD level.

1.9 RESEARCH DESIGN

This study is based on a literature review as the first phase, followed by an empirical study. The sources used for the literature study include text books, journal articles, symposia and conference papers, as well as academic theses. The themes covered in the literature review comprise the index theory in general, and its use in the built environment in particular; the history of tender price indices in South Africa, as well as a qualitative review of the approaches adopted by overseas countries in the compilation of the tender price indices, and other construction-based indices currently used in overseas countries.

The second phase is the empirical study. This consists of a secondary data analysis (SDA). According to Mouton (2001) SDA, using the existing numerical data, aims at analysing such data, in order to test the hypotheses, or to validate any new models. In this study, the secondary data sources comprise priced bills of quantities of successful tenders that form the basis of constructing a new model in the form of a tender price index. The research design can, therefore, be classified as a quantitative research design.

The third phase of the research is a quantitative analysis of the data collected from a questionnaire survey. Mouton (2001) states that surveys are studies where primary data are used; and they aim to provide a broad overview of a representative sample of a large population. In this study, the population of the survey covers the quantity surveying firms in South Africa that are registered with the ASAQS.

From the above it is clear that the research approach can be classified as mostly quantitative in nature and that the contribution to the existing knowledge is practical. At the end of the study the reliability, internal and external validity of the model will be tested.

It must be noted that the research methodology used in each phase (i.e. the data collection, the analysis, the interpretation, etc.) will be discussed in detail when dealing with each phase of the study.

1.10 OUTLINE OF THE STUDY

Chapter 1 provides the orientation of the study, including a background, problem statement and research design. Chapters 2, 3 and 4 contain the literature review, which provides the theoretical foundation of the study. Chapter 2 covers the general index theory. Chapter 3 gives an overview of the history of tender price indices in South Africa; while Chapter 4 looks at tender price indices, as well as other types of construction cost indices that are found in overseas countries.

A survey was conducted among quantity surveying companies in South Africa on their perception and use of tender price indices. This is contained in Chapter 5.

The empirical part of the study starts with Chapter 6 where a new basket of rates for a tender price index is determined. This is followed by Chapter 7 where all aspects regarding unit rates in a new tender price index are discussed. The actual construction of a new tender price index model is formalized in Chapter 8. Chapter 9 lists the findings of the study, answers the research questions; and also states the shortcomings of the model. Chapter 10 concludes the study by formally accepting the main and secondary hypotheses, lists some practical implications that may emanate from the study, and indicate some suggestions for further research.

An overview of the approach taken during the study is indicated in the flow chart in Figure 1.1.

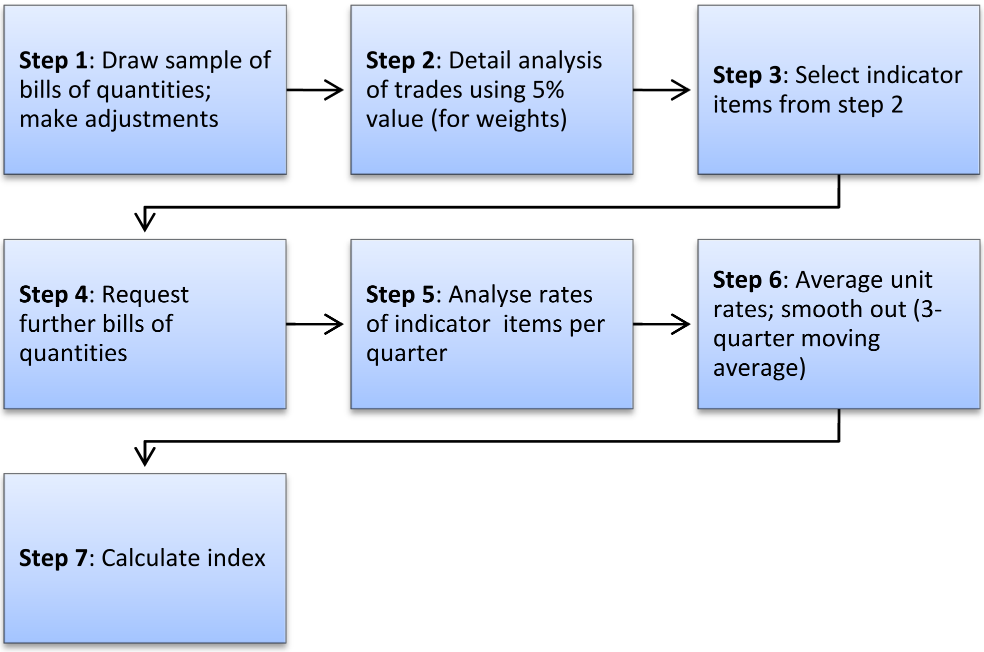

Figure 1.1: Flow chart of steps taken during the study

CHAPTER 2

THE LITERATURE REVIEW: INDICES IN GENERAL

2.1 INTRODUCTION

Changes occur on a daily basis in every person's life. These changes can be on demographic, economic, as well as social levels. According to Steyn, Smit, du Toit and Strasheim (2007), price changes have an effect on the lives of every family. These price changes, also termed inflation, causes a constant rise in cost of living which, in turn, leads to higher salary demands which, in turn, would increase production costs that can only be recovered by a rise in sales prices. Steyn *et al.* (2007) state that the calculation of indices, or index numbers, can be used to quantify such changes in a standardised manner. The definition of an index, as given by Steyn *et al.* (2007) is as follows: "An index is a ratio that measures a relative change".

Other definitions for index numbers are given by the Steel and Engineering Industries Federation of South Africa (SEIFSA) (undated), which states that "An index is a numerical scale representing a relative level of price at a particular date, compared with the price ruling at some other date". Flemming and Tysoe (1991) define an index as follows: "Index numbers of costs and prices provide a convenient means of expressing changes over time in the cost or prices of a group of related products in a single summary measure".

Another way of explaining index numbers, as indicated by Agarwal (2009), is that index numbers are intended to show the average percentage changes in the value of certain products at a specific time, place or situation, when compared to those at any other time, place or situation. Akintoye (1991) further stated that indices express the current price or quantity, as a percentage of the level at some reference point in the past. This is taken as 100; and consequently, in essence, indices provide a measure of trends.

An example of a typical index that is used world-wide is the consumer price index (CPI), which measures changes in the prices of goods and services consumed by households (Agarwal, 2009).

Marx (2005) is of the opinion that indices only measure relative numbers; and at best they can only give an indication of the measure with which a variable, compared to an earlier period, has changed. Therefore, an index figure cannot reflect any information on the actual level of a variable; and it cannot be very accurate. According to Marx (2005), therefore, index figures are in essence arbitrary; and they should be interpreted with circumspection.

Another warning is given by Agarwal (2009), who states that before work is started on the construction of an index, the objective of the index numbers must be clearly defined. If this is not done, the whole labour of constructing the index might be wasted; since no index can be an all-purpose index. According to Agarwal (2009), the primary requirement is to decide what must be measured; and what it is going to be used for.

All the steps that would normally follow in constructing the index, such as the choice of the population, the base period, the basket of goods, the formula, etc., depend on the objective of the index.

2.2 TYPES OF INDICES

The International Labour Organisation (ILO) (2004b) states that many different kinds of mathematical formulae have been compiled and proposed over the past 200 years. The ILO (2004b) further mentions that, while there is no single formula that would be preferred in all circumstances, economists and compilers of consumer price indices world-wide seem to be in agreement that the preferred formulae should belong to a small group of indices that are called superlative indices. The ILO (2004b) states that a characteristic feature of such superlative indices is that they treat the prices and quantities that are being compiled in both periods of the indices similarly.

However, before one can look at a group of superlative indices; it should be necessary to go back to the basic compilation of these indices. Steyn *et al.* (2007) are of the opinion that one must distinguish between simple and composite indices on the one hand, and un-weighted and weighted indices, on the other hand. Steyn *et al.* (2007) argue that a simple index is used to represent the price change of a single commodity. A composite index, on the other hand, represents the price changes of more than one commodity. The Organisation for Economic Co-operation and Development (OECD) (2008) uses the term composite indicators and state that a composite indicator is formed when individual indicators are compiled into a single index. According to the OECD (2008) a composite indicator measures multi-dimensional concepts that cannot be captured by a single indicator.

Further, when an un-weighted composite price index is calculated, the price changes of all the commodities are to be regarded as equally important; while in a weighted composite price index, different weights are allocated to the different commodities according to the relative importance of each (Steyn *et al.*, 2007). In a weighted composite price index, each indicator item has a weight attached to it which reflects its relative importance in the overall index. The impact that a change in the price of an indicator item has on the overall index, is therefore determined by the weight that is attached to it (Statistics South Africa, 2013).

As all of the important indices that are being used in the construction industry are weighted composite price indices, both simple and un-weighted indices will be ignored in this study. The general formula for a weighted composite price index, where the price of a specific commodity in the base period and in the current period are indicated by p_o and p_n respectively, and with a weighted series *(w),* is given by:

$$P = \frac{\Sigma P_n{}^w}{\Sigma P_o{}^w} \times 100$$

Much has been written in the past on price indices; and a number of indices have been constructed over time that can be used for tracking the movement of prices of goods over a certain time period. For the purposes of this study, only the most important and the most frequently used of these indices will be discussed. As different authors use different notations when discussing the formulae, the meaning of the notation used in this study is as follows:

p_o = price in base year

p_n = price in current year

q_o = weight in base year

q_n = weight in current year

All of these indices are known by the special names of their authors. The first index is called the Laspeyres index; and it was developed in 1871 by Etienne Laspeyres, a French statistician (Diewert, 2001). According to Yu and Ive (2008), the Laspeyres price index is a base weight index where the relative quantities of the base period provide the weighting for the respective prices. The formula for calculating the Laspeyres index (*Pl*) is:

$$Pl = \frac{\Sigma pnqo}{\Sigma poqo} \times 100$$

Akintoye (1991) was of the opinion that the Laspeyres index assumes that people are currently buying the same quantity as they bought in the base year, hence the reference to a base-weighted index. In the ideal situation, according to Yu and Ive (2008), the goods (or items) found in the base period are matched with the exact items found in the reference period; therefore the Laspeyres index (sometimes also referred to as a base weighted, match- item index), has a good control of the quality of the items being indexed.

The ILO (2004a) states that the advantage of applying the base weight, or fixed weighted, method is that it is consistent with the method used for other consumption goods and services, as well as the fixed basket-index formula. Therefore, according to the ILO (2004a), the Laspeyres index has until recently been used world-wide as the intellectual basis for the calculation of consumer price indices.

Marx (2005) is of the opinion that the Laspeyres index is the most popular composite index. The main advantage of this index, as stated by Marx (2005), is that a series of Laspeyres indices can be compared; as all they have a common denominator. Another advantage is that a Laspeyres index needs less information, when compared to other indices (Marx, 2005). As already mentioned, in the Laspeyres index, the weights are determined in the base year, and kept the same for the calculation of the index in ensuing years.

Yu and Ive (2008) state this as being a problem; since it does not take into account the quantities in the reference period, where people tend to substitute a cheaper item for a more expensive one, where there is a relative price change. The Laspeyres index is, therefore, criticised for its failure to capture the substitution effects (also called substitution bias). And, it may, consequently, overstate the inflation (Yu & Ive, 2008).

Marx (2005) confirms this problem, when he states that because fixed weights are used, the particular basket of items becomes unsuitable over time. Too much value may be attached to items of which the value has decreased: either because these items have become more expensive; or because they have disappeared from the market. The latter reason can be because the items or products have been replaced by newer, cheaper alternatives. Marx (2005) states an example of such in the building industry is where vinyl floor tiles have replaced wooden block flooring.

The second type of index is called the Paasche price index, named after the German economist, Herman Paasche, who developed this index in 1874 (Diewert, 2001). According to Akintoye (1991), the Paasche index assumes that people are buying the same quantity of items in the current year, as they were buying in the base year; and therefore, this is called a current weighted-price index. The Paasche index (*Pp*) is represented as follows:

$$Pp = \frac{\Sigma pnqn}{\Sigma pnqo} \times 100$$

The major advantage of current weighted indices over base weight indices, as indicated by Akintoye (1991), is that the items are weighted, in accordance with their current importance. There is, therefore, no danger that the index number could be misleading, due to the use of out-dated weights. Yu and Ive (2006) are of the opinion that the Paasche index is more suitable for deflating output than the Laspeyres index, because of the use of current outputs as the weightings.

Yu and Ive (2006), however, also mention that the Paasche index is criticized as understating inflation, because the choice of goods is not reflected under the base-period prices. Another problem identified with the Paasche index was indicated by van der Walt (1992), who concluded that the compiling of a Paasche type index normally requires more work than the Laspeyres index, because the weights must be determined every time from the start.

Van der Walt (1992) also stated that, when compared with the Laspeyres index, the Paasche index does not offer any additional statistical advantages. The ILO (2004a) mentions that statistical agencies do not produce Paasche type indices, because the lack of information on current period quantities prevents them from doing so, on a timely basis.

The third type of index is called the Irving Fisher price index. It is also called the Ideal index; the idea being that if one index (Laspeyres) overstates inflation, and another (Paasche) understates inflation, the answer would be to take the average of the two indices as a true measure of inflation (Yu & Ive, 2006). This is what Fisher, an American economist, did in 1921, when the index originated. It is the geometric mean of the Laspeyres and the Paasche indices; and it is expressed as follows:

$$P_f = \sqrt{\frac{\Sigma p_n q_n}{\Sigma p_o q_o} \times \frac{\Sigma p_n q_n}{\Sigma p_o q_n}} \times 100$$

Fisher dubbed this index as the "best form of index" (Yu & Ive, 2008); and in theory, it should be a better measure of inflation. Yu and Ive (2006), however, mention that this advantage comes with a cost, because the calculation of the index requires the information of quantities at both base and reference periods. Akintoye (1991) was also of the opinion that although the Fisher ideal index is theoretically an excellent index, the amount of information required to implement it makes it difficult to use as a general purpose index.

Another index that aims to rectify the difference between the Laspeyres and the Paasche indices is the Drobisch index. The difference between this index and the Irving Fisher index is that the Drobisch index uses the arithmetic mean of the two indices (Steyn *et al., 2007)*. This index is expressed as follows:

$$P_f = \frac{1}{2}\left\{\frac{\Sigma p_n q_o}{\Sigma p_n q_n} + \frac{\Sigma p_n q_n}{\Sigma p_o q_o}\right\} \times 100$$

It is the opinion of Yu and Ive (2008) that all three of the above methods assume that complete data for price and quantity are available. However, as mentioned before, new goods enter the market, and old goods drop out, on a regular basis. Yu and Ive (2008) state that when calculating any of the indices it is less than straight-forward to ascertain how much, for example, a lap top computer should have been priced in 1900, as well as how much a Model T Ford should cost in 2013.

Other indices that are found in some of the literature (for example the ILO, 2004b) are the Young index, the Walsh price-index and the Törnqvist price-index. Very little evidence could, however, be found in the literature that any of these indices are being used on a regular basis in the construction industry to calculate the movement of prices; and therefore, for the purpose of this study, these indices will not be discussed.

2.3 INDICES IN THE BUILDING INDUSTRY

2.3.1 Background

The following is a discussion on how indices, as described above, can generally be applied in the building industry (the specific need for and the use of indices in the building industry will be discussed later on in the study). According to Seeley (1996) the labour and material content of every building differs; and these cost variations must be taken into account when cost planning for buildings is done. The best way to adjust the available data is through the compilation of an index of building cost. One of the problems encountered in the literature is that different authors use different terminology to describe what essentially are the same concepts.

Flemming and Tysoe (1991) and Davis Langdon Management Consultancy (2008), for example, state that there are three main types of indices used in the construction industry:

- Building cost indices
- Tender price indices; and
- Output indices

In contrast, Eurostat (2008), as well as Statistics Norway (2008), mention that construction price indices can be grouped into three main types:

- Input indices
- Output indices; and
- Seller'-s' indices

To clarify these conflicting terms, Eurostat (2008) state that the terms "cost index" and "price index" should be considered from the point-of-view of a contractor, as depicted in Figure 1.

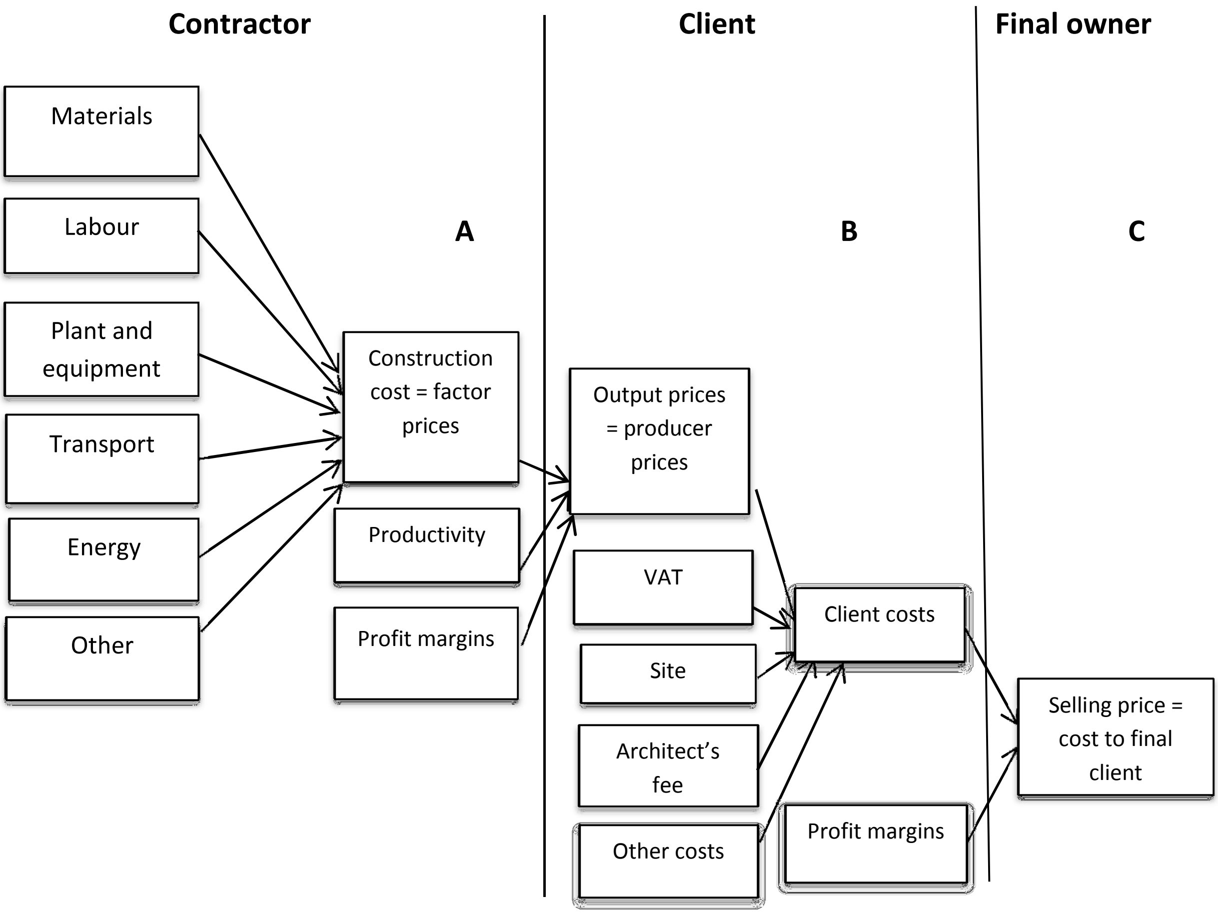

Figure 1.1: Cost trends incurred on a project (Eurostat, 2008)

In terms of Figure 1.1, the costs incurred by the contractor in carrying out the construction process (A in the diagram) can be referred to as the construction-input-price index; while the output-price index (B in the diagram) refers to the prices paid by the client. These two indices can be distinguished from the selling price index (C in the diagram), which measures any changes in the prices paid by the final owner. These terms will now be discussed in more detail.

2.3.2 Input-price indices

Input-price indices, also called building-cost indices (Ashworth, 1991), or construction-cost indices (Wang and Wei, 1998) are, according to McCabe, O'Grady and Waller (2002), as well as Statistics Norway (2007), representative of the construction-process inputs, such as materials, equipment, labour, machinery, transport, energy and other costs. An input index is a weighted index of price indices for a representative selection of basic input elements in the construction process (Mohammadian and Seymour, 1997).

McCabe *et al.* (2002) state that the primary objective of an input-price index is to reflect the local market prices; and it should not, according to the Statistics Directorate, European Union (1997), be used to provide information on price movement for finished construction works; as these prices do not reflect the complete range of influences that impact on market prices. Prism Economics and Analysis (2001) mention that they do not contain any assumptions or adjustments related to productivity, skills levels, or local code requirements.

Mohammadian and Seymour (1997) also add to this list, the contractor's overheads and profit margins that are generally excluded.

McCabe *et al.* (2002) are of the opinion that such indices could be useful for construction companies that move around the country between projects, and only need to know the differences in the cost of materials. According to Marx (2005), such indices can also be used to determine contract price adjustments - after a tender has been awarded. Such adjustments reimburse the contractor in respect of any cost increases of material and labour. SEIFSA (undated) states that a cost index also represents any changes in the cost of a commodity, and sites as an example: their published index of labour.

This index is compiled from a breakdown of the actual labour costs experienced by construction companies; and it is therefore a direct reflection of the cost of labour, and not of necessarily the price per hour that is charged to the end-user.

The charge to the end-user, according to SEIFSA (undated), includes profit; and, in a free market system, it is up to each supplier to determine his or her own profit margin.

2.3.3 Tender price / output-price indices

From the literature, it is evident that TPIs and output-price indices are essentially the same concept. Both McCabe *et al.* (2002) and prism Economics and Analysis (2001) state that output-price indices attempt to measure the total cost of construction of a completed structure in each location, meaning that these indices reflect the local conditions specific to each project. Statistics Norway (2009) confirms this, and adds that output-price indices also take into account any changes in productivity and contractors' profit margins, in addition to the input costs, as discussed previously. Marx (2005) who calls these indices contract-price indices, indicates that this monitors market prices, i.e. the price that a developer pays a contractor for erecting a building.

Marx (2005) further states that the factors influencing such indices are the contractor's profit and overhead costs, as well as his/her competition in the tender market, as this has an influence on the profit margin of tenderers. Seeley (1996), Beeston (1983), Ashworth (1991) and others, all define a tender-price index as being an attempt to represent the level of prices agreed upon between the clients and the contractors.

These prices move, according to any changes in the contractors' costs, as well as allowances for market conditions and profit. From this definition, it is clear that, according to the literature, output-price indices and tender-price indices are basically the same concept.

Because these indices take into account the tendering market, they are much more useful when updating prices for a design budget (Ashworth, 1991). Where input price indices measure changes in basic building costs, tender-price indices, according to Seeley (1996), indicate what the feeling of the building industry is about the current and future workload. Mohammadian and Seymour (1997), therefore, state that when output-price indices fall, or remain constant during an economic recession, input-price indices have been shown to rise during the same period. The reason for this tendency, according to Mohammadian and Seymour (1997), is that output-price indices reflect market prices, which can be much more volatile than basic input costs, such as labour and material. Beeston (1983) confirms this by saying that contractors slash their profit margins, when they are competing for scarce work, or *via* an increase, when they find orders easy to obtain, and when there is a glut of work.

Kirkham (2007) as well as Flemming and Tysoe (1991), site several advantages that tender-price indices have from the point-of-view of the client's quantity surveyor:

- It indicates the movement of the cost to the client, of projects over time, rather than the change in cost to the contractor;

- It allows comparison of the price obtained for a specific tender with the national or regional tender price trend;
- It allows for the cost relationship between different building types to be plotted;
- It gives an indication of the tendering climate at the date of tender, because it takes into consideration the variations in factor costs, as well as the effect of current economic conditions;
- As it is not based on other indices, any inherent inaccuracies are not compounded; and
- Cost planning can be improved; as the cost of known schemes, and other historical data are brought to a common level.

According to the Statistics Directorate, European Community (1997) the formulae that are most commonly used by European Union member countries for compiling output-price indices are the fixed base-weighted Laspeyres and the current weight Paasche indices. In the Laspeyres index, the weights are determined (fixed) in the base year, and kept as such for the calculation in ensuing years (Marx, 2005). Kirkham (2007) states that instead of analysing all the rates in bills of quantities, the amount of work can be reduced by selecting only the few largest items in each work section as weights.

Yu and Ive (2006) are of the opinion that by matching the goods found in the base period with the exact goods found in the reference period, the Laspeyres index has a good control of the quality of the goods being indexed. An example of a Laspeyres index is the BER building-cost index currently being used in South Africa.

For the Paasche index, being a current-weighted index, the priced bills of quantities can also be used (Beeston, 1983). The Building Cost Information Services (BCIS) in the United Kingdom use this method when compiling a tender-price index. According to Akintoye (1991), when compiling this index, a project index is first produced by taking the priced bills of quantities for a project, and then re-pricing any significant items. This is done by selecting the items in each trade that represent 25% of the value of the work in that trade, and re-pricing these items by using a schedule of standard base rates, from what is called a "price book" (Beeston, 1983).

The published tender-price index is an average of several individual project-index figures, calculated for the same period as that described above.

The requirements for a tender price-index (weights, rates, base period, etc.) will be discussed later on in the chapter.

2.3.4 Seller's price index.

The third type of index, the seller's price index is not much used in the building industry. The Statistics Directorate of the European Community (1997) indicated that these indices measure changes in the prices of construction output that is paid for by the final owner (or purchaser) of the construction product. According to Statistics Norway (2007), seller's prices include not only all the cost of the completed construction project, such as the cost of labour and the cost of the materials paid by the contractor, but also the cost of land, direct and indirect selling expenses, finance costs, professional fees to architects, engineers, quantity surveyors, etc., value-added tax, as well as the seller's profit.

2.4 FACTORS INFLUENCING THE COMPOSITION OF AN INDEX

2.4.1 Introduction

When constructing an index, decisions have to be made on a number of factors. While Seeley (1996) and Flemming and Tysoe (1991) each name four such factors, Akintoye (1991) is of the opinion that the following six factors all have an influence on the composition of an index:

- Purpose of the index;
- Availability of the data;
- Selection of items to be included;
- Choice of the base period;
- Choice of weights; and
- Method of construction.

Because of the importance that the above six factors have on the composition of an index, they will have to be taken into account when a new tender-price index is constructed. These factors will each be discussed in more detail.

2.4.2 Purpose of the index

According to Akintoye (1991), the purpose of the index, or the use for which the index is intended, should be established upfront, before any attempt is made to construct an index. The statement of the purpose of the index would influence all the factors involved in the construction of the index. Hassanein and Khalil (2006) share this opinion - that the correct interpretation of the index can only be made when its purpose is fully understood. The purpose of an index could, for example, be to measure the movement of tendered prices of commercial, industrial and public buildings over a period of time in South Africa

2.4.3 Availability of the data

Akintoye (1991) concluded that it is always important to ensure that there will be enough data in the right format available on a continual basis to construct an index. If not, this might distort the future usefulness and reliability of the index. Flemming and Tysoe (1991) state that instead of using information on the total price of a contract, it is possible to use information of the unit rates that were used for the different categories of work that make up the total contract price. Information on unit rates is readily available from priced bills of quantities; since a contractor who was the successful tenderer on a contract must submit his priced bills of quantities, containing all the unit rates for the project, before the start of the contract.

Yu and Ive (2008) confirm this, by saying that bills of quantities provide a rich source of information on the prices, as well as the quantities of the various trades that are measured for tenders of building projects. Akintoye (1991) also cites a study by Bowley and Corlett (1970), who recognised that a construction-price index that is based on a short list of items, based on priced bills of quantities, reflects the trend in prices shown by a full re-pricing of the bills of quantities.

Flemming and Tysoe (1991) state that this method requires access to a reasonably large number of representative bills of quantities; because the rates used by different contractors can vary considerably. The reason for this is because of the difference in the levels of efficiency, as well as the differences in the labour, materials and plant costs used by contractors' estimators.

Furthermore, different contractors adopt different practices in arriving at the final tender price (Flemming and Tysoe, 1991). Luckily, according to van der Walt (1992), tender prices for different types and sizes of buildings are obtained on a regular and wide-spread basis in

South Africa, by utilising bills of quantities; and it would, therefore, be meaningful to use this method to construct a tender-price index.

2.4.4 Selection of items

Flemming and Tysoe (1991) mention that selecting the items for inclusion in an index can be one of the more difficult problems when formulating an index, especially when there are a lot of possible items that could be included. Akintoye (1991), as well as Steyn *et al.* (2007), conclude that when constructing a composite index, such as the consumer price index, it is practically impossible and often unnecessary to include all consumer goods. Although selecting a large number of items can be construed as being more representative, Hassanein and Khalil (2006) acknowledge that collecting such large numbers would be very costly.

Steyn *et al.* (2007), therefore, suggest that a representative sample of items should be selected from the survey population and that only those items be used in the construction of the index. Steyn *et al.* (2007) further state that by using this method, there will be a time saving without any undue loss of accuracy of information. According to the Statistics Directorate of the European Community (1997), the decision on which actual items to include in the index is largely a matter of judgement; and it depends on the impact that these items may have on the total price of the project.

For the purposes of this study, the objective will, therefore, be to identify the minimum number of indicator items from priced bills of quantities that collectively represent a high proportion of the total value of various construction projects.

2.4.5 Base period

For the construction of indices, a decision has to be made on a base period (also called a reference period) with which the indices can be compared at a particular time (Agarwal, 2009). Ashworth (1991) stated that normally for general purposes, the cost at the base period is usually given the arbitrary value of 100 in order to allow for both increases, as well as decreases in the value of the data - without having to deal with negative numbers, where values fall below the base index number.

Statistics South Africa (2009) further mentions that the chosen period should preferably cover a seasonal cycle, typically a calendar year. Prism Economics and analysis (2001) calls this "normalisation" of the index, i.e. the indices are normalised to a baseline value of 100 that is assigned to a specific year, say 2006.

A number of authors (Akintoye, 1991; Flemming and Tysoe, 1991; Agarwal, 2009; Swarup, undated and Steyn *et al.*, 2007) conclude that generally one should choose a base period of reasonable economic stability, as well as a period that is not too distant in the past. Such a "normal" year is explained by Akintoye (1991) as a period of average, steady inflation - without any unusual occurrences. Unusual occurrences are further defined by Steyn *et al.* (2007), as war years, abnormal climatic conditions, such as droughts or floods, as well as industrial strikes and serious recessions.

The reason why the base period should not be too distant in the past, according to Steyn *et al.* (2007), is because the prices of commodities might change considerably, the specification of products may be upgraded; and some products might even disappear from the market altogether, if the time between the base period and the reference period is too long.

2.4.6 Choice of weights

As discussed before (2.4.4) it is possible to achieve a reliable index by significantly reducing the number of items in the index. Marx (2005) states that this makes the process of gathering market-related items easier and more manageable. Steyn *et al.* (2007) conclude that when an un-weighted composite price index is calculated, the price changes of all the commodities are regarded as being equally important. However, when items that are being considered for an index are not of equal importance, then the choice of weights for the different items becomes very important.

It is the opinion of Akintoye (1991) that the weights assigned to the various items must reflect their relative importance, and should be carefully chosen, in order to avoid biased and misleading results. Ashworth (1991) mentioned that the majority of the index numbers used in the construction industry include weighted items, according to their importance in the index, hence these indices being called weighted-composite indices (Steyn *et al.*, 2007).

This principle, as stated by Ashworth (1991), is commonly known as "the basket of goods". When using bills of quantities to determine the selection of items to be used in the index, Seeley (1996) concluded that the major items incorporating the largest price extensions in each trade of the bills of quantities, should be included in the index. Agarwal (2009) calls this system of weighting "value-weighting". Marx (2005) cites Mitchell (1971), who has shown that by selecting various items, which represent as little as 25% of the sample of the total contract value, an accepted level of reliability can be achieved.

By using a fixed-weight series, it can be used for as long as the base period is left unchanged (Steyn *et al.*, 2005). Marx (2005), however, cautions by saying that sooner or later, the items and weights will have to be revised, because of changes in the quality of the materials, improved construction techniques, etc. This would mean that a fundamental shift of the base period would also be necessary. This observation is confirmed in the literature on consumer price indices, where the ILO (2004a) mentions that weights should be updated once every five years, in order to ensure their relevance; while in the literature on construction price indices, Statistics Finland (2001) also quotes a figure of five-year intervals for the revision of their weighting system.

The Statistics Directorate, European Community (1997), on the other hand, is of the opinion that weights used for construction price indices need to be reviewed from time to time; and where necessary, these should be revised at least every five to ten years.

2.4.7 Method of construction

According to Akintoye (1991), the method of construction relates to the choice between a number of formulae that are available and; furthermore, it can be used to monitor the movement of prices in the building industry. Akintoye (1991) further states that the choice of a particular formula should be based on practical considerations. As discussed before (2.2), the most frequently used indices in the building industry are the Laspeyres index, where the base year weightings are being used for calculating the index, and the Paasche index, where the index uses weightings obtained from the current year or period in time that is under consideration.

2.4.8 Rates

Although not mentioned by Akintoye (1991), as one of the six factors that influence the composition of a tender-price index, the use and selection of unit-rates should also be discussed. The source of prices used in tender-price indices, are priced bills of quantities, where the measured quantities are multiplied by the unit rates inserted by the contractor, in order to obtain quantifiable items.

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The United Nations' economic and social council (2003) mentions that where an index is calculated for a relatively large geographical area, the price collection should be carried out in such a way that these prices (or rates in the case of tender-price indices) must be representative of the complete geographical area; as it is possible that there could be significant differences in price movements between different areas.

2.5 USE OF INDICES

From the literature, it is evident that construction-price indices can be used for a variety of purposes; and, as indicated by Mohammadian and Seymour (1997), by a number of role-players in the building industry such as producers and purchasers of construction projects, suppliers and manufacturers of construction products, designers, quantity surveyors, cost estimators and budget managers. Some of the particular purposes, for which such indices could be utilised, are as follows:

2.5.1 Cost planning

Flemming and Tysoe (1991) argued that in the process of cost planning, cost information that is available for use in cost planning, and that is based on past projects, would become out of date, if not updated on a regular basis. For this reason, cost indices, according to Kirkham (2007), are fundamental to cost planning, as they provide valuable insight into the changes in cost over time. This can be done for an item, or groups of items from one point in time to another (this is also called a "time series"). Ashworth (1991) agreed by saying that the process of cost planning requires the use of large amounts of historical cost data; and in order for them to be used effectively, the data would need to be updated by the use of indices.

2.5.2 Forecasting

Flemming and Tysoe (1991) stated that indices can play an important role in the forecasting of cost trends, which could be beneficial to both clients and building contractors. A lot of research that is done on construction price indices, as stated by Yu and Ive (2008), is about forecasting - by using time-series techniques, in which the past values of price indices are used to forecast their future values, and thereby to determine price inflation. The opinion of Ashworth (1991) was that, although the pattern of existing indices can be extended to a date in the future, the extrapolation of existing indices should be done with caution, because subjective allowances must be made to allow for the differences in the varying conditions between the past and the future.

Under stable conditions, the projection of indices is a simple matter; but the erratic behaviour of inflation, as experienced in recent years, has made accurate forecasting very difficult.

2.5.3 Updating cost estimates

The updating of elemental cost-analyses numbers is, according to Ferry, Brandon and Ferry (2003), perhaps the most common use of index numbers by quantity surveyors. In this way, the information on past projects can be brought up to current costs. Brook (1974) also stated that from a cost-estimating point of view, a common use of price indices is to update estimates to current costs; but this method can also be used to project estimates into the future. Both Brook (1974) and Ferry *et al.* (2003) caution that care should be taken, when updating information beyond a period of two years, because of the fluctuating climate of the construction industry.

2.5.4 Updating of tenders

As with estimates, tenders can be updated by contractors through the use of indices (Van der Walt, 1992). Seeley (1996) concluded that building-cost indices are used by contractors to assess the differences in levels of tenders at varying dates. In this way, a tender figure for a previous similar project can be brought up-to-date with current prices for comparison purposes. By calculating the percentage change between the building cost-index figure for a specific quarter of a specific year, and the same quarter of a previous year, the increases in building costs can be determined as a percentage per annum (Segalla, 1991).

2.5.5 Monitoring price movements

Because of its weighting system, the building-cost index provides useful tools for monitoring and analysing the movement of - not only building costs in general - but also the prices of separate components (Statistics Finland, 2001). An index, as indicated by Marx (2005), measures the changes in the cost of an item, or groups of items, over time and therefore, according to Ferry *et al.* (2003), through cost indices it should be possible to see the changes in the relationship between different cost components over time, for example structural steel versus reinforced concrete. This relationship can then be used as a possible solution for design problems, when one option appears to be a better proposition from a cost point-of-view.

2.5.6 Replacement cost of buildings

A number of authors (Segalla, 1991; Kilian, 1980 and Akintoye, Bowen and Hardcastle, 1998) are of the opinion that construction-price indices are used by the insurance brokering fraternity to calculate the replacement value of buildings. This is done by using an index value to calculate the percentage change in building costs, since the last valuation - up to the present time. This percentage change is then applied to the original replacement value of the building, in order to obtain the current replacement value.

2.5.7 Monitoring the national economy

Some countries use index numbers to monitor aspects of the national economy. According to Statistics Finland (2001), building cost indices are used as an indicator in the national economic policy, as well as in economic policy-making research. Likewise, Statistics Norway (2007) indicates that construction-cost indices can be used to estimate the output prices to deflate national accounts, and to estimate the national output of construction activities.

2.5.8 Negotiation of contracts

Brook (1974), as well as Statistics Finland (2001), concludes that an important function of construction-cost indices is in tying long-term building contracts, where it can be difficult to control escalation costs to the satisfaction of all parties, to the index. This can be done by linking the negotiation to a specific starting date, and then calculating the increase in cost, at regular intervals, by using the published index numbers.

2.6 PROBLEMS WITH INDICES

There are some inherent problems with the use of tender price indices. The following are some of the major problems, as sourced in the literature:

2.6.1 Accuracy of the index

As mentioned by Ashworth (1991), index numbers can at best only provide a general indication of the changes in the value of building projects; and therefore, they cannot be considered to be very precise. Van der Walt (1992) agreed by saying that an index is relative; in other words it is not its absolute value that matters, but its tendency over time. Hassanein and Khalil (2006) cite Chase and Nichols (1992), who mentioned that a perfect forecast is typically impossible; because there are too many factors in the construction environment that cannot be predicted with any degree of certainty.

One of these factors is that an index for a typical or model building is more of an economic model, indicating a general trend; and it may not be measuring the change over time for a particular project that is being developed (Kirkham, 2007).

2.6.2 Sample size

The Statistics Directorate of the European Community (1997) stated that, to determine an adequate number of respondents, is largely a sampling question. The larger the number of respondents, the more detailed would the indices need to be that are produced. In practice, however, according to the Statistics Directorate of the European Community (1997), the size of the sample is largely a trade-off against cost and the quality of the data. Ferry *et al.*

(2003) mention that in tender-based indices, a good sample of priced bills of quantities is needed to avoid bias caused by regional variations, and building functions that might distort the results.

Van der Walt (1992) agreed with this opinion, stating that tenders of only a small number of tenders would probably result in unstable indices.

The literature either differs, or is vague, about the actual number of priced bills of quantities that are required to construct a reliable tender-price index. Most authors that comment on the BCIS's tender-price index (such as Yu and Ive, 2006; Kirkham, 2007 and Ferry *et al.*, 2003) conclude that the BCIS aims at sampling 80 projects in each quarter; because it believes that if 80 projects are sampled, approximately 90% of the indices of individual projects would fall within about 2,8% of the average.

Yu and Ive (2006), however, indicate that this requirement is seldom met; and between 1990 and 2004, the BCIS's average quarterly sample size was 67. The reason for this drop in the number of priced bills of quantities can be attributed to a clear shift of British procurement methods between 1985 and 2004 - from traditional procurement with bills of quantities to lump-sum design and build (Yu & Ive, 2008). Akintoye (1991) was also of the opinion that a drop in construction activities would inevitably result in difficulty in meeting the requirement of 80 projects. In South Africa, Kilian (1980) argued that in the case of the BER index, it was found that about 40 projects are sufficient to have a stable index; while, according to Brook (1985) it was found that when the index value is based on less than seven projects, it cannot be regarded as being statistically stable.

2.6.3 Changes in quality

Another problem, as indicated by Kirkham (2007), is that changes in technology may make the mix of base weights atypical. Simonton (2004) states that building quality and specifications have improved steadily over time, because of advances in building technology, design and in processes. As a typical index would be measuring the trend of building costs for a typical or model building over time, these changes in quality would not necessarily be taken into account. Marx (2005) mentions an example where, if a standard interior door that is used today is of a better quality than the typical door that is used in the base period, the increase in the rate for the door is made up not only of the inflation in the building industry, but also of the improved quality of the product.

Kirkham (2007) adds to this by saying that as new techniques and materials come into greater use, their prices tend to decrease proportionally; while the cost of obsolescent technology tends to rise faster than the general rate of increase. One way of overcoming this problem, according to the Statistics Directorate of the European Community (1997), is to review the basket of items on a regular basis, so that the components and their weights reflect any of the changes in technical standards, new construction methods, new technology, new building materials, etc.

2.6.4 Unit rates

Kirkham (2007) states that one of the limitations of the tender-based index is the questionable validity of the rates of bills of quantities. Marx (2005) agrees with this, by saying that the unit rates in bills of quantities can differ markedly, because of the different approaches by tenderers to determine such rates. Marx (2005) cites Seeley (1996), who found that the standard deviation of individual tariffs of the average tariff of an item can be as much as 15%. Van der Walt (1992) further mentioned that, apart from different techniques that contractors use in building up their rates, such rates can sometimes be estimates of expected prices in the case of a fixed price contract. The reason for this is because the contractor would then have to allow for expected inflation for the duration of the contract in his rates; e.g. for example: what could he expect the price to be at the time when the work is finally executed?

2.7 SUMMARY

The use of index numbers is a well-established practice in different spheres of life, including the building industry. Although any index must be constructed with care, taking into account a number of considerations, it should be possible to have a tender-price index that serves its purpose - i.e. to measure the general movement of building costs over time.

2.8 CONCLUSION

As the aim of the study was to compile a new TPI for use in the South African building industry, a decision will have to be made on what route to follow, based on the literature of the existing indices, as described in this chapter. It is clear that a tender-price index (or output-price index) would be the best option, because it measures the movement of changes in contractors' prices, taking into account all factors, such as the contractors' input costs, as well as allowances for market conditions and profit.

Another issue that influences this choice is the availability of a sufficient number of priced bills of quantities in the South African building industry on a regular basis for the foreseeable future, to use as a basis for compiling such an index.

Another decision that has to be made is what formula to use. As stated before, the most well-known and often-used formulae are the Laspeyres and Paasche indices, with the Irving-Fisher index also being option. The biggest factor that counts against the use of the Paasche formula is the fact that, in order to use such an index, a schedule of standard base rates (or a price book) would be needed. As there is currently nothing of such a nature available in South Africa, a new schedule of base rates would have to be drawn up. Considering the amount of work involved, not only in drawing up such a schedule, but also in the execution of the index, where a project index must be compiled for every project, the author is of the opinion that a more logical choice would be to use the Laspeyres formula for composing a new tender price index for use in South Africa.

This would involve the analysis of bills of quantities in order to arrive at a set of fixed base weights, or a basket of items. Another consideration for using the Laspeyres formula is that the BER index that is currently in use in South Africa is also a Laspeyres-type index; and therefore, any comparison would be easier to make.

Although the Irving-Fisher formula is considered by some to be the most accurate of the available formulas, the possibility of using that as a basis would not be possible. The reason for this is the fact that only a Laspeyres-type index would be compiled; and, since the Irving-Fisher formula needs both a Laspeyres and a Paasche-based index for its calculation, this possibility is thereby eliminated.

CHAPTER 3

THE LITERATURE REVIEW: DEVELOPMENT OF BUILDING COST INDICES IN SOUTH AFRICA

3.1 INTRODUCTION

According to van der Walt (1992), no officially published building cost-related indices existed in South Africa until the 1960'-s. Some local quantity surveying practices, such as those of Borckenhagen and Louw had developed indices; but these indices were never officially published, and were for the practices' own use. These indices were mostly compiled by re-pricing existing bills of quantities against current tender prices, therefore being a Laspeyres-index (van der Walt, 1992).

3.2 THE UNIVERSITY OF STELLENBOSCH BER BUILDING-COST INDEX

3.2.1 History of the index

During the early 1960'-s a quantity surveyor responsible for research and development at the then Department of Public Works (DPW) in Pretoria, D. Brook, developed an index for use by the Department (Kilian, 1980). Although the exact date is not mentioned in the literature, Marx (2005) mentions that the index has a data-base going back to 1962; while Snyman (1988) indicated that the index dates back to 1963.

The BER was looking for a deflator for building prices in the middle 1960'-s (Kilian, 1980). It discovered the index developed and published by Brook for the DPW, and obtained permission from the DPW to take over this index. It subsequently, became necessary for the BER to develop its own index, and to set up a team consisting of Brook, the originator of the index, an economist, a statistician and an engineer, in order to re-access and streamline the composition of the Brook index. This subsequently resulted in the BER building-cost index in 1966 (Kilian, 1980).

Marx (2005) is of the opinion that because building costs refer to the cost of labour, material and equipment incurred by a contractor, the term “building-cost index” that is used by the BER for its index is rather confusing, and that the BER index is, in effect a contract price index.

3.2.2 Composition of the index

Brook (1974) described the methodology of the index as follows: “The basic logic involves the assumption that total building costs will move in accordance with the cost of the specific items selected for the purpose. The accuracy of the index would, accordingly, depend on the degree to which these items are representative of the most common, and therefore [the] most widely used, construction and finishing materials”.

According to Marx (2005) the index is based on a 100m^2, single storey building that Marx (2005) calls a “quasi-house” (the actual size of the original building was 1000 square feet). Although it is a single-storey building, Marx (2005) indicates that “… the cost of a suspended slab was somehow also included in the index”. (See Figure 3.1 for a plan and section of the building). From this building, 22 cost components were selected, and expressed as quantities (Brook, 1974).

Segalla (1991) stated that the reason for using these 22 components was because they are representative items from the original building. Snyman (1980) further mentioned that the items are weighted in proportion to the role played by each in the total cost. Not much is known about the building. Marx (2005) quotes Brook, who stated that the original building was apparently used as a military barrack, built in 1962. Brook (1974) himself stated the following about the building: “Consideration had been given to the incorporation of basic design criteria which varies from the simplest one of the fundamental ratio of light or

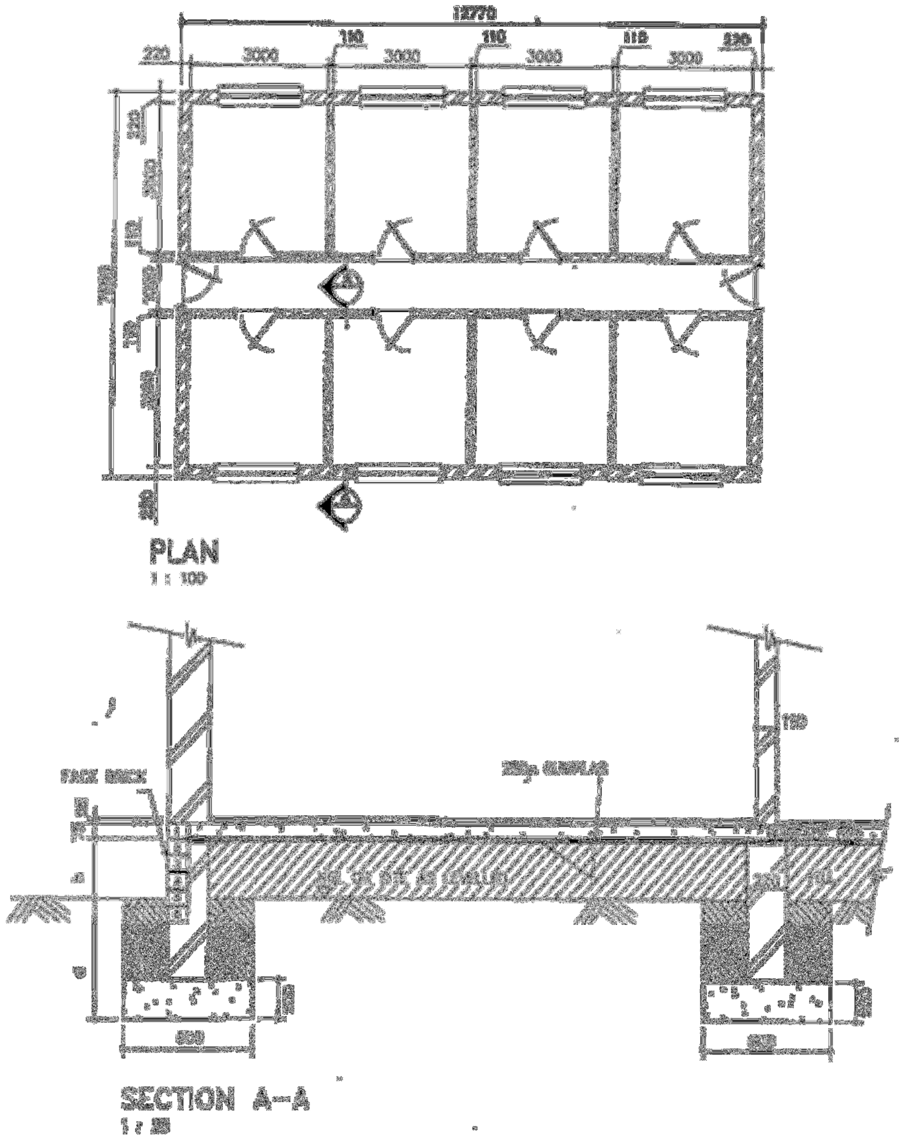


Figure X. Plan and section of building on which BER index is based (Marx, 2004)

Figure 3.1: Plan and section of “quasi-house” on which the BER index is based (Redrawn and metricised by Marx, 2005)

window area to floor area, to the more complicated criterion of a predetermined floor loading in respect of the ratio of formwork, steel and concrete in the selected floor slab".

This index is obtained by multiplying each of the 22 weighted components with the current tariff of the items. Marx (2005) reports that the information, on which the index is based, is supplied by quantity surveyors. This information includes the rates of the selected 22 items of accepted tenders, and is submitted to the BER on a standard form that is supplied by the BER (see Annexure 1 for an example of this form). The sum of the current market-related tariffs, multiplied by the base-period quantities, is then divided by the sum of the base-period tariffs multiplied by the base-period quantities, all multiplied by 100 (Marx, 2005).

From the foregoing, it is clear that the BER index is a Laspeyres index, as it involves the re-pricing of base-period quantities at current tariffs and then dividing this new "tender amount" with the "tender amount" of the base period, and then multiplying this figure by 100 to render it as a percentage.

Segalla (1991) noted that in order to ensure that correct comparisons are made the index allows a five per cent "p & g" amount per project. Today, these steps are referred to as the "preliminaries" which could be described as the information, the requirements and the restrictions of a general nature in a building project that cannot be allowed for in the measured items in bills of quantities (ASAQS, 1999). According to Segalla (1991), the five per cent was derived from norms established during previous analyses.

Quantity surveyors who submit information to the BER on completed projects are also required to indicate the amounts for electrical work, lifts, air conditioning, as well as rates for different types of sanitary fittings. Segalla (1991) mentioned in this regard that the amounts for electrical work, lifts and air conditioning are calculated as percentages of the specific contract amount; and when the index is published, the average percentages for these work sections for all projects received in a specific quarter are given. These percentages, as well as the published average rates for the sanitary fittings, however, have got nothing to do with the index and are supplied only as additional information that might be of use to the users (Marx, 2005).

The quantities that are used in the compilation of the index are indicated in Table 3.1. It must be noted that the descriptions used in this table are the original descriptions. Some of these descriptions were changed later on, in order to align them with the latest edition of the Standard System of Measuring Building Work (SSM) (ASAQS, 1999). This will be discussed later on in the study. The percentages in Table 3.1 were calculated by Marx (2005), who indicated that these may be considered to be the current weights of the index.

Table 3.1: Current quantities and percentages used to compile the BER index. (Brook, 1974 and Marx, 2005)

No.	Item	Unit	Quantity	Percentage
1	Excavation for footings	m^3	77	2.1
2	Mass concrete in footings	m^3	15	4.9
3	Reinforced concrete in slabs etc.	m^3	23	8.2
4	Centering to slabs less than 4,5m high	m^2	93	5.4
5	Reinforcement	Kg	907	3.1
6	Vinyl or similar flooring	m^2	84	4.2
7	Half brick wall	m^2	84	4.8
8	One brick wall	m^2	84	9.3
9	280mm Hollow wall	m^2	84	9.9
10	Facings	m^2	84	4.2
11	Asbestos or galvanised iron roof covering	m^2	279	15.7
12	38 x 114mm Sawn softwood in roof trusses	m	305	3.1
13	6mm Gypsum / asbestos ceiling (no brandering)	m^2	185	6.1
14	44 x 813 x 2032mm Semi-solid core door	No	10	2.2
15	76mm Mortise lock (4-lever) external quality	No	10	1.5

16	Steel door frame for 813 x 2032mm door (HB)	No	10	1.4
17	Steel or wooden window (stock)	m^2	9	2.1
18	25mm Cement screed	m^2	42	0.8
19	Internal plaster (one coat)	m^2	334	5.9
20	152 x 152mm White glazed tiles	m^2	8	0.7
21	3 Coats of PVA on plastered walls	m^2	334	3.7
22	Glass in steel or wooden frame	m^2	9	0.7
	Total			**100**

3.2.3 Discussion of BER index weights

As the intention of this study is to develop a new tender-price index for South Africa, and not primarily to look critically at other indices; it would, however, be worthwhile to look at the weights of the BER index, as indicated in Table 3.1; because, as mentioned before, it is the only building cost-index available in South Africa; and it is also a Laspeyres index, similar to the new envisaged index.

The following observations can be made in terms of the BER index:

- As noted before, the concrete slab was later added to the standard building. If one divides the 23m^3 of concrete that is allowed by the 93m^2 of formwork (or "centering" as it was originally termed), this then amounts to a slab thickness of 250mm, which can be considered an over-design for a building of this nature.
- There is an allowance of 84m^2 for 280mm hollow walls in the index. It is not clear where this item originates from, as there is no indication of such walls on the drawing. The amount for hollow walls is equal to that of one brick walls; and if one also takes the allowance for half brick walls, as well as facings into account, the total weighting for brickwork (or masonry, as indicated in the SSM) of 28,2%, seems extraordinarily high.

- The building's area is roughly 100m² in size on plan; while the allowance for roof covering in the index is 279m². It is difficult to envisage how this amount was arrived at; because, if an allowance is made for a 600mm wide overhang on all sides of the building, and the roof pitch is taken to be 30 degrees; then the amount for roof covering cannot be more than 145m². The allowance for roof covering in the BER index is, therefore, almost double what it should be, resulting in a very high percentage of 15,7% of the total index.
- The quantity for the ceiling is 185m², although the total area of the building is only 100m².
- There is an allowance of 84m² for vinyl flooring; yet the quantity for cement screed is only 42m².

As there is little or no information, on the selection and calculation of the weights for the BER index, it is difficult to comment further on the above observations; and on whether this was deliberately done, in such a manner, for a specific reason. The comparison between the new index and other indices will be done later on in the study.

3.2.4 Use and publication of the index

As mentioned before, quantity surveyors from all parts of South Africa analyse the bills of quantities of accepted tenders for projects that are administered by them; and they then complete the standard BER questionnaire, which is then processed at Stellenbosch. Snyman (1980) stated that the index measures the "in place" cost of the 22 representative items; and, unlike the contract-price adjustment provision (CPAP) formula, it includes productivity.

The current market rates of the 22 items, as supplied by quantity surveyors are scrutinised and adjusted to ensure that the information is reliable. Once calculated, the index value, the current market rates of the 22 items, and some other information (i.e. the average percentages for electrical work, etc. as described before) is published on a quarterly basis by the BER (Marx, 2004).

The figures for the last five quarters are listed as provisional; and they only become statistically more stable and reliable, as more information is received. According to Segalla (1991), the calculation is done for the middle month of each quarter, i.e. February, May, August and November. The index is always one quarter behind - due to the lag experienced in obtaining the data supplied by quantity surveyors. The aim of the BER is obviously to obtain information on as many projects as possible. Brook (1985) was of the opinion that when less than seven projects are analysed, the results cannot be regarded as statistically stable; and the results should, therefore, be treated with circumspection.

Brook (1985) further stated that research has shown that the index stabilises when approximately 40 projects are included in the analysis, and that the average index values differ only slightly, when either 40 or 80 projects are analysed.

3.2.5 Refinements of the index through time

Segalla (1991) has indicated that the fundamental formula for generating the index has remained unchanged since its initial development. This, in essence, means that the 22 items and their weights have not changed since the development of the index in the early 1960'-s by Brook. According to Segalla (1991), and Brook (1985), there has been continuous enhancement of the index through the years. Some of these changes/refinements are the following:

- The original base date of 1970 = 100 was changed a couple of times through the years, i.e. firstly to 1975 = 100 and then to 1990 = 100 (which is still the current base date). The April 1970 = 100 base date has been retained in the analyses' schedule of the index. The reason for this, according to Brook (1985), was for the sake of convenience - due to the fact that many subscribers and contributors have become accustomed to this particular base date over the years, and have used it to develop their own cost-information systems.

- The questionnaire was revised, with the section relating to external finishes omitted, as the information gathered in the past on this section was not meaningful (Brook, 1985). Instead, cost information on sanitary fittings and plumbing items was called for; and currently, a rate per sanitary fitting, as well as an all-in rate for reinforced concrete per cubic metre is provided in the analysis of the schedule. As mentioned before, the latter information does not, however, form part of the index.
- Brook (1985) stated that while the BER index is a quarterly index, numerous requests have been received throughout the years from users to provide them with monthly building-cost data. According to Brook (1985), this led to a decision by the Bureau to use methods of interpolation to publish the index on a monthly basis. Because the quarterly index values are centred on the middle months of calendar quarters, the values for other months can be calculated by means of interpolation, in which linearity is assumed (Brook, 1985). Whether this was ever done, and if so, for how long, is not clear, as the index is currently, and has been for the past number of years, being published on a quarterly basis only.
- Only one technical change, according to Brook (1985), was made to the method of calculation of the index up to 1985. Previously the base rates for the quarter immediately preceding that of the index to be computed were used in the calculations. After an investigation by the Bureau; it was decided to henceforth, use the base rates relating to the two quarters prior to those of the specific index being computed. Brook (1985) stated as a reason for this decision, that the rates for quarter t-2 were more stable than those for quarter t-1, as the former were usually based on a larger number of analysed projects.
- Segalla (1991) mentioned that the need for project-specific indices had existed for some time, since after the start of the index; but insufficient numbers of completed index forms had been received to achieve this. During 1989, the Bureau decided that

since the start of 1987, sufficient numbers of forms had been submitted for the calculation of project-specific indices (Segalla, 1991). Although Segalla (1991) mentioned that 28 categories of projects were identified for these project-specific indices, Kilian (1980) stated that it became a matter of urgency to compile indices for the 12 different types of buildings, which had been distinguished. The 12 types, according to Kilian (1980) and Segalla (1991), were: housing, flats, office blocks, shops, education, factories, churches, hospitals, police stations, post offices, and defence and municipal buildings. Again it could not be established whether these project- specific indices were actually published; and, if so, for how long. Currently (and for the past number of years), although different types of buildings are analised, there is no mention of project specific-indices in the quarterly BER publication.

- Kilian (1980) mentioned that it had long been felt that some more representative items should be added to the index; but that such revisions cannot be implemented unless the design of the basic building is changed. According to Kilian (1980), the Bureau was considering this point, although it was expected that should the number of representative items be increased, the number would, nevertheless, be kept to manageable proportions. Although the above was seemingly considered, it never happened; and the same 22 items are currently still being used to calculate the index.

3.3 THE CONTRACT-PRICE INDEX FOR BUILDINGS

3.3.1 Background

Very little is known about this index, except that it was compiled by Van der Walt, a quantity surveyor in private practice in Pretoria, RSA. The research that was done in the compilation of the index was adapted and presented as part of a PhD thesis in 1992 at the University of

Pretoria; but, as stated in the thesis, the study had already been conducted in the early 1970'-s and is based on the data for 1971 (Van der Walt, 1992).

The details of the index were made available to the then Central Statistical Services (CSS), currently known as Statistics South Africa, and published, as Statistical Newsletter P0153 since 1980. According to Klaas (2011), due to budget cuts regarding the 1997/1998 financial year, the CSS informed all users that it would no longer be able to produce the index. In order to enable stakeholders to find funding for the publication of the index, the CSS still published the index during the 1997/1998 financial year. Unfortunately, according to Klaas (2011), no stakeholder indicated that they would be interested to contribute to the cost of publishing the index; and therefore the last issue was that of June 1998, before it was discontinued.

3.3.2 Methodology

Van der Walt (1992) indicated that the index is a weighted average of price-relative indices with fixed base-year weights, and consequently a Laspeyres-type index. The weights were selected from the data collected from quantity surveyors by means of a questionnaire, which required analysis of the priced bills of quantities. These weights related to sub-sections of the trades found in bills of quantities. After establishing the weights, a short list of these sub-sections with corresponding weighted average values was determined for each of the various building types (Van der Walt, 1992). These building types were the following:

- Housing schemes: Blocks of flats with or without shops, or shopping centres; office buildings with or without shops; factory buildings; primary schools; secondary schools or technical colleges; university lecture rooms, and laboratories, etc., hospitals, and others.

The index was also published on a regional basis, where the country was divided into 11 regions, based on the classification, as used by the then Building Industry Council.

From Van der Walt's thesis (1992), it is unfortunately not clear what the exact weights were that were used for the index, as the weights that were allocated to each building type, do not add up to 100, which is standard practice for any weighted index. The sections and sub-sections used for the weights, nevertheless, are indicated in Table 3.2 (Van der Walt, 1992).

Table 3.2: Items for weights, contract price-index for buildings (Van der Walt, 1992)

EXCAVATOR
Mass excavations
Other excavations
Sundries
CONCRETE, FORMWORK AND REINFORCEMENT
Mass concrete
Reinforced concrete
Formwork
Steel reinforcement
PRECAST CONCRETE
Precast concrete
BRICKLAYER
Brickwork
Face brickwork
Clay tiles, etc.
WATERPROOFING
Roof work
ROOFER
Roof coverings
CARPENTER AND JOINER
Roof work
Roof sundries

Roof coverings
Ceiling
Suspended ceilings
Floors
Flush doors
Timber doors, etc.
Fittings, etc.
FLOOR COVERINGS, PLASTIC LININGS, ETC.
Floor coverings
IRONMONGERY
Ironmongery
METALWORK
Structural steelwork
Other steelwork
Door frames
Steel windows
Fittings
Glazed enamelled steel
Louvers
Partitions
PAVIER AND PLASTERER
Granolithic
Terrazzo
Screeds
Plaster
TILER
Porcelain tile work
Ceramic tile work
PLUMBER AND DRAINLAYER
Plate metalwork
Drain pipes
Sanitary fittings
Cast-iron, etc. pipes
Geysers
GLAZIER
Glass
PAINTER

PVA, etc.
Enamel paint
PROVISIONAL SUMS
Electrical installation
Lift installation
Air-conditioning installation

3.3.3 Publication of the index

As indicated, the CSS published the index on a quarterly basis as Statistical News Release P0153. According to Klaas (personal communication, 2011), the rates of items that appeared in bills of quantities were surveyed by quantity surveyors, and used to publish a contract-price index for buildings, as well as the weighted-average price indices, according to each region.

Statistical News Release P0153 for the first quarter of 1998 (CSS, 1998) stated that rates for the approximately 270 items appearing in priced bills of quantities for accepted tenders are called from quantity surveyors. These rates are raised by the percentage, which the value of the Preliminaries trade contributes to the total contract amount. A few of these rates are not taken into account; since they deviate considerably from the averages for the relevant items.

When looking at some of the last issues of the P1053 News Release that are still available, it is clear that not enough information was available to justify the publication of the index for different building types, as well as on a regional basis (only 17 bills of quantities were received for the first quarter of 1998). This resulted, for example, in indices that were not being published for five of the nine building types in the first quarter of 1998; and, similarly, no bills of quantities were received for four of the eleven regions.

3.4 CHAPTER OF SOUTH AFRICAN QUANTITY SURVEYORS

3.4.1 Background

Most of the following information was reported in a study by Miners (1969); since no other information could be found on this work that was done by the Chapter. According to Miners (1969), the chairmen of the Board of Trade and Industries, as well as the Industrial Development Corporation approached the then South African Chapter of Quantity Surveyors for information on the relative building costs in various cities throughout the country (for the sake of clarity, it must be pointed out that, according to Law (1985), the South African Council for the Quantity Surveying Profession was only established in 1970. Prior to that, the quantity surveying fraternity formed part of the then Institute of South African Architects, which was made up of five constituent bodies – a provincial institute of architects in four provinces, together with the Chapter of South African Quantity Surveyors).

The Cost Research Co-ordinating Committee of the Chapter was requested to proceed immediately with the task of collecting and processing all the relevant information.

3.4.2 The results of the survey

A circular was prepared requesting co-operation from all the quantity surveyors in the country. The required information was in the form of a questionnaire, containing general notes, as well as a list of 50 items commonly found in bills of quantities (no details could be obtained for these items). Information was limited to projects for which tenders had been received after 1 January 1964. The type and location of the building were also required.

On the return of the questionnaires, several approaches were decided upon as a check on the results. Firstly, the index for Pretoria was regarded as the base (100). Twelve other regions throughout the country were identified; and regional indices were expressed in relation to those of Pretoria. The returned questionnaires were sorted, according to the various regional groupings; and within each region, an average rate for all 50 items was calculated on a straight-forward statistical basis. A note was also made of the maximum and minimum number of rates returned from each region; and an index for each item in all the regions was calculated as a percentage of the Pretoria rate (Miners, 1969).

The second method, as reported by Miners (1969), involved the selection of about 30 items from the original 50 listed. These items were grouped into respective trades, and weighted within these trades. An average index within each trade (for every region) was then calculated, thereby resulting in a building-cost index expressed as the averages of all the trade indices.

The third method necessitated the selection of 20 key items, together with their respective indices, calculated as a percentage of the Pretoria rate for each region, as described before for the second method. Each item was then weighted in terms of its proportional value in a building contract. By multiplying each such index with its appropriate weight, and adding these extensions together, a relative building-cost index could be prepared, in terms of these totals as a percentage of the Pretoria total (Miners, 1969).

The last method that was considered was to see whether only four specially selected items could be used - without any weighting, in order to give comparable results. Miners (1969) indicated that in this case the average of the indices of the chosen items was calculated for each region; and these were then regarded as the final cost index.

Miners (1969) reported that in spite of the variation in approach of the four methods, all the results were comparable, and showed that the differences in cost between the regions were all of the same order. When the results were compared with the data compiled by some of the larger quantity surveying firms, there was also a correlation. From both a practical and a theoretical point of view, Miners (1969) was of the opinion that the third method discussed above (twenty selected items with their indices weighted in proportion to their value of a contract) appeared to be the most suitable. It was further found that these 20 items were representative of 43% of the total value of the contract.

A major shortcoming of this index according to Miners (1969), was that the amounts for the Preliminaries and General trade (as it was known then) in the bills of quantities were ignored; and that this omission could lead to substantial errors in an index. Miners' (1969) solution was for the percentage of Preliminaries and General amount, relative to the contract sum, is added to the rate of each item.

In conclusion, Miners (1969) stated that, although the suggested method had its limitations, a large enough statistical sample in the form of priced bills of quantities from quantity surveyors' offices, as well as the adjustment of the Preliminaries, as discussed above, would minimise such difficulties, and produce an index of "considerable national importance". Unfortunately, no additional information could be found on this effort to produce an index for the South African building industry.

3.5 CONTRACT PRICE PROVISIONS INDEX

3.5.1 Background

The Contract Price-Adjustment Provisions (CPAP) work group indices were introduced in early 1976 (Kilian and Snyman, 1985). These indices were previously known as the BIAC CPAP work-group indices; and are still often referred to as the Haylett formula, so named after the founder of the formula, P. Haylett, then chief quantity surveyor at the DPW in Pretoria. In 1995, the Joint Building Contracts Committee (JBCC) accepted responsibility for the administration of CPAP, as published by Statistics South Africa, with the signing of a copyright-licence agreement between Statistics South Africa, and the JBCC.

In 1998, the provision of the indices to the industry changed from a free publication to an annual subscription, payable by interested parties, which was designed to cover Statistics South Africa's fee, as well as JBCC's administration costs (JBCC, 2005). This situation changed again, when the contract between Statistics South Africa and the JBCC expired on 31 December 2011.

A new CPAP committee was formed from delegates of the three constituent bodies, viz. ASAQS, DPW and Statistics South Africa with ASAQS the publishing body. According to the new agreement, statistical release P0151 that contains the published CPAP indices is now published free of charge; and all changes/updates of the CPAP manual would be the responsibility of the CPAP committee (Statistics South Africa, 2014).

The CPAP index differs from the BER index in that it is not the same type of index as a tender-price index. A tender-price index, as indicated before, represents the cost that the client pays for a building; and it reflects contractors' views about labour and material cost during the construction period, as well as what the influence is of market conditions (also known as the "tendering climate") on profit margins (Davis Langdon Management Consultancy, 2008). CPAP, on the other hand, according to Kilian and Snyman (1985) was intended to compensate the contractor for cost increases, which he experienced during the construction period, and over which he had little or no control.

It would, however, be useful to discuss this index, as it is frequently used in the South African building industry, as an indicator of the movement of construction costs, and also to do a comparison with the movement of tender prices, in order to see whether there is any correlation. One such a comparison is done quarterly in a joint publication between Medium-Term Forecasting Associates (MFA) and the BER. In the report of the first quarter of 2011, it was, for instance, reported that Work group 180, lump-sum contracts, of the JBCC CPAP, rose by 3,9% on average for 2010; while the BER building-cost index declined by 0,6% for the same period (MFA, 2011)

3.5.2 The methodology

According to Snyman (1980), the principal components of building costs are: labour costs, material costs, and plant prices. The CPAP combine these components into the following 40 work groups, which then forms the basis for price-revision clauses, in terms of the formula (ASAQS, 2013):

Table 3.3: Contract-Price Adjustment Provisions: work group composition (ASAQS, 2013)

Alterations
Earthworks
Piling
Concrete (excluding formwork)
Formwork
Precast concrete
Post tensioning
Reinforcement
Brick and block work
Masonry
Waterproofing
Non-metallic roof coverings
Metal roofing (steel)

Metal roofing (aluminium)
Carpentry and joinery
Ceilings
Resilient floor and wall coverings
Ironmongery
Structural steel works in buildings
Metalwork
Partitioning systems
Aluminium work
Stainless steel work
In situ finishes
Tiling
Drainage
Plumbing
Aluminium shop-fronts and pre-glazed aluminium windows
Glazing
Painting
Roadworks
Electrical installation
Electrical – reticulation
Mechanical services
Ductwork installations
Refrigeration installations
Steel water pipe installations
Lump-sum contracts
Commercial industrial buildings
Preliminaries

The CPAP reflects the price changes, as closely as possible, within the philosophy of an index-based system. The formula-adjustment provision provides for the needs of contractors in the form of reasonable reimbursement for price fluctuations. An escalation-recovery formula method is the best way to avoid disputes between contractors and employers, as well as with sub-contractors (ASAQS, 2013).

The CPAP indices are calculated and published on a monthly basis by Statistics South Africa in Statistical release P0151. The information for calculating the indices is sourced by Statistics South Africa from material and plant merchants across the country; while labour costs are aligned with the CPI (Statistics South Africa, 2011).

According to the ASAQS (2013), on a contract where CPAP is applicable, the principal agent must calculate an adjustment amount for each valuation period, in respect of each applicable work group, by the application of the following formula:

$$A = 0.85 \times V \times (Xe / Xo - 1)$$

Where:	*A*	=	the adjustment amount
	0.85	=	a constant which provides for a 15% non-adjustable element
	V	=	the work value in such work group and the valuation period
	Xe	=	the value of the index applicable to such a work group and the valuation period for the calendar month during which the payment certificate is dated
	Xo	=	the value of the index applicable to such a work group for the base-month (ASAQS, 2013)

According to the ASAQS (2013), the CPAP is designed to reflect price changes, as closely as possible, within the constraints of an index-based system. Whilst a formula can never precisely reflect the actual cost fluctuations on a contract, the CPAP is designed to simplify adjustment procedures, while at the same time providing a level of compensation that is fair to both the employer and the contractor (ASAQS, 2013).

3.6 STEEL AND ENGINEERING INDUSTRIES FEDERATION OF SOUTH AFRICA (SEIFSA) PRICE AND INDEX PAGES

3.6.1 Background

The SEIFSA price and index pages have been published on a monthly basis since 1960; and they consist of indices, based on various SEIFSA surveys, as well as price indices measuring consumer or production inflation received from various organisations (SEIFSA, undated). The readership of the publication consists mainly of buyers, and of contract and procurement managers of large companies in the transport, metal, engineering and manufacturing industries, as well as government and large parastatals.

The aim of the publication, according to SEIFSA (undated), is to provide users thereof with an independent source of indices, to determine and negotiate contract-price adjustments, in order to ensure a fair and equitable deal for suppliers and manufacturers, as well as for their clients.

3.6.2 Published indices

The SEIFSA publication consists of approximately 150 independent market or product-specific indices that SEIFSA reviews and updates on a monthly basis. As it is not the intention of this study, to go into the details of all the indices, it will suffice to give a summary of the published indices, as indicated below:

- SEIFSA indices of wage rates and labour costs for hourly paid employees in the metal and engineering industry:
  - SEIFSA index of statutory labour costs;

  - SEIFSA index of statutory labour costs (field force), where a subsistence allowance is also paid;
  - SEIFSA index of actual labour costs;
  - SEIFSA index of actual labour costs (field force), where a subsistence allowance is paid;
  - SEIFSA index of actual wage rates;
  - Statistics South Africa – consumer-price indices;
  - Consumer-price index – all income groups.
- Price indices for products and services:
  - Domestic steel-price index;
  - Index for unworked materials – structural steel;
  - Merchant steel-price index;
  - SEIFSA index for foundry scrap;
  - Index for conductor-steel core (ACSR wire);
  - Index for round bars;
  - Strand for post-tensioning application;
  - Steel used in pipe-manufacturing industry;
  - Metal prices;
  - Statistics South Africa – production-price index;
  - Statistics South Africa index: steel tube, pipe and fittings;
  - SEIFSA cost index of materials used in the manufacture of power transformers;
  - Statistics South Africa index for electricity, gas and water;
  - SEIFSA indices for freight costs;
  - Statistics South Africa price index of selected materials;
  - Ruling price of certain electrical cable-manufacturing materials;
  - Statistics South Africa price index of selected materials;
  - SEIFSA index of plant and machinery costs before installation;
  - Index of stainless steel flat products (excluding imports);
  - Corrosion-resistant steel 3CR12;
  - Index of stainless steel flat products – cold rolled steel;
  - Price of aluminium products per ton (free on rail Richards Bay);

- Secondary aluminium ingot index;
- Index of movements in composite costs of production for the SA paint industry;
- Production-price indices.

3.7 SUMMARY

From the literature, as discussed above, it is evident that there is currently only one tender price (or building-price) index, the BER index, which is being used in South Africa. This index was established in the early 1960'-s, and has undergone little change, since its inception. Another index, based on the data gathered in 1971, was formulated by van der Walt and also introduced into the South African building industry. It was published as the "contract-price index for buildings" by the then South African Statistical Services, but was discontinued in early 1998, mostly due to a lack of funding.

Other indices that are being used by the South African building industry are mostly indices used for the calculation of contract-price adjustment, such as the JBCC CPAP work-group indices, as well as the SEIFSA price and index pages. Although CPAP indices differ from tender-price indices, they are discussed because of their usefulness in comparing the different movements in tender prices building costs.

3.8 CONCLUSION

It may be concluded, based on the literature review of the existing indices used in the South African construction industry, that there is room for a new TPI based on current construction methods and technology. The reason for this may be attributed to the fact that the only index currently published in South Africa for the building industry is based on a single-storey building, and that the weights of the index have not changed since its inception in the early 1960'-s. Because of the relative "age" of the current index, and the lack of any other indices with which to compare its accuracy, the local building industry has to make do with the uncertainty of whether the index is still relevant; and when it is being used, if the available data are trustworthy, and sufficiently reliable to base any calculations on.

CHAPTER 4

TENDER-PRICE INDICES IN SELECTED OTHER COUNTRIES

4.1 INTRODUCTION

A number of overseas countries publish TPI's for their building industries. The aim of this chapter is to conduct a short discussion of the various countries where such indices are being published, the type and composition of the indices, and how they relate to the situation in South Africa.

4.2 SOURCES

Various sources in the literature were accessed in order to observe what is happening in other countries regarding the use of TPI's for construction work. Eurostat (2008) did a survey among 25 countries, mostly European member countries; and it was found that output construction price indices are compiled by 14 member countries.

Another source of information was the BCIS that conducted research in 2009 on the comparison of building cost data between 40 different countries; most of which are member countries of the Royal Institution of Chartered Surveyors (RICS). Part of the survey for the research comprised the posting of questions on published tender-price indices. Of the 40 countries, 26 indicated that no tender-price indices are published; while 14 other countries did have some form of index that is published on a regular basis.

Before the above information was used in the study, it was, as far as possible, checked to see whether the information is still correct and relevant. Furthermore, the World Wide Web, as well as other sources of information (such as personal communication, papers published in academic journals, or those delivered at international conferences) was also used to gather information on countries other than those covered, as already indicated. It should be mentioned that only countries that were found to have recent, published tender price indices were included in this study. A number of countries *do* publish construction-related indices; but many do not publish TPIs for the building industry. The methodology used to gather information on tender-price indices published by overseas countries can therefore be described as a purposive sampling method. The following types of indices were, therefore, not used:

- Indices for residential projects; and
- Indices for civil engineering projects

It must be noted that some countries' input indices will be discussed, in order to examine the items used and the weightings thereof, in order to ascertain whether these are based on base-weighted principles.

4.3 COUNTRIES WITH TENDER-PRICE INDICES

The selected countries where TPI's are used comprise the following:

4.3.1 Hong Kong

The Hong Kong Government's Architectural Service Department: Quantity Surveying Branch, publishes a Building Works Tender Price Index on a quarterly basis. In a personal communication with Ho (2014), it was indicated that the index is based on the same principles as that of the BCIS's index *viz*. that it is a current-weight-match-item of the Paasche-type index. Information from priced bills of quantities of projects procured by the Architectural Services Department: Quantity Surveying Branch, and compiled by quantity surveying firms in private practice is used as the basis for the index.

From these bills of quantities, items with the greatest value are re-priced in descending order until a sufficiently large value is reached to produce a project index.

This index has been published since 1970; and it indicates the general cost trend of government building projects. These are based on contractors' priced bills of quantities for accepted building tenders — obtained through competitive tendering on new works contracts - let by the Architectural Service Department.

4.3.2 Ireland

The Society of Chartered Surveyors, Ireland, publishes on a quarterly basis a Construction Tender-Price Index, which has been in place since 1998. The information from priced bills of quantities of completed tenders is sourced from quantity surveyors, who have to complete a standard questionnaire. In this questionnaire, some mandatory information must be submitted, such as location, building type, form of contract, contract value and the contract period. The items for which rates should be submitted are the following:

- Excavation in foundation trenches 1.00 – 3.00m;
- Disposal of excavated material off-site;

- Filling to be obtained off-site to make up levels/filling of excavations;
- *In-situ* reinforced concrete grade 35 N 20 in slabs;
- Reinforcement bars 12 – 25mm in diameter;
- Reinforcement fabric reference A: 200 side- and end-laps;
- Formwork to soffits of slabs;
- Formwork to beams; isolated, square or rectangular-shaped;
- Formwork to columns; square or rectangular-shaped;
- Precast concrete; pre-stressed hollow core slab units; floor or roof slabs 200mm thick;
- Brickwork; clay facing bricks in walls, 100mm thick;
- Block work; concrete blocks in walls, 215mm thick;
- Mastic asphalt; roofing 20mm thick 2 nr. Coats;
- “Trocal” type-S roofing membrane; horizontal;
- Fibrous cement slate roofing; 600mm x 300mm with 32mm x 25mm softwood battens; sloping not exceeding 45 degrees;
- “Kingspan” rigid sheet roof covering; 80mm thick;
- “Kingspan” Topdeck membrane roof covering system; 100mm thick;
- Softwood, sawn, impregnated carcassing members; 100mm x 50mm;
- Ditto; 225mm x 44mm;
- Flush panel doors and associated frame sets; non-fire rated; for opening size 900mm x 2100mm;
- Fabricated structural steel; beams, stanchions and the like;
- Un-fabricated structural steel; angles and the like;
- Cold-rolled members; purlins, cladding rails and the like;
- *In-situ* finishes; bonding plaster 11 thick to walls;
- Render; first coat cement; 20mm thick to walls;
- Floor screed; 75mm thick to walls;
- Fitted-carpeting to floors;
- Carpet tiles to raised access floors;
- Stud partitions; boarded both sides; 75mm thick, 2700mm high;

- Suspended ceilings; 600mm x 600mm x 15mm fibreboard tiles; depth of suspension 150mm – 500mm;
- Gyprock wallboard 12.5mm thick suspended ceiling; depth of suspension 150mm – 500mm;
- Two coats emulsion paint; to plastered walls;
- Two undercoats, one coat full gloss finish; general surfaces of wood;
- All-in drainage rate; excavating trenches to receive pipes; 150mm concrete pipes on granular bed; average depth 500mm – 1000mm;
- *In-situ* Macadam surface paving; roads on hard-core base; 80mm thick in 2 nr coats.

The weighting of the items for the index was not reviewed.

4.3.3 Finland

Statistics Finland publishes a Building Cost Index 2000 = 100 that took effect from the beginning of 2001; - although the first index series compiled in Finland to describe the development of building costs dates back to 1914 (Statistics Finland, 2001). The weightings of the index are updated on a regular basis (approximately every five years), and the update of the index is normally a joint venture between Statistics Finland and the Technical Research Centre: Building and Transport.

The index is a fixed-weight Laspeyres-type input index and it is used to monitor the cost of a particular building project - by reference to the cost of the production factors invested in the project. The impact of price movements in each production factor on the index is determined by a weight that corresponds to its share of the building project.

The index is calculated as a weighted average of the indices for blocks of flats, detached houses, offices and commercial buildings, as well as industrial buildings and warehouses. The weights are based on the estimated share of these types of buildings of total new building production in 2000 to 2005. Each project type has its own distinctive breakdown of costs, which is reflected in the input weight distribution. The total costs of each type of building are obtained by adding up the main categories in the input nomenclature. For instance, materials account for 52% of the costs of building an attached house, labour for 31,5%, and other services for 16,5%.

For the material input, the weights of 53 items are being used. These items are as follows:

- Soil
- Site-surface structures
- Site equipment
- Concrete reinforcement steel
- Ready-mixed concrete wet
- Structural-section iron
- Bricks
- Blocks
- Mortars
- Ceramic tiles
- Concrete elements
- Wooden roof structures
- Fixing ironmongery
- Impregnated wood
- Panels
- Sawn timber
- Building boards
- Bituminous roofing
- Plastic flooring
- Wooden floors
- Floor screeds and renders
- Wall screeds and renders
- Paints
- Wall papers
- Kitchen fixtures
- Sanitary fixtures
- Kitchen appliances
- Water pipes
- Drainage pipes
- Piping equipment
- Appliances for drainage and water
- Radiator pipes
- Heating appliances
- Electric heaters

- Re-locatable partitions
- Ceilings
- Heat insulation products
- Wooden windows
- Metal doors and window frames
- Wooden doors
- Ironmongery
- Fireplace or stove
- Metal roofing
- Tile roofing
- Ventilation equipment
- Ventilation ducts
- Control systems
- Distribution boards
- Electrical installation
- Cable channel and racks
- Wiring
- Telesignal appliances
- Lighting

The index monitors the prices of 1300 items each month, from almost 400 informants, such as manufacturers and wholesale dealers (Statistics Finland, 2001). These prices are typical prices that a builder would normally have to pay for the item concerned. Labour costs used for the index are based on the average hourly wages for regular working hours collected from employer organisations in various fields of the building industry. This method is different from other methods where the actual tendered rates from contractors are obtained for use in an index.

4.3.4 The United Kingdom

Although mention was made previously in the study of the situation in the United Kingdom (UK), the following is a more comprehensive explanation of the composition of the tender-price index of the BCIS, the research arm of the RICS.

Information in the form of priced bills of quantities is collected from the RICS members (quantity surveying firms); and they cover building projects procured in a particular quarter for both public and private contracts. According to Yu and Ive (2006), the methodology used by the BCIS is to produce an index for each project received. This is achieved by analysing each project in isolation. From each trade of the project all those items with values greater than 1% of the measured work are identified. These items are then re-priced, by using so-called base rates in a descending order of value, until the value of the re-priced items is more than 25% of the value of that trade.

For base rates, the BCIS uses a schedule of rates, produced by them, of the base year. Only projects with a value of more than £100 000 are sampled. In using the above methodology, the BCIS index is a current-weight match-item Paasche index; as only items that can be matched to the schedule of base rates would be compared and current quantities in the bills of quantities are used to weight the prices (Yu & Ive, 2006).

Yu and Ive (2006) state that since 1984, each BCIS project index has been adjusted for the size, location and procurement method, before aggregating them into the published indices (indices are being published on a quarterly basis).

4.3.5 Australia

The Australian Institute of Quantity Surveyors (AIQS) publishes an “AIQS building-cost index by capital city” on a quarterly basis in the Building Economist, official journal of the AIQS. According to Postumus (2006), index figures from 1974 to 1995 were based on those generated by the members of the National Public Works Conference (NPWC). In 2005, the AIQS developed and published a new Building-Cost Index. Postumus (2006) states that the original NPWC index was based on cost-index rates for basic items, built up to allow for the cost of labour, material, plant, fabrication, cartage and servicing, plus allowances for waste, overheads and profit. The allowances for overheads in item rates differs from South African practice where allowances for such items are made in the Preliminaries trade (see item 6.4.2.4 for full discussion).

The building cost-index was then calculated by applying the cost-index rates to the items of the bills of quantities of fifteen typical projects.

The new index is based on observations made by various sources, such as the NPWC, BRIX quarterly survey results, and local quantity surveying chapter representatives. The results of the index are published in the form of a graph, showing the long-term movement in general building costs for each of the six capital cities in Australia *viz*. Brisbane, Sydney, Melbourne, Perth, Adelaide and Canberra, since 1985.

According to the AIQS (2011), the index is published "as a matter of interest only; and [it is] not intended to be relied upon by readers". The figures do not represent any specific type of project, nor are they likely to be indicative of very large or small projects.

4.3.6 Canada

The non-residential building-construction price index (NRBCPI) is a quarterly series measuring the changes in contractors' selling prices of non-residential building-construction materials (i.e. commercial, industrial and institutional). It is published by Statistics Canada (Statistics Canada, 2014). The index relates to general and trade contractors' work and it excludes the cost of land, design and development fees, as well as any real estate fees.

The population of the NRBCPI consists of building contractors that are primarily engaged in the construction of non-residential buildings in the census metropolitan (CMA) areas of Halifax, Montréal, Toronto, Calgary, Edmonton, Vancouver, and the Ontario part of the Ottawa-Gatineau metropolitan area. Respondents in the survey are obtained from a judgemental section in each CMA surveyed. They must be well-established and actively bidding and winning a share of the jobs in one of the seven CMA'-s included in the survey.

They are usually members of local associations, such as construction or trade associations. The data are collected by telephone survey, using a price report, and also by way of a mail-out questionnaire. Both the price report and the questionnaire were developed in the early 1980'-s in collaboration with industry specialists.

Collection occurs over the second and third months of each quarter, i.e. February and March, May and June, August and September, November and December. The prices of the sample survey are collected over a two-month period. The price information collected relates to the quarter in question; and it is derived from the bid prices for the 15th of the middle month of the quarter, or the nearest prior business day. The goal is to obtain the average bid price for each sample item for the reference quarter.

Fixed technical specifications of sample items of construction work selected from the building models are used in the collecting of the data. An example of such an item would be: "Supply and install carpet, 100% first quality, over-tuft cut nylon pile equal to 907 g/m^2" (Statistics Canada, 2014). In addition to the technical specification, the unit of measurement and quantity of the sample item as well as the type of building where the items are to be placed, are area defined, e.g. 810m^2 of carpet to be installed in office building to be located in a specific CMA. Selling prices include costs for materials, labour, equipment, provincial taxes and contractors' current overheads, as well as profit market conditions; while value added taxes are excluded.

The prices collected are obtained from a subjective sample survey; and they constitute a competitive price that would have a reasonable chance of being the low price in an actual bid; and therefore they are not typical “list” prices.

The NRBCPI is a composite, weighted index. Sample item weights are derived from a detailed cost analysis of each structure. The sample quantity weights are derived from the specifications of office, factory, school, warehouse and shopping-centre structure models completed in 2003 and 2004. The weights used at the CMA, building category and CMA composite levels are derived from the Building Permits Survey conducted by Statistics Canada. Each of the cities in the survey is visited every two years, in order to establish and maintain a good rapport with the sources of information, and to ensure obtaining reliable information.

4.3.7 Singapore

The TPI is published on a quarterly basis by the Singapore Government Building and Construction Authority (GBCA). The publication of the index started in 1987 and was re-based in 2005 (2005 = 100). According to Langdon and Seah Quantity Surveyors (2014), the tender- price index reflects the general movement of tender prices of three specific sub-sectors of the construction industry *viz*. residential buildings (public (HDB flats) and private (non-landed) as well as commercial office blocks. The index is compiled from the tender prices, which represent the cost that a client must pay to construct a new building.

According to Lo Yen Lee (2008), the previous TPI compiled by the GBCA was a building works index; and it excluded any substructures, as well as mechanical and electrical services. It was compiled by re-pricing a basket of cost-significant building items, using unit rates provided by the four largest quantity surveying firms in Singapore on a quarterly basis. The index that was published before 2009 also excluded preliminaries. Little else is known about the index regarding the methodology, weightings, information gathering, sampling, etc.

In a personal communication with a representative from the GBCA, it was indicated that since 2009, a new TPI is published by them. The actual compiling of the index is outsourced to a private quantity surveying company; and part of the agreement between the company and the GBCA contains a confidentiality clause that prohibits any of the parties from making public any detailed information regarding the compilation of the TPI public.

4.3.8 France

The construction-cost index (CCI) is a quarterly index that was first published in 1953 (4th quarter 1953 = 100). According to the National Institute of Statistics and Economics (INSEE), website (http://www.bdm.insee.fr/en/methods/default.asp, accessed 20 April 2014), the CCI actually measured the changes in general construction prices between 1953 and 1956; but since then, the CCI measures changes in the construction of new buildings mainly used for non-cohousing (e.g. individual houses) in France.

The first five New Housing Cost Price Surveys (NHCP) took place between 1969 and 1976. This survey was renewed in 1978; and it was then merged with the CCI. In 2009, the French National Statistical Information Council (CNIS) registered the CCI-NHCP on the programme of public-interest services.

Since 2010 the CCI has been calculated, using the hedonic method, based on elements derived from the quarterly survey concerning the five NHCP'-s. The hedonic model involves establishing a relationship, using an econometric model, between the market price of construction and the characteristics of the work, which evaluates the implicit value of these different characteristics. For each type of construction (pure individual, grouped individually and collectively), the logarithm of the average price of the building is modelled by using different explanatory variables: logarithm of the average surface, location of the building, number of levels of living space, basement, garage, boiler type, conventional heating, wall coverings and flooring, paint, non-equipped kitchen, the living standards of the construction site and the time variables of the six quarters covered.

The sampling model is the planning permission database. Five months before the start of each quarter, a sample of 1600 planning permissions is selected from the planning permission database issued in the mainland of France — for new housing to be used for residential purposes. The survey relating to 1600 planning permissions is then administered by post in two phases:

- A first phase which sets out to identify construction operations, which effectively conforms to the CCI requirements, with a four-page questionnaire sent out to the project owner two months before the start of the quarter.
- A second phase, in which the documents from the contract cover the first part concerning the administrative characteristics of the construction operation (price, date, etc.), and the second part its technical characteristics (surface area, number of levels, etc.).

Not all 1600 identified projects lead to construction because of the cancellation of permits, postponement, etc. Around 500 construction operations would be suitable for calculating the index. The model coefficients are re-estimated each quarter over a time window of six quarters; while the models themselves are reviewed periodically.

4.3.9 Norway

The index under observation is the construction-cost (CCI) index for residential buildings. Although the envisaged new TPI for South Africa will not include residential buildings in the model, it was deemed prudent to include this index into the discussion of overseas' indices, because it makes use of information obtained from so-called "apartment buildings" and not any single, stand-alone housing.

The CCI measures the price developments of material, labour, transport, plant and other types of input factors in the production of residential buildings, i.e. the costs incurred by the contractor/developer carrying out the construction work. The CCI is used to regulate the cost of construction work. At Statistics Norway, the CCI is used as a deflator in the National Accounts. There are 2910 subscribers to a monthly card. The subscribers are developers, contractors, builders, technical installation firms, and manufacturers of prefabricated houses, etc.

According to Statistics Norway (2014), two types of information need to be collected about the input factors: the percentage of each component (weights), and the prices. The weights are compiled every tenth year, through the cost studies of representative buildings; while the prices are measured monthly. The material prices are collected monthly by means of questionnaires, which are sent to the suppliers to the construction industry. Labour costs are based on quarterly wage statistics compiled by Statistics Norway; machinery costs are obtained from indices calculated by an external body; and transport costs come from indices compiled by Statistics Norway.

A sample of 400 suppliers to the construction industry (mostly wholesale companies) provides about 3800 price observations every month (Statistics Norway, 2014). The prices are tested to identify any large price changes compared to the previous month. Prices are also checked, when sorted by item, and when items are aggregated into groups. The CCI is calculated as a Laspeyres index. A new weight basis was adopted in January 2000, where the weights were based on calculations and accounting data from seven apartment-building projects and four detached house projects.

The weights that are used are square metres of utility floor space for dwellings under construction multiplied by the average price in Kroner per square metre utility floor space. The index goes back to 1978. Before that Aspelin-Stormbull AS (a supply company of building materials) calculated construction cost indices from 1932 to 1978.

4.3.10 India

Majumdar (2004) indicates that the Central Public Works Department (CPWD) of the Government of India publishes construction-cost indices for various locations in India at regular intervals.

The calculation of the index is based on 12 inputs; each being given a defined weightage. This weightage that is adopted in the calculation of the cost index is derived from the historical data for the type of construction being carried out and the technology being used. The 12 input items that are being used are indicated in Table 4.1.

Table 4.1: Inputs for building cost index in India (Majumdar, 2004)

No.	Item description		Unit	Weightage
1	Bricks		1000	10,50
2	Cement (OPC)		Quintal	14,50
3	Steel 50% small diameter (8 – 10mm) 50% high diameter (12 – 16mm)		Quintal	19,50

4	Aggregate (20mm size)		Cubic metre	7,00
5	Sand		Cubic metre	3,00
6	Paint (a) Synthetic enamel (b) Dry distemper	 50% 50%	 Litre Kg	3,00
7	Ply and commercial wood (i) 12mm particle board (ii) 12mm medium density fibre board (iii) Steel windows	 25% 25% 50%	Sqm	5,00
8	Pipes (i) 15mm GI pipes (ii) 100mm HCI pipes (iii) 20mm black conduit	 33,33% 33,33% 33,33%	Metre	2,50
9	Lamps and ceiling fans (i) Ceiling fan 48" (ii) 1200mm FI fitting with single tube	 50% 50%	Each	3,50
10	Electric machinery 7.5HP motors (1500 rpm)		Each	2,50
11	Wires and cables (i) Wires (70% of 1,5sq.mm; 30% of 4.0sq.mm) (ii) Cables (300sq.mm)		100 metre	4,00
12	Labour (i) Unskilled (ii) Skilled	 50% 50%	Each	25,00
	Total			**100,00**

The index is mostly used for the preparation of preliminary estimates for the CPWD. The cost of a project is estimated by using a "plinth-area" rate which is the unit cost of construction. This unit cost is then enhanced by the building-cost index issued by the CPWD to assess the current cost of production of a building.

According to Majumdar (2004) there are some inherent shortcomings in this cost index, *viz*. it is of a general nature and is designed on the basis of historical data for given types of buildings being built with specifications given in "CPWD plinth area rates" guidelines. The result of this is that when applied to works having different specifications, it does not yield accurate results. Majumdar (2004) suggested that the answer for this problem would be to produce different indices for different types of buildings and types of methodology used for construction.

4.4 SUMMARY AND CONCLUSION

In order to provide an overview of the methods used by different overseas countries as discussed above, Table 4.2 below summarises aspects such as sources of information, frequency of publication, type of index, etc.

Table 4.2: Summary of methods used by different overseas countries

Country	Frequency of publication	Source(s) of information	Type of index	Use of index
Hong Kong	Quarterly	Priced bill of quantities	Paasche	General cost trends of government buildings
Ireland	Quarterly	Priced bills of quantities	Laspeyres	General information to quantity surveyors
Finland	Quarterly	Questionnaires to manufacturers, etc.	Laspeyres	Monitoring of building cost
United Kingdom	Quarterly	Priced bills of quantities	Paasche	General information to building industry
Australia	Quarterly	Priced bills of	Laspeyres	For interest only

		quantities (of 15 typical projects)		
Canada	Quarterly	Survey from contractors' prices	Laspeyres	Measure changes in contractors' prices of non-residential buildings
France	Quarterly	Planning Permission department database	Hedonic model	Changes in general construction prices
Singapore	Quarterly	Priced bills of quantities	Unknown	General movement of tender prices of residential and office buildings
Norway	Quarterly	Questionnaires from suppliers; labour rates from Stats Norway	Laspeyres	Measures input factors in production of residential buildings
India	Quarterly	Historical construction data	Laspeyres	Preliminary estimates for use by CPWD

From the above it may be concluded that there is no real consistency in the way TPI' are being calculated in different countries. There are, however, broad areas of consensus regarding the compilation of tender-price indices, although there can be different approaches on how these aspects are being implemented in each country. The following aspects of a typical tender-price index can be highlighted:

4.4.1 Weighting and re-basing

Most countries use some form of weighting in their respective indices with the weights mostly being derived from the analysis of one or more building types on which the particular index is based. It is not clear from the literature at what frequencies indices are re-based, although most countries report that re-basing happens over the lifetime of the index, albeit at different intervals.

4.4.2 Index type

As most of the indices are weighted, and are composite indices with a fixed base-period, these indices can be classified as fixed-weight Laspeyres-type indices. The exception to this is the indices in the UK and Hong Kong, which is a current-weight match-item index, and therefore a Paasche-type index.

4.4.3 Rate sources

Countries that use bills of quantities as part of their procurement process, such as the UK, Ireland and Hong Kong, use priced bills of quantities of tendered projects as their source for obtaining prices. Other countries use various means of collecting price information, such as surveys (telephonic or via questionnaires) and can be in the form of individual prices for items of material, built-up rates of building components, labour rates, square metre rates of floor or building area, and so forth.

4.4.4 Publication of indices

Almost all the selected countries publish indices on a quarterly basis; and the responsible body for doing so is usually the national entity that publishes the statistical information for the country as a whole.

CHAPTER 5

SURVEY OF QUANTITY SURVEYING FIRMS IN SOUTH AFRICA

5.1 INTRODUCTION

The third research question of the study as set forth in Chapter One, was formulated as follows: "What are the uses and perceptions of tender-price indices in the quantity surveying profession in South Africa?" In order to investigate this sub-problem, and whether the stated hypothesis could be supported, a questionnaire was drawn up for distribution to the quantity surveying firms in South Africa.

Although, strictly speaking, the survey will not contribute directly to the compilation of a new TPI, it is still important to gauge the perception of quantity surveyors in South Africa towards, especially, the use of TPI's as part of their quantity surveying functions; as well as their perception of the current status of the BER. One of the reasons for engaging in this study, as indicated in Chapter 1, was the belief that there is a need for an up-to-date TPI in the industry – this need will be tested in the survey.

5.2 THE RESEARCH METHODOLOGY

As was mentioned in Chapter 1, this phase of the research is quantitative in nature and consists of a survey. According to Leedy and Ormrod (2010), survey research involves acquiring information about one or more groups of people by asking them questions and tabulating their answers. Leedy *et al.* (2010) further maintain that - by surveying a sample of a large population, the goal is to learn about their opinions; thus, this approach is called a descriptive survey. Saunders, Lewis and Thornhill (2009) concur with this by mentioning that the survey questionnaire is one of the most widely used data collection techniques within the survey strategy. Because each respondent of the questionnaire is asked to respond to the same set of questions, it provides an efficient way of collecting responses from a large sample (Saunders *et al.*, 2009)

Welman, Kruger and Mitchell (2007) state that survey questionnaires are used to obtain the following types of information:

- Biographical details;
- Typical behaviour;
- Opinions, beliefs and convictions; and lastly,
- Attitudes.

In the survey used in this study, biographical details, such as the size, and geographical location, as well as the economic sector of the responding firms were obtained. Furthermore, opinions and attitudes of firms towards TPI in general, and the BER index in particular were tested.

The above discussion regarding survey questionnaires correlates with the methodology used in this study. A series of questions were asked of willing participants; their responses were summarised by using statistical methods, such as percentages and frequency counts; and then inferences were drawn about the particular population — from the responses of the sample.

5.3 SURVEY QUESTIONNAIRE

The survey questionnaire was designed in accordance with the principles for survey questionnaires, as outlined by Welman *et al.* (2007).

Closed or pre-coded questions, defined by Welman *et al.* (2007) as, "questions which offers the respondent a range of answers from which to choose" were primarily used in the questionnaire, although the perceptions of the respondents were measured in one section, according to a Likert-rating scale, where the following options were used:

1 = absolutely disagree
2 = Disagree somewhat
3 = Unsure
4 = Agree somewhat
5 = absolutely agree

The layout and contents of the questionnaire were discussed with the Department of Statistics at the University of Pretoria. They raised some comments on the technical nature of the draft questionnaire. These comments were incorporated into the questionnaire; after which, it was distributed to eight respondents as a pre-test for clarity, consistency and time taken. Again, certain comments were raised on some aspects of the questionnaire, some which were incorporated. The draft questionnaire was then submitted to the University of Pretoria's Faculty of Engineering, Built Environment and Information Technology's committee for research ethics and integrity — who granted their approval that the questionnaire could be issued for research purposes (see Annexure 2 for a copy of the letter of approval).

The questionnaire consisted of the following sections:

- Section 1: Background information; this was the administrative part of the questionnaire in order to verify that practices ranging from small to large were among the respondents (3 questions)
- Section 2: Level of use and knowledge of the BER index; this section of the questionnaire was to gauge the level of knowledge, as well as the use of and contribution to the index (7 questions)
- Section 3: Perception regarding TPIs in general and the BER index in particular; in this section the perceptions of quantity surveyors regarding TPI's in general and the BER in particular was tested (8 questions)
- Section 4: What other information, apart from a national TPI, would be useful in quantity surveying firms/companies? Respondents could voice their opinion on any other information that they would deem useful to their practice (5 questions).

5.4 SAMPLING METHOD AND SAMPLE SIZE

According to Welman *et al.* (2007), research is conducted to investigate a research question, and data are collected, in order to solve the problem concerned. It is, therefore, important that the correct study object, or population, be chosen for the survey.

In this instance, the population could have included most or all of the built environment professionals, such as architects, engineers, quantity surveyors, landscape architects, town and regional planners, and projects managers, as well as other building professionals, such as contractors, property developers, etc. Apart from the fact that this population would be very big in size, making the survey both costly and logistically very difficult, the issue in question was: How many of these people are using cost- or tender-price indices on a regular basis?

After considering the above, it was decided to draw the sample from only quantity surveying practices. The reason for this was based mainly on the fact that quantity surveyors, as “construction cost advisors” (Hauptfleisch and Siglé, 2000) use tender-price indices on a regular basis, more so than any of the other built-environment professionals. Another factor was that a TPI is, in most instances, based on information obtained from priced bills of quantities that are produced by quantity surveying practices; therefore it was assumed that such practices would have a special interest in a questionnaire relating to a new TPI.

The reason why the questionnaire was distributed to quantity surveying practices and not to individuals only, was because currently it is mostly practices that subscribe to the BER/MFA Quarterly Survey; and specific information on this issue was required from quantity surveying practices.

A sample of South African quantity surveying practices could be considered to be representative of the population of built-environment professionals in South Africa, as it consists of practices of different sizes that are spread geographically throughout the country. Furthermore the size of the sample (all quantity surveying practices registered with the ASAQS) could be regarded as adequate to meet the objectives of the study.

5.5 THE SURVEY PROCESS

The ASAQS was approached with a request to distribute the questionnaire among all the quantity surveying practices registered with the ASAQS. The ASAQS is a voluntary association recognised by the South African Council for the Quantity Surveying Profession (SACQSP, 2000); and, according to its constitution (ASAQS, 2005), it may register quantity surveying practices in South Africa. The ASAQS, therefore, has a data base containing contact details, such as postal- and e-mail addresses of all the registered practices in the country.

After the ASAQS had agreed to distribute the questionnaire, it was submitted to the ASAQS in electronic (Excel spread-sheet) format (see Annexure 3 for a copy of the questionnaire). The questionnaire was also accompanied by a covering letter, giving a brief outline of the scope of the study, as well as the aims of the questionnaire. Furthermore, it requested that a senior person, such as a partner, in the practice should complete the questionnaire. The reason for this request was to ensure that the questionnaire, which was addressed to the practice or organisation, be completed by a member of the practice with sufficient experience to understand, interpret and answer the questions/statements. Lastly, it was stressed in the letter that it should not take longer than 15 minutes to complete the questionnaire.

Subsequently, the questionnaire was distributed by the ASAQS to 741 registered practices on their data-base by means of e-mail, as well as by post — with a request that the completed questionnaire be returned on or before a certain date — either by e-mail or by facsimile. The reasons for distributing the questionnaire by both e-mail and post was to ensure that it reach as many of the targeted sample as possible. Although the ASAQS does try to keep its data-base as up-to-date as possible, it is difficult to ensure 100% accuracy with the frequent opening and closing of practices, changes in both postal and e-mail addresses, etc.

Furthermore, although it was expected that the majority of the responses would be returned via e-mail (because of the ease of both completing and returning the questionnaire electronically), provision was also made to return it by means of faxing.

5.6 SAMPLING OBSERVATION ERRORS

Steyn *et al.* (2007) mention that sampling observation errors (also called non-sampling errors), are errors made by the sampler or respondent during the collection of the sample data. In this instance, because the questionnaires were distributed via e-mail and post, there was no personal contact with any of the respondents' practices. A possible observation sampling error could, therefore, be that the questionnaire could be completed by a person in a firm with little or no knowledge of the subject in question.

In order to try and eliminate such an error, it was specifically requested in the covering letter, as indicated before, that a senior person in the practice or organisation should answer the questionnaire.

5.7 RESPONSE

From the 741 questionnaires that had been distributed to South African quantity surveying practices, it was impossible to establish how many actually reached the targeted respondents. A factor that also played a role was that some of the faxed responses were unreadable. Eventually, a total of 148 valid responses were received. If these responses are divided by the 741 firms to which it was distributed, and the answer be expressed as a percentage, the response rate is roughly 20%. According to Hussey and Hussey (as quoted in Maritz, 2003), this response rate is acceptable for this type of survey. The period from the start of delivery to the last receipt was approximately five weeks.

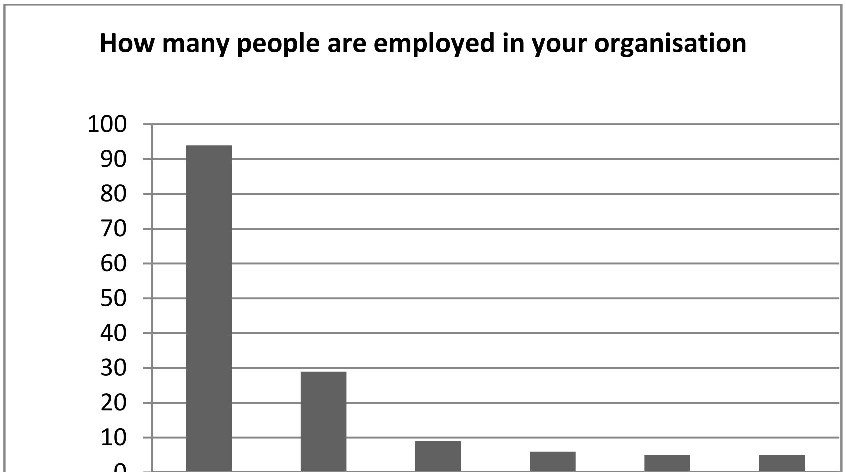
After all questionnaires had been received, they were encoded and submitted to the Department of Statistics at the University of Pretoria for statistical analysis. The next step was to decide how to present the results of the collected data. It was decided to use descriptive statistics, described by both Welman *et al.* (2007) and Keller and Warrack (2000) as statistics that deal with the description and summary of the data obtained. It was also decided to use graphical techniques to present the data in a way that would be easy to understand and interpret.

5.8 THE RESULTS AND DATA ANALYSIS

5.8.1 Section 1: Background information

Question 1: Size of organisation: How many people are employed in your organisation (local branch only if more than one branch)?

The first question in the administrative part of the questionnaire requested the respondents to indicate how many people are employed in their organisations. This was done, in order to verify that practices ranging from small to large were amongst the respondents. Figure 5.1 gives a distribution of the sizes of the respondents' practices.



	0 to 5	6 to 10	11 to 20	21 to 50	51 to 100	> 100
Series1	94	29	9	6	5	5

Figure 5.1: Size of respondents' practices

From Figure 5.1 it may be deduced that the majority of the respondents are small practices (83% of practices have got 10 or less employees). This is an accepted trend, not only within the quantity surveying profession, but in all built-environment professions.

<u>Question 2:</u> Location: In which province in the RSA is your organisation located (local branch if more than one branch)?

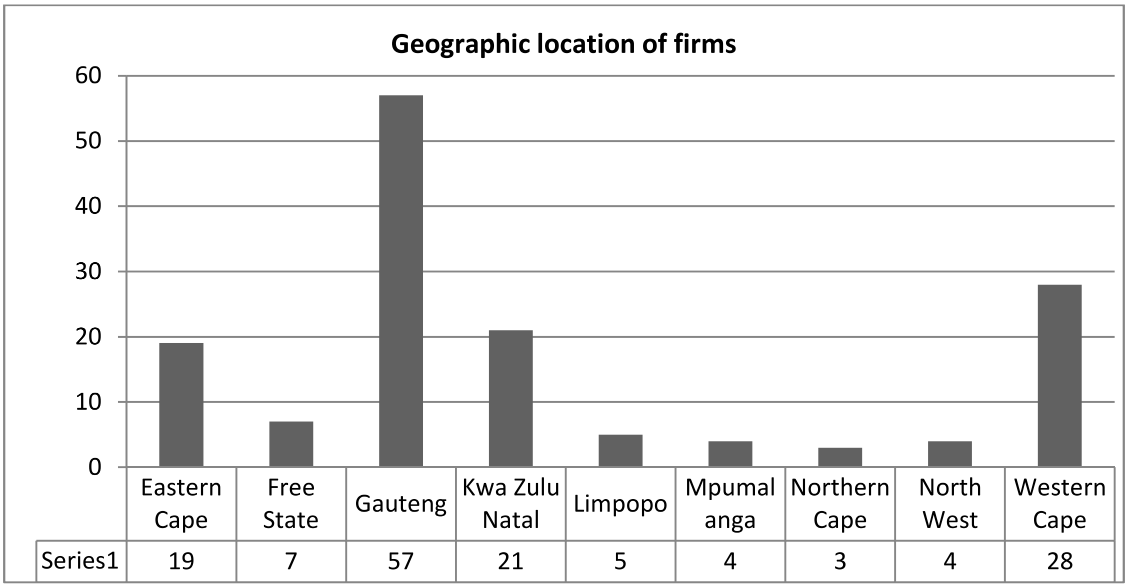


Figure 5.2: Distribution of geographic location of practices

It can be seen in Figure 5.2 that the responses were received from practices throughout the country — with the majority of the responses coming from the traditionally large provinces, Gauteng, the Western Cape and Kwa Zulu Natal (71% of the total).

<u>Question 3</u>: Economic sector: Indicate the economic sector, in which the main activity of your company falls.

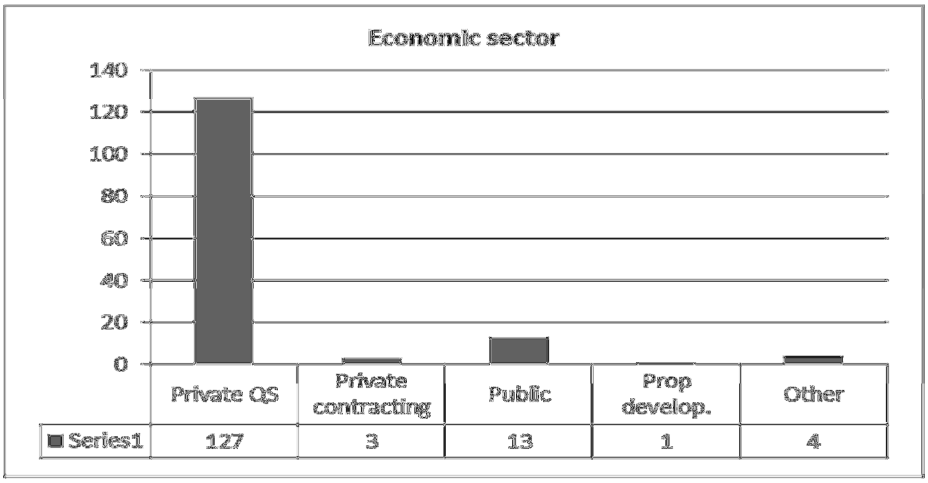


Figure 5.3: Economic sector of respondents

The majority of the respondents were private sector quantity surveying practices, which, from an academic perspective is good, because it is envisaged that the TPIs would mostly be used by quantity surveyors in private practices. The second largest group was the public sector (assumed to be mostly works departments in national and provincial governments), where quantity surveyors are also likely to use TPIs for internal cost monitoring and budgetary purposes. For clarity, “private contracting” means quantity surveyors working for private construction companies.

5.8.2 Section 2: Level of use and knowledge of the BER index

The aim of this section of the questionnaire was to gauge the level of knowledge, as well as the use of and contribution to the BER index. As previously indicated in Chapter 3, the BER Building-Cost Index is currently the only TPI that is published in South Africa; and it was important to gain insight into the above objectives.

<u>Question 4:</u> Are you familiar with the composition of the BER Building-Cost Index?

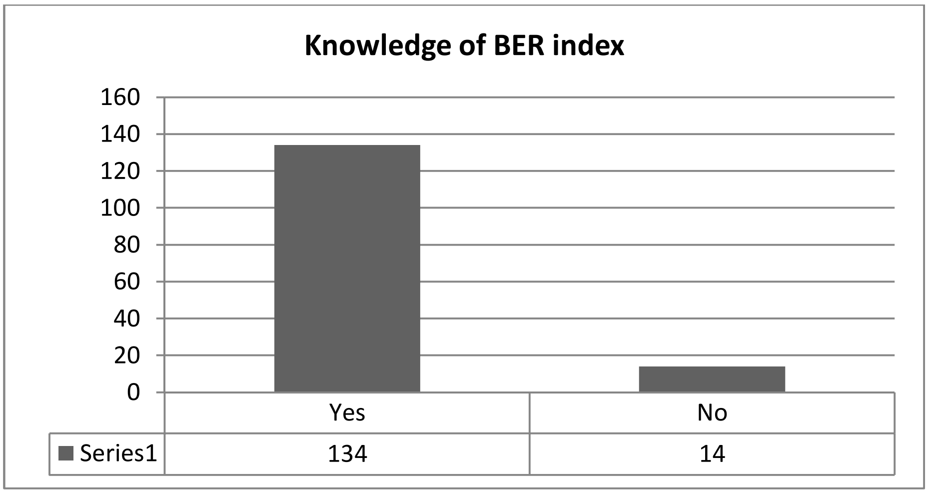


Figure 5.4: Knowledge of BER Index

It is clear from Figure 5.4, that the majority (91%) of the respondents were familiar with the composition of the BER index. This was a positive indication, because it meant that the respondents would have been able to correctly interpret the following questions.

Question 5: Are you/your company currently a subscriber to the quarterly BER/MFA Report on building costs?

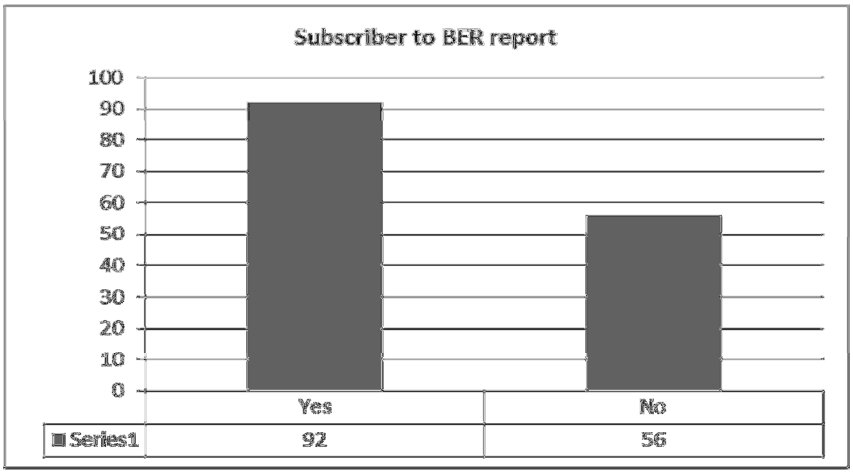


Figure 5.5: Current subscribers to BER/MFA report

The aim of this question was to determine what percentage of quantity surveying practices are currently subscribers to the quarterly BER/MFA report. As is depicted in Figure 5.5, 62%

(92 respondents) indicated in the affirmative. This can be seen as a fairly low percentage in light of the fact that is the only report of this kind available in South Africa.

Question 6: If your answer to the previous question was "no", have you previously been a subscriber?

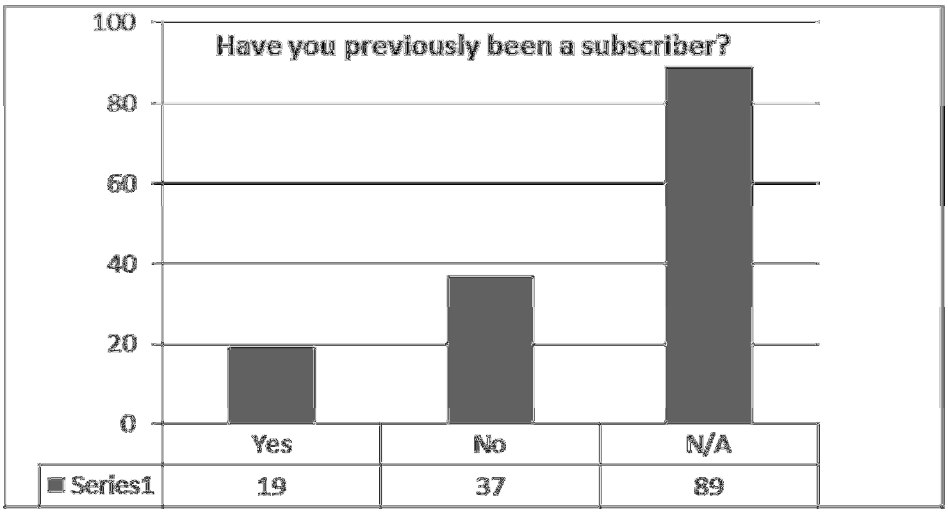


Figure 5.6: Previous subscription to BER/MFA report

With this question, the aim was to determine how many of the 56 respondents, who indicated in question 5 that they were not subscribers to the BER/MFA report, had previously subscribed to the report, but had subsequently relinquished their subscriptions. From Figure 5.6, it can be seen that 19 of the 56 (approximately 34%) had been subscribers previously.

Question 7: If you/your firm are not subscribers, do you still consult the BER/MFA report from time to time (i.e. by obtaining a copy from a colleague)?

There was a slight discrepancy in the response to question 7, as 57 firms responded; while 56 firms indicated in question 5, that they do not subscribe to the BER/MFA report. Of the 57 respondents 35 (61%) indicated that, although they do not subscribe to the report, they are still using it to some extent. If these 35 respondents are added to the 92 respondents that subscribe to the report, this effectively means that 127 of the 148 respondents (89%) consult the BER/MFA report — at some or other time.

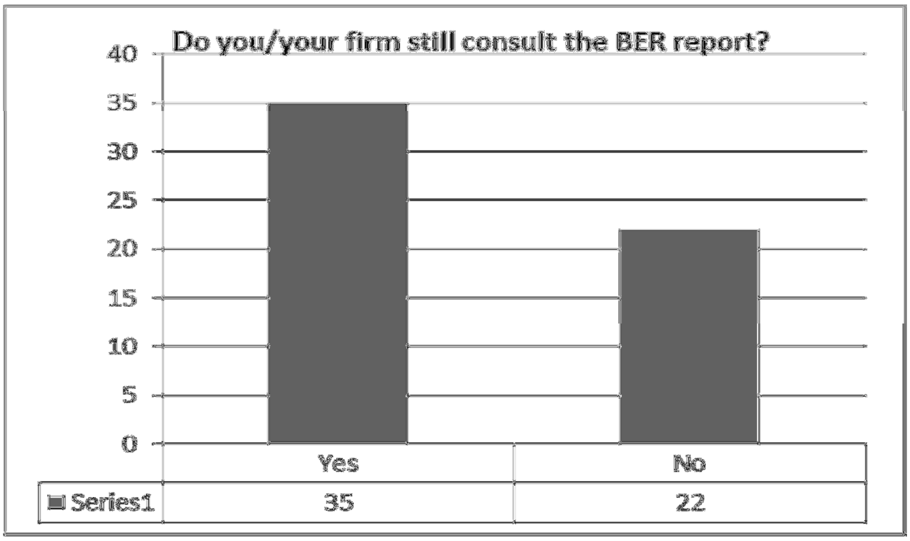


Figure 5.7: Do you/your firm still consult the BER/MFA report

Question 8. If you/your firm have unsubscribed from the BER/MFA report, please indicate the reason(s) for ending your subscription

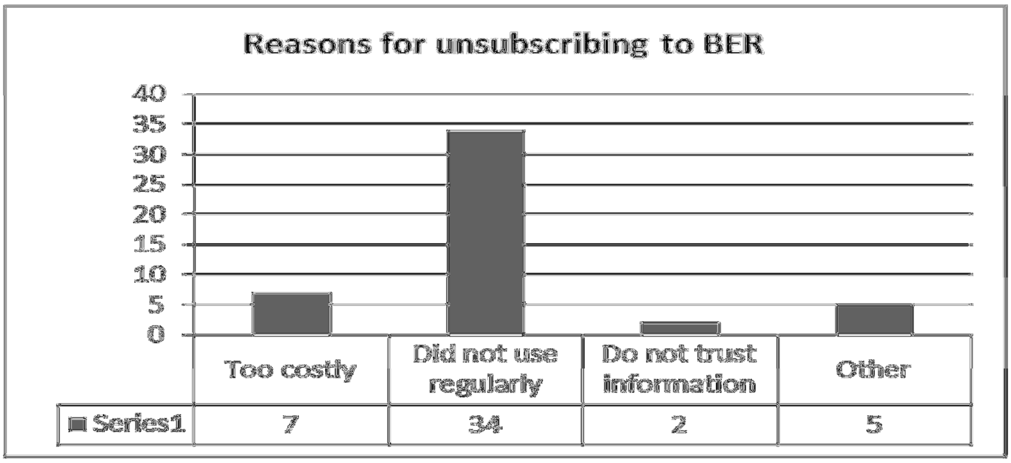


Figure 5.8: Reasons from unsubscribing to the BER/MFA report

A total of 48 firms responded to this question; 34 of which indicated the reason for unsubscribing, as “did not use it on a regular basis”. This number correlates with the 35 respondents in question 7, who indicated that, although they were not subscribers, they still consult the report from time to time.

Question 9: Does your firm contribute on a regular basis to the BER Building-Cost Index?

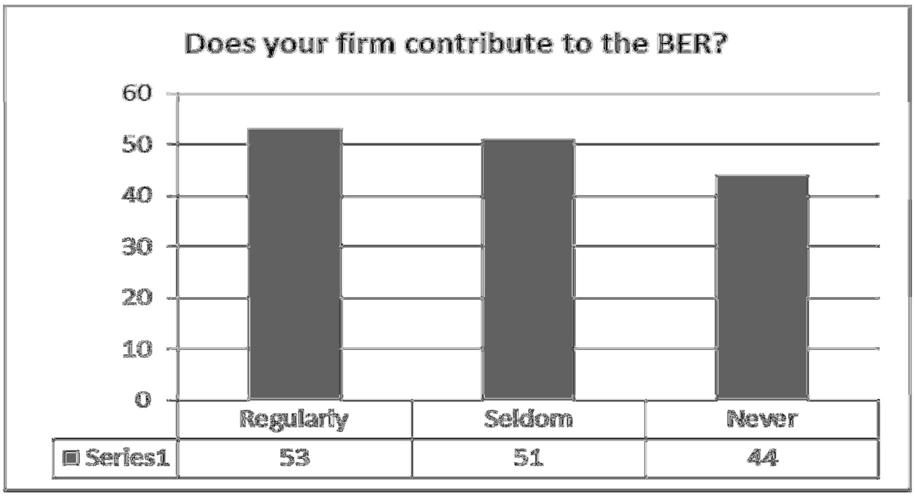


Figure 5.9: Does your firm contribute to the BER ?

This was an important question to test the reliability of the index. 95 respondents (64%) indicated that they either "seldom" or "never" contribute information to the BER Building-Cost Index. This is in contrast with the figures in question 7, where 89% of the respondents indicated that they use the index. One of the perceived problems with the validity of the BER Index is that quantity surveyors do not submit sufficient information. This was supported by Martin (as cited in Brümmer, 2003). He, Martin, wrote the following: "… the index has become unstable, and regionally unrepresentative, because insufficient questionnaires are completed to yield statistically reliable results."

Question 10: If your answer in the previous question was "Seldom" or "Never", please indicate the reason(s) for your answer.

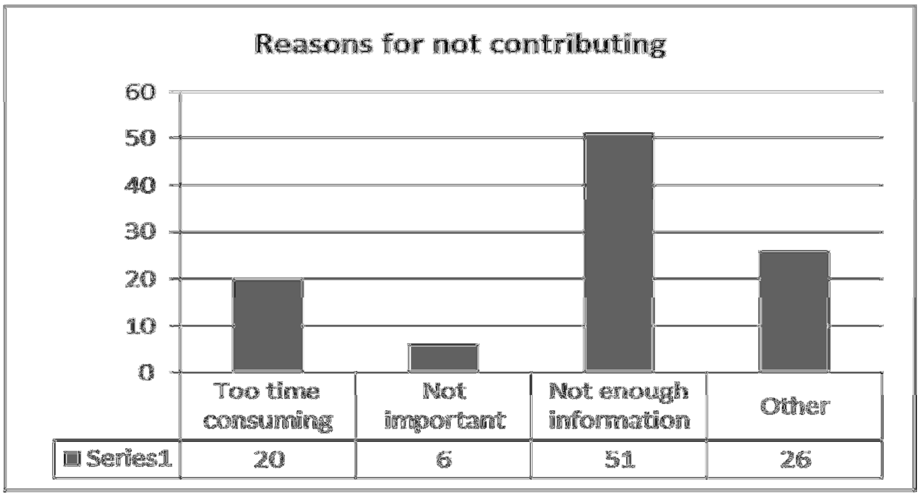


Figure 5.10: Reasons for not contributing to the BER

Although 95 respondents indicated in question 9 that they “seldom” or “never” contribute information to the BER Building cost Index, 111 firms responded to question 10, which might imply that many firms do not contribute on a regular basis. The majority of the respondents (51 or 50%) gave as their reason for not contributing that they do not have enough information; while for 20 firms (18%) it was too time-consuming to complete the forms. It is rather alarming that half of the respondents to this question (and 37% of the total respondents) do not have any information available to make a contribution; since information can be sent to the BER throughout the year for its quarterly publications.

The 26 respondents, who indicated “other” to this question, were asked to elaborate on their answer. The majority of these respondents remarked that “they were never asked to make a contribution”. Such an answer is, however, questionable, as the ASAQS requests its members regularly to contribute to the BER Building-Cost Index. Brümmer (2003) made such a request in a newsletter of the ASAQS that was sent out, from time to time, to all of its members.

5.8.3 Section 3: Your perceptions are wanted regarding tender-price indices in general, and the BER index in particular. (To what extent do you agree/disagree with the following?)

In questions 11 to 17 of this section, 143 respondents of the total 148 completed these questions, while 140 respondents completed question 18. No reasons were stated why some respondents did not complete the questions.

Question 11: A TPIis an important tool that is used by quantity surveyors, developers, etc. on a regular basis.

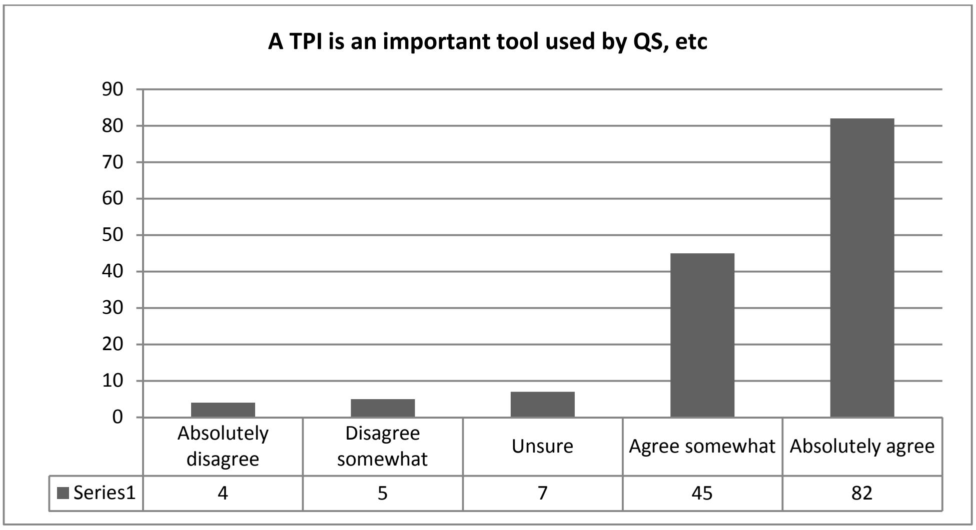


Figure 5.11: A TPI is an important tool that is used by quantity surveyors, developers, etc. on a regular basis.

The majority of the respondents (127 or 89%) agreed that a TPI is an important tool used by quantity surveyors and other built environment professionals on a regular basis. It may, therefore, be assumed that it would be a worthwhile exercise to establish a new TPI for the South African building industry, in order to compare this with other existing indices, as discussed before in Chapter Four.

Question 12: Does the current BER Building-Cost Index measures fluctuations in building costs accurately?

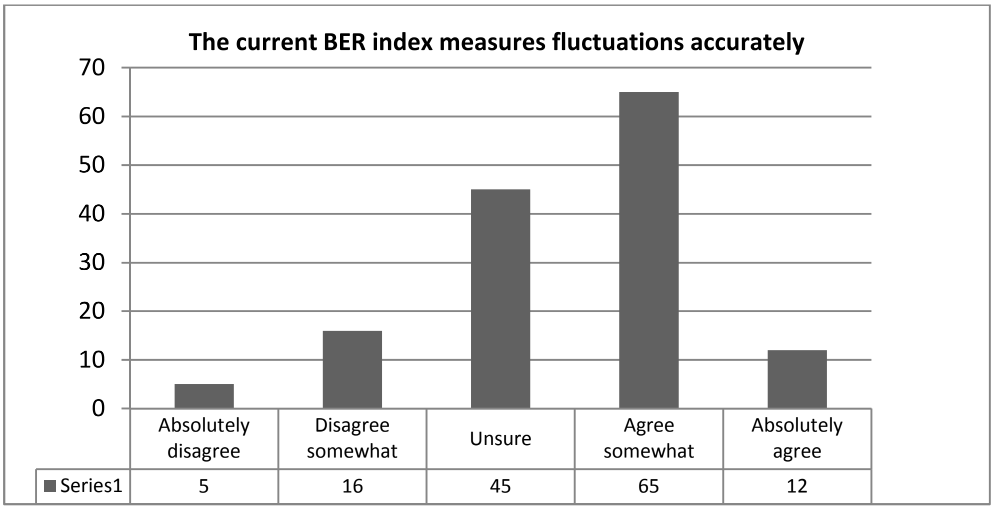


Figure 5.12: Does the current BER Building Cost Index measures fluctuations in building costs accurately?

Only 12, or 8%, of the respondents were convinced that the BER index measures fluctuations in building cost accurately, with 66, or 47%, disagreeing, or not being sure. This is an indication that there is enough doubt in the minds of South African quantity surveyors about the existing index to justify the establishment of another, alternative index.

Question 13: The BER Building Cost Index is outdated, and should be replaced by a new index, based on current building trends.

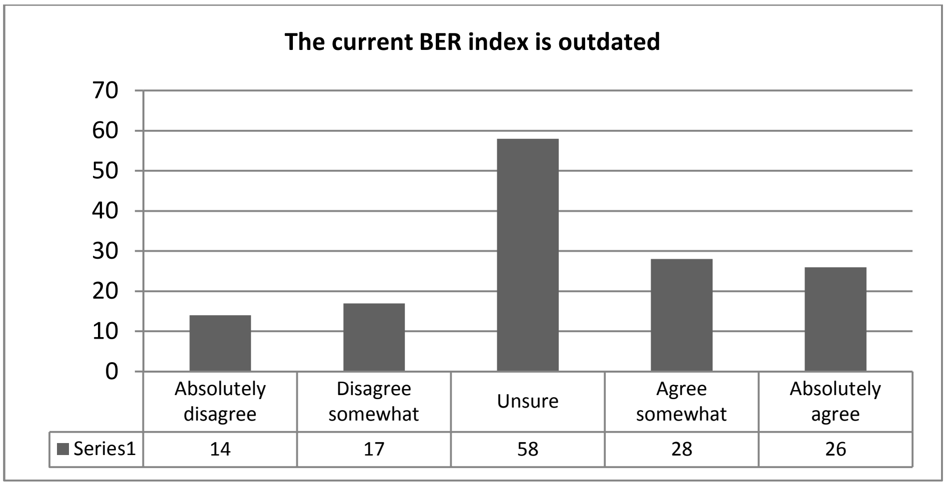


Figure 5.13: The BER Building Cost Index is outdated and should be replaced by a new index based on current building trends.

In this question, as indicated in Figure 5.13, the biggest percentage of respondents (41%) were unsure whether the statement regarding the BER index being outdated was true or not; while 38% agreed that it was outdated and should be replaced. Only 22% of the respondents, therefore, felt strongly that the BER index should stay as it is, again giving enough evidence that there is room for a new, alternative TPI in South Africa.

<u>Question 14:</u> A TPI should be compiled and published by an academic institution with expertise regarding the building industry.

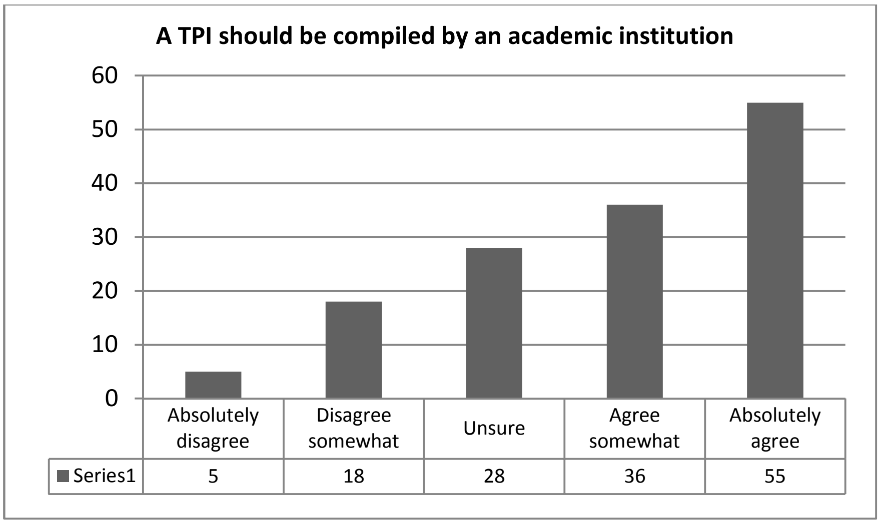


Figure 5.14: A TPI should be compiled and published by an academic institution with expertise regarding the building industry.

In question 14, the majority (64%) of the respondents agreed with the statement that a TPI should preferably be compiled by an academic institution with the necessary expertise regarding the building industry. In an academic institution, with a built-environment school or department, there is an accumulation of knowledge, especially in the field of construction economics. This knowledge could, therefore, be utilised, not only in the compiling of a new TPI, but also in other aspects of construction-cost research.

<u>Question 15</u>. :My practice/company would contribute information for the compilation of a TPI, if this could be done electronically (i.e. by submitting priced bills of quantities to a well-known service provider).

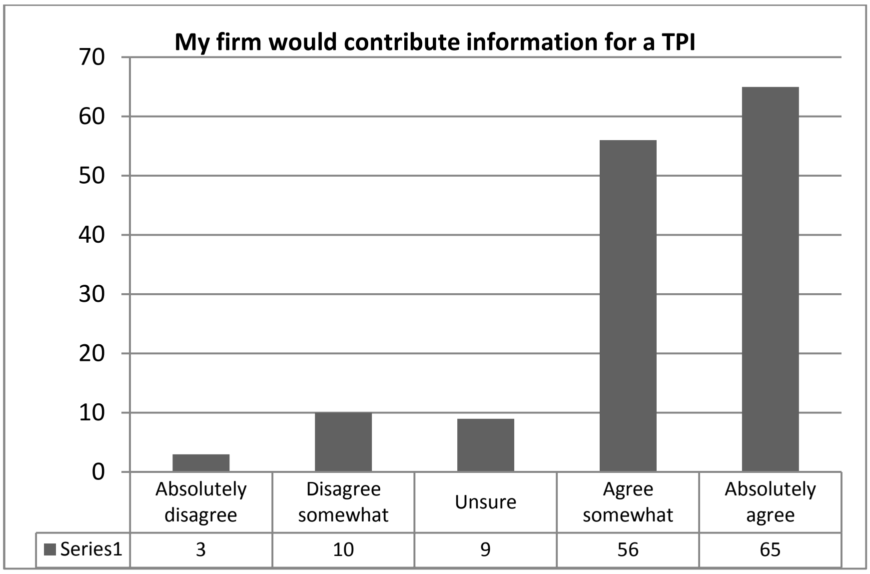


Figure 5.15: My firm/company would contribute information for the compilation of a TPI if this could be done electronically (i.e. by submitting priced bills of quantities to a well-known service provider)

The aim of this question was to explore whether the problem previously identified (see questions 9 and 10) regarding contributing information for compiling a TPI could be overcome. The majority of the respondents (121 or 85%) responded positively to this question. This can be compared to the 64% of respondents who, previously (question 9), indicated that they do not contribute information regularly and can be a positive indication.

Question 16: My practice would be willing to pay a subscription fee for a new TPI that is published regularly.

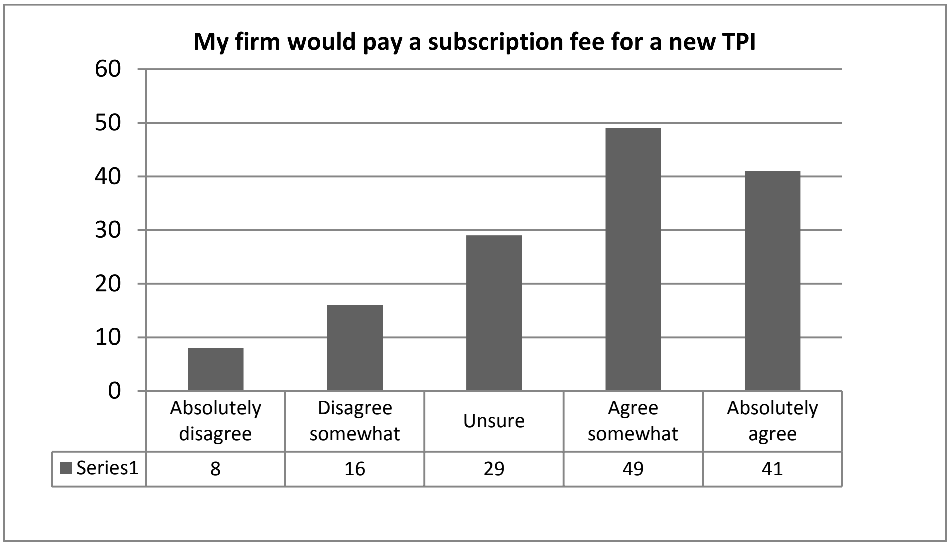


Figure 5.16: My firm/company would be willing to pay a subscription fee for a new TPI that is published regularly.

It was interesting to see that such a large number of respondents (90 or 63%) were willing to pay a subscription fee to obtain a new TPI that is published on a regular basis. This can be read in conjunction with question 13, where it was indicated that most respondents would like to have access to an alternative TPI.

Question 17: A TPI should be funded by external funds, and made available free of charge to the industry.

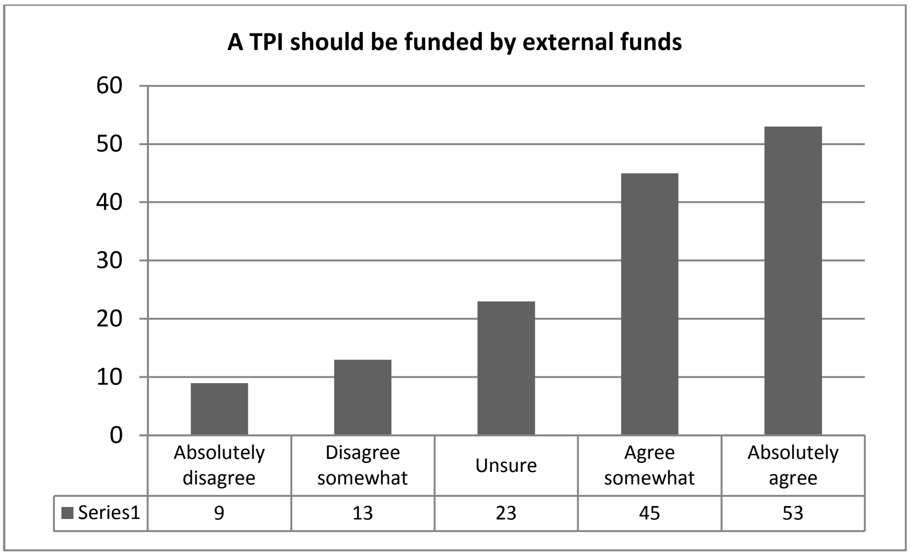


Figure 5.17: A TPI should be funded by external funds and made available free of charge to the industry.

The response to this question was in contrast to the previous question, as the majority of the respondents (69%) indicated their preference to receive a new TPI free of charge, although they would also be willing to pay a subscription fee. Perhaps, this is just a natural occurrence (especially among quantity surveyors, who are known for their ability to "look after money"), to prefer to get something free of charge, rather than paying for it!

<u>Question 18:</u> The ASAQS should play an active role in the publication of a tender-price index

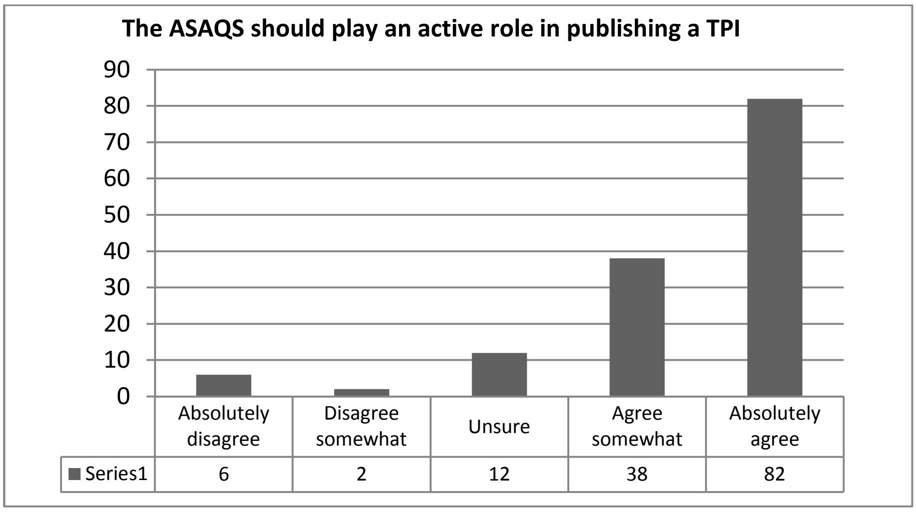


Figure 5.18: The ASAQS should play an active role in the publication of a TPI.

According to the constitution of the ASAQS (2005), one of the objects of the Association should be "to advance and promote the science of and practice of quantity surveying". This question was, therefore, asked to see whether the respondents were of the opinion that, as part of this stated objective, the ASAQS should play an active role in the publication of a TPI. As indicated in Figure 5.18, the overwhelming majority (86%) agreed with this statement.

5.8.4 Section 4: Please indicate what other information, apart from a TPI, would be useful to you/your practice.

Question 19: A TPI published per geographical region, i.e. Gauteng, Western Cape, Mpumalanga, etc. (see Figure 5.19 for the results to the question)

Question 20: A TPI for different building types, i.e. office buildings, shops, industrial buildings, etc. (see Figure 5.19 for the results to the question)

Question 21: Separate indices for electrical and mechanical work (see Figure 5.19 for the results to the question)

The aim of this section was to gauge from the respondents what other information they would like to have available in their practices. If a new TPI could be established with a sufficient number of active participants in the form of quantity surveying practices, then there would be scope to do much more with the available information, than just publishing a TPI.

The results of these three questions are graphically illustrated in Figure 5.19. In all three questions, the responses were overwhelmingly positive, with "yes" responses of 97%, 87%

and 89%, respectively, to the questions. This indicated that quantity surveying firms would welcome additional information, quite apart from a national TPI.

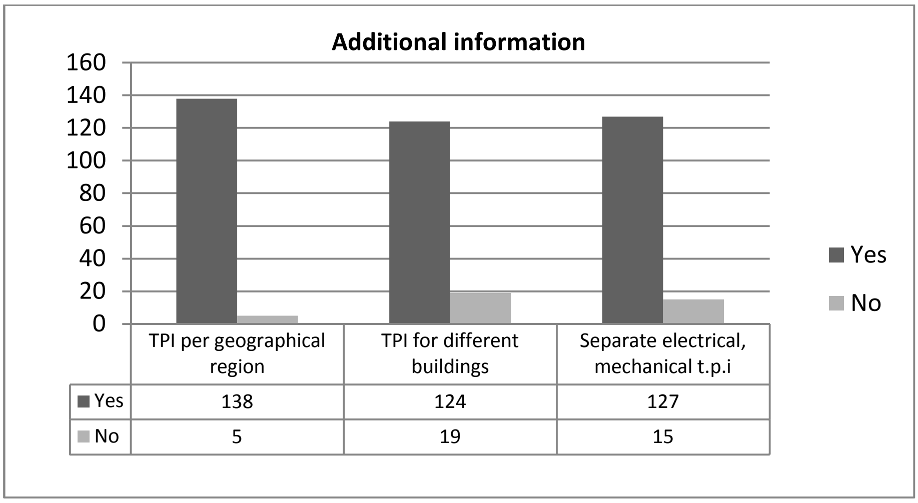


Figure 5.19: Please indicate what other information, apart from a TPI , would be useful to you/your practice

<u>Question 22</u>: The BCIS, the Royal Institution of Chartered Surveyors' Building-Cost Information Services, provides research and information on cost and other aspects to the United Kingdom's building industry. Do you think that there is a need for a similar body in South Africa?

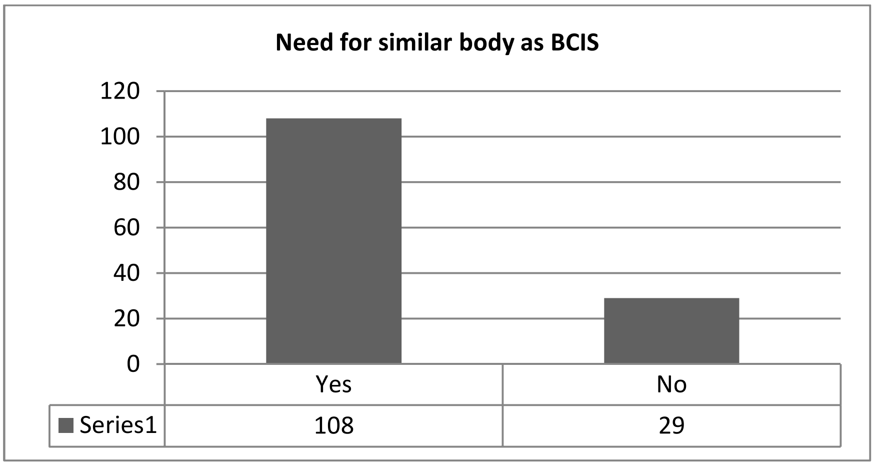


Figure 5.20: Do you think there is a need for a body similar to the United Kingdom's BCIS in South Africa?

According to the RICS's Building Cost Information Services (Internet: http://www.bcis.co.uk/about Accessed 1 June 2011), some of the services that they provide include measuring price movement, benchmarking, market research, statistical analyses, forecasting and impact studies. From the response in question 22, it is clear that, with a 79% "yes" response, most South African quantity surveying firms would appreciate the establishment of such a body doing similar work for the local building industry.

Question 23: What other statistics, apart from a TPI, would you find useful in your practice?

The aim of this question was to determine, in conjunction with question 22, what other statistical information quantity surveying firms would find useful to use in their practices. This information could be provided by a body similar to the BCIS in the UK. A selection of some of the responses to this open-ended question is presented verbatim below (some of these responses were given by more than one respondent):

A cost per m² for various types of buildings per region would be helpful.

A price index similar to the current BER index but with the well-known short-comings corrected, is needed. This study should lead to a new, practical cost-escalation model based, on rigorous research principles.

Norms and standard costs per bed for clinics and hospitals; cost per learner for schools.

Labour indices / statistics.

Reliable, dependable building price book disaggregated to major centres in the RSA.

Building material and labour-cost escalation based on different types of buildings.

Building cost per type of building.

Preliminaries percentages for projects.

A comparison between tender price-index and general inflation (consumer-price index).

Forecasts of anticipated future fluctuations.

Improvements on the Haylett formula.

Rentals and vacancies; local authority rates and taxes.

Tender prices in Africa.

Indices in respect of labour, plant, material and fuel; civil engineering tender-price index.

An average price schedule would be a useful guide to local QS'-s.

International benchmarking of costs.

Elemental rates; individual item rates.

The above open-ended questions can be categorised into the following broad subject areas of research:

- Cost per type of building. Information would be required in various formats for such research e.g. cost per m^2 per building type, or according to different building type norms viz. per bed (hospitals; clinics), per learner (schools), etc.
- Forecasts. Fluctuations in tender prices can be forecasted based on a reliable TPI; comparisons can be made with other indices, such as CPI, as well as international trends, including Africa.
- Information on individual tender rates, as well as preliminaries. This could take on the format of a "price book", similar to that published by the BCIS.
- Information of rental rates, vacancies, local authority rates and taxes.

- Indices for labour, plant, material and fuel costs; civil engineering work. This information is, to a large extent, already published by SEIFSA (discussed in Chapter Three), but research based on information supplied by quantity surveyors working in the civil engineering field could add value to the existing information.
- Improvements on the “Haylett” formula. This would need to consist of an investigation into the current way of calculation contract price-adjustment provisions in South Africa. As indicated in Chapter 3, the original “Haylett” formula is an input-price index.

5.9 SUMMARY

This chapter has presented and analysed the data collected through the questionnaires from 148 quantity surveying practices throughout South Africa. Each question was analysed individually; and the trends indicated by the collected data were presented graphically and then discussed.

A more comprehensive conclusion for the possible solving of the relevant sub-problem, concerning the attitude towards and the use of a TPI by quantity surveyors, appears in Chapter 10 of the study.

CHAPTER 6

DETERMINATION OF A NEW BASKET OF ITEMS AND ITS WEIGHTS

6.1 INTRODUCTION

The methodology for the determination of a new basket of weights that was used in this section was mostly based on what was stated in the literature, as discussed previously in Chapter 2.

As was seen in Chapter 2, item 2.4, the factors that should be considered when constructing an index consist of a selection of the constituent items, as well as the choice of the weights (Seeley, 1996; Flemming and Tysoe, 1991). Also discussed in Chapter Two were the different formulas that were derived over time, to calculate the price indices. According to Statistics Finland (2001), building-cost indices have been calculated for a long time as a fixed-weight composite, Laspeyres-type, price index.

The concept and use of base-weight indices (Laspeyres-type indices) against the use of current-weight indices (Paasche-type indices) were discussed previously (Chapter 2), as well as the preference for using base-weights in the Laspeyres-type index for calculating a new tender-price index for use in South Africa.

For the purpose of clarity, the Laspeyres formula is stated here again, as defined by Akintoye (1991):

$$\text{Base-weighted price index} = \frac{\text{Total cost of base-year quantities at current prices}}{\text{Total cost of base-year quantities at base-year prices}}$$

$$= \frac{\Sigma q_o \times p_n}{\Sigma q_o \times p_o} \times 100$$

6.2 THE USE OF WEIGHTS

6.2.1 Reasons for assigning weights

As has been noted before, index numbers are mostly weighted averages; and therefore, an important issue is the choice of weights to be used. As the Laspeyres index is a base-weighted index, this implies that the chosen weights for a particular base-year index would remain unchanged throughout the life-time of the index, or until the weighting system is updated. According to Steyn *et al.* (2007); when a composite index is being determined, it is often impossible or unnecessary to include all the items. An example of this is the consumer-price index, where it would be impossible to include all commodities in such an index.

Marx (2004) states that, even when one reduces the number of items significantly, it is still possible to achieve a reliable index. The advantage of reducing the items is that this makes the process of gathering rates for these items easier and more manageable.

A number of authors (Akintoye, 1991; Agerwal, 2009; Ashworth, 1991; and Segalla, 1991) state that the choice of weights in an index must reflect their relative importance, especially where a number of items are included; and all these items are not equally important. Akintoye (1991) was of the opinion that the weights must be carefully chosen, in order to avoid biased and misleading results. Ashworth (1991) stated that the majority of the index numbers that are used in the construction industry are calculated, according to the principle known as "the basket of goods", where items are selected for inclusion, which are appropriate and typical, and weighted according to their importance in the index.

The Statistics Directorate of the European Community (1997) mentioned that when deciding on whether or not to include an item in an index, this would depend on the impact that changes in the price of that item may have on the total price of the project. An example of this is where, if only the items contained in the shell of a building are included, this might be insufficient to measure price changes accurately, because items contained in the finishing work (i.e. the installation of fittings) could also have a significant impact on the building prices. Another example, although not related to the building industry, is given by Agerwal (2009) where he states that in the consumer-price index, any increase in the price of wheat would have a bigger effect on the consumer than would a rise in the price of cosmetics, reiterating that the relative importance of price changes recorded for an item would be termed as the weight of that item.

Another important aspect of the weights in an index related to the construction industry is mentioned by the Statistics Directorate of the European Community (1997). This stated that the impact of the diversity of construction activity on price trends is reduced by the calculation of weights from a selection of representative types of construction projects. By allocating weights, to either different categories of construction work carried out, or material components, makes these items independent of the nature of a particular project.

6.2.2 Source of information

The question can be asked where the information must be sourced from before a weighting system for an index can be constructed. Construction projects, according to Statistics Norway (2007), are divided into production factors, such as labour, materials, machinery, transport, energy, etc. — and by measuring the price changes of each component, changes in construction cost can be monitored. Davis Langdon Management Consultancy (2008), reported that, instead of using information about the total price of a contract, it is possible to use information about the unit rates of a contract. These unit rates are available from priced bills of quantities of accepted tenders, and are for particular categories of work that make up the total contract price of a project.

Although the rates used by different building contractors would vary because of factors, such as the differences in their efficiency levels, differences in types and sources of labour, material and plant used, as well as the different practices used by estimators to arrive at a total tender-price, this can be overcome by having access to a large, representative selection of priced bills of quantities of different projects.

Rates sourced from such bills of quantities have the advantage of being directly comparable because they refer to similar, specific construction operations (Davis Langdon Management Consultancy, 2008).

According to Ferry *et al.* (2003), an index which takes as its source of information the tender document, could be called a “tender-based index”. Ferry *et al.* (2003) further state that the accepted tender figure, based on the priced bills of quantities, is “a record of the market price for a particular building at a specific point in time”. Van der Walt (1992) was of the opinion that tender prices for bigger buildings in South Africa are gathered frequently by using bills of quantities; and that it would, therefore, make sense to use such information for the compilation of a TPI.

Davis Langdon Management Consultancy (2008) also states that bills of quantities for tender purposes have been consistently used in the UK over the last 30 to 40 years, because they provide an extremely valuable source of data.

Although this study concentrates on the compilation of a TPI, based on the Laspeyres formula as previously discussed, it can be noted that priced bills of quantities can be used in compiling both the Laspeyres and the Paasche formulas. Beeston (1983) stated that an index, which uses as quantities the items with the largest monetary value, actually occur in current individual bills of quantities. This is called a current-weighted, or a Paasche index.

In summary it may, therefore, be said that, in light of the above information, priced bills of quantities can be used as an effective source of information to determine the appropriate weights for a tender-price index.

6.2.3 Selection of items.

If bills of quantities, as discussed above, are going to be used, the next step is to determine how this should happen. According to Van der Walt (1992), the most important methods for the way in which an index can be calculated by means of bills of quantities, are the following:

<u>Re-pricing of bills of quantities.</u>

This method comprises the re-pricing of all bills of quantities for which tenders are received with base-year prices. This then gives a comparison with the current tender, according to which a Paasche-type index can then be calculated.

<u>A short-list of indicator items from bills of quantities.</u>

According to this method, a number of items (called indicator items) are picked from various groups of items. These items must be representative of the groups, from which they are selected. In the case of bills of quantities, the groups would comprise the different trades or part of trades that make up the bills of quantities. Akintoye (1991) sites Bowley and Corlett (1970), who also recognised that a construction price-index number, based on a short-list of items from bills of quantities, reflects the trend in prices shown by fully re-pricing all the bills of quantities.

The next issue is how many indicator-items would be necessary to compile an index. As the complete re-pricing of bills of quantities involves a substantial amount of work and time, Seeley (1996) was of the opinion that, in order to reduce this task to reasonable proportions, a sampling process can be used. Ferry *et al.* (2003) concur with this, by mentioning that the amount of work needed to analyse all the rates in bills of quantities can be reduced by taking the few largest items in work-sections into account; and this would result in a negligible degree of error.

The objective would then be to identify the minimum number of indicator items that collectively represent a high proportion of the total value of a construction project (Statistics Directorate, European Community, 1997). From the published literature, it is clear that a number of authors (Ferry *et al.,* 2003; Yu & Ive, 2008; Seeley, 1996; and Akintoye, 1991) agree that, what is called the “25% rule” can be applied. This rule implies that a project index can be produced by taking each section, or trade, of the priced bills of quantities, such as excavations or concrete work, and selecting those with the largest value in the section, then the second, and so on until a total of 25% of the section value is achieved (Ferry *et al.*, 2003).

Yu and Ive (2008) also mention that all items with values greater than 1% of the measured work must be selected first. As the total value of an item (quantity multiplied by the unit rate) is used, this system of weighting is known as “value-weighting” (Agerwal, 2009). Yu and Ive (2008) site Mitchell (1971) who found that the project indices of 80 bills of quantities, using the 25% rule, produced an average index 4,4% higher than is achieved when fully re-pricing the same bills of quantities.

It must be noted that the majority of the authors quoted above (Yu & Ive, 2008; Akintoye, 1991; Ferry *et al.*, 2003 and Seeley, 1996) studied and commented on the UK's BCIS index, which, as indicated previously, is a current-weight Paasche index, where the 25% selected items are being re-priced with base-year rates. The same principle could, however, be applied when constructing a Laspeyres index. This will be discussed later on in the study.

6.2.4 Advantages and limitations of weights

Van der Walt (1992) mentioned that the biggest advantage of the short-list method that is used for a weighted index, is that it is a relatively simple type of index that can easily be processed on a computer. Some of the limitations of a weighted index are as follows:

- One of the limitations that have already been discussed above, namely the amount of work involved in analysing all the rates in a large number of bills of quantities, can be solved by selecting only the major indicator items. Van der Walt (1992), however, stated that, as a possible limitation, the effective size of the sample could be decreased.
- The difficulty in obtaining priced bills of quantities for projects that is comparable. Ferry *et al.* (2003), list as one of the limitations of a tender-based index, the questionable validity of the rates in bills of quantities (this aspect will be dealt with later in the study). If, however, according to Ferry *et al.* (2003), a large enough sample of the projects is taken, the difficulties can be overcome by "trampling the problem to death". Yu and Ive (2006) quote a study by the RICS Construction Faculty, which found as long ago as 2002, that in the UK, there is a dwindling popularity of the firm bills of quantities procurement method in favour of a lump-sum design and build method. This trend could make tender price indices that are reliant on bills of quantities prone to larger sampling errors. In South Africa, however, this trend has

not yet been as prevalent; and it is foreseen that the availability of priced bills of quantities for use in a tender price-index will still be relevant in the near future.

- If only the most common and typical items are chosen from a trade, Van der Walt (1992) was of the opinion that the most basic work can be over-represented at the expense of the specialist work. Similarly, if items are only chosen in terms of their value, then some of the smaller trades, such as Ironmongery, might have no representation.
- The Statistics Directorate of the European Community (1997), as well as Mohammadian and Seymour (1997), stated that the weights for the various components of construction price-indices should reveal the characteristics of the period being compared. As time goes by, indices lose their relevance for various reasons, such as shifts in construction methods, practices, materials and technology from those prevailing in the base period. The Statistics Directorate of the European Community (1997), as well as Statistics Finland (2001), states that the indices' weighting system needs to be reviewed; and where necessary, it should be revised at least every five to ten years. Statistics Norway (2007) mentions a revision period of ten to fifteen years, in order for it to remain up-to-date with any new trends in construction activities.
- Although the issue of the choice of a base or reference year for the index will be discussed later on in the study, both Hassanein and Khalik (2006), as well as Statistics South Africa (2009), are of the opinion that the base year is not only important where rates or prices are concerned, but also with the choice of weights. It should ideally be a typical (recent) year, in which no unusual events have occurred.

6.3 THE CONSUMER-PRICE INDEX

The Consumer-Price Index (CPI) is defined by the United Nations Economic and Social Council (2003), as "a current social and economic indicator that is constructed to measure changes over time in the general level of prices of consumer goods and services that households acquire, use or pay for". The question might well be asked why the CPI should be included in the discussion of building-cost indices. Snyman (1980) named three reasons for doing so:

- It is a convenient measure of the general movement of prices of goods and services for the consumer; and consequently, it is often referred to as a measure of inflation;
- The CPI, due to its general acceptability, is a general yardstick with which to compare other indices; and
- It is used as a proxy for the increase in labour costs in some contracts.

As the CPI is not only used in South Africa, but world-wide; it is an important index and this methodology of compiling the index could also be applied, when compiling a TPI; and it, therefore, justifies a discussion in this study.

According to the International Labour Organisation (2004a), the Laspeyres formula is widely used as the intellectual basis for consumer-price indices around the world. The International Labour Organisation (2004b) further states that most consumer-price indices are calculated as weighted averages of the percentage price changes for a specified “basket” of consumer products. According to Wingfield and Gooding (2008), it would be impractical to measure price changes of every item bought by every household, when compiling the CPI.

Some individual goods and services represent typical household expenditure that is large enough to warrant inclusion in the basket in their own right (i.e. school fees, telephone and electricity charges, petrol, etc.). More commonly though, it is necessary to select representative items (a sample of specific goods) that can give a reliable measure of price movements for a broad range of similar items. An example is the price change for garden spades that might be representative of price changes for all garden tools. Wingfield and

Gooding (2008) call the selection of these representative items purposive sampling or judgemental sampling, rather than using traditional random-sampling methods.

There are further criteria, such as those used by Statistics South Africa (2007), to decide what items should be included in the basket. The first is where the expenditure of all goods and services that exceed a certain percentage of the total amount spent by the average household is considered for inclusion, irrespective of the number of households that have purchased that item. This criterion, according to Statistics South Africa (2007), is known as the "plutocratic criterion". The second criterion, called the "democratic criterion", is based on the percentage of households that actually purchase the product.

As with the weights of a tender price index, which has been discussed previously, the weights of the CPI basket should also be reviewed on a regular basis and revised if appropriate. Revisions of the weights on a regular basis is important, in order to reduce the impact that product substitutions, e.g. products that are no longer available in the market or have gone "out of fashion" with the public, have on the index. It also ensures that the basket of goods and services and their weights remain representative. This reduces the index's potential for giving a misleading picture; and, according to the United Nations Economic and Social Council (2003), should be done at least once every five years.

Statistics South Africa has adopted the Classification of Individual Consumption by Purpose (COICOP). This classification was developed by the United Nations, and is the standard international classification for consumer expenditure. It is also recommended by the International Labour Organisation for use in the compilation of consumer-price indices (Statistics South Africa, 2009).

The structure of the COICOP, according to the International Labour Organisation (2004a and b), is that the first level of classification consists of 12 Divisions, such as "food and nonalcoholic beverages". These Divisions cover the total consumption expenditures of households; and the breakdown is essentially done according to purpose. At the second level, the 12 Divisions are divided into 47 Groups, such as "food". Each Group is, in turn, divided into 117 Classes of products, such as "bread and cereal". Each class may then also be divided into more homo-geneous sub-classes, such as "rice".

When new weights for a tender-price index are established later in this study, the research will attempt to apply the above methodology, in order to ensure that it is based on well-known, established principles.

6.4 WEIGHTS IN A NEW TENDER-PRICE INDEX: CONSIDERATIONS

6.4.1 Introduction

From what has been discussed above, as well as previously in Chapters 2 and 3, it was decided to steer the study in the direction of a fixed-weight, short-list method, with priced bills of quantities as the basis. Although this method, as discussed before, contains some limitations, it was deemed to be the most appropriate way of constructing a new TPI for use in the South African building industry, mostly because priced bills of quantities are freely available, as they are is still one of the preferred procurement methods in South Africa. It is also expected to remain that way for the foreseeable future.

6.4.2 Considerations

When using the short-list method where bills of quantities are being used, some aspects would need to be considered:

6.4.2.1 Starting cost or end-cost

There is a question on whether the starting cost or end-cost of a project should be used when calculating the weights for an index. In a sense, the starting cost (or tendered amount) is still an estimate, as there are still factors, such as provisionally measured items, like foundations and plumbing work, as well as provisional sums and budgetary allowances that must be adjusted. Furthermore, in almost every contract, variation orders are issued throughout the duration of the contract that would only be finally determined by the agreement of the final account of the project. Only after all the above issues have been settled, would the end-cost of the project be finalised. Similarly, fully provisionally measured bills of quantities are being re-measured, as the project progresses; and the end-costs can only be known — after the completion of the project — when all the re-measurements have been agreed on with the contractor.

Van der Walt (1992) was of the opinion that there would not be any fundamental difference between the starting cost and the end-cost of a project, if the amounts for provisional sums are taken as fixed amounts.

The problem with using the end-cost is, firstly, that it would be more difficult to obtain the information from quantity surveyors, as this would mean that the original bills of quantities, as well as the agreed final account, must be submitted by the relevant project quantity surveyor. Secondly, there might be a big time lag between the start and the end of a project, especially on large projects, with a construction period of more than twelve months.

If the index has already been established, then the only relevant information required from the bills of quantities would be the item rates; and therefore, if the information only becomes available after the contract has been completed, the rates of a project with a long duration would only have historical value. The principle that is applied on tendered bills of quantities in the South African construction industry is that, although the tendered amount is fixed and the rates can be changed to rectify any mistake or unrealistic rate, once the contract has been signed, the rates can no longer be altered.

These rates of accepted tenders, as will be discussed later on in the study, would need to be used to calculate the index. As it is envisaged that the index will be calculated at quarterly intervals, it would, consequently, be important to source bills of quantities as soon as possible after they have been accepted for a project, thereby implying that the starting cost of a project would have to be used.

6.4.2.2 Trade or elemental basis

Bills of quantities comprise a number of bills; each bill covering a separate trade, such as earthworks, masonry, concrete, etc. In South Africa, almost all bills of quantities that are used for tender purposes in the building industry are drawn up according to the principles laid down in the latest edition of the SSM (ASAQS, 1999). Yu and Ive (2006) state that the items in a bill measure quantities in suitable physical units. These are taken from drawings prepared by the architect and engineering consultants. When tendering, the contractors compete by attaching different prices (rates) to each unit of the measured work.

Elements, on the other hand, are mostly used by quantity surveyors when compiling estimates for proposed projects. The Guide to Elemental Cost Estimating and Analysis for Building Work (ASAQS, 2013), which is mostly used in South Africa when doing elemental estimates, defines an element as: “That part of any building that always performs the same function, irrespective of its construction or specification”.

In turn, each element is sub-divided into components: For example, the element "external envelope" is sub-divided into components, such as brick and block walls, reinforced concrete walls, curtain walls, etc.

According to Van der Walt (1992), the different trades in bills of quantities are more uniform than elements. For instance, the "Masonry" trade contains only items concerned with brick and block work, such as half-brick walls, one-brick or cavity walls, face brickwork, etc. Elements, in contrast, can contain items from different trades in a single element. An example is the element "external envelope", which, as indicated before, can be sub-divided into components such as one-brick walls, external finishes (e.g. plasterwork), windows, doors, etc.

Similarly, the same component can occur in different elements, e.g. one-brick walls can occur in both the "external envelope" element, as well as in the "internal divisions" element. This makes it very difficult to provide a short-list of items for elements, as well as the weighting thereof. Another problem is the availability of elements. Whereas bills of quantities are more freely available, because of their use in procuring projects, elemental analyses are scarce; and would either have to be sourced from quantity surveyors where they are used in-house to provide estimates, or they would have to be re-produced at great cost from bills of quantities.

The most appropriate approach would, therefore, be to calculate the short-list of indicator items from trades in priced bills of quantities.

6.4.2.3 Contract sum

Another issue to consider is whether the tender sum, as it appears in the bills of quantities should be used, or whether any adjustments should be made to it. In most bills of quantities, the contract amount consists of the following:

- Preliminaries
- Building works
- External works
- Provisional sums
- Allowance for contingencies
- Value-added tax (14% on the total of the above)

As value-added tax (VAT) gets added to the sub-total of all the work involved with the building, it can be ignored; and all the item rates, as well as totals for items and trades as they are before tax, would be used. It would create more work on the index to add 14% to all rates when, calculating the index; and it would not make any difference to the outcome of the index.

Similarly, any allowance for contingencies can be left out of the equation. The aim of contingencies, defined in the SSM (ASAQS, 1996), as “provision for expenditure which cannot be determined during the preparation of the bills of quantities”. As discussed before, it would only become clear at the end of the contract, whether the provision would have been used in total, partially or not at all. As it was previously decided that the starting cost of a project should be used, any allowance for contingencies would, therefore, not be taken into account for any calculation of the index.

Another consideration when looking at the contract amount is whether to include the trade "External works" or not. Although they form part of the measured work in the bills of quantities, van der Walt (1992) stated that the amount or type of external work is a function of the nature of the site, and not of the building. It is, therefore, very diverse in the type of items that can be found in this trade. Another problem is that this trade is made up of items that might already have been measured in their original trades, such as excavations, concrete work, brickwork, etc. This would make the allocation of weights to this trade very difficult.

The answer to the problem would be to exclude this trade from the contract amount of the bills of quantities that are used to determine the weights for the index. Because of this decision, another problem presents itself, namely, the Preliminaries trade. The "External works" trade forms part of the measured work in bills of quantities; and if the "Preliminaries" trade is going to be expressed as a percentage of the measured work (as will be discussed later), then the "Preliminaries" trade would need to be adjusted *pro-rata* downwards, when the amount for "External works" is omitted from the tendered amount.

6.4.2.4 Preliminaries

Although the "Preliminaries" trade is not measurable, as are the other trades, it is still one of the trades in bills of quantities; and a decision should, therefore, be made on how to deal with the weighting thereof. Preliminaries are defined in the SSM (ASAQS, 1999) as, "…information and such requirements and restrictions of a general nature that may affect the cost of the works". Furthermore, the RICS-s' Standard Method of Measurement of Building Works (SMM7) (1998) noted that the "Preliminaries" section contains those items that are not specific to work sections; but they have an identifiable cost, for which it is useful to consider tendering separately.

The intention, therefore, of the “Preliminaries” trade is that it forms part of the bills of quantities; and it can be priced by contractors and, therefore, has to be included in a TPI.

According to Van der Walt (1992), the way in which contractors allow for “Preliminaries” in their tender prices differs a lot between various contractors. For example, some contractors allow for their profit in the “Preliminaries”; while others allow for it in their unit rates. Similarly, some contractors only price for certain items in the “Preliminaries” (such as plant or equipment), with the rest of the items resorting under “Preliminaries” allowed for in the unit rates; while other contractors will price everything in the “Preliminaries” trade.

The above is supported by a study done by Cruywagen (2009), where 28 projects’ “Preliminaries” were analysed; and it was found that if the “Preliminaries” amount was expressed as a percentage of the contract amount in these contracts, it ranged between 0,04% and 32,06% — with an average of 9,76% per project.

Van der Walt (1992) also mentioned that it can be accepted that contractors will price the “Preliminaries” higher (and more accurately) during times of prosperity in the building industry; while in times of adversity, this is the first place where they will cut their allowances for “Preliminaries”. Segalla (1991) stated that in the BER index, an allowance of 5% per project is made for “Preliminaries”, or “P&G” (“Preliminaries and General”), as it was called then.

In light of the above discussion, it would seem that to allow a fixed amount for “Preliminaries” in an index would not be correct, especially if the weights are going to be fixed for at least a five-year period; firstly, because of the difference that is found in the percentage allowed by contractors in tenders; and secondly, because of the changing nature of the allowance for “Preliminaries”, depending on the current economic climate. Van der Walt (1992) was of the opinion that there are two ways to deal with the “Preliminaries” trade. The first is to spread them as a percentage across all the item rates in the bills of quantities (in the same ratio as the "Preliminaries" were, when expressed as a percentage of the contract amount); while the second method is to treat it as a separate trade with their own weights.

Ferry *et al.* (2003) state that in the BCIS index, "Preliminaries" are dealt with by allowing for it as a percentage addition to the items in the bills of quantities. The main reason for this is that in the BCIS index, being a Paasche-type index, the selected tendered rates are being re-priced with rates in the base schedule, which already includes an allowance for "Preliminaries" (Yu & Ive, 2006). Because of the varied nature of the "Preliminaries" trade as indicated above, it is anticipated that it would be very difficult to identify suitable indicator items in the "Preliminaries" trade to which assign weights, if they are treated as a separate trade.

It would, therefore, seem that the most appropriate way to deal with "Preliminaries" in a new TPI for the South African building industry would be to allow for them as a percentage added to all the rates in the bills of quantities. This aspect will be dealt with in more detail later on in the study.

6.4.2.5 Provisional sums

Provisional sums are defined by the RICSs Standard Method of Measuring Building Works (SMM7) (1998), as "sums of money intended for elements of the works which have not been sufficiently designed but where there is certain defined information available". Sums of money are allowed in the "Preliminaries" trade for items, such as electrical installation, ventilation and air-conditioning installations, lift installations, fire detection and protection systems, access-control systems, piling, landscaping work, and the like.

Yu and Ive (2008) mention that these allowances are usually for specialist work, not designed by the architect; but in South Africa, this has changed during the last 10 to 15 years. In order to save time on the procurement process, more and more of the trades that traditionally were measured in the bills of quantities are now allowed for as provisional sums, or for what is also called "budgetary allowances". These allowances can be for almost any element of the works except the actual structure of the building; and they would include items, such as aluminium windows and doors, tiling work, structural steelwork, ceilings and bulkheads, signage, etc.

The difference between budgetary allowances and provisional sums is that budgetary allowances are allowed for as lump sums in the bills of quantities — with the work to be executed by the principal contractor, and re-measured during the course of the contract in terms of rates submitted against similar items in the tendered bills of quantities. Provisional sums, on the other hand, are tendered for by specialist nominated or selected sub-contractors.

Separate provision is made in the bills of quantities for the principal contractor to allow for his profit, as well as attendance on each provisional sum. The above procurement method is defined in the South African Council for the Quantity Surveying Profession's tariff of professional fees as "multiple procurement" (SACQSP, 2010).

Irrespective of whether the work was tendered for as provisional sums or budgetary allowances, it would be adjusted during the course of the contract, according to the actual costs incurred, either through re-measurement of the budgetary allowances as indicated above, or the final cost of the works, including the *pro-rata* adjustment for profit and attendance, for provisional sums. Work designed by consultants, other than the architect, such as electrical or mechanical engineers, normally falls under the jurisdiction of such consultants who will be fully responsible for all aspects of this work, such as design, supervision, variation orders, payment certificates and settlement of the final account.

When looking at other construction cost indices, it is interesting to note that in some of these, no provision is made for any inclusion of provisional sums. Yu and Ive (2006) have identified this issue as one of the areas of possible improvement of the BCIS formula, as all items, such as mechanical and electrical service systems — including comfort, cooling, heating systems, lighting, electrical supply systems, lifts and fire detection systems that are usually included as provisional sums in bills of quantities — are not included in the index.

The same applies for the BER index in South Africa, where average percentages for electrical work, lifts and air conditioning installations, are shown when the quarterly report of the index is published. This, however, does not form part of the index, and is merely the amount of each of these work sections expressed as a percentage of the contract amount of the particular tender, with all individual percentages averaged by the number of projects to which the particular items concerned are applied (Brook, 1974).

Yu and Ive (2006) state that in recent years, mechanical and electrical services have started to represent a significant portion of the cost of non-residential buildings, such as offices and hospitals, with a quoted figure of approximately 40% of contract amounts. When the weights for a new index are discussed later on in this study, it is envisaged that the above observation will be supported to a large extent. It is the opinion of van der Walt (1992) that when calculating a new index, the "Provisional sums" trade should be dealt with in a different manner than the other trades.

If the Provisional sums form a significant part of the tendered amount, they should also form part of the weights of an index, with each provisional sum being considered, according to its own merit, for assigning a weight to each. Furthermore, a standard indicator item or standard indicator items in the work would have to be identified, as was with other trades.

6.4.2.6 Influence of region and nature of the site

The prices of material and labour differ between different regions and between different cities and towns (sometimes even between cities or towns in the same region, e.g. between Johannesburg and Pretoria in the Gauteng region, even if only approximately 50 kilometres apart). Although it is, therefore, important to investigate these differences, it would only be necessary when dealing with rates or prices; and should have no influence on the selection of weights.

When it comes to the site of a project, issues such as the nature of the site, e.g. whether there are poor soil conditions, or if the access to the site is restricted, must be taken into account. Most building projects have fairly stable and uniform site conditions. If the nature of the site is classified as abnormal, i.e. having poor soil conditions, or a site with a steep slope, it would not have an influence on the building as a whole, but mostly on the foundations. The problem is normally overcome by the use of either piles or a stronger than normal foundation; whereas a sloping site could be dealt with by providing platforms over the site. The latter can be measured in the “Earthworks” trade or in the “External works” trade.

Where the weights for an index are concerned, any measurements associated with stronger foundations, such as extra excavations or concrete work, or any bulk excavations over the site, would be picked up when the weights are calculated for specific indicator items.

When it comes to the issue of a restricted site, for example, when erecting a building in a city centre, where there is limited working space on site, and access is restricted to one street, this would normally fall under the "Preliminaries" trade, and be dealt with in the same manner, as discussed previously.

In both of the above instances, the assumption can be made that for the purposes of this study, that it would have a negligible influence on the choice of the weights for a new index.

6.5 METHODOLOGY IN DETERMINING NEW WEIGHTS

6.5.1 Choice of buildings

It has been established from the investigation already done in this chapter, as well as in preceding chapters, that the calculation of a new TPI would be based on a base-weight index, with a short-list of indicator items, and that the information needed to establish this would be sourced from the priced bills of quantities. The next step in the research would then be to decide which projects' bills of quantities should be used. According to Davis Langdon Management Consultancy (2008), each construction project tends to be unique in some sense.

Apart from the fact that construction projects can be classified into different types, such as office buildings, shopping centres, hospitals, schools, warehouses, factory buildings, churches, etc., as well different types of residential buildings, such as houses, flats, retirement villages, etc., they could also, within these classifications, differ in size (e.g. the area that they cover, the height of the building, etc.), the complexity, the standard of finishes, the monetary value as well as the duration of the construction period. All the above issues make it extremely difficult to decide, which building type, or types, or a combination of building types, should be used as representative, in order to use these as the basis for determining weights for a TPI.

There are, according to Van der Walt (1992), basically two methods that can be used:

6.5.1.1 Weights for separate types of buildings

In this method, one building that is typical of a group, say office buildings, is selected; and the priced bills of quantities for this building are used to determine the weights for it.

<u>Advantages</u>

- The advantage of this method is that it would be a relatively simple exercise to determine the weights for each building type; and it would also be easy to update the weights on a regular basis, when they become out-dated.

<u>Disadvantages.</u>

- The choice of a “typical” building within a type would be arbitrary; as it would be difficult to decide what a typical building should look like, because of the varying nature of construction projects, as has already been discussed previously.

- Even though the choice of weights for one building type would be a fairly simple exercise, this would have to be repeated for the whole spectrum of different types of buildings; and an index would have to be calculated for each type.

Although this type of information could be a handy tool to compare the movement of prices in each building type, it could also become a cumbersome exercise to calculate a number of indices on a regular basis. Another problem associated with this method, and which will later be discussed in more detail, is whether there would be enough information available on a regular basis for each of the different building types, in order to calculate a meaningful index for each.

- If the purpose of an index is to calculate a TPI that reflects the movement of building prices for all buildings in South Africa, this method would not be able to satisfy this purpose. One way of solving this problem would be to calculate the mean value (this can either be the arithmetic or weighted mean) of all the indices for the different types of buildings; or a choice could be made of one of the building types that would be considered as representative of all building types. If the first option is taken, namely, the calculation of the mean value of all individual indices, it might yield an acceptable average index for all building types in South Africa; but it would exacerbate the already-mentioned problem of the amount of work that it would take to calculate a number of indices. If, on the other hand, one building type is selected as representative, the question would then automatically be asked which building type it would be, since an office block differs substantially from a warehouse; or a hospital differs from a shopping centre. An example of the latter method of compiling an index can be found in the BER building-cost index, which, as explained in Chapter 2, is based on 22 cost components that have been selected from, what is called by Marx (2004) a "quasi house": a 100m^2 single storey building, in which a concrete slab has been incorporated.

From the above it may be deduced that it is questionable whether this method of calculating weights for separate buildings would be a feasible method. Van der Walt (1992) was of the opinion, which is also supported by the above discussion, that the disadvantages outweigh the advantages and that an alternative method should be examined.

6.5.1.2 Weights based on a selection of building types.

This method, which is used in this study to compile a new TPI, is in essence using the analysis of a variation of different building types to compose an "average" representative building. This is an accepted method of calculating TPI's, as indicated by Van der Walt (1992), who stated that a set of standard weights may be used for all buildings. In Finland, the weights of the building-cost index are based on the estimated share of four different types of projects, i.e. blocks of flats, attached houses, offices and commercial buildings, and industrial buildings and warehouses (Statistics Finland, 2001). Similarly, a TPI in Singapore is compiled based on a range of building types, e.g. residential, commercial and institutional developments, weighted according to the proportion of the contract value of each type over a certain time period.

Furthermore, the Statistics Directorate of the European Community (1997) have indicated that in the compilation of construction-price indices, weights for different types of building construction could be used, based on the value of the respective share of each type of construction to the total value compiled from approved authority data.

It was decided to use the method of composing an "average" building for a number of reasons. Firstly, as discussed before, it is an accepted method of calculating a TPI. Secondly, it is the method followed by the BER to determine their TPI, and was also used by Van der Walt (1992) when he also calculated a TPI. When Miners (1996) embarked on an exercise to determine whether a TPI can be established in South Africa, it was reported that the method of using twenty selected items, weighted in proportion to their value of a contract, was the best to use. This method can also be considered to represent an "average" building and, based on the above, it is clear that the current and previous methods of calculation a TPI were based on an "average" building.

In the discussion later on in the study (see Table 6.2), it will be shown how the sample of buildings to be used was identified. From this sample it will be shown that the basis of deciding on weights for a TPI is also based on proportional representation of different building types (e.g. office buildings = 30%; shopping space = 25%; industrial space = 25%, etc.) similar to overseas countries.

A problem that was identified with using a range of specific buildings as basis for a TPI is the danger of not obtaining sufficient information on all building types in a specific time frame e.g. a quarter. As one of the perceived problems with the accuracy of a TPI is the lack of sufficient information, if one or more of the specific buildings is not represented during a time period, it can lead to skewed results.

Thirdly, as will be discussed later in the study (see 6.6.1), is that the determination of weights for a TPI is broadly based on CPI methodology. The CPI is calculated by collecting prices of a sample of representative items over a specific period of time, resulting in a basket of consumer goods and services (Statistics South Africa, 2009). Therefore, a TPI can also be based on a basket of items based on a sample of representative buildings (or "average" building).

In order to achieve the aim of an average building, the first step was to draw a sample of buildings that could be regarded as representative of the South African building industry. The information that was used was for this comprised those published by Statistics South Africa. One of their publications is Statistical release P5041.3, titled: "Selected building statistics of the private sector as reported by local government institutions, 2008" (Statistics South Africa, 2009).

The data published in this release contain information that is based on surveys done on a monthly basis from metropolitan and large local municipalities on building plans passed and buildings completed. The release is published annually; and it contains the data for the past twelve months. The June 2009 publication, which was used in this study, contained information for the twelve months of 2008.

The information in this release can be grouped into three areas:

Residential buildings

- Dwelling-houses
- Flats and townhouses
- Other residential buildings

Non-residential buildings

- Office and banking space
- Shopping space
- Industrial and warehouse space
- Other non-residential space

Additions and alterations

Of the above areas, additions and alterations were not considered for use, because, although they form a substantial part of the total expenditure reported in the release, it would be difficult to include them in a tender-price index because of the diverse nature of this category. Regarding residential buildings, it was decided not to take into account the quoted figures for dwelling-houses, as well as those for flats and townhouses. The reason for this was because quantity surveyors in South Africa only become involved in this category of construction to a limited extent; for example: large, luxury houses, or blocks of flats, but almost never in low-cost housing, single, stand-alone small or medium-sized houses or clusters of townhouse developments.

The latter construction types are almost exclusively procured on a lump-sum or design-and-built basis, without any, or a limited involvement of quantity surveying expertise.

There is a vast amount of information published in Statistical release P5041.3; but the information that was used in this study was limited to the following:

Table 76.1 – Value of non-residential buildings completed: Office and banking space, shopping space and industrial and warehouse spaces.

Table 76.2 – Value of non-residential buildings completed: Schools, nursery schools, crèches, hospitals, churches, sport clubs, recreation clubs, and other non-residential spaces.

Table 72 – Value of residential buildings: Dwelling houses, flats and townhouses, and other residential buildings. As discussed before, the data for dwelling houses, flats and townhouses were not going to be used, but the portion of the table labelled "Other residential and tourist accommodation" was included; as it represents the statistics on institutions for the disabled, boarding houses, hostels and tourism accommodation; for example: Hotels, guest houses, holiday chalets, bed-and-breakfast accommodation and casinos, all which could have required quantity-surveying involvement.

The data from these tables are indicated in Table 6.1.

Table 6.1: Value of completed buildings by municipalities, 2008. (Adapted from Statistics South Africa statistical release P5041.3)

Building type	**Total value (R'000)**	**% of total**
Office and banking space	4 805 301	35
Shopping space	3 636 047	27

Industrial and warehouse space	3 714 338	27
Schools, nursery schools, hospitals, etc.	145 406	1
Churches, sport and recreation clubs, etc.	282 209	2
All other non-residential space	137 826	1
Hotels, holiday chalets, tourism accommodation, etc.	892 815	7
Total	**13 613 942**	**100**

If one looks at the information in the above Table from a South African quantity surveyor's point-of-view, the immediate impression is that the percentage of industrial and warehouse space seems to be too high, compared with the other building types. The reason for this viewpoint is that a large proportion of these projects, such as factories and warehouses, are fairly simple buildings that require little or no architectural input, and can be procured on a design-and-supply or a lump-sum basis, without any quantity-surveying involvement.

This impression was confirmed when bills of quantities of completed projects were sourced from quantity-surveying firms; and it was found that the amount of industrial-type projects were less abundant, compared to, say, office blocks and shopping centres.

The next issue to take into account was the actual amount of priced bills of quantities that needed to be analysed in order to have sufficient information, so that weights could be determined that could be considered as representative of an average building in the South African building industry. Nothing could be found in the literature to guide the study in this regard. Van der Walt (1992), who did a similar type of study in the early 1970'-s (see Chapter 2 for discussion) got his information by means of questionnaires sent out to quantity surveying firms in South Africa, and from this questionnaire, no clear indication could be detected of how many priced bills of quantities were used in that study.

After deliberation with the Department of Statistics at the University of Pretoria, it was decided to first analyse 20 bills of quantities, then another 10, and finally another 10, bringing the total amount to 40 bills of quantities. A detailed discussion on this analysis will follow later on in the study; so it is sufficient to state at this stage, that it was found that the difference in the average percentages that were calculated for the various trades, decreased as the number of analysed projects increased; and therefore, it was decided to suffice with analysing 40 priced bills of quantities.

In terms of the sample of building types that were identified previously, from the data published by Statistics South Africa, a proportional allocation could be made for the 40 projects that needed to be sourced. As discussed, an adjustment was made to the number of industrial buildings, so that less of these projects were needed; while at the same time, the number of offices, as well as schools and hospitals, was increased. It was also decided to include a block of flats in the study. The reasoning behind this was that, although dwelling-houses and townhouses were not considered; high-rise blocks of flats are projects, where quantity surveyors are used; and it would, therefore, bring a certain amount of residential data into the equation, as well.

Table 6.2 indicates the type and number of projects that were sourced for analysing their priced bills of quantities, in order to determine the weights for aTPI.

Table 6.2: Number of bills of quantities per project type

Building type	**Number**	**% of total**
Office space	12	30
Shopping space	10	25
Industrial space	8	20
Schools and hospitals	3	7,50
Churches	1	2,50

All other non-residential space	1	2,50
Hotels, holiday chalets	4	10
Flats	1	2,50
Total	**40**	**100**

6.5.2 Collection method

The next step in the research method was to actually collect the priced bills of quantities for the number and type of projects that were chosen. It was decided to use a purposive sampling method for this purpose. Purposive sampling is described by Welman *et al.* (2007) as sampling, where "researchers rely on their experience, ingenuity and/or previous research findings to deliberately obtain units of analysis, in such a manner that the sample they obtain may be regarded as representative of the relevant population".

The main reason for using purposive sampling and not random sampling, was firstly, to speed up the process. If all quantity surveyors in South Africa were asked via a letter — to all the registered firms — to submit priced bills of quantities, it would probably have been a lengthy process to wait for a response. Secondly, it was to ensure that the information (in this instance the priced bills of quantities) was of good quality, and that the chosen sample size could be accommodated.

A number of prominent quantity-surveying firms throughout South Africa were contacted via e-mail correspondence. The contact information of these firms was sourced from the website of the ASAQS (www.asaqs.co.za), where all the firms that are registered with the ASAQS are listed per province. An effort was made to contact firms of different sizes; and, although most firms are situated in the larger cities and towns, some of those in smaller, rural towns were also contacted.

The request was made to these firms to provide priced bills of quantities for completed projects. It was explained to the firms that the bills were needed for research purposes; and the requirements were spelled out, i.e. that the projects should be procured between 2005 and 2008; they should preferably be new or so-called "green-fields" projects, although some element of alterations could be included. Furthermore, the information was requested on the type of project, the location, as well as the tender date. It was stressed that no sensitive information, such as the identity of the contractor, or that of the client was required, and that all information would be treated as confidential and only be used for research purposes.

To make it easier for the respondents to participate, the firms were requested to submit the information electronically. In South Africa, there are currently two electronic measurement systems that are being used by most of the quantity-surveying firms throughout the country to produce bills of quantities, with a small minority using spread-sheets for this purpose. The two companies market their software under the trade-names "WinQS" and QSPlus", respectively. These packages have been used over the past 20 years in the industry; and the software packages are updated frequently, in order to keep abreast with the latest developments and requirements of quantity surveyors in South Africa.

The fact that bills of quantities are produced electronically made it easy for firms to forward priced bills of quantities; as this saved them the cost and effort of printing the documents.

A number of firms responded positively; and a total of 183 priced bills of quantities were received from 27 different quantity-surveying firms. From these projects another purposive sample was drawn to match the selection of 40 projects previously chosen as representative of the building industry in South Africa. This selection was mostly performed on an *ad hoc basis.* Firstly, the bills of quantities were sorted into the relevant groups (offices, shops, etc.). Where a number of projects of a certain type were required, i.e. nine office blocks, a selection was made to represent as many regions (provinces) in South Africa as possible. The projects were also chosen to have different monetary values.

Ultimately, the selection of projects per building type as indicated in Table 6.2 that was chosen looked as follows:

Office space:

Nine office blocks, one library, one administration building, and one magistrate's court (twelve in total)

Shopping space:

Seven shopping centres, and three motor dealerships (ten in total)

Industrial space:

Two factories, two warehouses, three workshops and training centres, and one laboratory with stores (eight in total)

Schools and hospitals:

One primary school, one hospital, and one health-care centre (three in total)

Hotels, holiday chalets:

One hotel, one holiday chalets, one retirement village, and one university residence complex (four in total)

Flats:

One block of flats

All of the above chosen bills of quantities were measured, according to the SSM (ASAQS, 1999) by fifteen different quantity-surveying firms, and without any, or few alteration's projects involved. Although the location of the projects is not important when determining weights for a tender-price index, for representation sake, bills of quantities from seven of the nine provinces in South Africa were chosen — without any representation from Limpopo, and the North West Province.

Care was also taken to choose projects that vary in monetary value. From the 40 projects, the lowest project value was R2 789 374; the highest project value was R568 042 407; and the arithmetic mean of all 40 projects was R53 073 143 per project. The distribution of projects, according to their value is indicated in Table 6.3.

Table 6.3: Distribution of projects according to monetary value

Value (R'000 000)	**Number**	**Percentage**
0 to 20	17	42,50
20 to 50	11	27,50
50 to 100	9	22.50
Exceeding 100	3	7,50
Total	**40**	**100**

According to the above table, 70% of the projects used were of a value below R50m, and 30% were above R50m. Although little information is available on the average monetary value of projects in South Africa, it may be accepted that the above represents a fair distribution of projects in South Africa, according to monetary value where quantity surveyors are involved.

6.5.3 Base period

As indicated in Chapter 2, the choice of the base period of any index is an important factor to consider. As will be discussed later in more detail in the study, it was decided to take 2006, as the base period for the calculation of a new tender-price index. Although the base period is of more importance when choosing the rates that are going to be used in the base period, it is also important for the determination of weights.

Steyn *et al.* (2007) state that the base period should not be too far in the past, because of the possible change in appearance or quality of commodities over a period of time. This thought is confirmed by the International Labour Organisation (2004a), when it stated that it is desirable to use weights of a more recent period, in order to ensure that the index is weighted appropriately.

In this study, it was therefore attempted to obtain bills of quantities for projects procured during 2006, in order to coincide with the chosen base period. This was, however a difficult task, because of the specific requirements to obtain bills of quantities for the 40 projects needed, as discussed previously. The request made to quantity surveying firms to contribute priced bills of quantities was not prescriptive, in the sense that specific projects were required, but merely to contribute bills of quantities, because these were also going to be used later on for sourcing rates; and therefore, all kinds of projects were needed.

Ultimately therefore, in order to obtain the required sample of 40 priced bills of quantities for the building types identified, it was decided to broaden the spectrum and to cover a greater time period than just the base period. This is not an unusual practice, as is confirmed by the International Labour Organisation (2004a), which mentions that in some instances, the data for a single year may not be adequate, because the sample might not be large enough; and “an average of several years of expenditure data may then be used to calculate the weights”.

This was done in the study with the tender periods for the 40 chosen projects stretching over the time period between 2005 and 2008.

6.6 NEW WEIGHTS

6.6.1 Trades in bills of quantities

The first step in determining new weights after the process of identifying the 40 projects, as described above, was to decide — in terms of the COICP classification used in calculating the CPI (Statistics South Africa, 2009a) — how the different categories, classes, groups and products should look. A typical example of such a breakdown, as used in calculating the South African CPI is, given in Table 6.4.

Table 6.4: CPI weights for clothing and footwear (Statistics South Africa, 2009A)

3.CLOTHING AND FOOTWEAR				**4,42**
3.1 CLOTHING			3,13	
	Clothes for men	0,99		
	Clothes for women	1,03		
	Clothes for children and infants	1,11		
3.2 FOOTWEAR			1,29	
	Footwear for men	0,56		
	Footwear for women	0,36		
	Footwear for children and infants	0,37		

According to this Table, the category is “Clothing and footwear” with a weight of 4,42. This category is broken down into two classes, namely “Clothing” with a weight of 3,13, and “Footwear” with a weight of 1,29. Each of these classes is, in turn, broken down into “Groups”, such as “clothes for men” (0,99), “clothes for women” (1,03), and “clothes for children and infants” (1,11), respectively.

When the survey for the CPI is carried out, the prices for different products would be sampled. For example, under “clothes for men”, this would be products, such as shirts, trousers, jackets, etc.

In order to adhere to these principles, the various priced bills of quantities were broken down into the various trades in which they were measured, with the intention that the trades would form the different categories for the new TPI. As indicated before, all the sampled bills of quantities were measured according to the principles, as laid down in the SSM (ASAQS, 1999). Because of this, the trades occur on a consistent basis in most projects.

The following trades are listed in the SSM (ASAQS, 1999):

- Preliminaries
- Alterations
- Earthworks
- Lateral support
- Piling
- Concrete, formwork and reinforcement
- Precast concrete
- Masonry
- Waterproofing
- Roof coverings

- Carpentry and joinery
- Ceilings, partitions and access flooring
- Floor coverings, wall linings, etc.
- Ironmongery
- Structural steelwork
- Metalwork
- Plastering
- Tiling
- Plumbing and drainage
- Electrical work
- Mechanical work
- Glazing
- Painting
- Paperhanging
- External work
- Provisional sums

(Although "Provisional sums" are not listed as a trade in the SSM, provision is made for the allowance of provisional sums for specialist work in the "General instructions" of the SSM and it has, through the years, become customary with most South African quantity surveying firms to list such provisional sums as a separate trade.)

The first step was to adjust the priced bills of quantities, as discussed before, by omitting all allowances for contingencies and the "External work" trades, and then adjusting the Preliminaries amounts *pro-rata*. Furthermore, the amounts of the "Preliminaries" trade in each project were distributed *pro-rata* among the rest of the trades, because, as discussed previously (4.4.2.4), it was decided not to consider the "Preliminaries" trade as one of the categories in the tender price-index. The breakdown of all 40 projects into their respective trades is given in the table in Annexure 4.

As can be seen from Annexure 4, the arithmetic mean was calculated for each trade per project; and this average was then expressed as a percentage of the arithmetic mean of all the projects. A decision had to be made whether this percentage should be the arithmetic mean or a weighted mean, i.e. whether the projects that are larger in value play a more important role than the projects with a lesser value. After discussions with statisticians from the Department of Statistics at the University of Pretoria, it was decided to use the arithmetic mean, because the monetary value was already reflected in the particular trade.

For this study, it was important to use the amounts of the various trades as they occurred, because they portray the relative importance of each trade in terms of that particular project. An example of this can be seen if the value of the “Concrete, formwork and reinforcement” trades taken from projects 4 and 22, respectively. In project 4, the trade value of “Concrete, formwork and reinforcement” is R8 443 409,42, which represents 27,53% of the total project value of R30 665 560.74.

In project 22 the value of the “Concrete, formwork and reinforcement” is R149 505 153,03, which, in turn, represents 26,28% of the total project value of R508 041 796.88. From this, it is clear that certain trades are not necessarily more important in larger projects than they are in smaller ones.

It is also evident from Annexure 4 that all trades, as indicated in the SSM (ASAQS, 1999), are not always present in a project. Nine trades (“Earthworks”, “Concrete, formwork and reinforcement”, “Masonry”, “Waterproofing”, “Carpentry and joinery”, “Metalwork”, “Plastering”, “Paintwork” and “Provisional sums”) were represented in all 40 projects; while “Plumbing and drainage” and “Ceilings, partitions and access flooring” occurred in 39 projects.

The reason why all the trades are not always represented is mostly a function of the design of a project, i.e. if the building has a concrete slab for a roof, there would be no "Roof coverings" trade; and similarly, if only porcelain floor tiles are used through-out a building, there would probably be no trade for "Floor coverings".

If one further compares the trades that were used in the 40 projects with the standard trades in the SSM, as listed before, it can be seen that that the following trades were not represented at all in any of the projects: "Alterations" (the reason for this was because when bills of quantities were requested from quantity surveying firms, it was stated that new projects with no or minimum alterations were preferred), "Lateral support", "Piling", and "Mechanical work".

This is an indication that these trades are either not encountered frequently; and therefore need not be included in the weights of a new TPI; or, as in the case of "Piling" and especially "Mechanical work", are allowed for under "Provisional sums" as specialist work. "Electrical work" was measured in two of the projects as a separate trade; but for the sake of consistency, these amounts were added to the electrical allowances in the "Provisional sums" trade, where they occurred in the other 38 projects. Annexure 4 also shows that the trade amounts for "Precast concrete" and "Paperhanging" were relatively small (0,4% and 0,05%, respectively, of the total); and they also were not well represented, with "Precast concrete" that occurred in 20 projects and "Paperhanging" in only 5 projects.

In the table in Annexure 4, the standard deviation of each trade was also calculated. According to Steyn *et al.* (2007), the standard deviation is a measurement of the variability; and this shows how much variation there is from the mean. It can be seen from Annexure 4, that the standard deviation for most of the trades lies between 3% and 7% except for Precast concrete (9,54%) and Paperhanging (21,92%). This high standard deviation of the two trades indicates that the values are spread over a large range; and this, coupled with the low representation and percentage as indicated above, did provide sufficient evidence to decide not to include these two trades in the calculation of weights of a new TPI.

In tabular format, the trades, expressed as percentages (or possible weights) of an "average" building, are indicated in Table 6.5 below:

Table 6.5: Trades percentages

Trade	**Percentage**
Earthworks	1,70
Concrete, formwork and reinforcement	22,40
Masonry	5,80
Waterproofing	1,10
Roof coverings	1,70
Carpentry and joinery	2,70
Ceilings, partitions and access flooring	3,40
Floor coverings, wall linings, etc.	1,10
Ironmongery	0,70
Structural steelwork	2,70
Metalwork	5,70
Plastering	3,20
Tiling	2,40
Plumbing and drainage	4,10
Glazing	0,20
Paintwork	1,40
Provisional sums	39,70
Total	**100**

6.6.2 Detail analyses of trades

The next step was to do a detailed analysis of all the trades in the various bills of quantities of the 40 chosen projects. As discussed previously, when selecting a short-list of items from bills of quantities as weights, the objective should be to identify the minimum number of indicator items that collectively represent a high proportion of the value of construction projects (Statistics Directorate, European Community, 1997).

In order to comply with this objective, each project's bills of quantities were analysed by selecting all the measured items that had a monetary value of more than 5% of the total value of that particular trade. The 5% is an arbitrary value, as there is little indication in the literature, of how it was done with other price indices. When discussing the working of the BCIS-index, Yu and Ive (2006) indicate that when items are selected for re-pricing, those with a monetary value of more than 1% of the total project cost are selected first; and then in descending order of value, until 25% of the value of the trade is reached.

In this study, on a trial-and-error basis, 5% of the trade value was deemed to give an acceptable lower line of demarcation before items became insignificant in value.

Because of the difference between the various bills of quantities regarding size, complexity, finishes, etc. the number of measured items in the different bills of quantities ranged between a low of 190 items to a high of 791. With the 5% rule that was adopted, the average number of items that were selected amounted to 24,7% of the total amount in each project. These items represented an average of 75,6% of the total adjusted contract amount of the bills of quantities; and, if compared to the BCIS-index, where 25% of the items are considered to be adequate, can be deemed to satisfy the objective of selecting a relatively small number of representative items.

An example of the trade analysis of one of the bills of quantities is given in Table 6.6.

As can be seen from this Table, the total value for the trade "Concrete, formwork and reinforcement" for this project (project number 26) amounted to R2 357 886,00, with 5% of this amounting to R117 894,30. Seven items were identified from this trade, with amounts exceeding 5% of the trade value, e.g. 25MPa reinforced concrete in strip footings and bases; 25MPa reinforced concrete in surface beds, etc.

These seven items represented just over 73% of the trade value and 10,5% of the adjusted tender amount (adjusted tender amount, as explained before, is the actual tender amount less amounts such as the External works trade that was not included in the index) .

Table 6.6: Extract from bills of quantities analysis

Trade	Trade total	5% of trade	Item quantity	% trade	% adj.tender
Conc. Formwk. & Reinforc.	**2 357 886.00**	**117 894.30**			
25MPa r.c in strip footings, bases			333 500.00	14.14	2.03
25MPa mass conc. in surface bed			322 875.00	13.69	1.97
25MPa r.c in slabs and beams			271 400.00	11.51	1.65
Rough formwork to soffits of slabs 250-500mm			167 485.00	7.10	1.02

thick			
193 Fabric reinforcement.	175 240.00	7.43	1.07
High tensile reinf. 20-32 diameter	141 450.00	6.00	0.86
High tensile reinf. 10-16 diameter	317 860.00	13.48	1.90
	1 729 810.00	**73.36**	**10.53**

Following this exercise, the identified items were carried to another spread-sheet, indicating all the items for all the trades, in order to see, which items could be selected as indicator items in terms of both the frequency of occurrence, as well as the weight that they represent. Annexure 5 contains a table that shows an extract from this spread-sheet. (Because of the size of the document, only the "Masonry" trade is shown, although all other trades were analysed in a similar manner).

After all the items had been captured on the spread-sheet, the frequency, average percentage per item, as well as the average percentage per project was calculated. From Annexure 5, it is clear that in the "Masonry trade", the items of half brick walls (frequency 39), one brick walls (frequency 40), hollow walls (frequency 32), and extra over brickwork for face brickwork (frequency 29) comprised those items that occurred the most. This procedure was followed with all the trades.

After this exercise had been completed, it became evident that when comparing the average percentages for the various trades, as discussed and indicated in Table 6.5, with the average percentages of the trades, when only certain indicator items were used, as discussed above, the differences between certain trades became evident. This aspect will be discussed later on; but another issue that first had to be dealt with, was the "Provisional sums" trade. When looking at this trade, the percentage, in relation to the rest of the trades, seemed inordinately high (39.7%, as indicated in Table 6.5). The reason for this could be attributed to the fact that during the last number of years, more and more quantity surveying firms tend to not measure all the work at tender stage, but to rather follow the multiple procurement route, as discussed before.

This implied that only the so-called “wet trades”, such as “Concrete, formwork and reinforcement”, “Masonry” and “Plasterwork”, as well as “Earthworks” and portions of other basic trades, such as “Carpentry and joinery” (e.g. doors), are measured up-front, with the rest of the work being allowed for as either Provisional sums or Budgetary allowances. The reason for this practice was mostly to save time during the pre-contract stage; and this is done nowadays on most projects in the private sector.

In order to reduce the percentage for the “Provisional sums” trade, it was decided to move the items that could have been measured, if the design and specification had been completed at the tender stage, from the “Provisional sums” trade, and to allocate it to the various trades where it would have belonged if it had been measured (it was assumed that the amounts allowed were based on accurate estimates for budgeting purposes, and therefore would not differ much in value when being re-measured).

The items dealt with in this measure were, among others, structural steelwork, aluminium windows and doors, timber furniture and fittings, plumbing and drainage, and floor and wall tiling.

After all the items, which occurred frequently, had been identified, all 40 projects’ bills of quantities were re-visited — with the intention to look at those projects — where items with high frequency did not occur, i.e. if the item half-brick walls was identified in 38 projects; the other two projects were inspected. The reason for this was to see whether the specific item occurred at all in the other projects, or if it was not identified, because it was less than the 5% limit used. If it turned out to be the latter case, the percentage was also carried to the particular trade, in order to indicate the actual frequency of occurrence, as well as the representative percentage.

6.6.3 Indicator items

After the table with all the items had been updated as indicated above, the next decision to be made was whether the percentages of the various trades, as calculated from the trade analysis and indicated previously in Annexure 5, should stay as they were, or whether the identification of the various indicator items had had an influence on them. When looking at the percentages of the trades in the item spread sheet, it became clear that there is a difference between these percentages and those identified from the trade analysis.

A big part of this could be attributed to the exercise done when omitting measurable items from the “Provisional sums” trade, as discussed previously; but it could also be because when the most prominent items had been identified from the trades, the relative importance of some trades might have changed in relation to other trades. The reason for this was that some trades are more diverse than others, with a lot of smaller items that contributes to the total value, but are not big enough to be identified individually.

As the trade totals in the spread-sheet of the items used did not add up to 100 (because of the 5% limit), the total of each trade had to be extrapolated, in order for the totals of all trades to be 100. The percentage, or possible new weights, of the trades, according to the items identified, together with the percentages of the trades as calculated before, is indicated in Table 6.7.

Table 6.7: Trades percentages from items

Trade	**Percentage (trades)**	**Percentages (items)**
Earthworks	1,70	2.70
Concrete, formwork and reinforcement	22,40	20,00
Masonry	5,80	8,40
Waterproofing	1,10	1,10
Roof coverings	1,70	3,50
Carpentry and joinery	2,70	4,60
Ceilings, partitions and access flooring	3,40	3,40
Floor coverings, wall linings, etc.	1,10	1,10
Ironmongery	0,70	0,70
Structural steelwork	2,70	6,20
Metalwork	5,70	6,80
Plastering	3,20	3,40
Tiling	2,40	3,30
Plumbing and drainage	4,10	3,90
Glazing	0,20	0,20
Paintwork	1,40	1,80
Provisional sums	39,70	28,90
Total	**100**	**100**

The major differences, according to Table 6.7, occurred in the “Provisional sums” trade, which was reduced to a more realistic 28,90%, with a resultant increase in the “Structural steel”, “Metalwork”, “Carpentry and joinery”, “Roof coverings” and “Tiling” trades. Other changes occurred in “Earthworks” and “Masonry”, which increased, and in “Concrete, formwork and reinforcement” that decreased. The latter changes could be attributed to the nature of each trade with “Concrete, formwork and reinforcement” containing more of the so-called “sundry” items with a lower value.

6.6.4 Breakdown into categories and groups

In the following section the number of different items identified in each trade will be given. These items will be subdivided into groups, and each group will be allocated a percentage contribution to the weight of the trade. Following that, the items that occur most frequently will be selected for possible inclusion as indicator items.

6.6.4.1 Earthworks

Total number of items identified: 23

The most frequent items that occurred:

- Excavate not exceeding 2m deep for trenches (38)
- Extra over excavations, for carting away surplus material from site (37)
- Backfilling to trenches, holes (33)
- Filling and compaction under floors including scarifying (28)
- Filling and compaction under floors with imported material (33)
- Soil poisoning under floors/in trenches (37)

There are four groups that can be identified from this trade, with the following distribution:

- Excavations: 0,80%
- Carting away: 0,30%
- Filling: 0,90%
- Other: <u>0,70%</u>
- Total: <u>2,70%</u>

This is a fairly stable trade, consisting of items that pertain mostly to labour and/or the use of machinery. Although there are quite a number of items identified, a number of these are the same items, but with different depth increments, such as excavations, risk of collapse, etc. For indicator items, “excavate in trenches not exceeding 2m deep” and “extra over excavations for carting away surplus material from site”, were identified. Although the “filling” items had a high frequency, there could be a number of variables, such as location (under floors, behind retaining walls, etc.), different material (imported G4/5, from excavations), as well as grade of compaction (93/95/98% Mod AASHTO density) that play a role in the compilation of the rate; and they were, therefore, not considered.

Equally, soil poisoning was ignored, since it is, strictly speaking, not an excavation item.

6.6.4.2 Concrete, formwork and reinforcement

Total number of items identified: 35

The most frequent items that occurred:

- 25MPa reinforced concrete in strip footings/bases (37)
- 25/30MPa reinforced concrete in surface beds (39)
- 25/30MPa reinforced concrete in slabs, beams and inverted beams (34)
- Rough/smooth formwork to soffits of slabs propped 1,5 – 3,5m high (34)
- High tensile steel reinforcement 20 - 32mm diameter (33)
- High tensile steel reinforcement 10 – 16mm diameter (37)

There are four clear groups that can be identified in this trade, with the following distribution:

- Concrete : 8,80%
- Formwork: 3,46%
- Reinforcement: 7,22%
- Other: 0,52%
- Total: 20,00%

This is an important trade, as can be seen from the percentage that it represents of the total. The problem is that this can be very diverse, with both reinforced and unreinforced concrete, different concrete strengths, both rough and smooth formwork, with a host of different formwork components (to sides, soffits, edges, different propping heights for each, etc.), as well as different diameters of structural steel bars.

In order to have items that reflect the price movement in this trade, the following indicator items were identified: "25MPa reinforced concrete in surface beds"; "25/30MPa reinforced concrete in slabs, beams and inverted beams"; rough formwork to soffits of slabs propped 1,5 – 3,5m high" and "high tensile steel reinforcement 10 to 16mm diameter". With the inclusion of these items, the concrete rates would be covered for both high-rise and single-storey buildings. Rough formwork to soffits of slabs should be adequate to reflect the movement in formwork rates; and, similarly, one category of reinforcement should also be sufficient.

6.6.4.3 Masonry

Total number of items identified: 19

The most frequent items that occurred:

- Half brick walls (39)
- One brick walls (40)
- Cavity/hollow walls (32)
- Extra over ordinary brickwork for face brickwork (29)

This is a fairly homogeneous trade, where three groups can be identified with the relevant distribution:

- Brickwork: 6,58%
- Face brickwork: 1,22%
- Other: 0,60%
- Total 8,40%

This is also an important trade, which can have an influence on the movement of prices if there is an increase in the price of bricks. For this reason, it will be necessary to have as an indicator item "One brick walls" as this would cover all aspects of ordinary brickwork. But it might also be necessary to have "extra over ordinary brickwork for face brickwork" as an indicator item, as this would reflect any movement in the price of face bricks, if they differ from those of stock bricks.

6.6.4.4 Waterproofing

Total number of items identified: 17

The most frequent items that occurred:

- 250 micron waterproof sheeting under surface beds (38)

- 4mm Waterproofing system on flat roofs (31)
- Waterproofing compound on walls (25)
- Sealing compound in saw cut joints in floors (34)

The Waterproofing trade is fairly small, with three prominent groups, each with the following distribution:

- Waterproofing sheeting (floors and walls): 0,20%
- Waterproof membrane to flat roofs: 0,65%
- Sealing compound in movement/saw-cut joints: 0,18%
- Other: <u>0,07</u>
- Total: <u>1,10</u>

For this trade the most important indicator item would be "Waterproofing system on flat roofs", with "Waterproofing sheeting under surface beds" also included to act as a back-up, where there are no flat roofs measured in a project.

6.6.4.5 Roof coverings

Total number of items identified: 14

The most frequent items that occurred:

- 0,6mm Galvanised steel sheet roof covering with Chromadek finish (27)
- Insulation with roof covering (26)

It is interesting that, although this trade is supposed to also cover non-metal roof coverings, concrete and slate roof tiles were only measured in three projects. Metal roof coverings are, therefore, by far the most prominent group, with some smaller groups, as indicated below:

- Sheet-steel roof coverings: 2,66%
- Insulation with roof coverings: 0,47%
- Side cladding: 0,26%
- Flashings: 0,08%
- Other: 0,03%
- Total: 3,50%

It is quite obvious that the most important indicator item would be "0,6mm Galvanised steel-sheet roof covering with Chromadek finish", while "Insulation with roof covering" might also be used, because it goes hand-in-hand with roof coverings, but might have a different price movement because of the difference in material for roof coverings (steel) versus different types of insulation material, such as cellulose, glass wool, etc.

6.6.4.6 Carpentry and joinery

Total number of items identified: 35

The most frequent items that occurred:

- Wrought hardwood skirting (29)
- Single semi-solid door with veneer both sides (34)
- Class A/B single fire door (22)

This is a difficult trade, as there are a lot of smaller items that do not occur on a regular basis. It is also inflated by the allowance for joinery fittings, which add to the weighting of the trade; but they are difficult to use, as they seldom get measured in detail (except for some government projects). As can be seen from the distribution, there are a lot of groups that can be identified:

- Roof trusses: 1,32%
- Skirtings, rails, etc.: 0,37%
- Doors: 0,39%
- Windows: 0,07%
- Cupboards, work tops: 0,64%
- Fixed joinery: 1,71%
- Other: <u>0,10%</u>
- Total: <u>4,60%</u>

As indicated, the most prominent groups are roof trusses and fixed joinery items; but trusses, as fixed joinery, do not get measured in detail on a regular basis, and therefore there would be no readily available indicator items for these groups. The best indicator items to be used for this trade would, therefore, be “40mm single semi-solid doors with veneer both sides” and “75mm Hardwood skirting”.

6.6.4.7 Ceilings, partitions and access flooring

Total number of items identified: 21

The most frequent items that occurred:

- 600 x 600 x 12,5mm Vinyl ceiling suspended below concrete slab (26)

- Drywall partitioning (different heights) (17)

This trade contains a variety of different items, such as both suspended and nailed-up ceilings of differing materials, different types of cornices, partitions of different material and/or heights, etc. The following groups were identified:

- Suspended ceilings: 1,84%
- Nailed-up ceilings: 0,56%
- Partitions: 0,52%
- Access flooring: 0,39%
- Other: 0,09%
- Total: 3,40%

For this trade, the only indicator item necessary would be “600 x 600 x 12,5mm Vinyl ceiling suspended below concrete slab”, as this would adequately indicate any price movement within the trade.

6.6.4.8 Floor coverings, wall linings, etc.

Total number of items identified: 13

The most frequent items that occurred:

- Carpets on floors (various specifications) (31)

This is a fairly simple trade, with only two distinct groups:

- Carpets: 0,78%
- Vinyl tiles/sheeting: 0,29%
- Other: 0,03%
- Total: 1,10%

The obvious indicator item would be "500 x 500mm Carpet floor tiles to screeded floors". Vinyl tiles would not be considered because of their low frequency; and therefore carpet tiling would be considered an adequate indicator of any price movement in this category.

6.6.4.9 Ironmongery

Total number of items identified: 36

The most frequent items that occurred:

- PC amount for locks (15)
- Cylinder door lock (24)
- Door handles (15)
- Overhead door closer (15)

This is, once again, a difficult trade, which, although it is not one of the important trades in terms of value, contains a large number of different items. Another problem is that lately the trend among quantity surveying is to either allow for locks by way of Provisional sum/budgetary allowance, or as Prime Cost amounts. The following are the groups that have been identified:

- Door furniture: 0,46%
- Bathroom furniture: 0,06%
- Shelving, etc.: 0,04%
- Other: 0,14%
- Total: 0,70%

Because of the relative low level of importance and difficult nature of this trade, consideration was given to ignoring it; but in order to keep a balance between the important, bigger trades and the trades of lesser importance, it was decided to keep it as part of the weighting system with one indicator item, i.e. "Three-lever mortise lockset", in order to provide for any indication of price movement.

6.6.4.10. Structural steelwork

Total number of items identified: 23

The most frequent items that occurred:

- Welded and bolted roof trusses (21)

Although this is an important trade, where big cost fluctuations can occur because of the rise or fall of structural steel prices, it is also a diverse trade, where a lot of different components can be present. It is also further complicated by the fact that the steel structure in projects is more frequently allowed for in the "Provisional sums" trade. The following groups can be identified in this trade:

- Roofing steel: 3,80%

- Other structural steel: 0,72%
- Paint to structural steel: 0,11%
- Other: 0,13%
- Total: 6,20%

A typical indicator item for this trade would be "Welded and bolted columns, beams, etc."

6.6.4.11 Metalwork

Total number of items identified: 43

The most frequent items that 1occurred:

- Pressed steel door frames for single doors (33)
- Powder-coated aluminium windows and doors (32)

As can be seen by the number of items that were identified, this is a trade of a diverse nature, where a large number of different items can and do occur. The following groups could be identified:

- Sundry metalwork: 1,43%
- Steel door frames: 0,24%
- Aluminium windows and doors: 4,28%
- Steel windows: 0,20%
- Other: 0,65%
- Total: 6,80%

Although aluminium windows and doors forms the biggest group, it would be difficult to find an indicator item that represents this group, since items such as windows and doors, are normally measured in number with almost no standard items. An alternative is to determine a price per square metre for this group.

The future categorisation of aluminium windows and doors would also have to be monitored. Maritz (2003) suggested, in a study on the classification of construction information in South Africa, that aluminium work should be re-classified, to form a separate trade in the SSM. An indicator item that can be identified is "Galvanised pressed steel single rebated door frame for door 813 x 2032mm suitable for half-brick walls".

6.6.4.12 Plastering

Total number of items identified: 20

The most frequent items that occurred:

- Cement mortar screed on concrete (31)
- Internal plaster on brickwork (40)
- External plaster on brickwork (31)

This is a fairly stable trade, with a number of standard items that occur on a regular basis that could be grouped as follows:

- Screed and granolithic on concrete floors : 0,66%
- Internal plaster: 1,90%
- External plaster: 0,53%

- Other: 0,30
- Total: 3,40%

The indicator items that would be used in this trade are "25mm thick cement mortar screed on floors" and "One coat 1:5 internal cement plaster on brick walls".

6.6.4.13 Tiling

Total number of items identified: 11

The most frequent items that occurred:

- Wall tiling (36)
- Floor tiling (37)

This can be considered as a stable trade, with the only identified groups being the following:

- Wall tiling: 0.93%
- Floor tiling: 2,00%
- Other: 0,37%
- Total: 3,30%

Although the indicator items seem to be obvious, the biggest problem is the different types of tiling, with prices that differ considerably. The chosen indicator items should, therefore, be fairly standard items, such as: "300 x 300mm Ceramic tiles fixed to walls with tile adhesive" and "400 x 400mm Ceramic tiles fixed to floors with tile adhesive".

6.6.4.14 Plumbing and drainage

Total number of items identified: 63

The most frequent items that occurred:

- 110mm uPVC soil pipes in trenches (24)
- Close-coupled WC suite with seat, cistern, etc. (32)
- 15mm CP mixer tap (27)
- 150/200/450 Litre water heater (27)

This is a trade with a large number of items — because of its diverse nature comprising pipework of different material and different sizes, pipework in ground and against walls, different types of sanitary fittings, including taps, traps, etc., catch pits, junction boxes, inspection chambers, fire equipment, etc. — The consequent of this is that a large number of groups can be identified, but without any one clearly predominant group, as indicated below (from these groups the diverse nature is further emphasised by the fact that "other", i.e. items that cannot be allocated to one of the other groups, represent the biggest percentage).

- Storm water drainage: 0,37%
- Soil piping: 0,42%
- Sanitary piping: 0,07%
- Water piping: 0,51%
- Sanitary fittings: 0,80%
- Fire equipment: 0,09%
- Water heaters: 0,26%

- Rainwater disposal: 0,18%
- Other: 1,20%
- Total: 3,90%

In order to determine price movements in this trade, the following indicator items were decided on: "110mm uPVC soil pipes in ground not exceeding 1m deep", "White vitreous China WC close-coupled pan with matching 9 litre cistern and white double flap seat" and "150 Litre 400kPa electric water heater complete with control valve, safety valve, vacuum breakers, etc."

6.6.4.15 Glazing

Total number of items identified: 4

The most frequent items that occurred:

- 6mm Mirror to brickwork (36)

This is a fairly small and simple trade, mostly because aluminium windows and doors are predominantly being used in bigger buildings; and here the glazing is incorporated with the aluminium windows and doors. The result thereof is that only mirrors feature on a regular basis, and that only two groups can be identified:

- Glass: 0,14%
- Mirror: 0,06%
- Total: 0,20%

Although glass does appear in this trade, it is not on a regular basis; and therefore, the indicator item to be used in this trade would be:"6mm Silvered float glass copper backed mirror size 400 x 600mm high, fixed with mirror screws".

6.6.4.16 Paintwork

Total number of items identified: 23

The most frequent items that occurred:

- Two coats paint on internal plastered walls (40)
- Two coats paint on general surfaces of timber doors (35)

This is a fairly stable trade, with the following groups that stand out:

- Paint to plaster work: 1,31%
- Paint to metalwork: 0,08%
- Paint to timber: 0,35%
- Other: 0,05%
- Total: 1,80%

As paint to metalwork forms only a small part of the trade, it was decided to use only the following indicator items: "One coat primer and two coats interior quality PVA emulsion paint on internal walls" and "Three coats clear varnish on timber doors".

6.6.4.17 Provisional sums

Total number of items identified: 40

The most frequent items that occurred:

- Electrical installations (40)
- Mechanical installations (33)

After the "Provisional sums" trade had been refined to include only allowances for specialist items, as discussed previously, the trade's percentage decreased; and there remain fewer identifiable groups, as indicated below:

• Electrical installations:	14,77%
• Mechanical installations:	10,79%
• Piling:	0,42%
• Landscape installation:	0,46%
• Other:	2,46%
• Total:	28,90%

As can be seen from these groups, the most prominent are electrical installations and mechanical installations (which include air-conditioning, lifts, etc.). Because these groups are for specialist work, the quantity surveyor seldom becomes involved in the measurement and administration therefore; consequently, in order to identify indicator items that would show any price movements of this trade, the assistance of specialist consultants would have to engaged, or a rate per square metre would have to be used (this aspect will be discussed later on in the study).

6.6.5 Final weights according to groups and indicator items

From the above analysis, the weights for use in a new tender-price index could now be finalised. The indicator items, as identified, had to be extrapolated, in order to make up the total for each group. These indicator items will be used as the base-weights, from which rates will be calculated for priced bills of quantities; first base rates for the base period, and subsequently, for each quarter, in order to calculate the price movement of the index (this will be discussed fully in Chapter 8). The categories and indicator items with the relevant weights are indicated in Table 6.8. As can be seen from this table, there are 32 representative indicator items. Although there is no indication from the literature how many items are necessary to calculate an index, it is evident (as discussed previously in section 4.2.3), that it is beneficial to have only those items with the biggest monetary value that appear on a regular basis in projects, as part of the short-list of items.

It may therefore, be concluded that the 32 items in Table 6.8 satisfactorily meet this requirement.

Table 6.8: Final weights according to groups and indicator items

Item number	Categories and indicator items	% (items)	% (categories)
	Earthworks		**2,70**
1	Excavate not exceeding 2m deep for trenches	2,00	
2	Extra over excavations for carting away surplus material from site	0,70	
	Concrete, formwork & reinforcement		**20,00**

3	25/30MPa reinforced concrete in surface beds	3,40	
4	25/30MPa reinforced concrete in slabs, beams, inverted beams	5,60	
5	Rough/smooth formwork to soffits of slabs propped 1,5-3,5m high	3,60	
6	High tensile steel reinforcement 10-16mm diameter	7,40	
	Masonry		**8,40**
7	One brick walls	7,10	
8	Extra over ordinary brickwork for face brickwork	1,30	
	Waterproofing		**1,10**
9	250 Micron waterproof sheeting under surface beds	0,30	
10	4mm Waterproofing system on concrete roofs	0,80	
	Roof coverings		**3,50**
11	0,6mm Galvanised steel sheet roof coverings with Chromadek finish	3,00	
12	Insulation with roof coverings	0,50	
	Carpentry and joinery		**4,60**
13	Wrought hardwood skirting	2,20	
14	Single semi-solid door with hardwood veneer both sides	2,40	
	Ceilings, partitions and access flooring		**3,40**
15	600x600x12,5mm Vinyl suspended ceilings below concrete slab	3,40	
	Floor coverings, plastic linings, etc.		**1,10**
16	500 x 500mm Carpet floor tiles to screeded floors	1,10	
	Ironmongery		**0,70**
17	Three lever mortise lockset	0,70	

	Structural steelwork		**6,20**
18	Welded and bolted columns, beams, etc.	6,20	
	Metalwork		**6,80**
19	Galvanised pressed steel single rebated frame for door 813 x 2032mm suitable for half-brick walls	0,40	
20	Aluminium windows	6,40	
	Plastering		**3,40**
21	25mm Thick cement mortar screed on floors	0,90	
22	One coat 1:5 internal cement plaster on brick walls	2,50	
	Tiling		**3,30**
23	300 x 300mm Ceramic tiles fixed to walls with tile adhesive	1,00	
24	400 x 400mm Ceramic tiles fixed to floors with tile adhesive	2,30	
	Plumbing and drainage		**3,90**
25	110mm uPVC soil pipes in ground not exceeding 1m deep	1,10	
26	White vitreous china WC close coupled pan and matching 9 litre cistern and double flap seat	2,10	
27	150 Litre 400kPa electric water heater complete with control valve, safety valve, vacuum breakers, etc.	0,70	
	Glazing		**0,20**
28	6mm Silvered float glass copper backed mirror size 400x600mm high fixed with mirror screws	0,20	
	Paintwork		**1,80**
29	One coat primer and two coats interior quality PVA emulsion paint on internal walls	1,40	
30	Three coats clear varnish on timber doors	0,40	

	Provisional sums		**28,90**
31	Electrical installation	16,70	
32	Mechanical installation	12,20	
	Total	100,00	**100,00**

6.7 SUMMARY

The aim of this chapter was to determine a new basket of items and their weights for compiling a new-tender price index. In order to achieve this, it was firstly necessary to establish the reasons for assigning weights, as well as the choice of weights, the source of information, i.e. whether priced bills of quantities could be used for assigning weights, the selection of items, and in this case, the use of a short-list of indicator items from bills of quantities, as well as the advantages and limitations of weights in a tender-price index.

Furthermore, the Consumer Price Index was discussed, in order to determine whether the principles of the CPI index could be applied in compiling a tender-price index.

Before the items in a fixed-weight, short-list method, with priced bills of quantities as a basis, could be identified, consideration had to be given to issues, such as whether the initial cost or the end-cost of a project should be used, whether the trades, as they occurred in bills of quantities should be used, or rather elemental divisions; whether any adjustments needed to be done to the contract amount of projects used, and how the Preliminaries and Provisional sum trades should be incorporated in a TPI.

Furthermore, the methodology employed in determining new weights had to be discussed. This included the choice of buildings, and whether weights should be calculated for separate types of buildings. After it was shown that it would be best to have weights based on a selection of building types, i.e. composing an "average" representative building, the selection process of 40 representative buildings throughout South Africa was discussed. This included sample of projects to be used, the collection method of priced bills of quantities for these projects and the chosen base period.

Finally, it was shown how new weights were determined. This comprised firstly, the analysis of all the trades of the 40 chosen projects, where it had been decided to incorporate the Preliminaries trade *pro-rata* into the all trades of a project, and also the reasons why smaller, under-represented trades, such as "Precast concrete" and "Paperhanging", should not be used in an index. Secondly, it was shown how a detailed analysis of all the trades in all the projects was done. Each trade was discussed individually, indicating the various groups of items identified through the analysis, as well as the items that occurred most frequently, and were subsequently chosen as indicator items.

The results were presented in table format indicating the final weighting of groups and indicator items for use in a TPI.

6.8 CONCLUSION

From the research in this chapter, it has become clear that it is possible to use priced bills of quantities to select items to compose an "average" representative building. By analysing the priced bills of quantities from 40 selected projects, it was possible to, firstly, assign weights to the different trades, as measured in bills of quantities, according to a standard measuring system; and secondly, by adopting the "5% rule", weights were assigned to 32 indicator items representing each trade.

These weights will be used further on in the study as base weights for which base rates will be assigned, in order to construct a new TPI.

CHAPTER 7

UNIT RATES IN A NEW TENDER-PRICE INDEX

7.1 INTRODUCTION

According to the Statistics Directorate of the European Community (1997), the selection of appropriate prices is an important consideration in the development of a TPI. When compiling a consumer-price index, it happens in practice that the prices that are collected are not actual transaction prices, but they are rather the prices at which goods and services are sold in retail shops, supermarkets or service providers (International Labour Organisation, 2004b).

Similarly, when compiling a TPI, the aim is to use prices (or unit rates) that provide the closest approximation to the market prices that are paid by the purchaser of the construction-component items or construction services (Statistics Directorate: European Community, 1997).

In the development of a TPI, there are a number of issues that should be considered in the selection and use of unit rates. (It should be noted for clarity that although a number of terms are noted in the literature, e.g. prices, tariffs, rates, etc., for purposes of this study, the terms “unit rates” or “rates” will be used throughout).

7.2 SOURCE

As mentioned before, priced bills of quantities provide a valuable source of information on the unit rates of the various elements of building projects; as they are measured by quantity surveyors. Van der Walt (1992) stated that the best way to calculate the total contract price of a project is to build it up by pricing the bills of quantities in detail, and by using the contractor's own rates, as well as those obtained from the subcontractors. It was also Van der Walt's (1992) opinion that an index that is based on starting rates (as they are found in tender documents) would be of greater value than using final account rates. Flemming and Tysoe (1991) also mentioned that the rates obtained from the priced bills of quantities of accepted tenders refer to specific construction operations (e.g. brickwork, concrete work, etc.); and therefore, they have the advantage that the rates of such operations can be directly compared between different tenders. From the above; it is therefore, clear that priced bills of quantities from accepted tenders would be the ideal source of unit rates for using in a TPI.

7.3 SAMPLE SIZE

According to Flemming and Tysoe (1991), using priced bills of quantities as a source for the collection of unit rates requires access to a representative selection of priced documents. Representative in this case would mean that projects of different size, different types, and from across the country, would need to be sourced. It is also mentioned by Flemming and Tysoe (1991) that the sample of each period should be a sufficiently large number, because the unit rates inserted by different contractors could vary considerable for various reasons (these reasons will be discussed in point 7.5, hereafter in more detail).

As mentioned previously (see 2.6.2), it is not stated in the literature exactly what is meant by "a reasonably large amount"; but it may be assumed that the sample should be large enough to be statistically acceptable. Another factor that is discussed in this regard is mentioned by the United Nations Economic and Social Council (2003), who stated that it is an important consideration whether the index should relate to monthly or quarterly average prices; as this might have an influence on the practicability of carrying out price collections.

Similarly, the Statistics Directorate of the European Community (1997) was of the opinion that the sample size is a trade-off against cost, the quality of the data and the respondent loading, where it may be more appropriate to use resources to collect information of a higher quality *via* a smaller sample.

As mentioned above, the sample must cover all — or most — of the regions in South Africa. The reason for this, as indicated by Van der Walt (1992), is that unit rates vary from region to region, and even between towns or cities in any given region. These variations can be of such an extent that thought must be given to the possibility of having separate tender indices for each region. In his research, however, Van der Walt (1992) found that for practical reasons, such as the lack of enough construction activities in all regions, it is doubtful whether such indices could be calculated meaningfully or sufficiently accurate.

7.4 OTHER DIFFERENCES

The United Nations Economic and Social Council (2003) concurs with the opinion of Van der Walt (1992), who maintained — that because of the possible difference in price movements between geographical regions — price collection should be carried out in such a way that it would be representative of all the geographical regions or areas within the scope of the index.

Over and above any said geographical price differences that could occur, research by Van der Walt (1992) showed that there are no significant price differences between building work for the private and for the public sectors, as well as between different types of buildings that could necessitates separate indices for such building work. Having said that, separate indices for different building types might be of value, if they were based on different weightings for each different building type, rather than on price alone.

7.5 THE VALIDITY OF RATES

One of the criticisms of using rates in a TPI is that such unit rates might differ markedly between tenders. Seeley (1996) argued that unit rates in bills of quantities may not be realistic, as they are influenced by a number of factors, such as the tendering strategy of a firm, as well as the current economic climate. An example of this is given by Marx (2004) when he refers to so-called “front-loading”, a practice where a bigger percentage of profit is added to the unit rates of items that occur in the beginning of a contract, such as base excavations, in order to increase the contractor’s cash flow.

Snyman (1994) mentioned in this regard that in order to survive in a competitive environment, contractors need to assess the risks and uncertainties associated with the building industry. In order to do so, a contractor should acquire knowledge of the probable course of the building cycle, before inserting unit rates when tendering on a long-term contract.

Another argument raised by Van der Walt (1992) in this regard was that in some contracts, where no provision is made for price fluctuations, the unit rates are, in actual fact, estimates of future prices, when the work is finally executed. Theoretically, according to van der Walt (1992), these rates, therefore, anticipate future price increases and are not a reflection of the current prices.

Should the assumption be made that all the above-mentioned arguments are correct, the question could then be asked, whether this should pose a problem when compiling a new TPI. In a previous chapter (see 2.5.5), one of the uses of a TPI was identified as the monitoring of price movements. By using actual unit rates, in other words, those actually encountered during a certain time period of a building cycle, the exact movement of prices during that time could be reflected.

7.6 THE DIFFERENT UNITS

Although it is the aim of the study to use, as far as possible, unit rates as they occur in priced bills of quantities in the index; it might in some instances be necessary to convert certain rates to different units than those prescribed in the SSM (ASAQS, 1999). This is for practical reasons, in order to accommodate some rates in a better way. An example is aluminium windows and doors — where, because of the vast range of different items with different sizes that are encountered in bills of quantities, it would be difficult to determine a unit rate for a certain window or for a particular door size.

The alternative, therefore, would be to convert all aluminium window and door elements to a rate per square metre on elevation. Similarly, in the “Provisional sums” trade, the electrical and mechanical installations would have to be converted to an average rate per square metre of floor area.

7.7 ANALYSING BILLS OF QUANTITIES FOR USE IN AN INDEX

7.7.1 Base year

The base year, or reference period, as it is also referred to (United Nations, 2003), is the time period to which the estimated weightings relate (Statistics South Africa, 2009a). According to Kirkham (2007), all index numbers require the selection of such a base year; and the cost at that date is usually given the value of 100. Ashworth (1991) stated that the reason for setting the base period at 100 is to allow for both an increase, as well as a decrease in the value of the data, thereby avoiding any confusion of negative numbers, where a decrease results in values falling below the base index number.

Swarup (undated) mentions the following criteria, when choosing a base year:

- It should be a normal year, i.e. a year in which there is no abnormalities in the levels of production, trade or in the level and variations of prices. In this regard Agarwal (2009) is of the opinion that the base year should be devoid of any abnormal conditions such as war, drought, floods, earthquakes, etc.
- A year, for which reliable production price — and other required data, are readily available.
- A year, as recent as possible, that is comparable with other data series. Steyn *et al.* (2007) reiterate this, when explaining that the base period should not be too far in the past, because products can disappear from the market; and new products are introduced in the period between the base period and the current period, if the base period is too far in the past. Similarly commodities change in appearance or quality on quite a regular basis.

For the purposes of this study, the base year was chosen as 2006. The reason why 2006 was chosen as the base year was because it complied with most, if not all, of the requirements set out in the literature and described above.

The collection of data for the study was started in 2008; and therefore the one requirement for the base year, namely, that it should not be in the too distant past, could be considered to have been satisfactorily dealt with, by using 2006 as the base year.

In order to see whether the other requirement, i.e. that it should be a “normal” year, could be accepted, it would be necessary to look at historical reports on the South African economy in general, and the construction industry in particular. SouthAfrica.info (2007) quotes Statistics South Africa, who reported that the real annualised economic growth rates for the four quarters of 2006 were: 5%, 5.5%, 4.5% and 5.6%, respectively. SouthAfrica.info (2007) further reports that expansion in construction activity helped South Africa’s gross domestic product (GDP) grow by 4.7% in the first quarter of 2007, resulting in 34 consecutive quarters of economic growth since 1998, making it the longest upswing in the country’s history.

The increase in unadjusted GDP for the four quarters in 2006, according to Statistics South Africa (as quoted by SouthAfrica.info, 2007), were: 4.6%, 4.4%, 4.7% and 6.2%, respectively, yielding an annual growth rate of 5% in real GDP at market prices.

Regarding the construction industry, the Organisation for Economic Co-operation and Development (OECD) (2007) reports that, although the South African economy continued to grow strongly, it was not balanced with construction and services, including real estate; finance and business services expanded strongly, while the export-oriented sectors grew more slowly. The above phenomenon is also supported by SouthAfrica.info (2007), who quotes the Business Day newspaper in stating that the South African construction industry recorded a double-digit growth from 2004 to 2007.

This growth, up to 2007, was a steady growth, compared with the construction boom that hit the industry after 2007 — because of the major investment in, especially, infrastructural projects. SouthAfrica.info (2007) estimated this expenditure to be mostly in the following areas:

- R15-billion on preparations for hosting the 2010 Fifa World cup (mostly for building new and upgrading existing stadiums);
- R3,8-billion to improve public transportation and related infrastructure in the host cities of the 2010 World Cup;
- R20-billion plus for the Gautrain rapid rail link, connecting Pretoria, Sandton, Johannesburg and the O.R. Tambo international airport by high-speed train.

The above expenditure, together with various other smaller projects, amounted to an estimated R1,2-trillion spent on construction projects in the period 2007 to 2009 (SouthAfrican.info, 2007). This trend was confirmed by Industry Insight (2008), who compiled a construction-tender index, as shown in Figure 7.1.

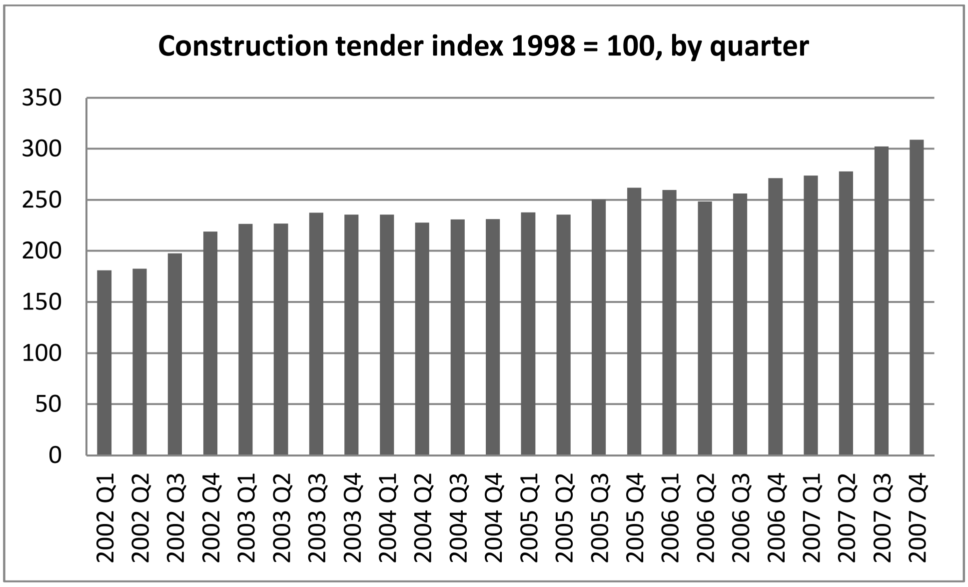


Figure 7.1: Construction-tender index 1998 = 100, by quarter. (Adapted from Industry Insight, 2008)

From this Figure, it is evident that there was a steady growth in total construction spending from 2002 to 2006, with a sharper increase from 2007, when the investment in infrastructural projects for the 2010 Fifa world cup accelerated, as indicated before.

It is clear from the above that 2006 can be used as the base year for a new TPI, as it is not too far in the past; and it may be considered as being a normal year, both in the general economy, as well as in the construction industry.

7.7.2 Variations in unit rates

According to Ferry *et al.* (2003), in order to obtain an average index rather than an index for each particular project, the unit rates for all the tenders sampled in a specific time period, are averaged by using either the geometric or the arithmetic mean.

One of the problems encountered when using unit rates of priced bills of quantities, as mentioned before, is that such rates can differ substantially between the various projects analysed. Flemming and Tysoe (1991) stated in this regard that it is generally accepted that in the UK, on a national basis, there is, on average, a range of approximately 30% about the mean. Van der Walt (1992) concurred with this, by saying that in cases where unit rates are priced exorbitantly, this could have an excessive influence on the index, if there is not a relatively large amount of information gathered.

One way of dealing with this problem, according to Van der Walt (1992), is to determine statistically the deviation coefficient of the unit rates considered for each quarter, and accordingly, to determine the upper and the lower limits for the rates. When these limits are exceeded, the rate should then be ignored, and the average, or base rate, should rather be used.

Another possible solution for this, according to Van der Walt (1992), is to calculate one or two standard deviations from the mean for all the rates. Van der Walt (1992), however, found that all the rates that fall outside this limit could not be discarded summarily, as this would change the distribution completely. The conclusion by Van der Walt (1992) on this matter was that any rates that seem to be not in line with the majority of the unit rates in the same reference period should be discarded — after using one's own judgement.

The way that the BER deals with this issue is explained by Segalla (1991), who stated that, firstly, base rates would have to be calculated for the 22 items used for the index. This is done by averaging the rates of all the projects of a specific quarter. The base rates that are used for the quarter being analysed, are actually the base rates, which were calculated two quarters back, as the BER found that the rates from two quarters back were more stable than those calculated in the analysed quarter.

Segalla (1991) further mentioned that, in order to allow some flexibility, upper and lower limits would need to be set for the base rates. These limits are allowances of 30% above and 20% below the base rates, which are being analysed for any specific quarter. The upper and lower limit figures are referred to as the maximum and minimum values of the base rate. The rates for all projects are then compared to the base rates; and if any rate exceeds the specified upper or lower limits, the minimum or maximum value is substituted for such a rate.

If any of the 22 rates do not occur in any of the projects, Segalla (1991) explained that provision is made for such rates by calculating the average percentage deviation from the base rate of all the rates in a project for which information has been received. This average percentage is then either added to or subtracted from, the base rate(s), which have not been entered in the submission form.

The above issue and how it was dealt with in this study, is explained in further detail in Chapter 8 when the actual calculation of the index is carried out.

7.8 SUMMARY AND CONCLUSION

The purpose of this chapter was to establish if and how unit rates of priced bills of quantities can be used in a TPI. It was established that bills of quantities can provide a valuable source of unit rates for use in a TPI. Regarding the size of the sample necessary to construct a meaningful TPI, it was found that, while it is difficult to establish a fixed number of priced documents that would be needed, it is clear that such a sample should be sufficiently large enough to be statistically acceptable; and it should cover all, or most of the regions in South Africa, during any given time period.

The problem of valid rates was discussed; and it was assumed that, although it is true that differences in unit rates would be encountered for various reasons — this would reflect the true movement of the tender prices.

The reason for using 2006 as base year was also analysed by looking at the criteria for choosing a base year; and it was found that 2006 satisfies these criteria, by being a fairly recent, as well as a relatively normal, year. Finally, there was a discussion on how to deal with variations in unit rates, both theoretically, as well as by looking at how the BER building-cost index deals with these variations; and these criteria should then be used when constructing a new TPI later on in the study.

CHAPTER 8

CALCULATION OF THE INDEX

8.1 INTRODUCTION

Since most of the basic requirements for the calculation of an index, such as the weightings (see Chapter 4) and the base year (see Chapter 5) have been established during the previous chapters, the actual calculation of a national TPI can now be done. However, there are also other factors, as discussed in previous chapters, that would first need to be addressed, before calculating the index.

8.2 SOURCE AND SAMPLE SIZE

It was established previously (see Chapter 7), that the rates in priced bills of quantities of accepted tenders would provide adequate information for a TPI, and that the sample size would need to be large enough and cover most of South Africa, in order to be representative. In order to achieve this requirement, a number of quantity surveying firms throughout South Africa were contacted — with the request to make available the priced bills of quantities of projects executed by the firms. The contact information of the firms was obtained from the website of the ASAQS; and the request was conveyed via e-mail correspondence to the various firms, explaining the reason for the request, and assuring all firms that none of the submitted information would be used for other purposes.

The first request was made in 2010, and repeated at irregular intervals until mid-2012. Various firms were contacted, on a random basis, from all the provinces in South Africa; and ultimately, priced bills of quantities of 231 projects were received in order to be analysed.

These were obtained from 37 firms for the period of January 2006 to June 2012. This represents 26 quarters; and the distribution per year is indicated in Table 8.1.

Table 8.1: Number of projects used per year

Year	Number of projects
2006	29
2007	31
2008	39
2009	36
2010	48
2011	36
2012	12 (1^{st} and 2^{nd} quarters)
Total	**231**

It must be noted that more priced bills of quantities were received than the 231 that were ultimately used; but some of the projects (e.g. refurbishment projects) did not have adequate relevant information. In some of the other projects that were received, essential information, such as the tender date, was not provided; and it was not always possible to trace the source of the project back to the particular person in the firm, in order to obtain the outstanding information.

This sample can be deemed representative of the country because of the following:

- A large variety of different building types, such as shopping centres, offices, schools, hospitals and clinics, churches, industrial buildings (factories, warehouses, etc.), swimming pool complexes, laboratories, lecture halls, university residences, airport terminals, police stations, etc. were included in the sample;

- The projects ranged in value, from a R1,01m gate house to a R593,9m airport terminal;
- Eight of the nine provinces in South Africa were represented in the sample, with the only exception being the Limpopo Province.

These bills of quantities were then arranged per calendar year; and each year, in turn, was arranged per quarter, which resulted in 26 quarters being covered from 2006 up to and including the second quarter of 2012.

8.3 THE METHODOLOGY

8.3.1 Analysing bills of quantities

The first step after the collection of the bills of quantities was to analyse these projects. This was done on an Excel spread-sheet, by going through the priced bills of quantities of each project, and listing the tariff of the various items that were selected as indicator items to make up the weightings, as discussed previously. For clarity, these indicator items are listed below:

- Excavations not exceeding 2m deep for trenches;
- Extra over excavations for carting away surplus material from site;
- 25/30MPa reinforced concrete in surface beds;
- 25/30MPa reinforced concrete in slabs, beams and inverted beams;
- Rough/smooth formwork to soffits of slabs, propped up exceeding 1,5m and not exceeding 3,5m high;
- High tensile steel reinforcement 10 to 16mm in diameter;
- One brick walls (superstructure);

- Extra over ordinary brickwork for face brickwork;
- 250 Micron waterproof sheeting under surface beds;
- 4mm waterproofing systems on concrete roofs;
- O,6mm galvanised steel sheet roof coverings with Chromadek finish;
- Insulation to underside of roof coverings;
- Wrought hardwood skirting;
- Single semi-solid door with hardwood veneer both sides;
- 600 x 600 x 12,5mm Vinyl suspended ceiling below concrete slab;
- 500 x 500mm Carpet floor tiles to screeded floors;
- Three-lever mortise lockset;
- Welded and bolted structural steel columns, beams, etc.;
- Galvanised pressed steel single rebated frame for door 813 x 2032mm suitable for half-brick walls;
- Glazed aluminium windows;
- 25mm thick cement mortar screed on floors;
- One coat 1:5 internal cement plaster on brick walls;
- 300 x 300mm ceramic tiles fixed to walls with tile adhesive;
- 400 x 400mm ceramic tiles fixed to floors with tile adhesive;
- 110mm diameter uPVC soil pipes in ground not exceeding 1m deep;
- White vitreous chine WC close coupled pan and matching 9 litre cistern and double flap seat;
- 150 litre 400 kPa electric water heater complete with control valve, safety valve, vacuum breakers, etc.;
- 6mm silvered float glass copper backed mirror size 400 x 600mm high and fixed with mirror screws;
- One coat primer and two coats interior quality PVA emulsion paint on internal walls;
- Three coats clear varnish on timber doors;
- Electrical installation including light fittings, etc.;
- Mechanical installation.

More items than those listed were extracted from the bills of quantities, the reason being that in some instances, the exact item as listed might not have been available, but a close substitute was. An example of such items can be found in the Formwork trade, where a number of items can be found over and above those listed, e.g. "Rough (or smooth) formwork to soffits exceeding 250mm and not exceeding 500mm thick, propped up exceeding 1,5m and not exceeding 3,5m high". Similar items with different slab thicknesses and different increments of propping heights can be found.

Another example is suspended ceilings where, although 600 x 600 x 12,5mm Vinyl suspended ceiling is listed, acoustic, as well as gypsum suspended ceilings, were also looked at, as well as different tile sizes and thicknesses. A number of these items were, therefore, also listed in the analyses, and were taken into account in cases where the original items were not measured; and the rates for these "fringe" items were in the same order of magnitude as the original items. An example of a typical quarter (project number one of the third quarter of 2010) is given in Table 8.2.

Table 8.2: Capturing of indicator items per quarter

ITEM		Q3:2010:1	Prelimina-ries	Total
EARTHWORKS			1.04	
Excavation for bulk excavations, trenches and holes. (0-2m)		40.00	1.04	41.60
Extra over carting away of excavated materials		40.00	1.04	41.60
CONCRETE, FORMWORK & REINFORCEMENT				
reinforced concrete in surface bed (20MPa)				
reinforced concrete in surface bed (25MPa)				
Reinforced concrete in slabs, beams, inverted beams (25MPa)		1 085.00	1.04	1 128.51
Reinforced concrete in slabs, beams, inverted beams (30MPa)		1 140.00	1.04	1 185.71
Smooth formwork to soffits of slab (D1) (1.5-3.5m)				
Smooth formwork to soffits of slab (D1) (3.5-5m)				
Smooth formwork to soffits of slab (D1) (1.5-3.5m)(250-500mm thick)				
Smooth formwork to soffits of slab (D2) (1.5-3.5m)				
Smooth formwork to soffits of slab (D2) (3.5-5m)				
Rough formwork to soffits of slab (1.5-3.5m)				
Rough formwork to soffits of slab (250-500mm)(1.5-3.5m)				
High tensile steel reinforcement (10mm ø)		7 800.00	1.04	8 112.78

High tensile steel reinforcement (12mm ø)		7 800.00	1.04	8 112.78
High tensile steel reinforcement (16mm ø)		7 800.00	1.04	8 112.78
MASONRY				
One brick wall in superstructure		315.00	1.04	327.63
Extra over brickwork for face brick work		150.00	1.04	156.02
WATERPROOFING				
Damp-proof sheeting under surface beds		7.50	1.04	7.80
Waterproofing membrane on concrete roofs		150.00	1.04	156.02
ROOF COVERINGS				
0.6mm Galvanised steel roof covering (>25° pitch)				
0.6mm Galvanised steel roof covering (<25° pitch)				
Insulation to underside of roof covering				
CARPENTRY & JOINERY				
Wrought hardwood skirting				
Single semi-solid door with hardwood veneer				
CEILINGS				
Vinyl suspended ceilings		131.00	1.04	136.25
Acoustic suspended ceilings				
Gypsum suspended ceilings		203.00	1.04	211.14
FLOOR COVERINGS				
Carpets on floors (tiles)				
Carpets on floors				
IRONMONGERY				
Door lock set (three- lever)		100.00	1.04	104.01
STRUCTURAL STEELWORK				
Welded columns, beams etc.				
METALWORK				
Single steel door frame (one-brick wall)(1.2mm)		725.00	1.04	754.07
Glazed aluminium windows				
PLASTERING				
Cement plaster screed on concrete (30 - 50mm)				
Internal cement plaster on brick work		49.00	1.04	50.96
TILING				
Wall tiling		249.00	1.04	258.98
Floor tiling		281.00	1.04	292.27
PLUMBING AND DRAINAGE				
110mm soil pipes in trenches (0-1m) incl. trench				
WC Suite		991.00	1.04	1030.74
Electric water heater (150 L)		7 256.00	1.04	7 546.97
GLAZING				
0.6mm Mirror to brickwork (450*600)				
0.6mm Mirror to brickwork (400*900)				
PAINTWORK				
Paint on internal plaster		34.50	1.04	35.88
Paint on timber doors		68.00	1.04	70.73

PROVISIONAL AMOUNTS				
Electrical installation		7 199 110.00	1.04	7 487 794.31
Mechanical installation				

Because of the vast amount of information contained in this spread-sheet, not all 231 projects will be shown. As can be seen for Table 8.2, not all the items were priced in each project. As was also discussed in Chapter 4, it was decided to include the Preliminaries section of each project, with the applicable rates of the project, and not to express Preliminaries as a separate trade. From Table 8.2 it is evident that the Preliminaries for this project amounted to 10,40% of the total tendered project cost (less the amount for Preliminaries); and thus 10,40% was added to each rate. The above method of capturing indicator items was repeated for all the projects.

The next step was to transfer all the selected indicator items from the spread-sheet, as indicated above, to another spread sheet. This meant that where more than one unit rate was selected from the priced bills of quantities, as discussed before, now only one would be selected (those that were closest to the original list of indicator items where there was no exact match). Only the rates inclusive of the respective preliminary percentages were used. What also needed to be done, as explained in Chapter 5, was to convert some of the items to different unit rates than those in the bills of quantities.

These items were aluminium windows, which are measured in number according to the SSM, to a rate per square metre on elevation, as well as electrical and air mechanical installations, where the provisional amounts (or some-times measured work), were converted to a rate per square metre of the building's total floor area. An example of a typical quarter captured in the described fashion is given in Annexure 6.

From the table in Annexure 6, which represents the second quarter of 2010, it can be seen that seventeen projects were analysed. It is evident from this table that, of the 32 items that make up the basket of items, no single item appeared in all seventeen projects, and seven items appeared in sixteen projects. A further four items appeared in fifteen projects; one item appeared in fourteen projects; and another three items appeared in thirteen projects. Ten of the items appeared in less than nine of the projects. A similar distribution, as that found in this quarter, also appeared in all the other quarters that were analysed (the indicator items and the factors having an impact on them will be discussed in detail, later in this chapter).

8.3.2 Variations in unit rates

The findings of the literature regarding the variations in unit rates across projects were discussed in Chapter 7. When analysing the unit rates in this study, similar trends as those mentioned in the literature were found. Looking at the "rates analysis for index: Q2, 2010 (indicator items)" (Annexure 7), where the highest and lowest rates in this particular quarter are highlighted, it can be seen that the unit rates differ substantially between projects.

Some of the individual indicator items are listed Table 8.3, in order to show the percentage deviation from the arithmetical mean.

Table 8.3: Deviation from arithmetical mean (extract from Q2: 2010)

Item	Mean	Highest	% Deviation	Lowest	% Deviation
Excavate in earth not exceeding 2m deep	R85,50	135,79	+ 58,82	32,66	- 61,80
Reinforced concrete in slabs, beams	1 209,51	1 758,17	+ 45,36	907,91	- 24,98
Steel reinforcement for concrete	8 635,31	11 129,00	+ 28,88	7 080,24	- 18,01
One brick wall	304,53	426,54	+ 40,07	201,83	- 33,72
Single timber door	645,46	954,87	+ 47,94	312,20	- 51,63
Internal cement plaster	62,89	84,44	+ 34,27	41,35	- 34,25
Paint to internal plaster	30,67	63,28	+ 106,33	28,21	- 8,02

Electrical installation	901,51	2 036,38	+ 125,89	429,76	- 52,33
Average			**+ 60,95**		**- 35,59**

As can be seen from the above table, the average deviation of the highest priced rates from the arithmetic mean is approximately +61%; while the average deviation for the lowest rates is approximately 36%. Although this exercise was not carried out on all the analysed quarters, a visual inspection of the respective spread-sheets shows that it can be accepted that a similar trend would occur in all of the analysed projects for all the years under scrutiny.

The obvious question that arises from this occurrence is how to deal with these outliers; in other words, rates that were priced either substantially higher or lower in comparison to the majority of the rates for similar indicator items. As discussed in Chapter 7, the literature shows how this is dealt with in other TPI's; and this research will test the different methods, in order to arrive at an acceptable solution.

As can be observed from the "rates analysis for index: Q2, 2010" (Annexure 6), the rates of all projects in a quarter were averaged; and these rates can therefore be taken to be the base rates for the indicator items for that quarter. In this regard this is in line with the BER method, with the exception that the rates for that quarter are taken and not those of two quarters back. Although the BER do it their way because of the belief that the rates of two quarters back are more stable, this is not necessarily the case, if enough information is received for a particular quarter. Even then, late information can be added on, as and when it is received; and the updated data can be published as a revision with the next quarter's run.

This rates analysis, as discussed above, was then taken; and the BER's method of allowing limits of 30% above and 20% below the base rate was tested. This was done by taking the base rate of an item, calculating the limits, and then omitting all items that fell outside these limits. A new mean was then calculated from the remaining items and compared with the original base rate in an attempt to establish whether there were any differences. Examples of such calculations, done on rates, as indicated previously in Table 8.3, are shown below.

Item: Reinforced concrete in slabs and beams

Base rate: R1 209,51; +30% = R 1 572,36; -20% = R967,61

Rates in quarter 2, 2010:

1086,60	**1758,17**	1309,25	**907,91**	1292,25	1029,58	1537,35	1017,48	974,61	1250,08	1246,65	1282.06

1302.46	**938.69**

Mean (of items within upper and lower limits): R 1 211,67

Item: One brick wall

Base rate: R304,53; +30% = R 395,89; -20% = R243,62

Rates in quarter 2, 2011:

239,05	**426,54**	324,69	**201,83**	**237,77**	256,88	395,34	**216,73**	**229,09**	**238,24**	311,01	**423,78**	**419,49**

333,87	372,13	246,09

Mean (of items within upper and lower limits): R320,00

Item: Carpets on floors

Base rate: R175,48; +30% = R 228,12; -20% = R140,38

Rates in quarter 2, 2011:

96,51	**235,67**	**108,28**	**139,27**	147,04	**228,91**	**278,23**	158,76	186,63

Mean (of items within upper and lower limits): R164,14

Item: Paint to timber doors

Base rate: R46,02; +30% = R 59,83; -20% = R36,82

Rates in quarter 2, 2011:

49,98	51,76	41,90	43,42	56,29	**62,67**	39,53	56,78	45,48	**63,28**	**35,66**	38,95	43,09
33,34	**28,21**											

Mean (of items within upper and lower limits): R46,71

Item: Floor tiling

Base rate: R298,08; +30% = R 387,50; -20% = R238,46

Rates in quarter 2, 2011:

331,41	**228,31**	**214,72**	**199,92**	321,51	382,99	285,12	**139,51**	**161,89**	**489,65**	**545,32**	**204,88**	369,85

Mean (of items within upper and lower limits): R281,81

Item: Mirror to brickwork

Base rate: R456,14; +30% = R 592,98; -20% = R364,91

Rates in quarter 2, 2011:

179,29	**331,39**	394,05	**360,13**	**732,26**	**300,03**	**895,83**

Mean (of items within upper and lower limits): R394,05

Discussion:

When analysing the above calculations, it may be deduced that in some instances (e.g. “Reinforced concrete in slabs and beams”), the introduction of upper and lower limits does not have any significant influence on the base rate. In this example (where the highlighted rates are those rates that fall outside the upper and lower limits), only three of the original fourteen items are discarded; and the mean calculated from the remaining items only differs by + 0,18% from the original.

If, however, one looks at the following item, “One brick wall”, it becomes a different scenario. In this case, nine of the original sixteen rates are discarded; and the mean now differs by approximately 5,3% from the original. Similarly, in the next item, “Carpets on floors”, six of the nine original rates are discarded, respectively, and the mean changes to -6,5% from the original. In the following items that were looked at, “Paint to timber doors”, “Floor tiling” and Mirror to brickwork”, respectively, five of the original fifteen items, eight of the original thirteen items, and six of the original seven items are discarded; and here, the mean differs by +1,5%, -5,44% and -13,61%, respectively, from the original.

Although the differences from the mean do not seem to be exceptionally large, they might become problematic when calculating the index, if all 32 items show a difference. This is apparent when looking at the last item, “Mirror to brickwork”, where six of the seven items were discarded; and it seems, based on this observation, that the fewer the number of items that are captured in a quarter, the higher the risk of getting skewed data when this method is followed.

A few calculations were done, by using the standard deviation from the mean as a basis; but, as previously also observed by van der Walt (1992), too many rates fall outside the limits that are set, when using this method; and therefore, it was not pursued any further.

A statistical method to identify outliers was also pursued. According to Steyn *et al*. (2007), one such method is called box-and-whisper plots. In this method the values in a data range is ordered in numerical order. The median of this range is found, which in turn divides the data into two halves. To divide the data in quarters, one then finds the median of each of the two halves. These three data points in the range divide the entire data set into quarters, or quartiles; the middle number of the first half is q1; median of the complete set is q2, and q3 is the middle number of the second half. Steyn *et al*. (2007) defines an outlier as an observation that is more than one "jump" outside q1 or q3, i.e. an observation larger than q3 + t or smaller than q1 – t, where t is 1,5 times the difference [t = 1,5 (q3 – q1)].

The following box-and-whisper plot is an example from the data:

Data set (rates for a single semi-solid timber door, Q3: 2010) in numerical order:

459.71	482.29	494.25	525.00	532.36	556.4	1193.01

Median = 525.00

q1 = 482.29

q2 = 556.4

Formula: 1.5(q3 – q1)

1.5(556.4 – 482.9)

1.5(74.11)

= 111.17

Calculation to find outliers:

482.29 – 111.17 = 371.13 (lower limit of "box"

556.40 + 111.17 = 667.57 (upper limit of "box")

From this calculation it is clear that the value 1193.01 is an outlier as it falls outside the upper limit of the "box".

This method was used to calculate the outliers of all unit rates per quarter. The result was that outliers were found to be present in a number of these data sets.

This matter was discussed with the Statistics Department at the University of Pretoria to ascertain their opinion. In light of the fact that the information in question (unit rates per quarter) does not contain any statistically big samples (the highest number of projects that were analysed in one quarter was seventeen), the Statistics Department suggested that one make use of a more simple method — where, from a series of unit rates, the rates with the highest and lowest value respectively be discarded — and the mean of the remaining rates was then calculated. These figures would then be used as the base rates for that quarter.

The advantage of using this method is that only the highest and lowest outliers are eliminated; while the rest of the rates in the series are still being used. Especially where, in a quarter, information for a particular rate is only received for, say, ten projects, the new mean would still be calculated from the remaining eight rates, when the highest and lowest rates are discarded. This is, in comparison with the "+30%; -20%" method, where there is a chance that the majority of the rates might be discarded from a series, resulting in a skewed figure as the mean.

This method was applied on all the information received for the study; and an example is given in Annexure 7. In this table the highest and lowest rates received for each indicator item for that particular quarter (quarter two of 2010) are highlighted. The column marked "Average" indicates the arithmetic mean of all the rates for the indicator item; and the column "Av (-high; low)" indicates the arithmetic mean of the rates without the highest and lowest outliers. From this table, it can be seen that, after the above calculations were done, in 10 of the 32 items, the difference between the two mean rates was more than ten per cent.

If one looks at one of the items, "Single pressed steel door frame" where the difference is -20,57%, the reason for this can clearly be seen, where the two outliers (high: 858,82 and low: 380,31) were eliminated. A similar trend, as that indicated in Annexure 7, was found in all quarters that were calculated in this way. The majority of the two means for all the items was found to have a difference of less than ten per cent; and in those cases where the difference exceeded ten per cent, the cause was that either one, or both of the highest and lowest values, were exceptionally big outliers.

The problem — where a low number of rates were received in a quarter — was also solved, to some extent; because where no rate was received, the mean rate of the previous quarter was used (this seldom occurred). Where one rate was received, that rate was used; while if two rates were received, their average was used. In cases where three rates were received, one's own judgement was used — by either keeping the mean of the three rates if there was little difference between the rates (a figure of plus or minus 20% from the mean was used as a norm); or if one rate was considered to be an outlier, it was discarded.

The use of the above method was deemed to be a statistically sound way of dealing with variations in unit rates.

8.3.3 Discussion of indicator items

Before proceeding to the calculation of the actual index, it is important to discuss the movement of the individual indicator items in order to explore what inherent problems there might be regarding each item (if any), what influence each item has on the index, and whether it would require any changes to the methodology discussed above, if the index were going to be used in future for commercial purposes.

<u>Excavations and carting away excavated material</u>

Excavations comprise one of the groups of items that occur frequently in projects; in this research, 213 of the total 231 projects (92,2%) contained a rate for "Excavate in earth for trenches not exceeding 2m deep". As can be seen from Figure 8.1, there was no significant movement in the rate for this specific excavation item between 2007 and 2011 with the rate fluctuating between R70/m^3 and R90/m^3 for most of the time. There seems to be a slow increase in the rate from the end of 2011 (Figure 8.1).

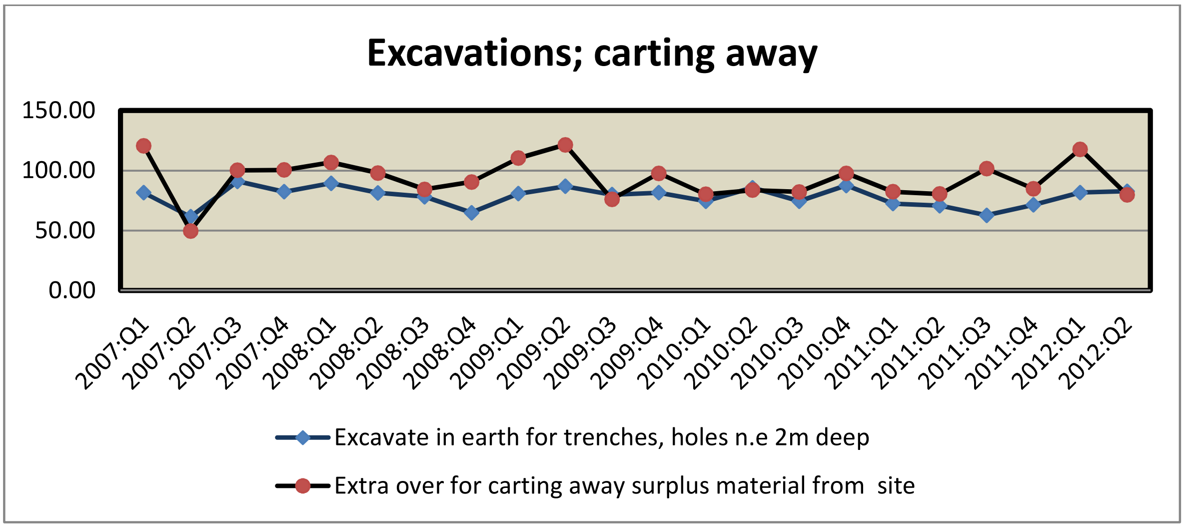


Figure 8.1: Excavation and carting away: rate movement

The fact that there was no real increase in the rate is unusual, as the rates for excavation are either labour-based (for excavations done by hand) or machine-based. In both instances, it would have been expected that increasing labour rates (for hand excavations), as well as higher prices for excavating machinery, plus increasing fuel prices, might have led to an increase in the rate for excavations. This rate should, nevertheless, be kept as part of the index.

Regarding the second item, “Extra over for carting away surplus material from site”, it is also an item that occurred on a fairly regular basis, with 193 projects (83,5% of the total) containing this item. As can be seen from Figure 8.1, the movement of this rate seems to be more volatile than that of excavations, fluctuating from below R60/m^3 to as high as R120/m^3, with the majority of the rates lying between R80/m^3 and R100/m^3. The reason for these fluctuations can be attributed to the fact that the rate for carting away surplus material from a site is mostly a factor of the haulage distance if a contractor has to locate his own dumping site.

Because of the volatility in the movement of this rate, thought should be given whether to retain the rate as part of the index, or replaced with another rate.

<u>Concrete</u>

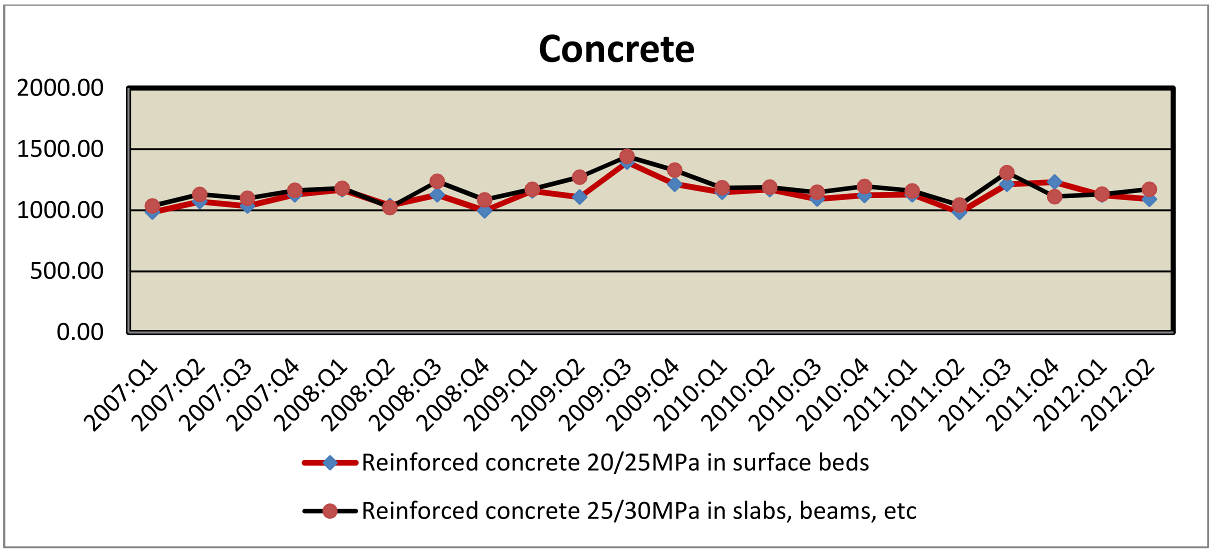


Figure 8.2: Concrete: rate movement

Two concrete items, viz. "Reinforced concrete 20/25Mpa in surface beds", and "Reinforced concrete 20/25MPa in slabs, beams and inverted beams" were selected as indicator items; since they are an integral part of most building projects; and the movement of the price could have a meaningful influence on the index. Both items are important, because in the absence of a concrete structure, e.g. in a single-storey building, or an industrial building with a structural steel frame, a concrete surface bed would, in most cases, still be present.

As concrete comes in different strengths such as 15MPa, 20MPa, 25MPa and 30MPa, it was decided to concentrate on the rates for 20MPa and 25MPa, respectively, because there is normally not a large difference in the rate of these two strengths; and in most instances, one of the two items would be present in a project. Both items had a good representation in the analysed projects, with "Reinforced concrete in surface beds" featuring in 198 projects (85,7%), and "Reinforced concrete in slabs, beams and inverted beams" in 195 (84,4%) projects.

As can be seen from Figure 8.2, there was a similar movement in the rates of both items, with concrete in slabs having a slightly higher average rate than concrete in surface beds.

This higher rate can be attributed to the added allowance of transporting the concrete (e.g. by pumping) in suspended slabs. The unit rates started in 2007, at an average of approximately R1 000,00/m^3, with a steady increase after that to a peak average of approximately R1 400,00/m^3 in 2009. The rates fluctuated after that, to about R1 200,00/m^3 in 2012, from where it is anticipated to start increasing again, as the building industry recovers from the economic slump. Because of the frequency in occurrence, as well as the relative importance in the weighting of the index, it is considered important that both rates be retained, as part of the index in future.

Formwork

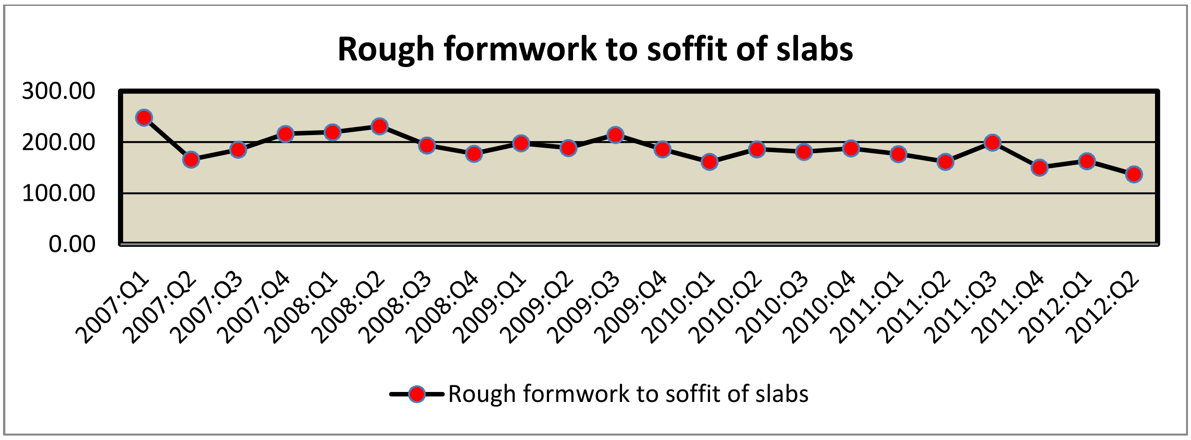


Figure 8.3: Formwork: rate movement

One formwork item, “Rough formwork to soffits of slabs” was used as the indicator item. Formwork forms an integral part of the trade “Concrete, formwork and reinforcement”; but it is also an important indicator item on its own, with a weighting of 3,6% of the overall index. Although numerous different items are normally measured as part of a concrete structure, “Rough formwork to soffits of slabs” can be deemed to be representative of this part of the trade, as it would occur in almost all projects with a concrete-framed structure. This is confirmed by the good representation of 183 in the analysed projects (79,2%).

The rate, as can be seen from Figure 8.3, showed peaks in 2008 and 2009 of between R200 and R250/m², where-after it decreased to below R200/m² in 2010 to 2011. The further decline in 2012 can be questioned, and should be considered as an outlier. This is an important indicator item; and it should be kept as part of the index.

<u>High tensile steel reinforcement</u>

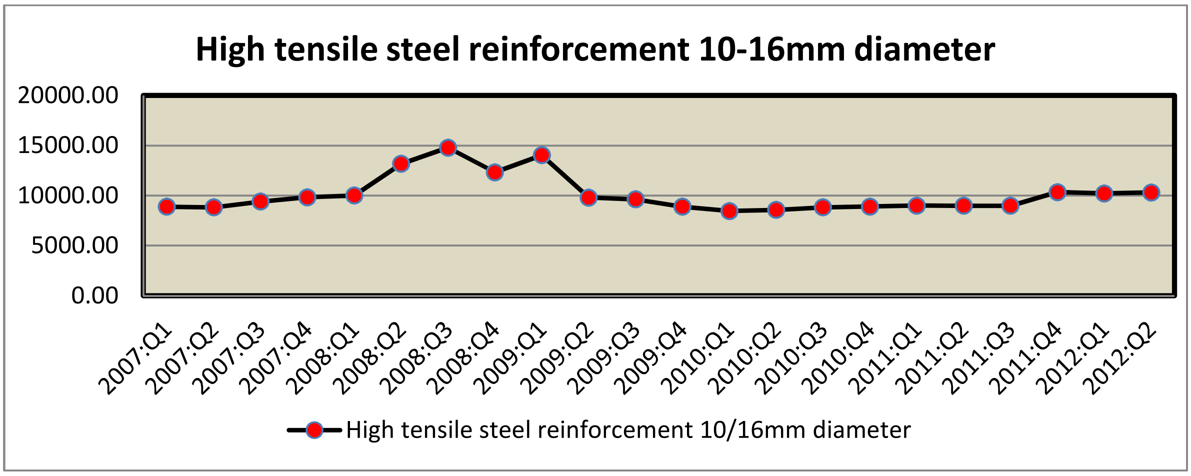


Figure 8.4: High tensile steel reinforcement: rate movement

Steel reinforcement is also one of the important indicator items, with a weighting of 7,4% in the index. This is also evident when looking at the item's representation, viz. in 206 projects (89,2% of the total). Although steel reinforcement is measured in different diameters, e.g. 8, 10, 12, 16, 20, 25 and 32mm; it was initially found that in most projects, the majority of the steel reinforcement measured varied between 10 and 16mm diameter; and secondly, that in most priced bills of quantities, contractors do not make a distinction between the different diameters when pricing the document, because all diameters are priced at the same unit rate.

It can be seen in Figure 8.4 that the rate of steel reinforcement started in 2007 at approximately R9 000/ton, rising to R10 000/ton at the beginning of 2008, after which a sharp rise in the steel price occurred, resulting in an average unit rate of more than R14 000/ton at the beginning of 2009. After this steep rise, the rate flattened out again during the last half of 2009 keeping steady at between R9 000 and R10 000/ton for 2010 and 2011.

During the last quarter of 2011 the rate started to show an increase again to over R10 000/ton for the first half of 2012. Since the movements in the price of steel reinforcement, as described above, can have a marked influence on the overall movement of the index, it is important that this item should remain part of the index.

Brickwork

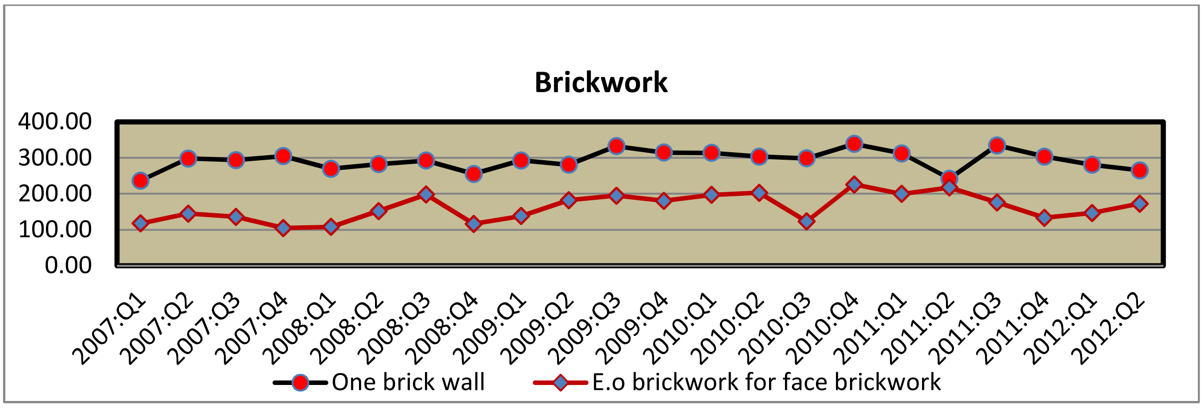


Figure 8.5: Brickwork: rate movement

For the brickwork trade, the following indicator items were chosen: “One brick wall” and “Extra over ordinary brickwork for face brickwork”. Brickwork is an important element in almost all buildings; and it also has a relatively high importance in the index, with a combined weighting of 8,30%. The importance of the “One brick wall” item is further illustrated, when looking at the frequency with which it appears in the analysed projects, viz. in 223 projects (96,5% of the total). The item “Extra over ordinary brickwork for face brickwork" did not appear that frequently, with an appearance in 127 projects, or 55% of the total. The latter relatively low frequency can be attributed to the fact that face brickwork is mostly used as an external finish, and it therefore, competes with other external wall finishes, such as plaster and paint, various wall claddings, aluminium curtain walling and shop fronts, etc.

When looking at the average unit rates for the two items, as shown in Figure 8.5, it can be seen that the rate for one-brick walls started at a low of around R230/m^2 in 2007, with a gradual increase to approximately R340/m^2, at the end of 2010. Thereafter, the rate shows a gradual decline to about R280/m^2 by the middle of 2012. The correctness of this decline can be questioned, and might be attributed to the relatively low number of projects received for 2012 (the sharp decline indicated in the second quarter of 2011 can be considered an outlier). This rate is a very important unit rate, in the context of the index; and it must be retained.

Regarding the second indicator item, "Extra over ordinary brickwork for face brickwork", the price movement of the unit rate seems to be less stable than that for one-brick walls. This can be attributed to the fact that face bricks come in a wide variety of quality and colours; and therefore, there could be a difference in the purchase price of the various types of face bricks. Another factor that could play a role in the pricing of this rate is transport, where, if bricks have to be transported over long distances from the factory, they can add substantially to the rate. Nevertheless, from Figure 8.5 it is evident that there was a steady increase in the rate/m^2 for face brickwork between 2007 and 2012, from approximately R120/m^2 to R170/m^2 to a high of just over R200/m^2 in 2010 and 2011.

Thought should be given as to whether to retain this item as part of the index, due to the fluctuations in price, as well as the relatively low occurrence in projects, as discussed above.

Damp-proofing

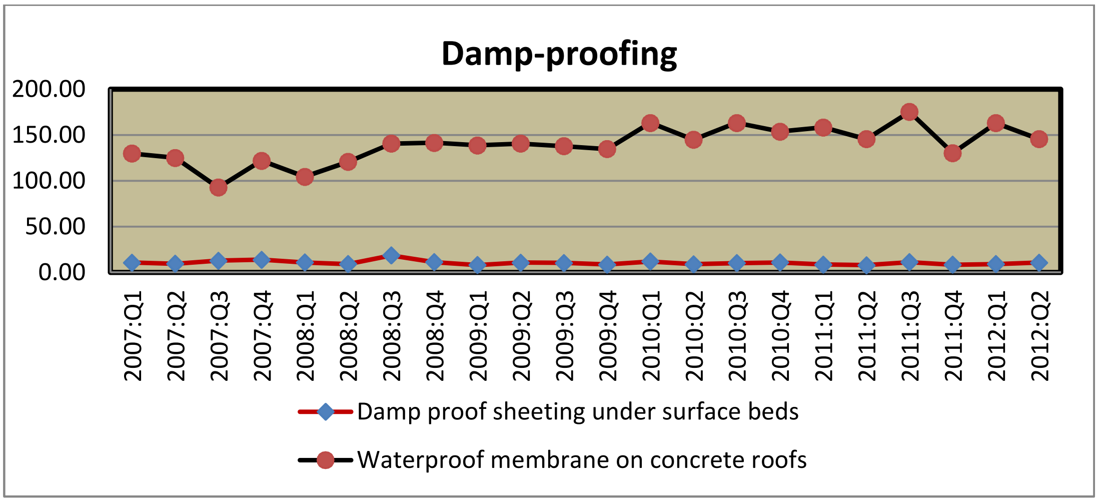


Figure 8.6: Damp-proofing: rate movement

In this section, two indicator items were chosen, viz. “Damp-proof sheeting under floors” and “Waterproof membrane on concrete roofs”. In terms of importance, relative to the index, these items do not make a very important contribution to the index, with a combined weighting of 1,1%. Regarding the frequency, “Damp-proof sheeting under floors”, it occurred in 208 of the projects (90%), and “Waterproof membrane on concrete roofs in 150 projects, or 64,9%. The reason why the latter item occurs less frequently could obviously be attributed to the fact that such an item would only be measured where a building has a full, or partly, concrete roof, and not where other roofing finishes are utilised.

From Figure 8.6, it can be deduced that there was almost no movement in the rate of damp-proof sheeting under floors; and the reason for this is because it is a low-cost item, with the rate fluctuating between R10/m^2 and R12/m^2 from 2006 to 2012, with occasional rises in the rate to R14/m^2 at the end of 2007, and R18/m^2 by the middle of 2008. The continuous use of this item should be investigated, the reason being the relatively small influence that the movement in the rate has on the overall index.

When looking at the second rate, "Waterproof membrane on concrete roofs", the movement in the rate is much more volatile, as can be seen from Figure 8.6; but the general overall trend is upwards, ranging from a low of R100/m2 at the start of 2007, to a high of R175/m2 at the end of 2011. The upward trend is to be expected, because of a steep hike in bitumen prices, due to a shortage thereof, during 2010 and 2011, because of maintenance shutdowns at some oil refineries (Engineering News, 2010); while the volatility in the rate can be attributed to the different types of waterproofing that are available on the market for the waterproofing of concrete roofs.

If thought is given to not use the rate for damp-proof sheeting under surface beds in future, then the rate for waterproof membrane on concrete roofs should be kept, in order to have some representation from the waterproofing trade.

Galvanised steel roofing and insulation

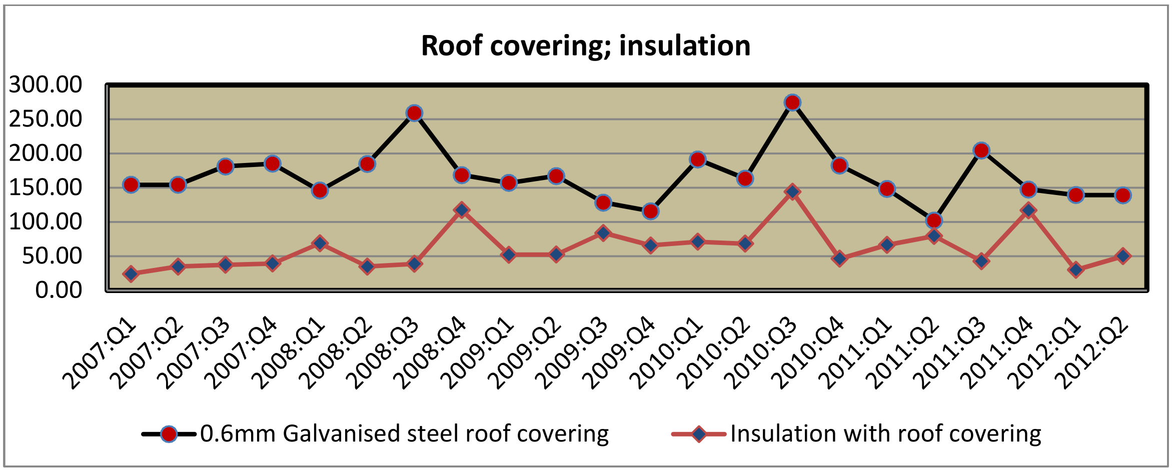


Figure 8.7: Roof covering and insulation: rate movement

The trade "Roof coverings" is represented in the index by two items, viz. "0.6mm Galvanised steel roof covering" and "Insulation with roof covering". The item for steel roof coverings occurred in 102 projects (44,1%), and the insulation item in only 90 projects (38,9%). The low representation can be attributed to the fact that not all buildings would necessarily have a roof covering item because, the roof can be a concrete slab; and if there is a roof covering item, it could consist of steel sheeting, fibre-cement sheeting, concrete tiles, slate tiles, etc. Similarly insulation is not specified on all steel sheeting roofs.

As can be seen from Figure 8.7, the unit rate for steel sheeting shows a fairly erratic movement over the time span of the study. Apart from the possibility that the relatively low representation could have an influence on the fluctuation, it could also be attributed to the fact that not all galvanised steel sheeting is the same: with different thicknesses and quality, ranging from 0,5mm to 0,6mm thickness, as well as either light or heavy industrial grade. Furthermore, most steel sheeting has a coloured silicone polyester coating; but this could be either one full coating on one side, or a full coating one side plus half-a-coating on the other side. Also available on the market is steel sheeting with a coloured-alloy coating comprising a combination of aluminium, zinc and silicone.

All of the above factors can have an influence on the unit rate. The price of insulation for roof covering seems less volatile, with outliers in 2008, 2010 and 2011. This is mostly due to the relatively low representation of this item, as discussed before. With the exception of the outliers, the rate moved between approximately R35/m^2 in 2007, to R50/m^2 in 2012. It is recommended that “Galvanised steel roof covering” be kept as part of the index, but that “Insulation with roof coverings” be discontinued in future. If more projects can be sourced for a future index, it might also be advisable to narrow the description down, so that only one particular item is used as an indicator item, which would largely negate any big fluctuations.

<u>Timber door and skirting</u>

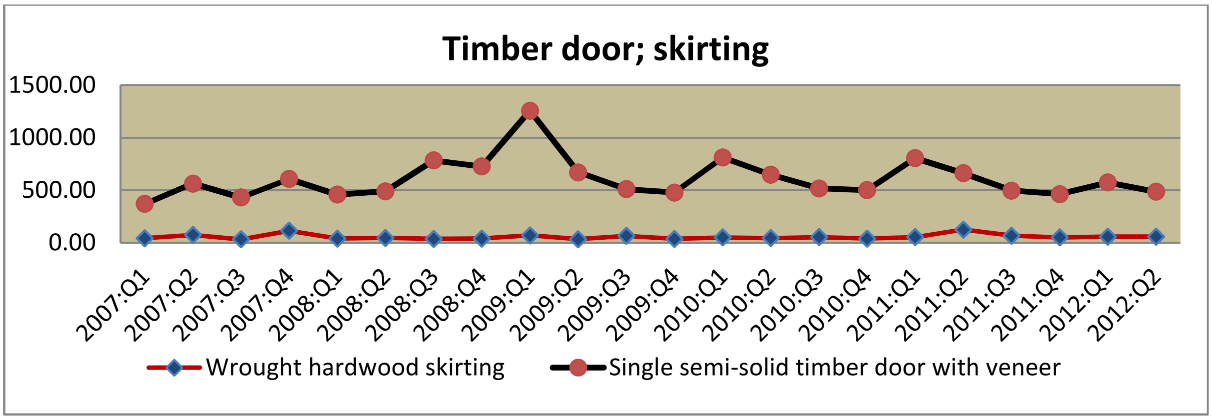


Figure 8.8: Timber door and skirting: rate movement

Two items, *viz*. "Single semi-solid timber door with veneer both sides" and "Wrought hardwood skirting" were selected to represent the "Carpentry and Joinery" trade, as indicated in Figure 8.8. The results of the analysis were disappointing, firstly due to the relatively low representation of both items in the analysis (151 occurrences for timber doors, or 65,4%, and 131 occurrences for timber skirting, which amounts to 56,7% of the total number of projects).

It is clear from Figure 8.8, that there were a number of outliers in the unit rate of timber doors, which can be attributed to the low occurrence of the item, as discussed, as well as the difference in the specification of the item — with the different types and quality of veneer that can have an influence on the rate. On average, the rate fluctuated from below R500/door in 2007, to just above R500/door in 2012 – not a great movement in the rate. Regarding timber skirting, there was hardly any movement at all during the period of analysis, with the rate fluctuating between R45 and R60/m.

As doors are an integral part of any building project, this item should be kept, with an effort being made to obtain rates for products with a similar specification. Hardwood skirting, on the other hand, can in future possible be replaced by another item, because of the relatively low influence on the index, as well as the fact that it does not occur in the majority of projects.

<u>Vinyl / acoustic suspended ceilings</u>

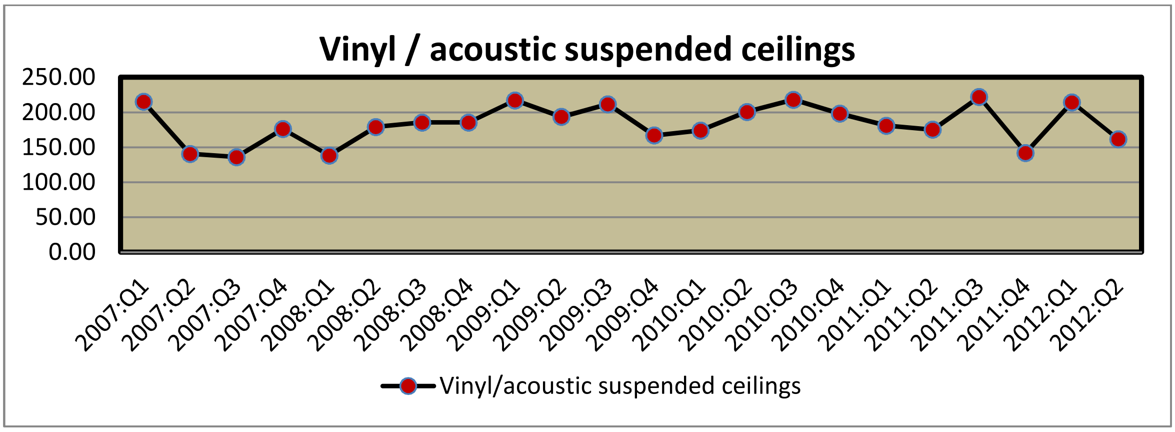


Figure 8.9: Vinyl / acoustic suspended ceiling: rate movement

Two different types of suspended ceilings, viz. vinyl cladded and acoustic tiles, were chosen to represent the trade "Ceilings, partitions and access flooring", the reason being to have a wider spread of available rates. It can be seen from Figure 8.9, that the movement for this indicator item for this time period, was rather erratic, with some big outliers. The reason for these fluctuations can be attributed to different reasons, the first being that the item did not have a large representation in the analysed projects (131 occurrences or 56,7%).

This low representation could, in turn, be as a result of the multiple-procurement system, where ceilings are not always measured in the original bills of quantities, but allowed for as a provisional sum for work to be done by a specialised subcontractor. Another reason for the rate fluctuation could be put down to the different specifications between various ceiling types. Both vinyl-clad and acoustic ceiling tiles come in different sizes, e.g. 600 x 600mm, or 600 x 1200mm, as well as different thicknesses, ranging between 9mm, 12,5mm and 15mm thick. All of the fore-mentioned can have an influence on the rate. From Figure

8.9, it can be seen that the rate for suspended ceilings ranged between R140/m^2 at the beginning of 2007, to a high of around R200/m^2 in 2009, declining to approximately R160/m^2 in 2012.

If, in future, this indicator item could achieve a higher representation rate, it should be kept as part of the index, because it is the only representative item for the trade.

Carpets on floors

This indicator item represents the trade "Floor coverings, plastic linings, etc.", and can either be carpet tiles, or so-called "wall-to-wall" carpets. As carpets compete with other floor finishes, such as vinyl tiles and vinyl sheeting, as well as floor tiling (incorporated in the "Tiling" trade), the frequency is not very high, with the item occurring in 101 projects;

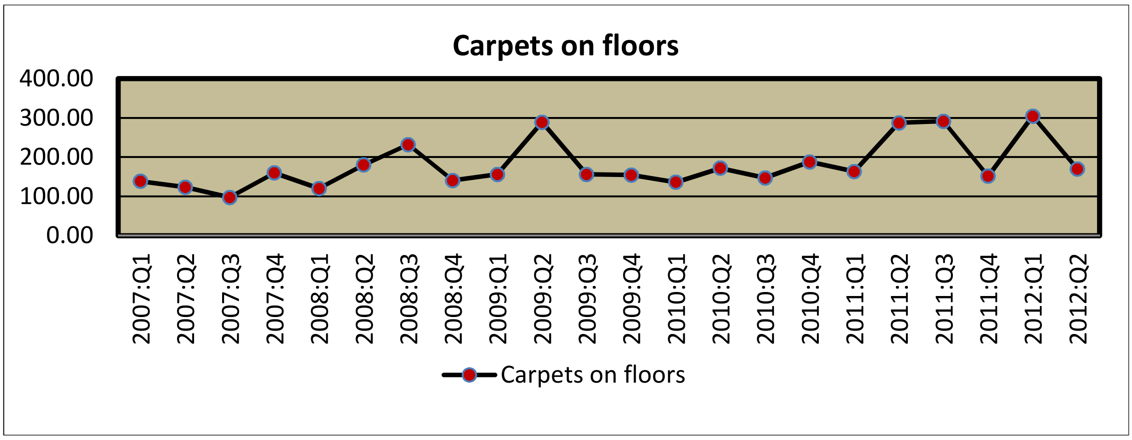


Figure 8.10: Carpets on floors: rate movement

(43,7%). It is clear from Figure 8.10, that the movement of this item was erratic, with big fluctuations occurring, ranging in price between R90/m^2 and R300/m^2. The reason for these outliers can be attributed to the low occurrence of the item in projects, as well as the difference in specification between different types of carpets. Due to the price fluctuation and the relatively low importance of this item (1,1% weighting of the index), thought should be given on whether to keep this item as part of the index in future, or replacing it with another item.

<u>Door lock set</u>

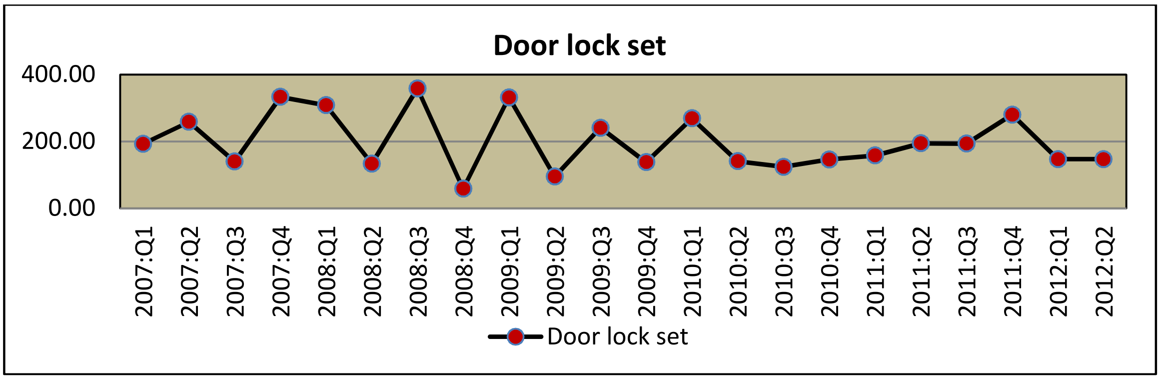


Figure 8.11: Door lock set: rate movement

Ironmongery, as stated before, is a difficult trade for which to find representative items because of the diversity thereof, with a large variety of items that could be part of the trade. The item chosen for this trade, “Three-lever mortise lockset”, can be considered to be representative; but in this research, it occurred in only 112 of the analysed projects, or 48, 5%. This relatively low representation can also be attributed to the multiple-procurement system, as discussed before, where most of the ironmongery trade (e.g. locks, door handles, hinges, etc.) are allowed for as a provisional sum, or measured as prime cost items, where an amount is allowed for the purchase of the specific item — with an opportunity for the contractor to price his labour, overheads and profit.

In other projects, the items were measured as “labour-only” items where the contractor was given the opportunity to price for his labour only to fix the item. The material price for the items was then either allowed as a provisional sum or, in some instances, it was provided for by the Client. All the above, as well as the fact that there are different brands of three-lever locksets on the market, all with different prices, resulted in an item with a volatile price movement, as can be seen from Figure 8.11. Given this erratic behaviour, coupled with the factors described above, as well as the relatively low weighting of the item in the index (0,7%), it is advisable to look for an alternative item in a future updated index.

Structural steel in columns and beams

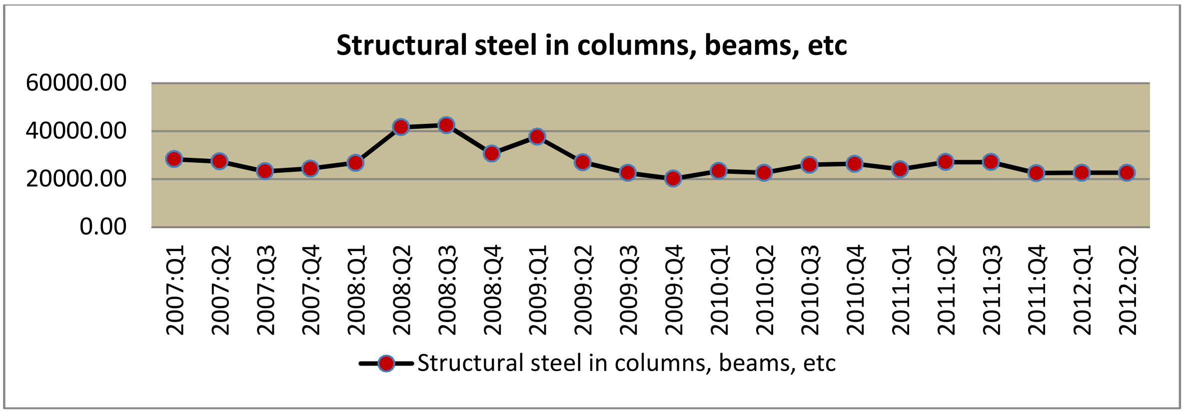


Figure 8.12: Structural steel in columns and beams: rate movement

For the trade “Structural steelwork”, the indicator items chosen were those of structural steel columns and beams, as these items are normally priced at a similar rate. This is an important indicator item in terms of the index, as it contributes 6,2% of the weighting of the index. Unfortunately, this item was poorly represented in the analysed projects, with only 81 occurrences (35%). The reason for this is mostly because not all buildings contain structural steel elements (e.g. a building with a concrete frame and roof), as well as the multiple-procurement system used on some projects, where structural steel was allowed as a provisional sum, as it is mostly executed by a nominated or selected subcontractor.

When looking at the rate itself, it is clear from Figure 8.12, that the movement of this item is very similar to that of high-tensile steel reinforcement (see Figure 8.4), as it was also subjected to the same sharp rise in the price of steel at the beginning of 2008, which lasted until the middle of 2009. During this period, the rate of steel went up from about

R23 000/ton in 2007, to approximately R42 000/ton in the middle of 2008. During the subsequent recession, the price went down to R22 000/ton (end of 2009), where-after it stayed fairly constant for the rest of the period, fluctuating between R23 000/ton and R26 000/ton.

Because, as stated, this is an important item in the index, it should be kept, with a concerted effort made to get more information with regard to structural steel rates as priced by subcontractors, if they are to be allowed for as a provisional sum in multiple procurement-systems, as described above.

Single pressed steel door frame (for one brick wall)

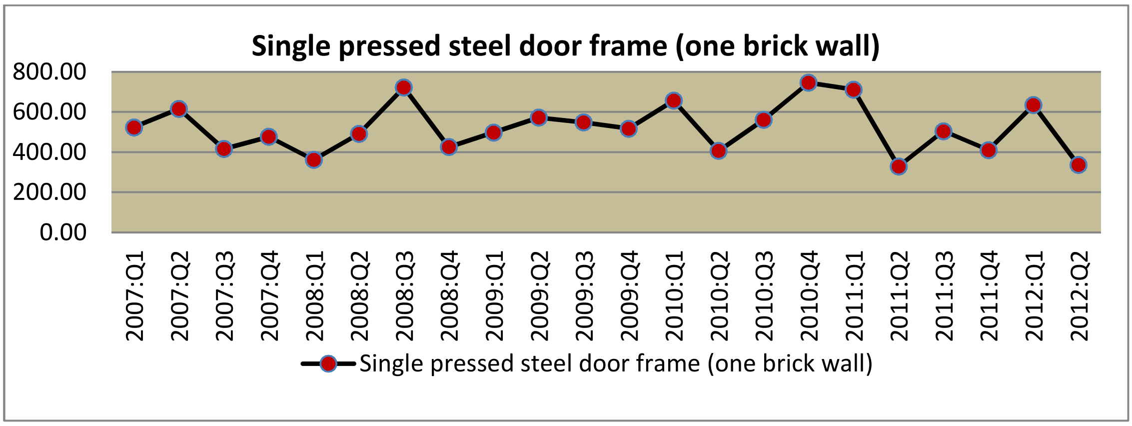


Figure 8.13: Single pressed steel door frame (for one brick wall): rate movement

This item, one of two representing the metalwork trade, was represented in 129 (55,8%) of the projects. This is a relatively low representation; and it is because steel door frames compete with timber door frames on the market, the latter item being preferred in coastal areas. It is clear from Figure 8.13, that the price movement of this item has shown a lot of volatility during the research period. This movement is difficult to explain, since it is an item that is supposed to be uniform in composition and method of fabrication. Resulting from this phenomenon, and the relatively low importance in the index (0,40%), thought should be given on whether to keep this item in future as part of the index.

Aluminium windows

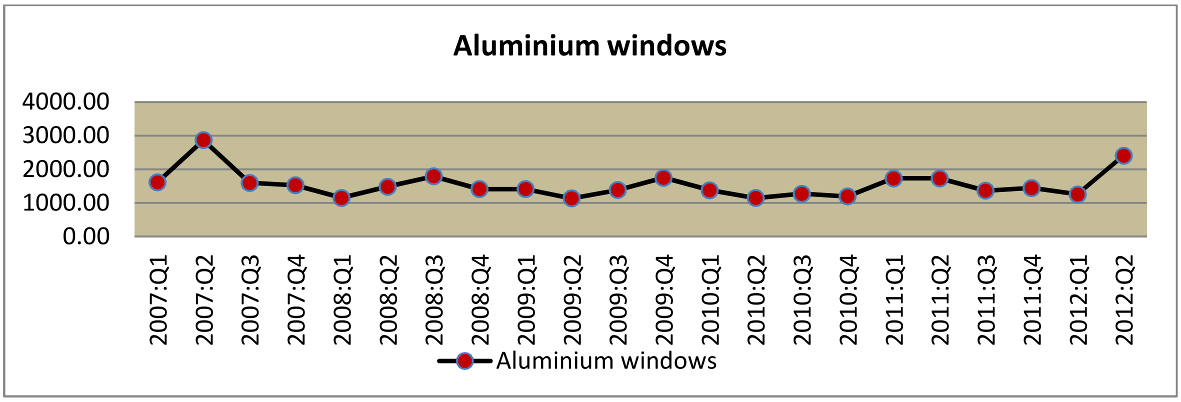


Figure 8.14: Aluminium windows: rate movement

This is an important item in the index, as it carries a weighting of 6,40%. Unfortunately, the representation in the analysed projects was relatively poor, with only 64 projects (27,7%) having aluminium windows as part of the measured work. This is also a factor of the multiple-procurement system, as it is a popular commodity in projects, but is mostly allowed for as a provisional sum in the bills of quantities.

As was mentioned before, this is also an item where there was a deviation from the standard method of measurement, since it is difficult to find a representative window type in the measurement of aluminium windows, because of the fact that most of the windows are purpose-made and almost any size or permutation is possible. It was, therefore decided to convert the rates of the measured windows to a rate per square metre on elevation. In Figure 8.14, it is shown that this rate moved between R1 100/m^2 and R1 700/m^2 during the analysed period, with outliers encountered at the beginning and at the end of the period, and a possible increasing trend for 2011.

The fact that there is a spread in the rate is not unusual, since there can be a difference in the specification of windows between projects, with different thicknesses of glazing used, whether the glazing is tinted or not, double-glazing, heat-reflective glazing, as well as a difference in the type and colour of anodizing of the frames. Despite these differences, this item must be kept as part of the index; and as such, more information should be obtained from projects in the form of successful subcontract tenders.

Cement plaster screed on concrete floors and internal cement plaster on brick walls.

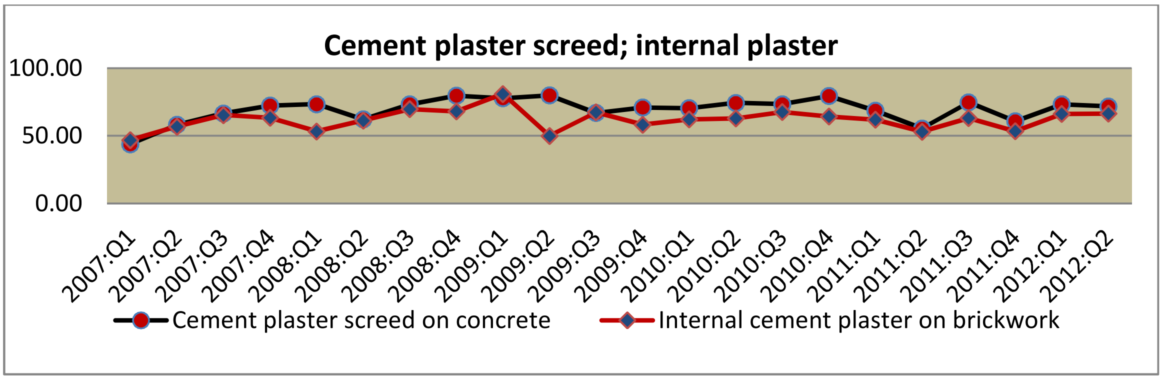


Figure 8.15: Cement plaster screed and internal cement plaster: rate movement

The "Plastering" trade in the SSM is represented by two items, viz. "25mm thick cement plaster screed on floors" and "One-coat internal cement plaster on brick walls". The plastering trade has an average weighting of 3,4% in the index; but it could be considered fairly important, because of the good representation that these indicator items have in most projects. Cement plaster screed occurred in 168 projects (72,7%), and internal cement plaster occurred in 221 projects or 95,7%, which makes it one of the best-represented items in the index.

Figure 8.15 shows a relatively consistent movement, with the two items following almost the same curve (cement plaster screed being slightly higher). The rate for internal cement plaster started off in 2007 at approximately R45/m^2, and gradually increased in value throughout the analysed period to approximately R66/m^2 in 2012. As mentioned, these items are important for the index, as they have good representation, and do not show much volatility in the movement of the rates.

Wall and floor tiling

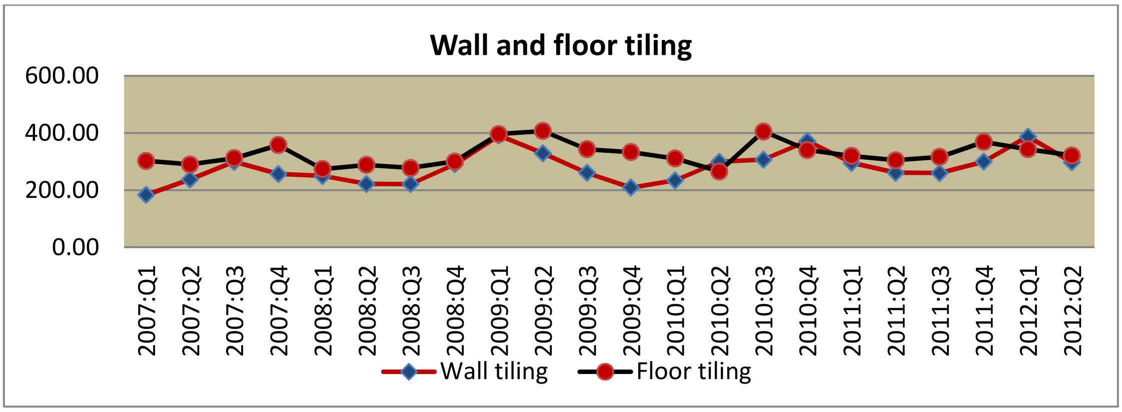


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Figure 8.16: Wall and floor tiling: rate movement

Items for wall and floor tiling were chosen to represent the tiling trade. In terms of the index, it is also a fairly important trade with a weighting of 3,30%. Although the tiling item has to compete with other wall and floor coverings, it was reasonably well-represented, with wall tiling having 183 occurrences (79,2%) and floor tiling 176 occurrences (76,`%). This representation was despite the fact that tiling is also becoming more frequently part of the "Provisional sums" trade where a provisional amount is allowed and then tendered for at a later stage in the contract.

The price movement indicated in Figure 8.16 shows some volatility, which can be attributed to the large variety in the type of tiles, as well as the difference in specification present in the market. Nevertheless, both types showed consistent movement during the analysed period, with a gradual increase in the over the time period. Wall tiles increased from R180/m^2 in 2007 to approximately R370/m^2 in 2012; while floor tiling went from R300/m^2 in 2007 to a high of R400/m2 in 2010; and then levelled out at approximately R340/m^2 in 2012.

It is important that tiling should be kept as part of the index; but it is possible that it could only be one of the two items. Since the representation seems to be almost equal, it might be prudent to keep floor tiling, as it currently carries the bigger weighting in the index (2,30% as opposed to 1,00% for wall tiling).

<u>110mm Diameter uPVC soil pipe in ground (0 – 1m deep) including trenches, WC suite and electric water heater</u>

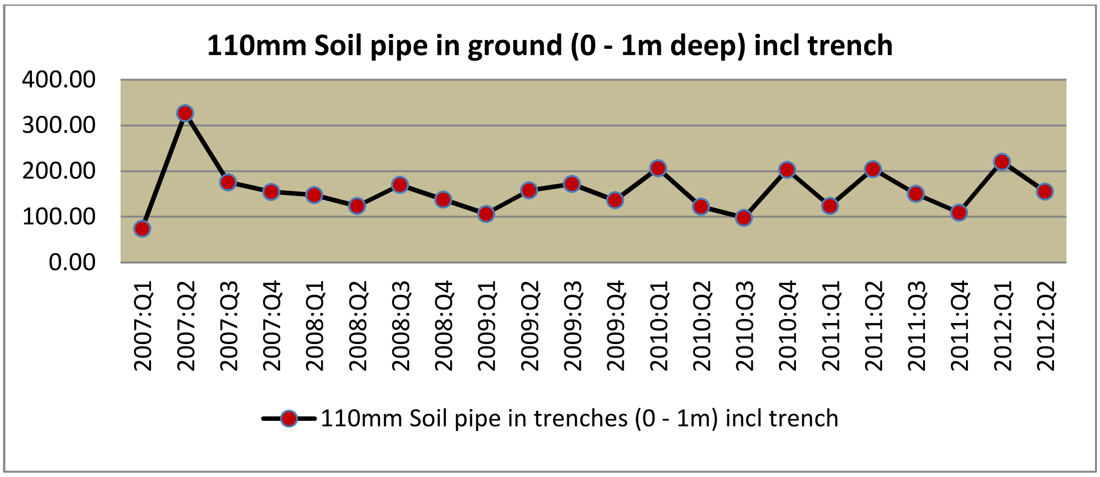

Figure 8.17: 110mm Diameter soil pipe in ground (0 – 1m deep): rate movement

The “Plumbing and drainage” trade was represented by three items, *viz*. “110 mm diameter soil pipe in trenches, 0 – 1m deep”, as well as “White vitreous china WC close-coupled pan with matching 9-litre cistern and double-flap seat”, and “150 Litre 400kPa electric water heater complete”. Unfortunately, due to the multiple-procurement process, not one of these items was well-represented in the analysed projects, with the 110mm soil pipe being present in 92 projects (39,8%), the WC suite in 105 projects (45,5%), and the electric water heater in 99 (42,9%) projects.

As can be seen from Figure 8.17, there seems to be a fair amount of fluctuation in the price of the 110mm diameter soil pipe, with some big outliers in the beginning of the period (2007), but from then on ranging between R110/m and R200/m for the rest of the analysed period. The reason for this erratic behaviour can mostly be contributed to the difference in the pricing of the trenches in which the pipes are laid, and not so much in the price of the pipes themselves, with the rate for trenches based on either hand- or machine-excavation that can differ substantially. Notwithstanding this phenomenon, it is important to keep this item as part of the index, as it represents all pipework in the trade; and an effort will have to be made to obtain more information on the item in future applications. Another alternative, for future consideration, is to use a rate, for example, “110mm uPVC pipe to walls”, as this will indicate only the rate of the pipe and labour to fix it, eliminating the problem of excavations that form part of the rate.

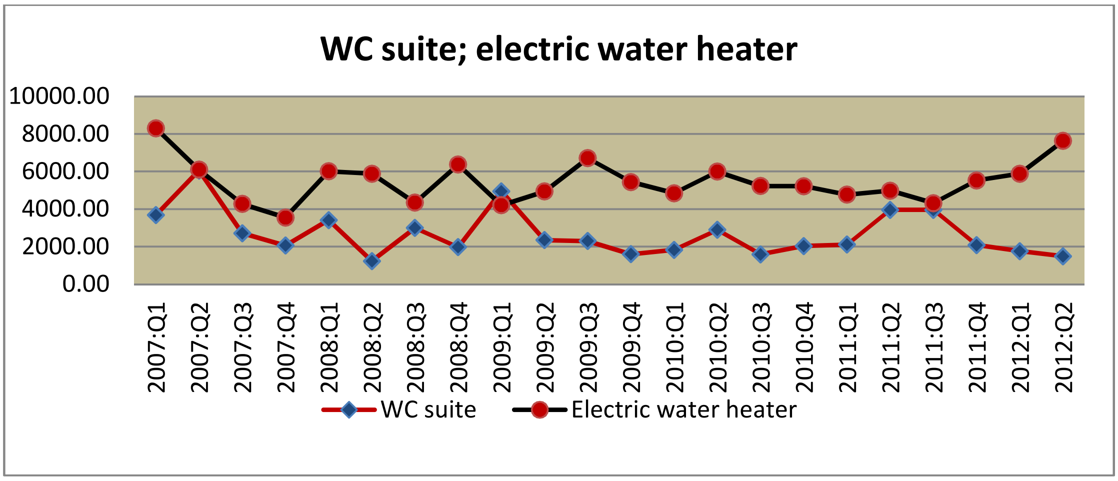

Figure 8.18: WC Suite and electric water heater: rate movement

As with the 110mm diameter soil pipe, both the WC suite and the electric water heater showed erratic price movements for the period under analysis. The same problem is applicable to both these items, viz. the range in specification from different suppliers for the same type of item. It can be seen in Figure 8.18, that the rate for a WC suite fluctuated between R1300 and over R4000 each, with an average of approximately R2000 each between 2009 and 2011; while the rate for an electric water heater ranged between R4000 and R6000 each for the period of analysis.

Thought must be given to keeping one of these two items, preferably the WC suite, as it seems to occur on a more regular base in projects — with a concerted effort to obtain more rates in available projects. The rate for the electric water heater, though, can in future be replaced with another rate.

<u>6mm Mirror to brickwork</u>

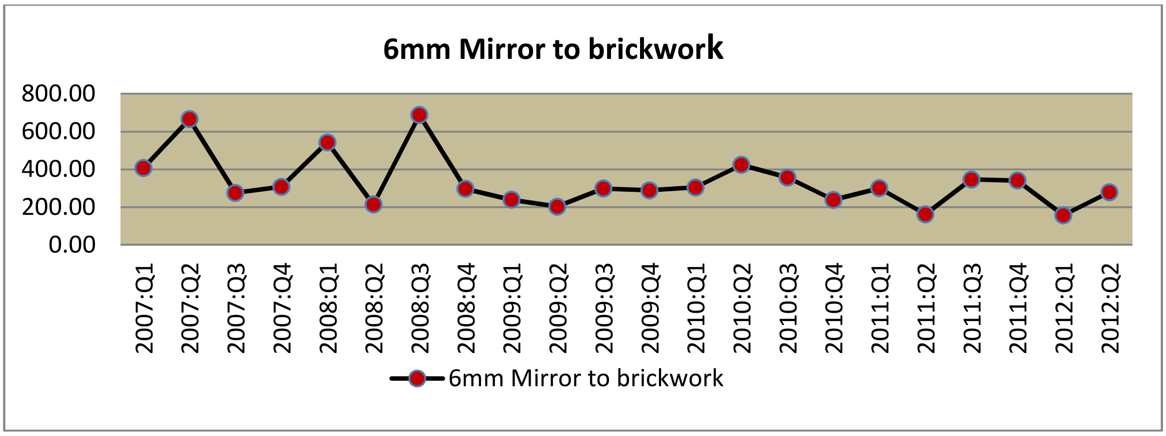

Figure 8.19: 6mm Mirror to brickwork: rate movement

The “Glazing” trade is represented by the item “6mm silvered float glass copper-backed mirror, size 400 x 400mm high fixed to brickwork”. Due to the relatively low representation (102 projects or 44,2%), as well as the fact that items for different sizes of mirrors were used (if only 400 x 400mm sizes were chosen the representation would have been even lower), the movement of this item was fairly erratic, with big outliers at the beginning of the period up to the end of 2008. Since 2009, the movement seems to have flattened out more, with the rate fluctuating between R180/m^2 and R380/m^2.

This item is relatively unimportant in terms of the index with a weighting of only 0,20%; and therefore, could be considered to be substituted with another rate in future.

Paintwork

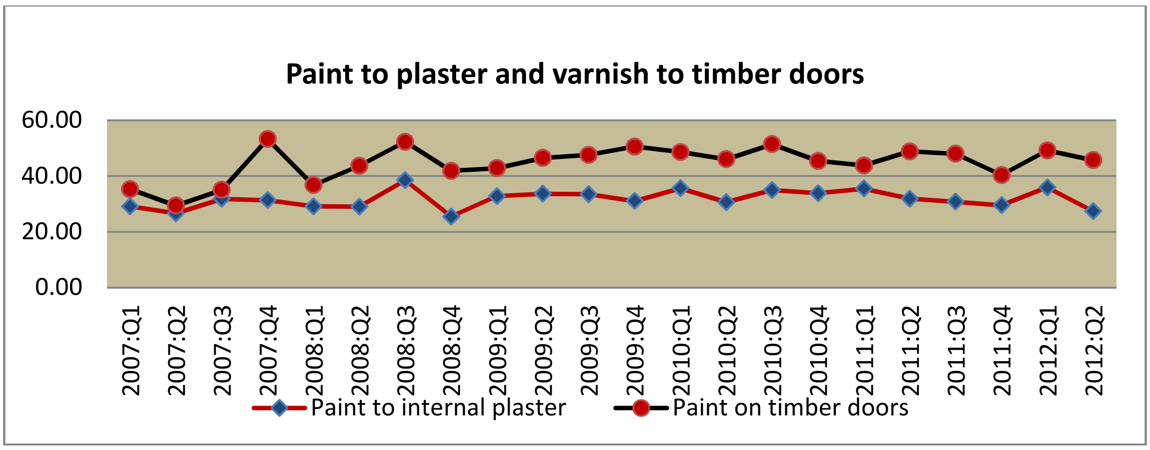

Figure 8.20: Paint to plaster and varnish to timber doors: rate movement

Two items, *viz*. "One coat primer and two coats interior quality PVA emulsion paint on internal walls", and "Three coats varnish on timber doors" represented the paintwork trade. Both items were well-represented with the paint-to-plaster item occurring in 220 projects (95,2%), and the item of varnish to timber doors in 209 (90,5%) projects. As can be seen from Figure 8.20, the rate for both items, after a few outliers at the beginning of the analysed period, remained fairly constant, with the paint-to-plaster item staying just above R30/m^2, and varnish to timber doors moving between R40/m^2 and R50/m^2.

As the "Paintwork" trade's weighting in the index is relatively low (1,80%), only one item can be used to represent the trade in the index. With the paint-to-plaster item having the biggest contribution to this weighting (1,40%), and also having the best representation in the analysed projects, as indicated before, it will be the ideal item to keep as part of the index.

Provisional sums

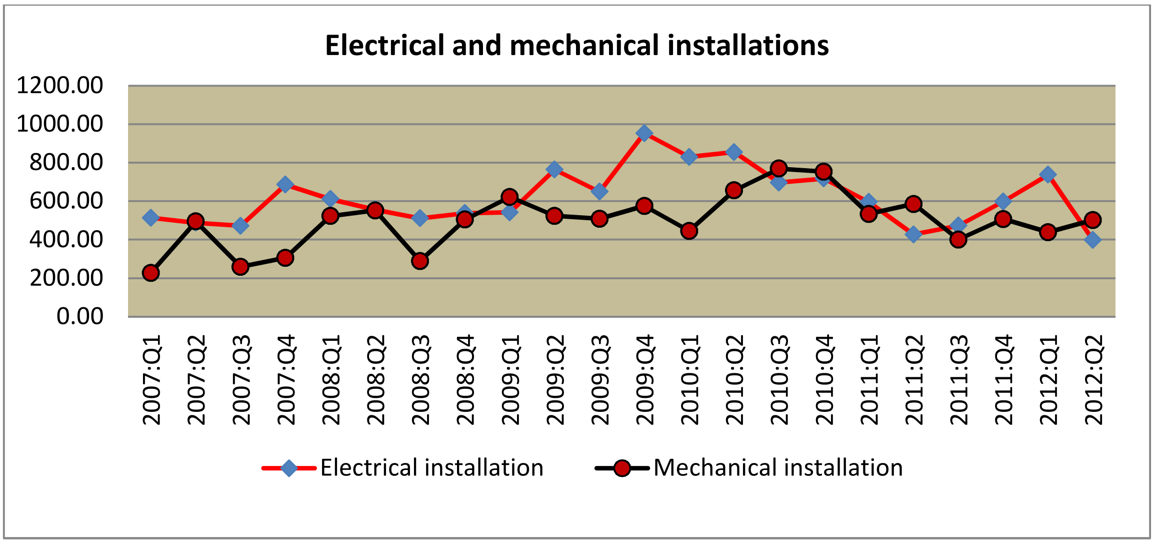

Figure 8.21: Electrical and mechanical installations: rate movement

This is a very important trade in terms of the index, with a weighting of 28,90%; and it is represented by two items, *viz*. electrical installation and mechanical installation. Electrical installation has a good representation, with an occurrence in 202 projects (87,5%). The projects with no electrical representation were mostly alterations projects, where there was either none, or very little, electrical installation work involved; while in some projects, the electrical installation was omitted from the bills of quantities, because it was tendered for as a separate contract (this happens with schools projects in some provinces).

Mechanical installation, on the other hand, was not so well-represented, with occurrence in 137 projects (59,3%). This can be attributed to the fact that not all projects contain some form of mechanical installation, such as air conditioning, and lifts, etc.

As can be seen from Figure 8.21, the movement of both items was fairly erratic, with the electrical installation showing a general upward curve in price movement from 2007 to a peak in 2009, and then decreasing again to a low in 2011. Mechanical installation, on the other hand, followed an almost similar trend, but with a less high peak in 2010, and also decreasing in value towards 2012.

The reason for the fluctuation in the rates for both the electrical and mechanical installation rates can be attributed to the calculation method of the rates. As discussed before, the rates were obtained by dividing the allowed provisional amount for each installation in a project by the floor area of the particular project. This is not an ideal way of dealing with the problem, but the best option under the circumstances.

Both these items should be kept in the index. In future, it would be better to have the project quantity surveyor supply the rate per square metre for both items, as he would have the relevant knowledge of the project that cannot always be obtained from the bills of quantities. This would also ensure that the calculations are being done on a consistent basis, by using the same factor (i.e. gross floor area of the project).

8.4 CALCULATION OF THE INDEX

The next step in the process was to transfer the averaged rates per item for each quarter, as discussed above, to a spread-sheet. Even though the rates have been averaged, it became apparent that there was still a large amount of fluctuation among the rates that occurred from one quarter to another. In order to smooth out the effects of these price volatility and create a clearer picture of changing price trends, was to calculate a three-quarter moving average for each rate for the time period under investigation. According to Steyn *et al.* (2007), as well as Levine, Berenson and Stephan (1998), a moving average is commonly used with time-series data to smooth out short-term fluctuations, and to highlight longer-term trends, or cycles. The greatest advantage of a moving average, according to Levine *et al.* (1998), is that it fixes the irregular fluctuations in a time series. For comparison purposes, it was decided to also calculate the un-smoothed figures. This was done to observe whether there were any big differences between the smoothed and un-smoothed calculations.

Since a TPI, such as the one in this study, is a typical time-series, it could be considered appropriate to use a three-quarter moving average to smooth out any short-term fluctuations, as discussed before. Part of the spread-sheet that contains the three-quarter moving average of all the rates for the period under investigation is indicated in Annexure 8.

8.4.1 Determination of the index base

The above action was followed by the actual calculation of the index. Firstly, the base of the index had to be established. As discussed previously, it was decided to use 2006, as the base year (2006 = 100). Discussions with the Statistics Department at the University of Pretoria led to the decision to use the whole of 2006 as the base, i.e. the average of all indicator items over all four quarters of 2006 were calculated. In doing so, the same principles, as discussed before in terms of calculating average rates, were adhered to. This was achieved by identifying the highest and lowest rates for each indicator item in each quarter (outliers), and then calculating the arithmetic mean of the remaining rates.

After this was done, the base for the index was calculated by multiplying the weighting for each indicator item with the base rate for 2006 as indicated above. The resultant total, as shown in Table 8.4 (243 535,96) could, therefore, be considered as being equal to 100.

Table 8.4: Calculation of the index base (2006 = 100)

INDICATOR ITEMS	Weight (w)	Rate: 2006 (po) base rate	Total (pow)
EARTHWORKS			
Excavate not exceeding 2m deep for trenches	2.00	68.03	136.06
Extra over excavations for carting away surplus material from site	0.70	77.59	54.31
CONCRETE, FORMWORK & REINFORCEMENT			
25/30MPa reinforced concrete in surface beds	3.40	931.38	3 166.69
25/30MPa reinforced concrete in slabs, beams, inverted beams	5.60	946.75	5 301.80
Rough/smooth formwork to soffits of slabs propped 1,5 – 3,5m high	3.60	163.29	587.84
High tensile steel reinforcement 10/16mm diameter	7.40	8866.25	65 610.25
MASONRY			
One-brick walls	7.10	241.42	1 714.08
Extra over ordinary brickwork for face brickwork	1.30	114.66	149.06
WATERPROOFING			
250 Micron waterproof sheeting under surface beds	0.30	11.57	3.47
4mm Waterproofing system on concrete roofs	0.80	101.06	80.85
ROOF COVERINGS			
0.6mm Galvanised steel roof covering with Chromadek finish	3.00	126.43	379.29
Insulation with roof covering	0.50	48.66	24.33
CARPENTRY & JOINERY			
Wrought hardwood skirting	2.20	34.24	75.33
Single semi-solid door with veneer both sides	2.40	433.58	1 040.59
CEILINGS, partitions and access flooring			
600x600x12,5mm Vinyl suspended ceilings below concrete slab	3.40	138.52	470.97
FLOOR COVERINGS			
500 x 500mm Carpet floor tiles to screeded floors	1.10	109.47	120.42
IRONMONGERY			
Three lever mortise lockset	0.70	193.13	135.19

STRUCTURAL STEELWORK			
Welded and bolted columns, beams, etc.	6.20	21229.01	131 619.86
METALWORK			
Galvanised pressed steel single rebated frame for door 813 x 2032mm suitable for half-brick walls	0.40	250.24	100.10
Aluminium windows	6.40	1055.15	6 752.96
PLASTERING			
25mm Thick cement mortar screed on floors	0.90	64.65	58.19
One coat 1:5 internal cement plaster on brick walls	2.50	54.09	135.23
TILING			
300 x 300mm Ceramic tiles fixed to walls with tile adhesive	1.00	225.63	225.63
400 x 400mm Ceramic tiles fixed to floors with tile adhesive	2.30	277.92	639.22
PLUMBING & DRAINAGE			
110mm uPVC soil pipes in ground not exceeding 1m deep	1.10	128.54	141.39
White vitreous china WC close coupled pan and matching 9 litre cistern and double-flap seat	2.10	2321.71	4 875.59
150 Litre 400 kPa electric water heater complete with control valve, safety valve, vacuum breakers, etc.	0.70	4762.73	3 333.91
GLAZING			
6mm Silvered float glass copper- backed mirror size 400 x 600mm high fixed with mirror screws	0.20	148.29	29.66
PAINTWORK			
One coat primer and two coats interior quality PVA emulsion paint on internal walls	1.40	25.42	35.59
Three coats clear varnish on timber doors	0.40	34.17	13.67
PROVISIONAL SUMS			
Electrical installation	16.70	571.78	9 548.73
Mechanical installation	12.20	571.78	6 975.72
			243 535.96

8.4.2 Calculation of the complete index

After the above steps had been taken, the calculation of the complete index for the time period under investigation could take place. This was done by following the principles of the Laspeyres index as discussed previously:

$$P_I = \frac{\Sigma p_n q_o}{\Sigma p_o q_o} \times 100$$

Where:

PI = index

$\Sigma p_n q_o$ = total of base year quantities at current prices

$\Sigma p_o q_o$ = total of base year quantities at base year prices

An example of the calculation for quarters one and two of 2007 is given in Table 8.5.

Table 8.5: Calculation of index: quarters one and two, 2007

INDICATOR ITEMS	Weight (w)	Rate: Q1 2007 (po)	Total (pow) Q1:2007	Weight (w)	Rate: Q2:2007 (po)	Total (pow) Q2:2007
EARTHWORKS						
Excavate not exceeding 2m deep for trenches	2.00	73.23	146.46	2.00	73.87	147.74
Extra over excavations for carting away surplus material from site	0.70	101.12	70.78	0.70	85.63	59.94
CONCRETE, FORMWORK & REINFORCEMENT						
25/30MPa reinforced concrete in surface beds	3.40	999.54	3 398.44	3.40	1010.20	3434.68
25/30MPa reinforced concrete in slabs, beams, inverted beams	5.60	1005.94	5 633.26	5.60	1055.30	5909.68
Rough/smooth formwork to soffits of slabs propped 1,5 - 3,5m high	3.60	204.74	737.06	3.60	192.11	691.60
High tensile steel reinforcement 10-16mm diameter	7.40	9350.22	69 191.63	7.40	9017.24	66727.58
MASONRY						
One brick walls	7.10	244.85	1 738.44	7.10	266.06	1889.03
Extra over ordinary brickwork for face brickwork	1.30	122.11	158.74	1.30	126.62	164.61
WATERPROOFING						
250 Micron waterproof sheeting under surface beds	0.30	10.55	3.17	0.30	9.95	2.99
4mm Waterproofing system on concrete roofs	0.80	116.24	92.99	0.80	131.33	105.06
ROOF COVERINGS						
0.6mm Galvanised steel sheet roof covering with Chromadek finish	3.00	146.17	438.51	3.00	156.46	469.38
Insulation with roof covering	0.50	45.7	22.85	0.50	34.73	17.37
CARPENTRY & JOINERY						
Wrought hardwood skirting	2.20	43.32	95.30	2.20	58.70	129.14
Single semi-solid door with hardwood veneer both sides	2.40	413.22	991.73	2.40	485.63	1165.51
CEILINGS						
600 x 600x 12,5mm Vinyl suspended ceilings below concrete slab	3.40	175.74	597.52	3.40	183.44	623.70
FLOOR COVERINGS						
500 x 500mm Carpet floor tiles to screeded floors	1.10	123.89	136.28	1.10	139.33	153.26
IRONMONGERY						
Three lever mortise lockset	0.70	171.53	120.07	0.70	180.73	126.51
STRUCTURAL STEELWORK						
Welded and bolted columns, beams, etc.	6.20	24643.72	152 791.06	6.20	26115.68	161917.22
METALWORK						
Galvanised pressed steel single rebated frame for door 813 x 2032mm suitable for half-brick walls	0.40	343.87	137.55	0.40	471.14	188.46
Aluminium windows	6.40	1608.93	10 297.15	6.40	2280.73	14596.67
PLASTERING						
25mm Thick cement plaster screed on floors	0.90	56.91	51.22	0.90	58.20	52.38
One coat 1:5 internal cement plaster on brick walls	2.50	56.46	141.15	2.50	55.46	138.65

TILING						
300 x 300mm Ceramic tiles fixed to walls with tile adhesive	1.00	205.18	205.18	1.00	208.35	208.35
400 x 400mm Ceramic tiles fixed to floors with tile adhesive	2.30	290.42	667.97	2.30	286.71	659.43
PLUMBING & DRAINAGE						
110mm uPVC soil pipes in ground not exceeding 1m deep	1.10	109.04	119.94	1.10	189.72	208.69
White vitreous china WC close coupled pan and matching 9 litre cistern and double-flap seat	2.10	3027.48	6 357.71	2.10	4350.39	9135.82
150 Litre 400kPa electric water heater complete with control valve, safety valve, vacuum breakers, etc.	0.70	6072.06	4 250.44	0.70	6750.55	4725.39
GLAZING						
6mm Silvered float glass copper-backed mirror size 400 x 600mm high fixed with mirror screws	0.20	233.69	46.74	0.20	409.53	81.91
PAINTWORK						
One coat primer and two coats interior quality PVA emulsion paint on internal walls	1.40	28.37	39.72	1.40	27.78	38.89
Three coats clear varnish on timber doors	0.40	38.94	15.58	0.40	33.79	13.52
PROVISIONAL SUMS						
Electrical installation	16.70	621.99	10 387.23	16.70	533.82	8914.79
Mechanical installation	12.20	349.41	4 262.80	12.20	357.35	4359.67
Total			**273 344.67**			**287 057.59**

The above exercise was repeated for the total period under investigation (2007 to the second quarter of 2012. It can be seen that the Laspeyres formula was followed by multiplying the base year weightings with the current indicator prices, which were calculated, as discussed before. Following that, the totals for each year were used in the total formula, in order to calculate the price movement per quarter. For example, the calculation for Quarter one, 2007 would be:

$$\frac{273\,344{,}67}{243\,535{,}96} \quad X \quad 100$$

$$= \underline{112{,}24}$$

Similarly, the calculation for Quarter two, 2007 would be:

$$\frac{287\,057{,}59}{243\,535{,}96} \quad X \quad 100$$

$$= \underline{117{,}87}$$

The calculation for the full time period, first quarter 2006 to end of second quarter 2012 analysed in this study, is shown in Table 8.6.

Table 8.6: Calculation of price movement: 2006 to 2012 (2nd quarter)

2006	100.00
Q1 2007	112.24
Q2 2007	117.87
Q3 2007	117.22
Q4 2007	114.72
Q1 2008	113.44
Q2 2008	133.13
Q3 2008	153.80
Q4 2008	158.99
Q1 2009	157.90
Q2 2009	139.93
Q3 2009	131.25
Q4 2009	111.34
Q1 2010	106.94
Q2 2010	106.22
Q3 2010	110.33
Q4 2010	113.52
Q1 2011	114.28
Q2 2011	115.48
Q3 2011	115.87
Q4 2011	115.54
Q1 2012	112.68
Q2 2012	110.41

When the above movement is shown graphically, the result is indicated in Figure 8.22.

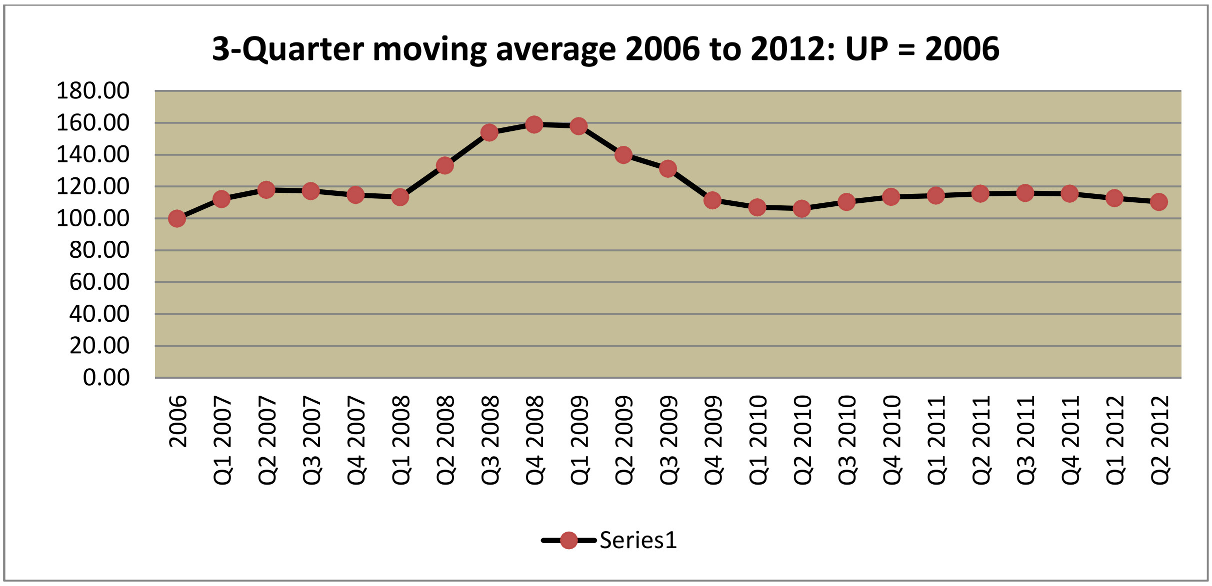

Figure 8.22: Three-quarter moving average 2006 to 2012 (2nd quarter)

8.4.3 Discussion

As indicated before, a TPI is an indication of the movement of a basket of rates over a period of time; and therefore it would be difficult to prove that such an index is "accurate". In this instance, the index under scrutiny (for research purposes the index can be termed the "UP 2006" index) shows, as depicted in Figure 8.22, an upwards curve from 2006 (UP 2006 = 100) to about the end of 2008, where the index peaked at 158.99. This represents an increase in prices of almost 60% over a two-year (or eight quarters) period, or an average of approximately 7,5% per quarter.

As indicated before, this was a period in the history of the South African building industry, which overlapped with a world-wide boom in construction activity, as well as the local demand for building projects, especially in the light of the then upcoming 2010 Soccer World Cup, together with major investment in infrastructural projects, such as main roads and the Gautrain rail project. The general movement of this peak in the UP 2006 index, consequently, seems to be in line with the general movement of the country's economy.

After the construction boom period, there was a sharp decline in construction activities. This could be attributed to the conclusion of the World Cup projects, as well as the world-wide economic recession, which also started to have an impact on the South African economy. The UP 2006 index shows a similar movement in this regard, with the trend going down from the 158,99 figure in the fourth quarter of 2008, as mentioned, to a low of 106,24 in the second quarter of 2010. This represents a decline of 33,18% over a six-quarter period, with an average of approximately 5,5% per quarter. After this the UP 2006 index shows a relatively consistent movement over the following two years until the end of the research period, the second quarter of 2012.

This movement seems to be consistent with what emerged from the projects that were investigated over this period — *viz*. that tendered rates did not show any significant amount of increase — during this two-year period.

As indicated previously, it was also decided to calculate the un-smoothed figures in order to do a comparison with the smoothed, three-quarter moving average. This calculation is shown in Table 8.7

Table 8.7 Calculation of price movement: smoothed and un-smoothed data

2006	100.00	100.00
Q1 2007	112.24	120.25
Q2 2007	117.78	124.27
Q3 2007	117.22	107.12
Q4 2007	114.72	112.75
Q1 2008	113.44	120.45
Q2 2008	133.13	166.18
Q3 2008	153.80	174.72

Q4 2008	158.99	136.00
Q1 2009	157.90	162.92
Q2 2009	139.93	120.85
Q3 2009	131.25	109.99
Q4 2009	111.34	103.19
Q1 2010	106.94	107.65
Q2 2010	106.22	107.82
Q3 2010	110.33	115.52
Q4 2010	113.52	117.22
Q1 2011	114.28	111.06
Q2 2011	115.48	118.60
Q3 2011	115.87	118.07
Q4 2011	115.54	109.94
Q1 2012	112.68	110.04
Q2 2012	110.41	111.24

The difference in the movement of the two calculations is graphically illustrated in Figure 8.23. as can be seen from this figure, the movement of the two data sets follow in general the same curve, but the un-smoothed movement is more volatile than the three-quarter moving average with bigger up-swings and lower downswings, all which is the result of the smoothing by the three-quarter moving average (as intended).

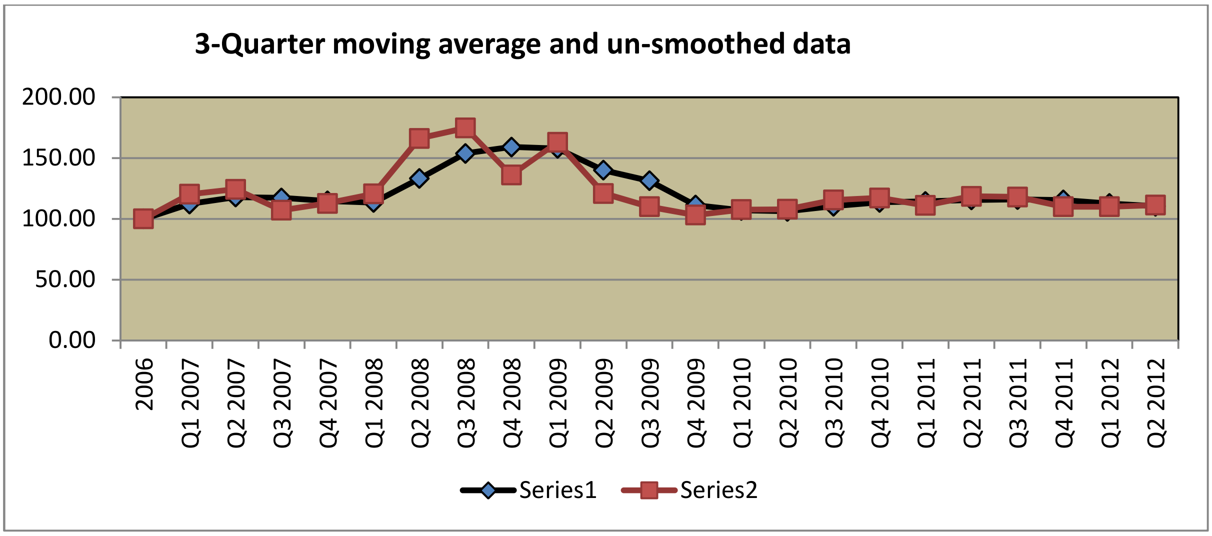

Figure 8.23 Comparison: three-quarter moving average and un-smoothed data

A more detailed analysis of the UP 2006 index, where it will be compared with other indices, as well as the movement of individual rates, etc. will be done later in the study, under the heading of “Research Findings”.

8.5. SUMMARY

In this chapter, the calculation of the index was discussed with reference to the source and sample size of the unit rates that were used in the index, as well as the method of dealing with outlying rates. Each of the individual indicator items was also discussed in terms of their influence on the index, and whether they should be kept in any future use of the index. After that, the use and calculation of a three-quarter moving average of the rates was explained. This was then used to calculate the complete index, with the movement thereof graphically presented.

8.6. CONCLUSION

It may be concluded for this chapter, that the composition of the UP 2006 index was done, according to accepted practice regarding tender price indices, as indicated in published literature, as well as similar types of indices to those used in other countries. There will be a discussion later in the study, where it will be compared with other indices, and with the movement of the economy in general, to further test its validity; but in general terms, it can be accepted that the basic composition of the index was in terms of the accepted norms and standards. The discussion of individual rates indicated that some changes, and/or the omission of some items, might be necessary in the weighting of the index. This will be taken into consideration in any further commercial use of the index.

CHAPTER 9

THE RESEARCH FINDINGS

9.1 INTRODUCTION

In Chapter 1 the following research questions were identified for the purposes of this study:

Question 1: Why would it be necessary to establish a new TPI for the South African building industry?

Question 2: What methodology should be used, in order to establish a new TPI?

Question 3: What are the uses and perceptions on TPIs by the quantity surveying profession in South Africa?

Question 4: How do overseas countries, such as Australia and the UK, compare with South Africa regarding similar types of indices?

The research findings of the study relating to the above questions will now be discussed.

9.2 THE RESEARCH FINDINGS

9.2.1 The findings: Question 1

As stated in the introduction, this question relates to why it is considered necessary to establish a new TPI for the South African building industry. This aspect of the study was discussed in Chapter 3, where the development of cost indices in South Africa was investigated. As explained in this chapter, the BER building-cost index is currently the only index of its kind that is being published in South Africa. The history, as well as the compilation of the BER index, was explained by means of a literature study. From this study, it became evident that the BER index is based on a single-storey building, and that the weights of the index have not been revised since the inception of the index in the early 1960-s.

Based on the above evidence, coupled with the fact that there is no other similar index available in South Africa against which to compare the accuracy of the BER index, it may be concluded that there is an opportunity to establish a new TPI for the South African building industry: one that is based on more recent indicator items that are based on a greater variety of buildings.

9.2.2 The findings: Question 2

The aspects related to this question were discussed in Chapter 2 by means of a literature review of the index methodology. After looking at different types of indices, as discussed in the literature, it was decided — for this study, to use a weighted-composite price index, since most of the important indices that are being used in the construction industry comprise such indices. It was further decided to make use of the methodology, as found in a Laspeyres index: *viz*. a base-weight composite index. The reason for this decision was, according to Marx (2005), because it is the most popular composite index.

Another advantage of using a Laspeyres-type index as basis, is because the BER building-cost index is also a Laspeyres index; and therefore, any new index can be easily compared with it.

After deciding on the type of index to use, the following six factors, all of which have an influence on the composition of an index, were investigated:

9.2.2.1 The purpose of the index

It was established that the reason for establishing a new TPI for the South African building industry would be to measure the movement of tender prices of commercial, industrial and public buildings, over time in South Africa.

9.2.2.2 Availability of the data

From the literature, it may be deduced that that there should be enough data in the right format available on a continuous basis, in order to construct and maintain a TPI on a long-term basis. It was concluded by a number of authors (Yu & Ive, 2008; Akintoye, 1991; Flemming & Tysoe, 1991) that bills of quantities provide a rich source of information on the rates, as well as the quantities of the various trades that are measured for tenders of building projects. Van der Walt (1992) concluded, more than 20 years ago already, that in South Africa tender prices for different types and sizes of projects are obtained regularly throughout the country by means of bills of quantities.

Since this situation is still relevant today, it was decided to use priced bills of quantities of successful tenderers, as the data source.

9.2.2.3 Selection of items to be included

As stated in the literature, it was required that a representative sample of items should be surveyed from the entire survey population, in order to be used in the construction of an index, *viz.* the minimum number of indicator items from priced bills of quantities that collectively represent a high proportion of the total value of all the various construction projects. The actual choice of indicator items to be used in the construction of a new index, as well as the weight thereof, will be discussed under the heading: ""Choice of weights" (9.2.2.5).

9.2.2.4 Choice of base period

As discussed in Chapters 2 and 7, the base year for the purposes of this study was chosen as 2006. The reason why 2006 was chosen as base year was because it complied with most of the requirements, as described in the literature for an acceptable base year: *viz.* a relative normal year (no wars, droughts, floods, etc.), a year for which reliable data are available, and a fairly recent year.

9.2.2.5 Choice of weights

The actual selection of indicator items, together with the determination of the weights, was discussed in Chapter 6. It was first decided to compose an "average" representative building, by analysing the priced bills of quantities of 40 representative buildings of various types and sizes throughout South Africa. The decision to use an "average" building was based on the fact that currently the BER index, as well as Van der Walt's index is based on an average building. Further, the study is based on CPI methodology which is calculated from one basket of weights; similar to the principles of an average building. From these 40 buildings, a basket of weights was determined by analysing the trades of the various projects. Secondly, by adopting the “5% rule”, weights were assigned to 32 indicator items, representing most of the trades as found in the SSM. These indicator items and their weights were used further on in the study as base weights, in order to construct the new TPI.

9.2.2.6 Method of construction

The method of construction relates to the choice between the numbers of formulae that are available to monitor the movement of prices in the building industry. As mentioned before (9.2.2), the Laspeyres index, where base year weightings are used as the method of constructing the index, was used for purposes of this study.

9.2.3 The findings: Question 3

The uses and perceptions of TPI’s by South African quantity surveying firms were determined by means of a questionnaire survey; and this was discussed in Chapter 5. The main findings that arise from this survey are the following:

- As many as 89% of the respondents indicated that they consult the BER/MFA report from time to time, although they do not necessarily subscribe to the report;
- A total of 64% of the respondents, either seldom or never, contribute information to the BER building-cost index. This can be problematic in terms of the stability of that index. The main reasons for not contributing any information were given as being that practices do not have enough information; they were never asked to make a contribution; or that it is too time-consuming to complete the forms;

- The majority of the respondents (89%) agreed that a TPI is an important tool for use by quantity surveyors;
- The statement that a new TPI should be compiled by an academic institution with the necessary expertise in the building industry, was supported by the majority (64%) of the respondents;
- When asked the question whether their practices would be willing to contribute information, such as priced bills of quantities for the compilation of a TPI electronically, the response of 85%, in favour of this suggestion, was positive;
- The majority of the respondents (63%) indicated that they were willing to pay a subscription fee to gain access to a new TPI, provided that it was published on a regular basis. This can be read in conjunction with a previous question, where most of the respondents indicated that they would like to have access to an alternative TPI;
- In contrast with the previous question, when asked whether a TPI should be funded by external funds and made available free of charge to the industry, the majority of the respondents (69%) indicated their preference to receive a new TPI free of charge;
- An overwhelming majority of the respondents (85%) agreed with the statement that the ASAQS should play an active role in the publication of a new TPI;
- In terms of other information, apart from a general TPI for building-cost movement; the majority of the respondents indicated that they would also find it useful to have a TPI published per geographical region; a TPI for different building types, as well as separate indices for electrical and mechanical works;
- The majority of the respondents (79%) agreed when asked, whether there is room in South Africa for an organization similar to that of the BCIS in the UK.

In summary it may be concluded from the response to the survey that the majority of the quantity surveyors in South Africa have a positive perception towards the use of tender-price indices in general. A further conclusion is that it is evident that quantity surveyors would welcome the introduction of a new TPI, based on recent information, in the South African building industry.

9.2.4 The findings: Question 4

A separate Chapter (Chapter 4) was dedicated looking at the occurrence of tender-price indices in a number of selected countries. Various sources were utilized to obtain the necessary information regarding the compilation, use, methodology, and so forth of indices in overseas countries: for example, surveys by other bodies, the World Wide Web, personal communication, papers published in academic journals, or those delivered at international conferences.

The findings of this investigation are that, although a number of countries do produce and publish tender-price indices, there is no real consistency in the way that this is being done. Broad areas of consensus regarding the compilation of TPIs in different countries are the following:

- Weighting and re-basing: Most countries use some form of weighting in their respective indices. Re-basing does happen over the lifetime of an index; but the frequency differs between different countries.
- Index type: The most common type of index that is used is a fixed-weight Laspeyres-type index.
- Rate sources: Priced bills of quantities are generally used as rate sources in countries, where they form part of the procurement process. Otherwise, various means of collecting information on rates (e.g. surveys) are utilized.
- Publication: Almost all the selected countries publish indices on a quarterly basis.

9.2.5 Construction of the index

As stated in Chapter 1, the aim of the study was to establish a new TPI for the South African building industry. The findings of the research questions that flowed from the main problem statement (how to establish a new TPI), have already been discussed; and therefore, the results can now be discussed. The calculation of the actual index was done in Chapter 8; and for clarity, a short summary of the procedure followed, will now be given.

Source and sample size: A total number of 231 priced bills of quantities from those collected from quantity surveyors in South Africa were utilized in the calculation of the index. This sample provided sufficient variation in terms of project type, as well as monetary value, to be deemed adequate and appropriate for purposes of the study.

Analysing bills of quantities: The priced bills of quantities of the 231 projects indicated above were analysed per quarter, in terms of the 32 indicator items that were previously identified as being representative items.

Dealing with variations in unit rates: After the analysis of the bills of quantities was complete, it was found that substantial variations occurred in unit rates during the same time period. Various ways of dealing with the problem of outliers were experimented with, resulting in the methodology, where the values of both the highest and lowest unit rate of an item in a quarter were discarded; and the arithmetic mean of the remaining items was calculated for use as the base rate for that quarter.

Discussion of indicator items: The movement of each of the indicator items was shown graphically and discussed, in order to look for any inherent problems there might be, and to ascertain whether any changes might be required in future. It was found in this analysis that consideration should be given in future to the replacement of some of the current indicator items in the index with other items with a greater frequency of occurrence and/or a bigger weighting in the index.

9.2.5.1 Calculation of the index

The calculation of the index, called UP 2006 index for the purposes of this study, can now be discussed. Some important issues regarding this calculation are the following:

Three-quarter moving average: It was shown previously (in 9.2.5) how excessive variations in unit rates were dealt with. After this exercise was done for each quarter, it became apparent that there were still a large number of fluctuations among the unit rates. Consequently, it was decided to calculate a three-quarter moving average of the rates, in order to smooth out any short-term fluctuations. For clarity the un-smoothed data set (before the three-quarter moving average was calculated) was also shown and a comparison done with the movement of the three-quarter moving average in order to determine whether there was any significant difference. Since the two data sets largely followed the same curve, it was decided to use the three-quarter moving average as basis for the index.

Index base: The whole of 2006 was used as the base year (2006 = 100). This was achieved by averaging all indicator rates for all four quarters of 2006, thereby resulting in the base rates. After this was done, these base rates were multiplied by the weightings of each indicator item. The resultant total could then be considered to be equal to 100 (refer to Table8.4).

Calculation of complete index: The calculation of the complete index for the time period under investigation could now take place — by following the principles of the Laspeyres index. The calculation for the full time period can be seen in Table 8.6; and is graphically illustrated in Figure 8.22.

9.2.5.2 Comparison with other indices

In the discussion that followed the completion of the UP 2006 index calculation (8.4.3), it was mentioned that although the index was constructed, according to well-known tender-price methodology and that it could, therefore, be assumed that the basic composition of the index was in terms of accepted norms and standards. However, the index had to be compared to other similar indices, in order to further test its validity.

According to the published literature, it is difficult to say whether any index is sufficiently accurate or inaccurate, as an index, according to van der Walt (1992), is relative, and that it is not its absolute values that are important, but its tendency over time. Resulting from the above, the following comparisons can, therefore, be made:

9.2.5.2.1 BER and UP 2006

It is a logical step to do a comparison between the BER building cost-index and UP 2006 index, as the BER index is currently the only other similar index available in South Africa. It must be noted that, in order to compare the two indices over the same time period, it was necessary to extract the information for the BER index from the published information by Medium Term Forecasting Associates (2008, 2010, 2012 & 2013) for the time period under investigation (2006 to second quarter 2012), and then to extrapolate this data to coincide with UP 2006 (*viz*. with 2006 = 100). The results of this comparison are graphically illustrated in Figure 9.1.

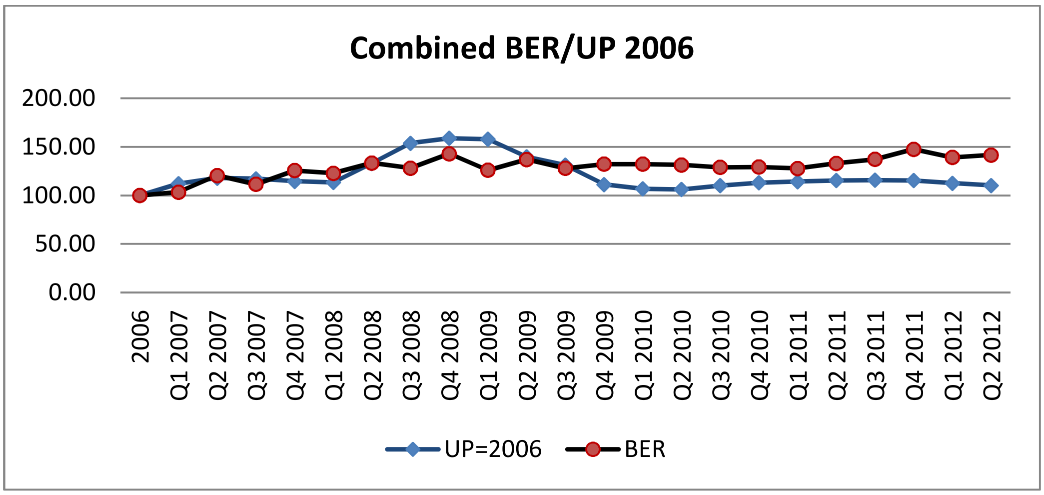

Figure 9.1: Combined BER/UP 2006 indices

As can be seen from Figure 9.1, there is a reasonable degree of correlation between the two data sets. Both graphs show an upward curve from 2008 to the beginning of 2009, although the UP 2006's upward trend is more pronounced. The biggest difference between the two graphs is shown in the rest of 2009, when the UP 2006's trend is sharply downwards — from a number of about 158 to just above 106, — whereas the BER's downward trend is more gradual (from a number of 132 to approximately 127). During 2010 to the middle of 2011, the BER stays almost on the same level — with an upward trend towards 2012; while the UP 2006 is showing a more gradual upward curve that is still below the total level of that of the BER.

9.2.5.2 BER and UP 2006 combined with CPAP workgroup 181 and CPI P0141

Although the BER building-cost index is the only index similar to the UP 2006 index, there are other indicators that could be looked at for discussion purposes. The first of such indicators is Workgroup 181 of CPAP. As discussed before in Chapter 3, the CPAP indices represent the composite indices of the components of various cost inputs of building contractors, such as labour, material, plant and fuel. Workgroup 181 of the CPAP indices represents commercial and industrial buildings throughout South Africa; and these indices are published together with other Workgroups as part of Statistical Release P0151, published by Statistics South Africa.

As with the BER index, the information was extracted from these publications for the time period under investigation, and then extrapolated to co-inside with UP 2006.

The CPI is published monthly, as Statistical Release P0141, by Statistics South Africa. This release contains the results of the monthly survey of consumer (retail) prices. The purpose of the survey, according to Statistics South Africa (2008 – 2012), is to collect and provide information regarding the changes in the overall level of prices of goods and services bought by average households in South Africa. The same procedure was followed, as with the BER and Workgroup 181: information was extracted for the same time period and extrapolated, so that the results for 2006 represent 100.

The results of the combined UP 2006, BER, Workgroup 181 and CPI are graphically illustrated in Figure 9.2.

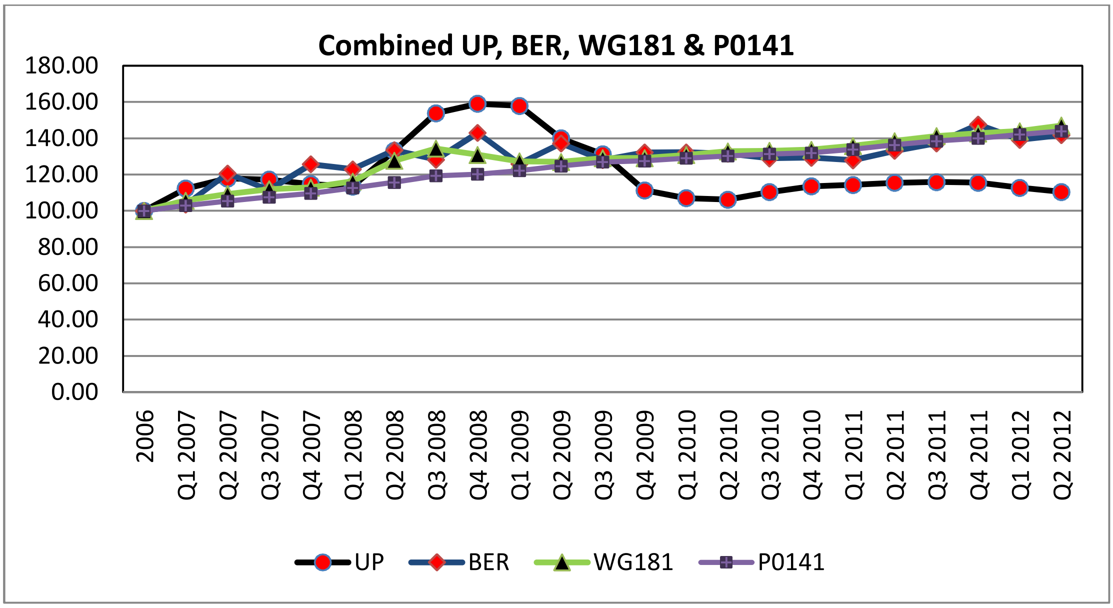

Figure 9.2: Combined UP, BER, Workgroup 181 and CPI

From Figure 9.2, it may be observed that the graph for Workgroup 181 shows a steady increase over the two years from 2006 to the end of 2007 (12,92%). Following that, there is then a sharp upward curve in the graph, with an increase of 18,95% during the first three quarters of 2008. This is in line with the graphs of both UP 2006, as well as BER, although less pronounced. After that, the graph shows a slight decrease of 5,44% to the second quarter of 2009; where-after it steadily increased right through to the second quarter of 2012. This last-mentioned increase is in contrast with UP 2006, which shows a sharp decline during 2009, and a slow increase from 2010 to 2012.

The BER also indicates a slight decrease during 2011, although not as pronounced as UP 2006. The fact that Workgroup 181 did not indicate the sharp decrease in prices, as was found in comparison with the graphs on tendered rates, can be attributed to the fact that it can happen during times of a decline in a country's building activities that, although the input prices will still rise — due to increases in the cost of labour and material — those tender rates could still come down. This is because of the competitive nature of the building industry, where contractors tend to price their costs for Preliminaries, as well as for profit and overheads, very low — in order to stay in business. This statement is confirmed by authors, such as Mohammadian and Seymour (1997); Seeley (1997); and Marx (2005). On this issue, Marx (2005) states the following: *"A big demand for construction work usually means that tender prices increase more than building costs, [and this is] due to an already high work load. In such a case, a tender(er) is not hard up for work so, he increases the profit margin when tendering. When work is scarcer, tender prices are cut drastically to obtain work, with the result that tender prices drop, despite possible cost increases".*

Mohammadian and Seymour (1997) concur with this view, by indicating that one reason for this is that the output-price indices reflect the market prices, which are much more volatile than the basic material and labour input costs.

9.3 SHORTCOMINGS OF THE INDEX

The shortcomings of the index, as identified in the research, can be summarised as follows:

9.3.1 Number of projects

According to the literature, an "adequate" number of priced bills of quantities of projects is needed to calculate a successful index, although no indication is given as to what an "adequate" number should be. The UP 2006 index is based on an average of 36 projects per year, or nine projects per quarter (Table 8.1). Since not all indicator items appear in every project; and because of the variations that occur between the unit rates received for the same item, it would be ideal if a greater number of projects could be obtained. Although it is difficult to speculate on what a good number of projects would be; it was found in the research that when in excess of fifteen projects were analysed in a quarter, the differences in unit rates seemed to become less pronounced.

One of the questions asked in the survey of South African quantity surveying practices was whether the practices would be willing to contribute information in electronic format to be used for the compilation of an index. The majority of practices answered positively to this question (see Figure 5.15). Another question related to the involvement of the ASAQS in the publication of a TPI; and the majority of the practices indicated that the ASAQS should play an active role in the publication thereof. It is, therefore, envisaged that South African quantity surveying practices could be asked to submit priced bills of quantities of projects in electronic format to the ASAQS — which, in turn, could make this information available for research purposes to interested parties. One of the uses of such information would be the continuous publication of an index.

9.3.2 Multiple procurement

As discussed previously, the current way of procuring tenders — where a large part of the bills of quantities consists of provisional sums — limits the amount of information that is available and useful in terms of an index. If more priced bills of quantities could be sourced, as discussed under 9.3.1, the request to quantity surveying practices should be to, not only submit the original priced document used for tendering purposes, but all "mini-bills" that are subsequently used to procure tenders for nominated and selected subcontractors, such as structural steelwork, tiling, ceilings, ironmongery, plumbing and drainage, and so forth.

9.3.3 Individual indicator items

As discussed in Chapter 8, it was found that some indicator items that are being used in the basket of items, seemed to be superfluous; either because they did not make a significant contribution to the index; or because there were two similar items, where one of these items would have been adequate to show any movement of the unit rate for such items. Examples of such items that were discussed are: Waterproofing under surface beds, timber skirting, cement-plaster screed to concrete floors, three-lever locksets (although this item could possibly be kept, if enough information is received), mirror to walls, etc. In future, when the indicator items of the index and their weights need to be revised, these specific items should be considered for scrutiny.

9.3.4 Electrical and mechanical installations

Currently, the indicator items for electrical and mechanical installations are expressed as a rate per square metre of the various projects, as previously discussed in Chapter 8. This only gives a very broad indication of the movement of the rates of these items; and this could be deemed to be unsatisfactory, as these two items constitutes a large part of the index (28,90%, as per Table 6.7), for which more accurate information is needed. The ideal situation would be where electrical and mechanical installations for a number of projects could be analysed, so that the indicator items with the biggest monetary value, which appear on a regular basis, could be identified.

The unit rates for these indicator items should then be obtained from reputable sources on a regular basis, such as consulting electrical and mechanical engineering practices, consulting quantity surveying practices that specialises in electrical and mechanical work, as well as from major electrical and mechanical contractors. If this is successful, it may even lead to separate indices for mechanical and electrical installations that could be used in conjunction with a TPI; and which could, at the same time, satisfy some of the requests for additional information, as indicated by various respondents to the survey of quantity surveying practices.

9.4 SUMMARY

The research findings of the four research questions posed in Chapter 1 were discussed in this chapter. The method of construction, as well as the calculation of the new TPI, was also looked at and discussed. As it was found that the UP 2006 index is based on acceptable tender-price methodology, the index could be compared with other existing indices, in order to test its validity. Such a comparison was done between UP 2006 and the BER building-cost index, as well as a combined comparison between UP 2006, BER, CPAP workgroup 181, and CPI P0141.

From this comparison, it could be deduced that there is a correlation between UP 2006 and BER. Although the correlation of UP 2006 and BER with workgroup 181 and CPAP P0141 is less clear, the overall movement of the four indices, as indicated in the combined graph, can be assumed to be an acceptable trend, because of the cyclical nature of the building industry, as indicated in the literature.

CHAPTER 10

CONCLUSION AND RECOMMENDATIONS

10.1 INTRODUCTION

This research was prompted, because there is currently only one TPI available in the South African building industry. This index, the BER building-cost index, was established during the mid-1960s, based on a single storey building. Van der Walt (1992) also constructed a TPI that was published for some years by Statistics South Africa; but was this discontinued during the late 1990'-s — due to a lack of funding. This raised the question whether there is a need for a new TPI for the South African building industry, comprising a basket of weights and indicator items, based on a variety of recently erected building projects.

10.2 ACCEPTING THE PROPOSITIONS

Emanating from the research findings, as stated in Chapter 9, the propositions that were put forward in Chapter 1 can now be tested:

Secondary proposition one: *South Africa's building industry needs a new TPI because of the age of the current index*. This proposition can be accepted, since it is clear from the discussion of the history of indices in South Africa, and in particular that of the BER building-cost index, as well as in consideration of the results of the survey conducted of quantity surveying practices in South Africa, that the South African building industry can only benefit from a new TPI. Currently, there is no means or mechanism to check whether the BER index is still measuring the movement of building cost accurately; while a new TPI would fulfil that function.

Secondary proposition two: *The methodology for constructing a new index must be based on general index theory, as well as recent information, such as that provided in recently priced bills of quantities.* This proposition can also be accepted, since it is clear from the study that by using existing index theory — that has been tested over time in various countries — as well as by using information obtained from recently prices bills of quantities, that a new, reliable TPI could be constructed. The only proviso that must be added in this regard is that there should be enough information available in the format of priced bills of quantities of recently tendered projects — from all over the country.

Secondary proposition three: *The perception among quantity surveyors in South Africa is that a TPI would be a useful tool, but that there is a need for a new, recently constructed TPI for the South African building industry.* Resulting from a survey of quantity surveying practices in South Africa, it is evident that quantity surveyors, in general, see a TPI as a useful tool to be used in their daily quantity surveying work; and therefore, they use the BER index on a regular basis. They are also of the opinion that there is a need for a new TPI for the building industry, because they are generally unsure whether the BER index still measures the movement of building costs accurately.

Secondary proposition three, can therefore, on the basis of the above, be accepted.

Secondary proposition four: *Different countries use different approaches to calculate indices, although there are broad areas of consensus among the countries, as well as within South Africa, such as weighting, type of index, rates sources, publication thereof, etc.* It was found from the selection of countries that were examined that a number of these countries make use of TPIs that are similar in nature to those examined in this study. Although the approach to the construction of such indices may differ in some aspects from country to country, most of the major issues related to index theory, such as weighting, the type of index, the sources of rates (i.e. priced bills of quantities), the frequency of publication, and so forth, remain largely constant. Therefore, secondary proposition number four can be accepted.

Primary proposition: *It should be possible to establish a new tender-price index with a wider range of indicator items, based on buildings that represent current building methods.* From the secondary hypotheses, as well as from the research findings, it may be concluded that the new TPI that was developed, UP 2006, is based on buildings that represent current building methods, since the weightings were derived from the analysis of 40 recent building projects. These projects were chosen from a sample that represents the type and quantity of building projects erected during a certain time period throughout South Africa. From these 40 projects, 32 indicator items were identified, based on their relative importance, as they have occurred in the various trades of each building. From this, the assumption can be made that the primary proposition can be accepted.

10.3 CONCLUSION

It was established in Chapter 1 that there is a definitive need for a study of this nature due to the fact that there is currently only one similar type of index available in South Africa, the correctness of which can be questioned.

Validity is defined by Saunders *et al*. (2009) as the extent to which data collection methods accurately measure what they were intended to measure. In the model that was presented, internal validity of the outcomes was established because the changes that occurred in the dependent variable (cost fluctuations) were due to the dependent variable (fixed-weighted indicator items) rather than other external factors. Similarly external validity was established because a representative sample (priced bills of quantities of completed projects) was used to construct the model. Because of the above, the model can be considered valid as it measures the movement of tender prices as intended.

The model can furthermore be considered to be reliable as it was based on existing theory and therefore it can be expected that similar observations would be made by other researchers if the study is repeated elsewhere.

Because the model can be classified as “new knowledge”, it will be contribute to the existing body of knowledge of the South African quantity surveying profession where little research has been done on this topic in the past.

10.4 PRACTICAL IMPLICATIONS

The study has resulted in a model for a new TPI for the South African building industry, UP 2006, which would have the following practical implications:

- If an agreement can be reached between the ASAQS and South African quantity surveying practices on the submission of priced bills of quantities of completed projects, on a regular basis to the ASAQS, for use in the continuous calculation of the index, the index could be published quarterly on a commercial basis for use by the South African building industry.
- If enough information is submitted in the format described above, separate indices could be constructed and published for different building types, such as offices, shopping centres, industrial buildings, hospitals, and so forth.
- The index could be used, in collaboration with economists and/or econometricians, to forecast the movement of tender prices, based on historical information, as this derived from the index.
- Although it is questionable whether there would ever be enough information available in the form of priced bills of quantities of accepted projects, in order to publish the index on a regional basis, viz. for each province in South Africa, research

could be conducted, in order to be able to use regional factors in conjunction with the index (see discussion in 10.4)

- All the above could lead to the establishment of a building-cost research centre similar to the BCIS, probably situated at an academic institution, where most of the work and research, as described above could be conducted

10.5 SUGGESTIONS FOR FURTHER RESEARCH

Before some of the practical implications, as discussed in 10.3, can be implemented, the following research would have to be conducted:

- Analysing priced bills of quantities for different building types, such as offices, shopping centres, industrial buildings, hospitals, and so forth in order to have bespoke indices for each of these building types.
- Similarly, separate indices for electrical and mechanical work could be constructed, although information on tendered rates would have to be sourced from electrical and mechanical consultants, as well as electrical and mechanical contractors, because most quantity surveying practices do not measure this type of work on a regular basis.
- As stated in the literature (Statistics Finland (2001); Statistics Directorate, European Community (1997), etc.), the weights of a TPI need to be revised at least every ten years. Since the base period for UP 2006 was 2006, it will be prudent that such a revision must be undertaken after 2016.
- Analysing rates for a number of indicator items (preferably more than the number used for the index) on a regional basis, in order to: a) See whether there are noticeable differences in the pricing of these rates between the different regions: and b) if this is the case, to convert these differences into regional factors that could be utilized in converting the index to be used on a regional basis.

- With the assistance of information technology specialists, a software program could be developed for the capturing of data and the calculation of the TPI, which is currently done by means of an Excel spread-sheet. This could be done in collaboration with the providers of the measurement software packages that are currently used to draw up bills of quantities.

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PERSONAL COMMUNICATION

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ANNEXURE 1: COPY OF BER QUESTIONNAIRE

BER
BUREAU FOR ECONOMIC RESEARCH

Privaatsak /Private Bag 5050,
Stellenbosch, 7599
Fax (021) 883 9225
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BOUKOSTE-INDEKS: ONTLEDING VAN AANVAARDE TENDERPRYSE

BUILDING COST INDEX: ANALYSIS OF ACCEPTED TENDER PRICES

Neem asseblief die volgende in ag wanneer u die vraelys op die keersy voltooi:

1. Slegs een vraelys word vir elke projek benodig.
2. Prys die verskillende items in ooreenstemming met 'n aanvaarde tender.
3. Voorlopige bedrae (elektriese werk, hysers en lugreëling): Meld slegs die netto bedrag ; bediening en wins uitgesluit.
4. Alle gekwoteerde pryse en tariewe moet BTW uitsluit.
5. Alle inligting word vertroulik hanteer.

Stuur asseblief hierdie vorm met die sakeopname vraelys terug en dieselfde keerdatum geld.

Dankie vir u bereidwilligheid om ons met die samestelling van hierdie indeks te help. Om ons dank prakties uit te druk, sal u 'n brief met besonderhede van u projek en 'n vergelyking met die nasionale boukoste-indeks ontvang.

Please bear the following in mind when you complete the questionnaire on the reverse side:

1. Only one questionnaire is required per project.
2. Price the different items in accordance with the prices of an accepted tender.
3. Provisional amounts (electrical work, lifts and air conditioning): State only the net amount; attendance and profit excluded.
4. All prices and rates quoted must exclude VAT.
5. All information will be treated as confidential.

Please return this form with the business survey questionnaire and the same deadline applies.

Your willingness to assist us in compiling the index is greatly appreciated. As a practical way

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Please print / Gebruik asb. drukskrif

For office use only				
Form No.				
Firm code				
Index				

Name /Naam ....

Firm / Firma ....

Address / Adres ....

Postal code ....

Tel. Area code .... No .... Fax Area code .... No ....

Please complete or tick the appropriate boxes.
Voltooi of merk asb. die toepaslike blokkies.

PROJECT & TOWN/PROJEK & DORP _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Contract period (months)/Kontraktydperk (maande)

Tenders received (number)/Tenders ontvang (aantal)

Private sector/Privaatsektor 1

Public sector/Openbare sektor 2

PROJECT TYPE/PROJEKTIPE

Housing/Behusing	1	Flats/Woonstelle	2
Offices/Kantore	3	Shops/Winkels	4
Education/Opvoedkundig	5	Factory/Fabriek	6
Church/Kerk	7	Hospital/Hospitaal	8
Police station/Polisiestasie	9	Postal/Poswese	10
Defence/Verdediging	11	Other (specify)/Ander _ _ _ _ _ _ _ _ _ _ _ _ _ _ _	12

DATE TENDER CLOSED/DATUM WAAROP TENDER GESLUIT HET

	Q1			Q2			Q3			Q4		
20….	J	F	M	A	M	J	J	A	S	O	N	D

AMOUNTS/BEDRAE

	Rand only, excl VAT Slegs rand, sonder BTW
Contract amount/Kontrakbedrag	
Preliminary & gen/Voorafgaande & alg	
Contingencies/Onvoorsiene uitgawes	
Electrical work/Elektriese werk	
Lifts/Hysers	
Air-conditioning/Lugreëling	

Price the following items strictly according to the description. Use only rates from the bill analysed and where applicable. Otherwise, leave blank. All prices must exclude VAT.

Prys die volgende items volgens die beskrywing. Gebruik slegs die tariewe van die hoeveelheidslys wat ontleed word en waar van toepassing. So nie, laat blanko. Alle pryse moet BTW uitsluit.

ITEM	Rand	C
Excavation for footings/Uitgrawings vir voetstukke m^3		
Mass concrete in footings/Massa beton in voetsukke m^3		
Reinforced concrete in slabs etc/Gewapende beton in blaaie ens. m^3		
Centring to slabs less than 4,5m high/Formering vir blaaie 4,5m m^2		
Reinforcement/Bewapening kg		
Vinyl or similar flooring/Viniel of soortgelyke vloerafwerkings m^2		
Half brick wall/Halfsteenmuur m^2		

Distance from nearest city (km)	0-100	100- 200	200-300
Afstand van naaste stad (km)	1	2	3

TYPE OF TENDER/TIPE TENDER

Open tender/Oop tender	1
Selected tender/Uitgesoekte tender	2
Negotiated contract/Onderhandelde kontrak	3

PROVINCE/PROVINSIE

Western Cape/Wes-Kaap	1	Northern Cape/Noord-Kaap	2
Free State/Vrystaat	3	Eastern Cape/Oos-Kaap	4
KwaZulu-Natal	5	Mpumalanga	6
Northern Prov./N.Prov.	7	Gauteng	8
North-West/Noordwes	9		

STRUCTURE/STRUKTUUR

Conventional in situ concrete/Gewone in situ beton	1
Pre-cast concrete/Voorafvervaardigde beton	2
Structural steel/Strukturele staal	3

INTERNAL PARTITIONS/ INTERNE AFSKORTINGS

Conventional (brickwork)/Gewoon (baksteen)	1
Demountable/Verwyderbaar	2

FOUNDATIONS/FONDAMENTE

Conventional/Gewoon	1
Piling/Heipale	2

One brick wall/Eensteenmuur	m^2	
280mm Hollow wall/280mm Holmuur	m^2	
Facings/Siersteenwerk	m^2	
Asbestos or galvanised iron roof covering/Asbes of Gegalvan.dak	m^2	
38mmx114mm sawn softwood in roof trusses/hout in dakkappe	m	
6mm Gypsum/asbestos ceiling (no brandering)/Plafon	m^2	
44x813x2032mm Semi-solid core door/Halfsoliede kerndeur	No	
76mm Mortice lock (4 lever) external quality/Insteekslot buite	No	
Steel door frame for 813x2032mm door (HB)/Staal deurkosyn	No	
Steel or wooden window (stock)/Staal of hout venster (standaard)	m^2	
25mm Cement screed/25mm Sement vlaklaag	m^2	
Internal plaster (one coat)/Binnepleister (een laag)	m^2	
152x152mm White glazed tiles/Wit glasuur teëls	m^2	
Glass in steel or wooden frames/Glas in staal of houtrame	m^2	
3 Coats of PVA on plastered walls/3 Lae PVA op gepleister. mure	m^2	

RATE PER SANITARY FITTING TARIEF VIR SANITÊRE TOEBEHORE		Rand only, excl. VAT/Slegs rand, sonder BTW
WC suite/WK stel	ea./elk	
Basin/Wasbak	ea./elk	
Stainless steel sink/Vlekvryestaalopwasbak	ea./elk	
20mm Gal. steel/copper pipe / Gegalv. staal/koper pyp	m	
100mm CI/PVC pipe / Gietyster/PVC pyp	m	
100mm SW/PVC drain pipe / EW/PVC rioolpyp	m	

ANNEXURE 2: COPY OF LETTER OF APPROVAL BY ETHICS COMMITTEE

University of Pretoria

Reference number: EBIT/37/2010 8 November 2010

Mr JHH Cruywagen
Postnet Suite 899
Private Bag X4
Menlo Park
0102

Dear Mr Cruywagen

YOUR RECENT APPLICATION TO THE FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

1. I hereby wish to inform you that the research project titled "Towards the establishment of a relevant national tender price index for the SA building industry" has been approved by the Committee.

   This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Codes of Research Ethics of the University of Pretoria, if action is taken beyond the approved proposal.

2. According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of any member of the Faculty Committee who will deal with the matter.

3. The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.

Prof. J.J. Hanekom
Chairman: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, THE BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

ANNEXURE 3: COPY OF SURVEY QUESTIONNAIRE

UNIVERSITEIT VAN PRETORIA
UNIVERSITY OF PRETORIA
YUNIBESITHI YA PRETORIA

Departement Konstruksie-ekonomie/
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November 2010

RESEARCH PROJECT – PhD-DEGREE

"TOWARDS THE ESTABLISHMENT OF A RELEVANT NATIONAL TENDER PRICE INDEX FOR THE SOUTH AFRICAN BUILDING INDUSTRY"

The above-mentioned research project refers.

Currently there is only one index in South Africa based on tender prices of contractors, namely the Bureau of Economic Research's BER Building Cost Index. This index was established in the early 1970's and has undergone very little changes since then.

The purpose of the thesis is to conduct a critical review of the BER Building Cost Index in terms of composition and information gathering as well as the correctness thereof. The results of this questionnaire are aimed to obtain a view on the current perspective of quantity surveyors on the use and correctness of the BER Building Cost Index as well as the need for a new, alternative tender price index for use in the South African building industry.

It would be greatly appreciated if a senior quantity surveyor in your office can spend ten minutes of his/her time and complete the accompanying questionnaire on behalf of the company. The questionnaire may be completed electronically and e-mailed or faxed to the researcher on or before 3 December 2010. All responses will remain anonymous and confidential.

Please do not hesitate to contact the researcher should you wish to receive a copy of the questionnaire results and conclusions. Your input is highly regarded and extremely valuable to influence the possible development of a new tender price index for the South African building industry

Should you require further information please contact us at the following addresses:

Contact: **Professor Tinus Maritz**

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0002

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Contact: **Mr. Hoffie Cruywagen (researcher)**

TOWARDS THE ESTABLISHMENT OF A RELEVANT NATIONAL TENDER PRICE INDEX FOR THE SOUTH AFRICAN BUILDING INDUSTRY

Respondent number

FOR OFFICE USE

*Please answer all the questions by marking with a **"X"** in a yellow box.*

SECTION 1: BACKGROUND INFORMATION

1. Size of organisation: How many people are employed in your organisation (local branch only if more than one branch)?

1)	0 - 5		3)	11 - 20		5)	51 - 100	
2)	6 - 10		4)	21 - 50		6)	> 100	

V1

2. Location: In which province in the RSA is your organisation located (local branch if more than one branch)?

1)	Eastern Cape		4)	KZN		7)	Northern Cape		
2)	Free State		5)	Limpopo		8)	North West		
3)	Gauteng		6)	Mpumalanga		9)	Western Cape		

V2

3. Economic sector: Indicate the economic sector in which the **main** activity of your company falls

1)	Private Quantity Surveying	
2)	Private Contracting	
3)	Public	
4)	Academic	
5)	Property development	
6)	Other (please specify)	

V3

SECTION 2: LEVEL OF USE AND KNOWLEDGE OF THE BUREAU FOR ECONOMIC RESEARCH (BER) INDEX

4. Are you familiar with the composition of the BER Building Cost Index?

1)	Yes		2)	No	

V4

5. Are you / your company currently a suscriber to the quarterly BER / MFA Report on Building Costs?

1)	Yes		2)	No	

V5

6. If your answer to the previous question was "no", have you previously been a subscriber?

1)	Yes		2)	No		3)	N/A	

V6

7. If you / your firm, are not a subscriber, do you still consult the BER / MFA report from time to time (i.e. by obtaining a copy from a colleague)?

1)	Yes		2)	No		3)	N/A	

V7

8. If you / your firm have unsubscribed from the BER / MFA report, please indicate the reason(s) for ending your subscription

1)	Too costly		V8 .1
2)	I / we did not use it on a regular basis		.2
3)	I / we did not trust the information published in the report any more		.3
4)	Not applicable		.4
5)	Other (please indicate the reason):		.5

9. Does your firm contribute information to the BER Building Cost Index:

1)	Regularly	
2)	Seldom	
3)	Never	

V9

10. If your answer in the previous question was "Seldom" or "Never", please indicate the reason(s) for your answer:

1)	Too time consuming to complete the forms		V10 .1
2)	Do not consider it important enough		.2
3)	Do not have enough information to contribute on a regular basis		.3
4)	Other (please indicate the reason):		.4

SECTION 3: **YOUR PERCEPTION REGARDING TENDER PRICE INDICES IN GENERAL AND THE BER INDEX IN PARTICULAR (to what extent do you agree/disagree with the following statements?)**

1)	2)	3)	4)	5)

	Statement	absolutely disagree	disagree somewhat	unsure	agree somewhat	absolutely agree		
11.	A tender price index is an important tool that is used by quantity surveyors, developers, etc on a regular basis						V11	
12.	The current BEO Building Cost Index measures fluctuations in building cost accurately						V12	
13.	The BEO Building Cost Index is outdated and should be replaced by a new index based on current building trends						V13	
14.	A tender price index should be compiled and published by an academic institution with expertise regarding the building industry						V14	
15.	My firm/company would contribute information for the compilation of a tender price index if it can be done electronically (i.e by submitting priced bills of quantities to a well known service provider)						V15	
16.	My firm/company would be willing to pay a subscription fee for a new tender price index that is published regularly						V16	
17.	A tender price index should be funded by external funds and made available free of charge to the industry						V17	
18.	The Association of SA Quantity Surveyors should play an active role in the publication of a tender price index						V18	

SECTION 4: **PLEASE INDICATE WHAT OTHER INFORMATION, APART FROM A NATIONAL TENDER PRICE INDEX, WOULD BE USEFUL TO YOU / YOUR FIRM / COMPANY**

19. A tender price index published per geographical region, i.e. Gauteng, Western Cape, Mpumalanga, etc

1)	Yes		2)	No		V19	

20. A tender price index for different building types, i.e. office buildings, shops, industrial buildings, etc

1)	Yes		2)	No		V20	

21. Separate indices for electrical and mechanical work

1)	Yes		2)	No		V21	

22. BCIS, the Royal Institution of Chartered Surveyors's Building Cost Information Services, provides research and information on cost and other aspects to the United Kingdom's

building industry. Do you think that there is a need for a similar body in South Africa?

1)	Yes		2)	No	

V22

23. What other statistics, apart from a tender price index, would you find useful in your firm / company?

-
-
-
-
-
-

V23 .1 .2 .3 .4

Thank you for your time and co-operation

PLEASE MAIL THIS QUESTIONNAIRE BACK TO:

hoffie.cruywagen@up.ac.za

or FAX it to: (012) 420 3598

ANNEXURE 4: TABLE – 40 PROJECTS SUMMARY

Breakdown of projects by trade

NO.	PROJECT TYPE	Earthworks	Conc, fmwk & reinf	Precast conc.	Masonry	Waterproof.	Roof cover.	Carpentry & join.	Ceilings, etc	Floor coverings.	Ironmongery.	Structural Steel	Metalwork	Plastering	Tiling	Plumbing & drn.	Glazing	Paintwk.	Paperhang.	Provisional sums	Total
1	Motor dealership	114 058.68	1 878 212.51		548 968.24	58 309.78	674 197.78	32 371.34	220 014.98	50 938.21	44 404.29	1 129 653.00	810 585.63	184 803.48	725 602.80	440 109.79	11 319.12	138 182.71	69 586.62	1 920 625.27	**9 051 944.23**
2	Office building	211 102.83	3 152 767.05	30 160.61	983 524.90	147 881.34	278 443.33	700 429.07	761 480.66	377 498.08	192 912.04		813 769.77	470 129.60	342 361.90	579 741.86		387 085.55	87 930.18	4 219 188.26	**13 736 407.02**
3	Health centre	219 595.22	861 706.55		1 788 010.80	97 217.76	563 094.77	1 390 625.73	845 888.84	623 415.77	546 568.71	244 701.28	796 791.09	480 313.62	128 599.60	825 754.77	60 019.47	409 125.62		6 807 880.99	**16 689 310.59**
4	Retail and offices	539 320.78	8 443 409.42		2 303 643.19	271 432.35	587 694.98	78 243.81	926 731.66		43 839.43	1 965 177.90	1 416 669.78	727 671.80	1 182 786.08	2 320 060.40	9 148.81	305 268.64		9 544 461.71	**30 665 560.74**
5	Factories	198 067.00	1 541 077.50		824 148.00	197 871.00	1 022 854.29	45 939.00	251 667.00	30 030.00		3 075 542.82	524 949.00	233 640.00	191 145.00	260 458.45	31 418.00	119 586.00		3 877 000.00	**12 425 393.06**
6	Admin blcok & lecture rooms	103 084.65	951 630.38	39 062.21	667 485.74	79 750.20	82 209.08	201 699.55	301 673.57	191 760.76	55 341.85		307 025.42	129 409.17	44 744.30	187 741.82	141.91	107 282.09		1 629 914.54	**5 079 957.25**
7	Value centre	263 311.77	1 869 001.00		651 538.14	85 672.79	550 449.54	24 708.53	294 388.13		53 389.76	1 145 119.83	406 630.34	133 696.21	275 491.37	282 130.55	3 445.85	99 751.49		3 462 494.69	**9 601 219.99**
8	Motor dealership	534 795.30	7 266 471.35		949 388.57	250 043.22	652 684.42	33 803.38	624 889.69	230 465.33	0.00	1 310 567.52	2 134 238.13	1 272 224.10	736 914.75	1 500 670.29	10 443.07	444 410.50		4 725 900.00	**22 677 909.60**
9	National library	1 607 252.37	39 448 102.11	1 236 989.71	6 934 740.20	2 310 616.12	968 278.98	11 854 876.23	4 243 599.00	5 492 723.31	567 852.07	7 824 318.96	15 512 031.48	3 639 902.84	3 435 334.20	2 760 498.48	93 477.76	1 773 677.52	194 964.09	89 953 402.15	**199 852 637.58**
10	University residence	558 642.25	16 530 543.12		4 938 504.20	313 808.79	741 608.77	1 525 381.23	399 663.30	12 897.77	2 738 981.61	4 134 408.40	8 220 723.34	3 258 818.30	4 875 296.50	11 454 719.80	48 445.73	1 240 266.36		24 117 493.44	**85 110 202.91**
11	Animal enclosures	220 312.14	3 076 178.10	94 907.30	1 676 728.46	199 491.67		123 090.47			848.08		1 067 472.17	776 644.08			106 066.30	284 878.11		1 316 661.57	**8 943 278.45**
12	Magistrate's court	918 523.94	3 276 375.69	27 864.29	1 494 881.52	143 746.11	224 182.92	1 719 671.85	277 308.01	151 046.41	157 824.16	257 864.68	757 404.04	250 109.08	308 899.54	1 029 613.74	7 502.08	147 394.71		8 406 604.97	**19 556 817.73**
13	Block of flats	657 302.85	17 243 921.73	451 765.22	4 575 428.96	610 972.21		1 222 374.26	241 194.88	781 905.62	340 751.94	2 334 318.42	2 045 727.20	3 410 510.47	2 995 910.40	3 588 985.32	32 332.69	2 063 597.14		17 610 838.49	**60 207 837.81**
14	Laboratories	1 442 797.85	15 248 945.09	46 484.65	1 257 646.22	1 101 730.09	397 033.39	354 806.63	986 674.11	73 661.70	426 528.68	1 342 605.14	1 589 408.62	1 598 076.70	238 573.94	1 903 051.35	13 687.12	1 187 680.07		29 002 814.35	**58 212 205.71**
15	Retirement village	5 837 810.96	10 930 207.21		23 530 548.14	544 699.00	9 448 753.22	23 335 883.40	9 231 616.89	1 705 533.06	2 598 287.12		3 489 699.93	14 652 521.62	8 138 087.87	16 731 962.13	1 266 724.46	4 281 500.36		31 227 818.54	**166 951 653.91**
16	Training facility	64 014.18	4 695 272.88	36 444.49	1 312 324.27	47 978.00	979 352.59	110 217.93	929 324.11	558 757.48	81 129.75	2 025 980.51	2 095 080.12	1 089 173.79	418 682.90	1 501 860.02	3 748.38	177 775.64		8 921 458.58	**25 048 575.63**
17	Hall and resource centre	677 877.81	1 194 939.79		879 925.66	85 213.81	225 718.14	204 274.11	226 432.86	30 170.09	81 751.60	483 604.19	101 208.37	376 550.96	454 561.20	1 126 292.37	69 076.48	84 431.38		1 887 843.07	**8 189 871.91**
18	Holiday chalets	160 187.67	368 766.52		1 455 607.19	12 865.54	723 974.10	761 966.29	53 557.58		23 037.73		615 806.35	132 816.93	218 277.92	639 509.28	18 794.80	239 186.59		1 559 011.13	**6 983 365.63**
19	Primary school	1 082 502.88	3 728 211.78	154 782.86	7 384 426.17	341 353.46	2 170 441.63	1 598 394.19	1 467 003.91	80 298.37	479 484.95		924 838.91	656 858.72	1 062 182.00	2 693 994.57	418 252.35	1 308 512.98		4 443 066.66	**29 994 606.39**
20	Office block	336 537.17	2 017 861.70		1 048 228.22	16 288.38	324 818.78	167 537.04	199 450.13	70 227.65	22 102.08	529 967.48	389 585.67	152 923.25	234 462.53	301 406.80	7 586.79	133 040.26		3 816 756.14	**9 768 780.06**
21	Rooms, country estate	114 803.26	1 504 681.32	16 657.99	1 709 302.70	203 037.38	274 882.97	620 486.38	505 948.45	414 792.97	10 838.43		1 794 697.68	719 789.98	1 528 323.47	1 429 369.06		253 139.63		6 799 100.38	**17 899 852.06**
22	Computer centre	2 113 514.93	149 505 153.03	316 638.42	12 044 408.63	5 013 010.30		868 045.13	23 659 324.91	2 299 581.75	900 749.56		25 989 928.95	11 499 327.25	1 643 064.47	2 120 113.88	46 410.46	2 038 791.43		327 983 733.77	**568 041 796.88**
23	Workshop & offices	567 400.32	3 798 584.27		1 149 484.28	72 934.60	507 029.03	135 147.90	341 509.52	172 131.46	102 437.43	1 750 599.61	1 200 364.72	559 969.72	595 641.65	1 959 311.11	12 783.24	208 047.28		5 276 298.31	**18 409 674.45**
24	Hospital	2 653 470.78	17 066 156.72		5 218 450.43	2 183 315.88	247 447.96	1 210 716.09	2 902 980.78	1 980 836.91	1 330 117.95		2 166 417.29	3 862 745.03	554 927.60	4 839 088.80	62 460.58	2 302 883.36		37 334 367.74	**85 916 383.91**
25	Labs, stores	274 077.44	2 640 832.32	44 038.40	1 580 065.54	143 718.96	680 603.28	80 270.40	224 742.00	72 811.20	15 036.00	1 260 000.00	628 807.20	811 479.20	858 082.40	385 678.72	2 488.64	166 561.92		6 552 000.00	**16 421 293.62**
26	Warehouse, offices	734 658.00	2 144 704.12		578 682.59	114 598.69	893 527.89	357 448.14	53 444.85			1 147 054.73	394 413.24	148 343.71	184 923.20	180 720.40	1 796.70	131 859.75		1 963 390.56	**9 029 566.56**
27	Factory	485 219.19	251 555.24	1 512.39	198 581.55	18 993.53	261 874.50	15 730.96	12 046.43	2 275.09	12 860.50	483 008.23	125 851.57	37 278.73	19 290.75	175 954.29	22 364.41	16 782.39		648 169.20	**2 789 348.95**
28	Call centre	2 362 901.28	6 345 316.13		1 682 160.07	406 233.22	291 364.60	237 853.86	3 949 340.80	546 468.37	169 538.00		316 147.73	619 108.27	846 771.83	948 721.01	19 074.42	252 308.87		15 742 733.72	**34 736 042.20**
29	Office block	1 235 576.64	23 326 120.20	3 554 694.62	3 010 016.72	2 612 519.07	1 236 617.10	388 024.19	954 544.81	2 307 317.86	117 852.50	2 046 811.26	1 573 140.77	2 225 360.72	3 748 709.06	1 816 194.78	0.00	612 447.14	634 922.92	38 749 533.31	**90 150 403.67**
30	Office block	714 714.71	14 235 954.25	607 083.72	2 524 991.92	625 269.14	428 170.43	965 870.98	5 095 799.37	1 304 011.33	1 408 945.65	478 243.55	16 340 808.39	1 635 773.75	2 243 338.56	3 515 497.58	24 280.06	841 291.20	75 221.83	21 380 537.70	**74 445 804.11**
31	Church admin	1 106 777.58	8 612 360.07		2 500 123.94	229 341.03	1 076 651.55	335 278.14	1 624 099.93	455 829.93	308 006.19	4 475 913.05	1 862 553.61	875 009.88	1 195 991.13	939 319.30	28 971.78	444 461.99		11 232 221.75	**37 302 910.84**
32	Office block	768 770.55	27 758 353.56		2 061 625.18	1 650 206.32		396 774.75	3 977 432.55	1 221 640.00	113 998.65	897 763.35	5 567 988.03	2 542 952.97	2 766 757.51	3 596 204.18	102 276.84	914 675.95		26 063 547.30	**80 400 967.68**
33	Office block	58 081.59	3 582 110.94		1 054 893.85	111 472.70	154 736.74	431 796.73	618 671.48	72 303.85	90 915.13	734 783.30	1 311 248.59	190 779.98	496 526.58	326 064.84	56 259.52	187 986.73		3 675 376.48	**13 154 009.05**
34	Office park	580 384.70	12 306 074.13	667 166.02	3 571 424.91	946 107.85		231 963.45	221 911.42	976 517.43	899 757.98		6 987 311.96	1 080 784.98	1 966 700.88	2 224 331.21	29 332.39	1 273 809.34		8 644 991.54	**42 608 570.21**
35	Retail centre	2 461 575.06	17 920 227.99	469 804.98	7 044 692.02	670 205.15	3 024 636.08	2 089 984.14	1 672 658.56	161 154.75	114 236.91	4 547 739.84	2 351 389.95	2 707 825.54	1 491 558.98	2 725 745.14	46 268.07	1 264 515.34		20 170 791.39	**70 935 009.87**
36	Value centre	263 213.17	1 868 301.16		651 294.17	85 640.71	550 243.43	24 699.28	294 317.30		53 369.77	1 154 541.91	406 478.08	133 646.15	275 388.21	282 024.91	3 444.56	99 714.14		3 451 347.31	**9 597 664.25**
37	Shopping centre	528 847.22	9 144 094.29	240 370.65	3 062 032.24	149 323.20	1 974 772.80	686 776.51	996 880.50		36 810.61	3 949 545.60	1 433 538.58	934 969.47	360 098.55	1 033 968.95	2 619.16	560 644.58		9 593 893.54	**34 689 186.45**
38	Shopping centre	1 117 744.21	6 150 883.85	249 513.63	3 845 121.92	173 597.52	1 962 628.92	1 140 810.13	1 471 971.69		85 736.74	4 252 362.66	1 299 723.21	1 066 026.06	549 187.61	1 659 551.34	9 620.73	668 166.11		14 370 805.09	**40 073 451.42**
39	Motor dealership	310 004.29	8 366 466.89		1 054 477.73	285 201.23	969 447.65	70 607.61	336 678.31	166 303.32	113 891.70	1 936 427.51	1 752 020.29	1 230 498.18	990 646.90	1 278 351.75	5 979.31	373 268.75		6 832 320.11	**26 072 591.53**
40	Retail and apartment block	210 814.62	15 346 845.86	99 992.29	3 570 173.43	556 655.12	235 278.17	1 017 978.80	219 466.27	260 306.57	205 594.59	0.00	3 002 065.44	1 508 179.21	2 721 600.38	4 811 371.09	39 244.70	1 140 755.24	0.00	16 556 316.77	**51 502 638.56**
	TOTAL	34 409 647.87	475 598 377.79	8 385 934.45	123 317 700.63	23 168 323.25	35 385 703.81	56 792 557.58	71 616 329.23	22 875 612.39	14 545 730.15	56 918 624.71	120 524 540.65	68 016 643.52	51 045 444.56	86 376 144.12	2 727 306.73	28 684 744.88	1 062 625.64	841 472 710.50	**2 122 924 702.47**
	Average/project	860 241.20	11 889 959.44	209 648.36	3 082 942.52	579 208.08	884 642.60	1 419 813.94	1 790 408.23	571 890.31	363 643.25	1 422 965.62	3 013 113.52	1 700 416.09	1 276 136.11	2 159 403.60	68 182.67	717 118.62	26 565.64	21 036 817.76	**53 073 117.56**
	Average % per project (total)	1.62	22.40	0.40	5.81	1.09	1.67	2.68	3.37	1.08	0.69	2.68	5.68	3.20	2.40	4.07	0.13	1.35	0.05	39.64	
	Standard deviation	3.07%	5.02%	9.54%	3.33%	4.16%	4.53%	7.07%	5.62%	4.83%	4.46%	3.11%	4.29%	4.22%	3.16%	3.62%	7.73%	2.95%	21.92%	6.22%	

ANNEXURE 5: MASONRY ANALYSIS

MASONRY	1	2		3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Half brick walls	0.12	0.33		1.09	0.38	0.36	0.13	0.46	0.13	0.27	1.42		0.31	2.04	0.11	0.93	0.19	0.35	0.82	0.39	0.44	0.52
One brick walls (incl foundations)	4.51	1.48		3.52	3.06	3.54	2.79	3.94	2.28	1.12	1.94	5.46	3.45	3.6	1.69	8.58	0.81	4.87	4.18	6.8	5.46	3.13
One-and-a-half brick wall				0.38																		1.50
Two and a half brick walls (incl foundations)						0.5						1.9										
Mass brickwork (incl foundations)												2.25										
Attached piers												1.47										
Hollow walls	0.12	1.69			0.54	0.19	1.58	0.18		0.26	0.61	1.34	0.1	0.88	0.06		2.57		10.76			0.15
500mm Solid walls																						0.83
100mm Wide concrete block walls																						
Bagging of 1:3 sand/cement mix on bwk																						
110x75mm Prefabricated conc lintels																				2.35		
E.o for face brick work		0.73		3.09	1.45	1.61	2.14	1.1	0.05	0.62	0.53		2.24			1.76	0.85	1.45	0.93	7.76	2.46	
Brick-on-end soldier course lintel																0.58				0.57		
50mm Precast conc paving blocks							0.65		0.58										1.12			
300x300x15mm Mazista slate tiles on floors							1.94															
150mm Wide reinforcement																0.84						
30x1,6mm Wall tie	0.09									0.13	0.14							0.48				
Natural stone wall cladding																						0.76
100x100x100mm Glass block wall																		0.59				
Percentage of adj. tender amount	**4.84**	**4.23**	**0.00**	**8.08**	**5.43**	**6.20**	**9.23**	**5.68**	**3.04**	**2.40**	**4.64**	**12.42**	**6.10**	**6.52**	**1.86**	**12.69**	**4.42**	**7.74**	**17.81**	**17.87**	**8.36**	**6.89**

MASONRY	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	Frquency	Aver.(iter	Aver. (projects)
Half brick walls	0.16	0.19	0.79	0.38	0.35	0.15	0.15	0.02	0.06	0.41	0.06	0.41	0.30	0.20	0.47	0.08	0.11	0.13	1.49	39	0.43	0.27
One brick walls (incl foundations)	0.88	3.00	2.44	5.49	3.10	2.99	1.17	1.49	1.35	2.90	0.75	2.24	1.35	2.33	3.94	5.62	6.17	1.35	2.04	40	3.17	3.17
One-and-a-half brick wall								0.29		0.69		0.74		0.54						6		0.10
Two and a half brick walls (incl foundations)										0.26										3		0.07
Mass brickwork (incl foundations)																				1		0.06
Attached piers																				1		0.04
Hollow walls	0.03	0.56	1.36	0.75	1.40		1.80	0.16	0.20	0.04	1.05	0.53	1.29	2.70		0.27	0.55	1.78	1.38	32	1.15	0.92
500mm Solid walls																				1		0.02
100mm Wide concrete block walls													2.50							1		0.06
Bagging of 1:3 sand/cement mix on bwk								0.13												1		0.00
110x75mm Prefabricated conc lintels																				1		0.06
E.o for face brick work	0.54	0.91		0.75	0.88	1.71	0.96	0.06	0.29	0.76		1.48			1.22	0.05	0.14			29	1.33	0.96
Brick-on-end soldier course lintel																				2	0.58	0.03
50mm Precast conc paving blocks											0.33		1.77			0.85	1.04			7	0.78	0.16
300x300x15mm Mazista slate tiles on floors																				1		0.05
150mm Wide reinforcement																				1		0.02
30x1,6mm Wall tie																				4	0.21	0.02
Natural stone wall cladding								0.61	0.64			1.36		1.48		0.57	0.52			7		0.02
100x100x100mm Glass block wall																			0.27	2		0.01
Percentage of adj. tender amount	**1.61**	**4.66**	**4.59**	**7.37**	**5.73**	**4.85**	**4.08**	**2.76**	**2.54**	**5.06**	**2.19**	**6.76**	**7.21**	**7.25**	**5.63**	**7.44**	**8.53**	**3.26**	**5.18**			**6.33**

ANNEXURE 6: RATES ANALYSIS FOR INDEX: Q2, 2010

RATES ANALYSIS FOR INDEX: Quarter 2, 2010

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average	Av(-high,low	Difference	Freq.
Excavate in earth for trenches, holes n.e 2m deep	78.78	110.32	99.50	47.60	82.70	100.38	135.79	68.32	60.91	75.80	135.14	83.26	68.88	100.16		87.86	32.66	85.50	85.69	0.21	16
Extra over for carting away surplus material from site	43.46	82.73	162.35	89.91	124.06	123.84	87.04	89.81	113.58	43.32	39.42	70.46	40.79	99.05			79.32	85.94	83.64	-2.67	15
Reinforced concrete 20/25MPa in surface bed	1054.00	1366.08	1309.25	848.57	1137.18	929.65	1537.05	973.00	991.91	974.61	1461.41	1818.15	1205.36	1179.61		1302.46	948.48	1189.80	1169.29	-1.72	16
Reinforced concrete 25/30MPa in slabs, beams, etc	1086.60	1758.17	1309.25	907.91	1292.25	1029.58	1537.35		1017.48	974.61	1250.08		1246.65	1282.06		1302.46	938.69	1209.51	1188.92	-1.70	14
Rough formwork to soffit of slabs	146.69	170.93	282.80	130.11	155.07	168.88	324.96		134.27	155.94	200.85	195.66	177.20	311.61		183.48	138.61	191.80	186.31	-2.87	15
High tensile steel reinforcement 10/12mm	7714.86	8643.03	10474.00	7245.93	9149.13	7993.61	8634.60	7501.59	8462.48	7580.30	9376.75	9728.55	9202.00	11129.00		8248.93	7080.24	8635.31	8568.27	-0.78	16
One brick wall	239.05	426.54	324.69	201.83	237.77	256.88	395.34	216.73	229.09	238.24	311.01	423.78	419.49	333.87		372.13	246.09	304.53	303.15	-0.45	16
E.o brickwork for face brickwork	141.26	237.35			182.98		214.46	195.40			219.81		201.74	166.94		494.28		228.25	202.67	-11.21	9
Damp proof sheeting under surface beds	8.69	7.41		10.90	9.30	7.07	13.93	5.90	6.97	7.58	11.17	9.49	8.78	11.13		11.37	8.61	9.22	9.11	-1.16	15
Waterproof membrane on concrete roofs	124.69	131.36	193.77	136.46	108.55	121.26			24.55	230.66		152.31	154.25	152.47		88.76	265.13	144.94	144.96	0.01	13
0.6mm Galvanised steel roof covering	157.56	179.34		94.36	133.36			115.57			166.57		204.44	183.63			217.36	161.35	162.92	0.97	9
Insulation with roof covering		39.99	47.13	43.48				160.85			49.34		34.02	198.10			65.31	79.78	68.16	-14.56	8
Wrought hardwood skirting	27.17	43.82	57.61	45.27	67.20		32.50					29.27			47.63	54.17		44.96	44.32	-1.41	9
Single semi-solid timber door with veneer	461.81	799.80			461.07	377.17		312.20	456.71	649.74	559.70		916.18	954.87	850.50	830.06	761.11	645.46	647.62	0.34	13
Vinyl/acoustic suspended ceilings		160.17	240.90	106.10	238.81		168.24	177.92			182.98		204.28	263.76		330.78	168.42	203.85	200.61	-1.59	11
Carpets on floors		96.51	235.67	108.28			139.27					147.04	228.91	278.23	158.76		186.63	175.48	172.08	-1.94	9
Door lock set		247.09	644.15	79.34		126.58					61.28	95.20					155.61	201.32	140.76	-30.08	7
Structural steel in columns, beams, etc					23363.88			21962.89					20950.65			27780.69		23514.53	22663.39	-3.62	4
Single pressed steel door frame (one brick wall)	380.31		523.70	407.25		477.36	858.82	518.18	313.69					606.53				510.73	406.67	-20.37	8
Aluminium windows and doors	1256.69	1091.55			1006.51		1125.76						1097.91	1909.09				1247.92	1142.98	-8.41	6
Cement plaster screed on concrete (30/40mm)		100.42		70.82		90.07	93.08		77.02	48.73	87.80	97.76	40.30	61.21		64.09	52.62	73.66	74.32	0.90	12
Internal cement plaster on brickwork	63.02		73.32	52.68	41.35	84.44	82.83	51.96	74.55	54.15	55.04	78.83	50.09	82.35	51.03	67.19	43.48	62.89	62.89	0.00	16
Wall tiling	195.59		424.20	386.47	321.51		191.49	330.98				125.03	312.23	437.74	249.48	209.00	369.85	296.13	299.08	1.00	12
Floor tiling	331.41	228.31	214.72	199.92	321.51		382.99	285.12			139.51	161.89	489.65	545.32		204.88	369.85	298.08	265.85	-10.81	13
110mm Soil pipe in trenches (0 - 1m) incl trench		103.69		176.65			69.10	128.88			133.76							122.42	122.11	-0.25	5
WC suite	817.12	3981.29											2599.09	2386.06	3005.10	3603.37		2732.01	2898.41	6.09	6
Electric water heater											5997.03							5997.03	5997.03	0.00	1
0,6mm Mirror to brickwork	179.29	331.39				394.05					360.13	732.26				300.03	895.83	456.14	423.57	-7.14	7
Paint to internal plaster	30.42	29.48	41.90	26.13	22.74	27.02	34.82	25.26	19.04	22.74	31.41		31.06	40.06	43.09	37.78	27.70	30.67	30.61	-0.19	16
Paint on timber doors	49.98	51.67	41.90		43.42	56.29	62.67	39.53	56.78	45.48	63.28		35.66	38.95	43.09	33.34	28.21	46.02	46.06	0.09	15
Electrical installations	704.64	2036.38	673.08	512.45	539.47	1952.63	1093.73	1301.53	641.95	677.01	877.65	797.93	815.11	591.52		429.76	779.39	901.51	854.15	-5.25	16
Mechanical installation		1458.49	453.48	359.19		1055.21	263.55	549.10	330.10	770.76			836.37	587.73		805.11	811.87	690.08	655.89	-4.95	12

Table 8.3. Rates analysis: 2nd quarter 2010

ANNEXURE 7: RATES ANALYSIS FOR INDEX: Q2, 2010 (INDICATOR ITEMS)

RATES ANALYSIS FOR INDEX: Quarter 2, 2010

Indicator item	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Average	Av(-hi,lo)	Diff.	Freq.
Excavate in earth for trenches, holes n.e 2m deep	78.78	110.32	99.50	47.60	82.70	100.38	135.79	68.32	60.91	75.80	135.14	83.26	68.88	100.16		87.86	32.66	85.50	85.69	0.21	16
Extra over for carting away surplus material from site	43.46	82.73	162.35	89.91	124.06	123.84	87.04	89.81	113.58	43.32	39.42	70.46	40.79	99.05			79.32	85.94	83.64	-2.67	15
Reinforced concrete 20/25MPa in surface beds	1054.00	1366.08	1309.25	848.57	1137.18	929.65	1537.05	973.00	991.91	974.61	1461.41	1818.15	1205.36	1179.61		1302.46	948.48	1189.80	1169.29	-1.72	16
Reinforced concrete 25/30MPa in slabs, beams, etc	1086.60	1758.17	1309.25	907.91	1292.25	1029.58	1537.35		1017.48	974.61	1250.08		1246.65	1282.06		1302.46	938.69	1209.51	1188.92	-1.70	14
Rough formwork to soffit of slabs	146.69	170.93	282.80	130.11	155.07	168.88	324.96		134.27	155.94	200.85	195.66	177.20	311.61		183.48	138.61	191.80	186.31	-2.87	15
High tensile steel reinforcement 10/12mm	7714.86	8643.03	10474.00	7245.93	9149.13	7993.61	8634.60	7501.59	8462.48	7580.30	9376.75	9728.55	9202.00	11129.00		8248.93	7080.24	8635.31	8568.27	-0.78	16
One brick wall	239.05	426.54	324.69	201.83	237.77	256.88	395.34	216.73	229.09	238.24	311.01	423.78	419.49	333.87		372.13	246.09	304.53	303.15	-0.45	16
E.o brickwork for face brickwork	141.26	237.35			182.98		214.46	195.40			219.81		201.74	166.94		494.28		228.25	202.67	-11.21	9
Damp proof sheeting under surface beds	8.69	7.41		10.90	9.30	7.07	13.93	5.90	6.97	7.58	11.17	9.49	8.78	11.13		11.37	8.61	9.22	9.11	-1.16	15
Waterproof membrane on concrete roofs	124.69	131.36	193.77	136.46	108.55	121.26			24.55	230.66		152.31	154.25	152.47		88.76	265.13	144.94	144.96	0.01	13
0.6mm Galvanised steel roof covering	157.56	179.34		94.36	133.36			115.57			166.57		204.44	183.63			217.36	161.35	162.92	0.97	9
Insulation with roof covering		39.99	47.13	43.48				160.85			49.34		34.02	198.10			65.31	79.78	68.16	-14.56	8
Wrought hardwood skirting	27.17	43.82	57.61	45.27	67.20		32.50					29.27			47.63	54.17		44.96	44.32	-1.41	9
Single semi-solid timber door with veneer	461.81	799.80			461.07	377.17		312.20	456.71	649.74	559.70		916.18	954.87	850.50	830.06	761.11	645.46	647.62	0.34	13
Vinyl/acoustic suspended ceilings		160.17	240.90	106.10	238.81		168.24	177.92			182.98		204.28	263.76		330.78	168.42	203.85	200.61	-1.59	11
Carpets on floors		96.51	235.67	108.28			139.27					147.04	228.91	278.23	158.76		186.63	175.48	172.08	-1.94	9
Door lock set		247.09	644.15	79.34		126.58					61.28	95.20					155.61	201.32	140.76	-30.08	7
Structural steel in columns, beams, etc					23363.88			21962.89					20950.65			27780.69		23514.53	22663.39	-3.62	4
Single pressed steel door frame (one brick wall)	380.31		523.70	407.25		477.36	858.82	518.18	313.69					606.53				510.73	406.67	-20.37	8
Aluminium windows and doors	1256.69	1091.55			1006.51		1125.76						1097.91	1909.09				1247.92	1142.98	-8.41	6
Cement plaster screed on concrete (30/40mm)		100.42		70.82		90.07	93.08		77.02	48.73	87.80	97.76	40.30	61.21		64.09	52.62	73.66	74.32	0.90	12
Internal cement plaster on brickwork	63.02		73.32	52.68	41.35	84.44	82.83	51.96	74.55	54.15	55.04	78.83	50.09	82.35	51.03	67.19	43.48	62.89	62.89	0.00	16
Wall tiling	195.59		424.20	386.47	321.51		191.49	330.98				125.03	312.23	437.74	249.48	209.00	369.85	296.13	299.08	1.00	12
Floor tiling	331.41	228.31	214.72	199.92	321.51		382.99	285.12			139.51	161.89	489.65	545.32		204.88	369.85	298.08	265.85	-10.81	13
110mm Soil pipe in trenches (0 - 1m) incl trench		103.69		176.65			69.10	128.88			133.76							122.42	122.11	-0.25	5
WC suite	817.12	3981.29											2599.09	2386.06	3005.10	3603.37		2732.01	2898.41	6.09	6
Electric water heater											5997.03							5997.03	5997.03	0.00	1
0,6mm Mirror to brickwork	179.29	331.39				394.05					360.13	732.26				300.03	895.83	456.14	423.57	-7.14	7
Paint to internal plaster	30.42	29.48	41.90	26.13	22.74	27.02	34.82	25.26	19.04	22.74	31.41		31.06	40.06	43.09	37.78	27.70	30.67	30.61	-0.19	16
Paint on timber doors	49.98	51.67	41.90		43.42	56.29	62.67	39.53	56.78	45.48	63.28		35.66	38.95	43.09	33.34	28.21	46.02	46.06	0.09	15
Electrical installation	704.64	2036.38	673.08	512.45	539.47	1952.63	1093.73	1301.53	641.95	677.01	877.65	797.93	815.11	591.52		429.76	779.39	901.51	854.15	-5.25	16
Mechanical installation		1458.49	453.48	359.19		1055.21	263.55	549.10	330.10	770.76			836.37	587.73		805.11	811.87	690.08	655.89	-4.95	12

ANNEXURE 8: THREE-QUARTER MOVING AVERAGE

THREE-QUARTERS MOVING AVERAGE	2006:Q3	2006:Q4	2007:Q1	2007:Q2	2007:Q3	2007:Q4	2008:Q1	2008:Q2	2008:Q3	2008:Q4	2009:Q1	2009:Q2	2009:Q3	2009:Q4	2010:Q1	2010:Q2	2010:Q3	2010:Q4	2011:Q1	2011:Q2	2011:Q3	2011:Q4	2012:Q1	2012:Q2
Excavate in earth for trenches, holes n.e 2m deep	59.58	78.55	81.56	61.49	91.00	82.39	89.38	81.45	78.26	64.85	80.78	86.94	79.97	81.57	74.53	85.69	74.51	87.54	72.45	70.71	62.80	71.43	81.64	82.75
moving average			73.23	73.87	78.02	78.29	87.59	84.41	83.03	74.85	74.63	77.52	82.56	82.83	78.69	80.60	78.24	82.58	78.17	76.90	68.65	68.31	71.96	78.61
Extra over for carting away surplus material	96.14	86.73	120.50	49.65	100.29	100.44	106.71	97.93	84.40	90.45	110.37	121.43	76.12	97.71	80.17	83.64	82.18	97.75	82.36	80.49	101.57	84.84	117.78	79.82
moving average			101.12	85.63	90.15	83.46	102.48	101.69	96.35	90.93	95.07	107.42	102.64	98.42	84.67	87.17	82.00	87.86	87.43	86.87	88.14	88.97	101.40	94.15
Reinforced concrete 20/25MPa in surface bed	1038.79	975.24	984.58	1070.78	1034.64	1127.22	1168.44	1038.33	1126.47	996.33	1157.39	1108.25	1392.93	1213.85	1147.71	1169.29	1092.29	1122.00	1127.87	982.54	1213.04	1231.42	1123.62	1090.84
moving average			999.54	1010.20	1030.00	1077.55	1110.10	1111.33	1111.08	1053.71	1093.40	1087.32	1219.52	1238.34	1251.50	1176.95	1136.43	1127.86	1114.05	1077.47	1107.82	1142.33	1189.36	1148.63
Reinforced concrete 25/30MPa in slabs, beams,	981.99	999.83	1035.99	1130.09	1098.02	1162.39	1180.65	1023.29	1236.20	1086.13	1172.36	1271.74	1441.35	1328.35	1184.42	1188.92	1147.41	1196.32	1158.45	1042.78	1308.93	1111.60	1131.54	1172.55
moving average			1005.94	1055.30	1088.03	1130.17	1147.02	1122.11	1146.71	1115.21	1164.90	1176.74	1295.15	1347.15	1318.04	1233.90	1173.58	1177.55	1167.39	1132.52	1170.05	1154.44	1184.02	1138.56
Rough formwork to soffit of slabs	204.12	162.13	247.96	166.23	185.52	216.32	219.68	231.18	193.84	177.58	197.89	188.85	214.43	186.05	161.51	186.31	181.30	187.92	177.03	161.99	199.22	150.69	163.12	137.04
moving average			204.74	192.11	199.90	189.36	207.17	222.39	214.90	200.87	189.77	188.11	200.39	196.44	187.33	177.96	176.37	185.18	182.08	175.65	179.41	170.63	171.01	150.28
High tensile steel reinforcement 10/12mm	9829.25	9331.87	8889.53	8830.33	9401.36	9842.40	10014.52	13173.72	14786.50	12325.30	14034.10	9799.09	9628.04	8896.11	8464.83	8568.27	8826.94	8910.34	9005.66	8982.79	8994.84	10349.60	10222.52	10316.46
moving average			9350.22	9017.24	9040.41	9358.03	9752.76	11010.21	12658.25	13428.51	13715.30	12052.83	11153.74	9441.08	8996.33	8643.07	8620.01	8768.52	8914.31	8966.26	8994.43	9442.41	9855.65	10296.19
One brick wall	234.16	263.70	236.70	297.79	293.65	304.75	269.35	282.26	292.07	255.36	292.38	280.37	332.37	314.35	313.33	303.15	298.48	338.61	312.02	241.68	334.45	303.42	280.49	265.17
moving average			244.85	266.06	276.05	298.73	289.25	285.45	281.23	276.56	279.94	276.04	301.71	309.03	320.02	310.28	304.99	313.41	316.37	297.44	296.05	293.18	306.12	283.03
E.o brickwork for face brickwork	131.10	117.61	117.61	144.65	135.85	104.68	107.64	152.10	197.67	116.42	138.18	182.16	194.84	180.21	196.70	202.67	122.87	225.84	199.59	217.25	176.06	132.99	146.49	172.42
moving average			122.11	126.62	132.70	128.39	116.06	121.47	152.47	155.40	150.76	145.59	171.73	185.74	190.58	193.19	174.08	183.79	182.77	214.23	197.63	175.43	151.85	150.63
Damp proof sheeting under surface beds	11.38	9.41	10.85	9.60	12.91	14.00	10.93	9.13	18.67	11.31	8.20	10.70	10.39	8.70	12.09	9.11	10.27	10.94	8.65	7.91	11.24	8.57	9.24	10.72
moving average			10.55	9.95	11.12	12.17	12.61	11.35	12.91	13.04	12.73	10.07	9.76	9.93	10.39	9.97	10.49	10.11	9.95	9.17	9.27	9.24	9.68	9.51
Waterproof membrane on concrete roofs	79.92	138.89	129.91	125.18	92.76	122.00	104.48	120.78	140.79	141.57	138.77	140.74	137.86	134.82	163.31	144.96	163.29	153.91	158.45	145.54	175.27	130.35	163.01	145.57
moving average			116.24	131.33	115.95	113.31	106.41	115.75	122.02	134.38	140.38	140.36	139.12	137.81	145.33	147.70	157.19	154.05	158.55	152.63	159.75	150.39	156.21	146.31
0.6mm Galvanised steel roof covering	123.22	161.20	154.09	154.09	180.91	185.07	145.77	184.44	259.10	168.36	157.02	166.96	128.17	115.57	191.09	162.92	274.33	182.31	148.14	101.98	204.26	147.35	139.10	138.83
moving average			146.17	156.46	163.03	173.36	170.58	171.76	196.44	203.97	194.83	164.11	150.72	136.90	144.94	156.53	209.45	206.52	201.59	144.14	151.46	151.20	163.57	141.76
Insulation with roof covering	67.67	45.42	24.02	34.74	37.35	39.26	68.56	34.76	38.64	117.13	52.15	52.18	83.86	65.60	70.90	68.16	143.81	46.25	66.40	79.44	42.77	117.04	29.96	49.85
moving average			45.70	34.73	32.04	37.12	48.39	47.53	47.32	63.51	69.31	73.82	62.73	67.21	73.45	68.22	94.29	86.07	85.49	64.03	62.87	79.75	63.26	65.62
Wrought hardwood skirting	28.04	58.94	42.99	74.18	32.93	113.96	39.57	45.74	36.97	39.19	70.71	33.50	65.82	37.61	49.98	44.32	53.22	40.59	53.63	124.82	66.91	50.79	58.69	58.40
moving average			43.32	58.70	50.03	73.69	62.15	66.42	40.76	40.63	48.96	47.80	56.68	45.64	51.14	43.97	49.17	46.04	49.15	73.01	81.79	80.84	58.80	55.96
Single semi-solid timber door with veneer	345.94	524.44	369.29	563.17	431.58	606.95	458.51	490.29	783.43	725.81	1257.22	669.90	510.32	478.14	811.54	647.62	518.06	500.74	804.56	662.84	496.54	462.47	573.77	486.01
moving average			413.22	485.63	454.68	533.90	499.01	518.58	577.41	666.51	922.15	884.31	812.48	552.79	600.00	645.77	659.07	555.47	607.79	656.05	654.65	540.62	510.93	507.42
Vinyl/acoustic suspended ceilings	117.59	194.67	214.95	140.70	136.07	176.11	138.44	179.09	185.53	185.62	217.07	193.48	211.59	167.03	174.17	200.61	218.00	198.21	181.03	175.25	222.00	142.08	214.42	161.41
moving average			175.74	183.44	163.91	150.96	150.21	164.55	167.69	183.41	196.07	198.72	207.38	190.70	184.26	180.60	197.59	205.61	199.08	184.83	192.76	179.78	192.83	172.64
Carpets on floors	77.19	155.80	138.69	123.50	97.52	159.81	120.31	180.33	231.84	140.45	156.06	289.22	155.98	154.46	136.02	172.08	147.31	187.74	163.45	287.39	291.43	151.75	304.60	169.93
moving average			123.89	139.33	119.90	126.94	125.88	153.48	177.49	184.21	176.12	195.24	200.42	199.89	148.82	154.19	151.80	169.04	166.17	212.86	247.42	243.52	249.26	208.76
Door lock set	230.84	90.73	193.02	258.43	139.64	333.03	308.37	133.47	358.39	58.57	331.35	94.87	240.60	138.03	269.01	140.76	123.87	145.78	158.13	194.23	193.38	279.84	146.87	146.70
moving average			171.53	180.73	197.03	243.70	260.35	258.29	266.74	183.48	249.44	161.60	222.27	157.83	215.88	182.60	177.88	136.80	142.59	166.05	181.91	222.48	206.70	191.14
Structural steel in columns, beams, etc	23002.65	22594.71	28333.80	27418.54	23285.74	24384.10	26791.04	41635.22	42508.41	30649.19	37628.00	27030.50	22582.06	20165.92	23365.99	22663.39	26006.97	26401.50	24120.23	27146.96	27116.36	22510.06	22646.55	22656.88
moving average			24643.72	26115.68	26346.03	25029.46	24820.29	30936.79	36978.22	38264.27	36928.53	31769.23	29080.19	23259.49	22037.99	22065.10	24012.12	25023.95	25509.57	25889.56	26127.85	25591.13	24090.99	22604.50
Single pressed steel door frame (one brick wall)	233.29	274.94	523.38	615.10	416.21	476.42	361.94	491.15	721.94	425.25	498.20	571.75	547.97	517.18	656.95	406.67	561.28	746.07	711.84	328.38	504.35	410.49	634.48	336.31
moving average			343.87	471.14	518.23	502.58	418.19	443.17	525.01	546.11	548.46	498.40	539.31	545.63	574.03	526.93	541.63	571.34	673.06	595.43	514.86	414.41	516.44	460.43
Aluminium windows and doors	851.18	2359.19	1616.43	2866.58	1596.63	1523.67	1149.48	1479.77	1790.93	1408.63	1408.63	1137.03	1383.37	1747.83	1378.17	1142.98	1274.97	1191.21	1727.57	1727.57	1363.77	1445.12	1254.08	2405.02
moving average			1608.93	2280.73	2026.55	1995.63	1423.26	1384.31	1473.39	1559.78	1536.06	1318.10	1309.68	1422.74	1503.12	1422.99	1265.37	1203.05	1397.92	1548.78	1606.30	1512.15	1354.32	1701.41
Cement plaster screed on concrete (30/40mm)	54.26	72.63	43.85	58.12	66.52	72.39	73.40	62.24	73.30	79.69	77.85	79.94	66.87	70.95	70.43	74.32	73.42	79.43	68.57	55.44	74.68	60.80	73.32	71.74
moving average			56.91	58.20	56.16	65.68	70.77	69.34	69.65	71.74	76.95	79.16	74.89	72.59	69.42	71.90	72.72	75.72	73.81	67.81	66.23	63.64	69.60	68.62
Internal cement plaster on brickwork	59.84	62.62	46.92	56.84	65.44	63.41	53.36	61.36	69.74	68.13	80.93	50.02	67.44	58.24	62.16	62.89	67.64	64.37	61.94	53.11	63.10	53.49	66.16	66.41
moving average			56.46	55.46	56.40	61.90	60.74	59.38	61.49	66.41	72.93	66.36	66.13	58.57	62.61	61.10	64.23	64.97	64.65	59.81	59.38	56.57	60.92	62.02
Wall tiling	228.10	203.65	183.78	237.63	299.03	256.98	250.17	222.04	221.82	290.80	391.42	329.06	260.57	209.03	234.53	299.08	307.16	371.94	295.97	261.40	260.05	299.70	387.45	297.52
moving average			205.18	208.35	240.15	264.55	268.73	243.06	231.34	244.89	301.35	337.09	327.02	266.22	234.71	247.55	280.26	326.06	325.02	309.77	272.47	273.72	315.73	328.22
Floor tiling	301.36	267.12	302.78	290.24	311.91	357.68	274.32	288.80	278.22	300.44	396.17	407.22	343.37	333.02	310.98	265.85	405.12	340.40	319.66	304.73	316.30	369.04	343.22	321.64
moving average			290.42	286.71	301.64	319.94	314.64	306.93	280.45	289.15	324.94	367.94	382.25	361.20	329.12	303.28	327.32	337.12	355.06	321.60	313.56	330.02	342.85	344.63
110mm Soil pipe in trenches (0 - 1m) incl trench	84.62	168.71	73.78	326.68	175.85	154.58	147.87	123.59	169.69	138.03	106.25	157.83	171.89	136.10	206.04	122.11	98.02	203.18	123.73	204.42	150.31	109.28	220.48	155.51
moving average			109.04	189.72	192.10	219.04	159.43	142.01	147.05	143.77	137.99	134.04	145.32	155.27	171.34	154.75	142.06	141.10	141.64	177.11	159.49	154.67	160.02	161.76
WC suite	2084.19	3317.46	3680.78	6052.92	2719.20	2061.30	3418.59	1233.45	3000.92	1977.92	4948.07	2351.10	2295.93	1601.22	1830.49	2898.41	1588.49	2035.83	2112.33	3960.71	3961.31	2088.97	1764.84	1489.10
moving average			3027.48	4350.39	4150.97	3611.14	2733.03	2237.78	2550.99	2070.76	3308.97	3092.36	3198.37	2082.75	1909.21	2110.04	2105.80	2174.24	1912.22	2702.96	3344.78	3337.00	2605.04	1780.97
Electric water heater	4061.74	5853.08	8301.37	6097.21	4278.43	3547.54	6009.22	5880.21	4340.37	6370.31	4205.58	4935.31	6709.20	5437.08	4846.66	5997.03	5224.22	5216.52	4767.72	4979.15	4319.49	5529.52	5882.80	7626.04
moving average			6072.06	6750.55	6225.67	4641.06	4611.73	5145.66	5409.93	5530.30	4972.09	5170.40	5283.36	5693.86	5664.31	5426.92	5355.97	5479.26	5069.49	4987.80	4688.79	4942.72	5243.94	6346.12
0,6mm Mirror to brickwork	138.03	155.63	407.40	665.56	276.09	307.76	543.39	214.08	688.08	297.30	239.71	203.55	298.71	289.48	304.84	423.57	357.25	238.44	300.46	162.48	347.19	341.25	157.50	279.28
moving average			233.69	409.53	449.68	416.47	375.75	355.08	481.85	399.82	408.36	246.85	247.32	263.91	297.68	339.30	361.89	339.75	298.72	233.79	270.04	283.64	281.98	259.34

Paint to internal plaster	28.41	27.57	29.13	26.63	31.80	31.36	29.10	29.00	38.46	25.46	32.78	33.66	33.48	31.00	35.62	30.61	34.96	33.81	35.51	31.86	30.76	29.52	35.87	27.36
moving average			28.37	27.78	29.19	29.93	30.75	29.82	32.19	30.97	32.23	30.63	33.31	32.71	33.37	32.41	33.73	33.13	34.76	33.73	32.71	30.71	32.05	30.92
Paint on timber doors	44.85	36.65	35.31	29.41	35.04	53.27	36.74	43.71	52.27	41.87	42.81	46.48	47.61	50.58	48.60	46.06	51.41	45.42	43.82	48.85	48.00	40.38	49.19	45.70
moving average			38.94	33.79	33.25	39.24	41.68	44.57	44.24	45.95	45.65	43.72	45.63	48.22	48.93	48.41	48.69	47.63	46.88	46.03	46.89	45.74	45.86	45.09
Electrical installations	751.85	600.50	513.62	487.35	471.59	685.28	610.59	555.52	510.84	537.48	541.95	763.73	649.13	952.93	829.48	854.15	696.62	717.35	595.54	426.78	472.74	598.27	737.57	397.64
moving average			621.99	533.82	490.85	548.07	589.15	617.13	558.98	534.61	530.09	614.39	651.60	788.60	810.51	878.85	793.42	756.04	669.84	579.89	498.35	499.26	602.86	577.83
Mechanical installation	470.83	349.70	227.71	494.65	258.88	305.88	522.89	551.60	289.21	503.93	621.68	523.55	508.47	575.30	444.93	655.89	768.39	753.05	533.48	584.64	400.66	506.69	438.72	502.12
moving average			349.41	357.35	327.08	353.14	362.55	460.12	454.57	448.25	471.61	549.72	551.23	535.77	509.57	558.71	623.07	725.78	684.97	623.72	506.26	497.33	448.69	482.51

ANNEXURE 9: CERTIFICATE OF LANGUAGE-EDIT

LQA

Language Quality Assurance Practitioners

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15 September 2014

TO WHOM IT MAY CONCERN

We hereby certify that we have language-edited the doctoral thesis by J.H.H. Cruywagen entitled: TOWARDS THE ESTABLISHMENT OF A RELEVANT TENDER-PRICE INDEX FOR THE SOUTH AFRICAN BUILDING INDUSTRY.

We are satisfied that, provided the changes we have made are effected to the text, the language is of an acceptable standard, and is fit for publication.

Kate Goldstone
BA (Rhodes)
SATI No: 1000168
UPE Language Practitioner (1975-2004)
NMMU Language Practitioner (2005)

Dr Patrick Goldstone
BSc (Stell.)
DEd (UPE)

Language Quality Assurance – Certification Statement

Paint to internal plaster	28.41	27.57	29.13	26.63	31.80	31.36	29.10	29.00	38.46	25.46	32.78	33.66	33.48	31.00	35.62	30.61	34.96	33.81	35.51	31.86	30.76	29.52	35.87	27.36
moving average			28.37	27.78	29.19	29.93	30.75	29.82	32.19	30.97	32.23	30.63	33.31	32.71	33.37	32.41	33.73	33.13	34.76	33.73	32.71	30.71	32.05	30.92
Paint on timber doors	44.85	36.65	35.31	29.41	35.04	53.27	36.74	43.71	52.27	41.87	42.81	46.48	47.61	50.58	48.60	46.06	51.41	45.42	43.82	48.85	48.00	40.38	49.19	45.70
moving average			38.94	33.79	33.25	39.24	41.68	44.57	44.24	45.95	45.65	43.72	45.63	48.22	48.93	48.41	48.69	47.63	46.88	46.03	46.89	45.74	45.86	45.09
Electrical installations	751.85	600.50	513.62	487.35	471.59	685.28	610.59	555.52	510.84	537.48	541.95	763.73	649.13	952.93	829.48	854.15	696.62	717.35	595.54	426.78	472.74	598.27	737.57	397.64
moving average			621.99	533.82	490.85	548.07	589.15	617.13	558.98	534.61	530.09	614.39	651.60	788.60	810.51	878.85	793.42	756.04	669.84	579.89	498.35	499.26	602.86	577.83
Mechanical installation	470.83	349.70	227.71	494.65	258.88	305.88	522.89	551.60	289.21	503.93	621.68	523.55	508.47	575.30	444.93	655.89	768.39	753.05	533.48	584.64	400.66	506.69	438.72	502.12
moving average			349.41	357.35	327.08	353.14	362.55	460.12	454.57	448.25	471.61	549.72	551.23	535.77	509.57	558.71	623.07	725.78	684.97	623.72	506.26	497.33	448.69	482.51