



**THE INFLUENCE OF ECONOMIC FACTORS ON SOUTH AFRICA'S CIVIL ENGINEERING
CONSULTING FIRMS**

by

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Date

ABSTRACT

The infrastructure and construction activity of a country are strong drivers of economic development and the prosperity of a nation. This has been studied and discussed by various scholars such as Ruddock (2008) and Ofori (1990). As the construction industry prospers, employment is provided to many citizens, thereby improving living conditions due to the newly built infrastructure. This state of prosperity is often followed by a state of recession in the economy where jobs are scarce, interest rises and the price of commodities rises.

In recent years, it has become glaringly evident that economic cycles have influenced several industrial sectors, including the construction industry and its civil engineering consulting (CEC) firms. In order to ensure that CEC firms remain financially sustainable throughout different macroeconomic cycles, it is necessary to study the economic factors with the highest impact on CEC firms. The aim of this work is to determine the economic factors that affect CEC firms through the different macroeconomic cycles and in which phase of the cycles these economic factors impact CEC firms.

To address the aim of the study, mixed methods research was employed. Semi-structured interviews formed part of the qualitative methods used and statistical econometric tests formed part of the quantitative tests used. Seven semi-structured interviews were conducted, with five interviews at CEC firms, one with an employer, in this case South African National Roads Agency (SANRAL), and one with the Consulting Engineers of South Africa (CESA) association. The econometric data analysis made use of ADF Unit Root tests, Johansen Co-Integration tests and Granger Causality tests.

The quantitative results showed that gross domestic product (GDP) and gross fixed capital formation (GFCF) of total investment indicate a change in total revenue of construction consulting firms. The Granger Causality results showed that construction value added (CVA) and GFCF of construction investment tend not to cause nor indicate a change in revenue of construction consulting firms, and vice-versa. The semi-structured interviews identified 16 economic factors that affect CEC firms. These factors were determined to be caused primarily by the South African economic activity, construction activity and CEC industry.

It was observed that these factors can occur in different phases of a macroeconomic cycle, with business confidence and foreign investment having the highest influence during the recovery phase, capacity of firms and tender roll out having the highest influence during the peak phase, training of governmental staff and diversification having the highest influence during the downswing cycle, and strategic planning of CEC firms having the highest influence during the through phase of the cycle.

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- My Tareia brotherhood, for the endless motivation and support.

DEDICATION

To my father, who has always been my biggest inspiration and role model.

To my mother, who has always given me confidence and moral support.

To my brother, who is always in my heart.

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LIST OF ABBREVIATIONS

Abbreviations	Definition/Explanation
ACEC	American Council of Engineering Companies
APEG	Association of Professional Engineers and Geoscientists
CEC	Civil Engineering Consulting
CESA	Civil Engineers of South Africa
CIDB	Construction Industry Development Board
CPS	Construction Professional Services
CVA	Construction Value Added
DPSA	Department of Public Service Administration
ECSA	Engineering Council of South Africa
GDP	Gross Domestic Product
GFCF	Gross Fixed Capital Formation
SARB	South African Reserve Bank
SANRAL	South African National Roads Agency
SAFEC	South African Forum of Civil Engineering Contractors
STATSSA	Statistics of South Africa

Chapter 1: Introduction

1.1 Introduction

The contribution of the construction industry to the South African economy in terms of gross domestic product excludes certain important sub-sectors of the construction industry such as consulting services and material suppliers for the construction industry. In addition to these exclusions, the cyclical relationship of causation between the general economy and the construction industry remains unclearly defined. For a construction consulting service firm such as a civil engineering consulting (CEC) firm, it is challenging to determine which economic factors impact the sustainability of the firm. Taking into consideration the current macroeconomic environment, this is aggravated by two main conditions. Firstly, the economic contribution from the consulting firms into the construction industry and the general economy is not yet well reported; and secondly, the cyclical relationship between the construction industry and the civil engineering consulting (CEC) industry is not yet well defined. These conditions can negatively affect the sustainability of CEC firms, especially when there is no benchmark over which economic factors are monitored by CEC firms during the various phases of the macroeconomic cycles.

This research aims to identify the particular economic factors that influence the sustainability of CEC firms in South Africa through the macroeconomic cycles. In order to attain this aim, it is initially necessary to establish the type of causation relationship that total revenue from construction professional services (CPS) has with South Africa's general economy and South Africa's construction industry. Secondly, economic factors those firms have used in the past to remain sustainable in South Africa must be identified. As an outcome, the study seeks to determine *which* factors need to be monitored and *when* these should be monitored to ensure sustainability of CEC firms through macroeconomic cycles.

This chapter presents a brief introduction into the research on the economic factors that influence civil engineering firms through macroeconomic cycles in South Africa. The aim of this chapter is to present the rationale for conducting this study and an explanation of *how* the study will be conducted.

1.2 Background

The infrastructure and construction activities of a country are strong drivers of economic development and the prosperity of a nation. This has been studied and discussed by different scholars such as Ruddock and Ruddock (2008) and Ofori (1990). As the construction industry prospers, employment is available to many citizens, thereby improving living conditions with newly built infrastructure. However, this state of prosperity is frequently followed by a state of economic recession during which time jobs are scarce, interest rates rise and commodity prices increase.

These fluctuations between prosperity and recession are experienced in every sector and industry of the economy. As the ways each sector and industry experience these fluctuations tends to differ, it is crucial for every economy, in general, and for each individual sector, to monitor these fluctuations to ensure sustainability.

On a macroeconomic level, economic fluctuations are monitored constantly, taking into account all sectors of economic activity. The government and certain independent organisations monitor and publish the information gathered on a monthly, quarterly, semesterly and yearly basis. This information most often refers to the economic growth of the country, represented by the gross domestic product (GDP). In simple terms, GDP refers to the sum of all goods and services traded for money over a period of time (Constanza *et al.*, 2014). The construction industry, through public and independent organisations, also monitors economic activity specific to the sector, and publishes such information to aid contractors in understanding the impact the economy is having on the construction industry, and vice versa (

Figure 1-1).

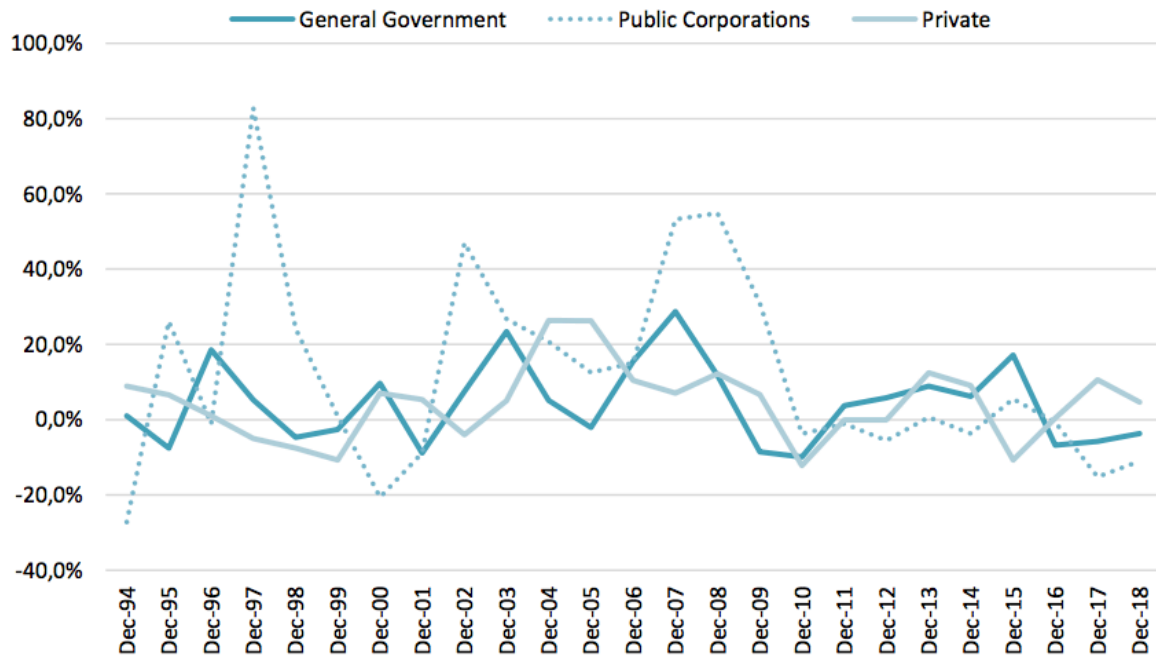


Figure 1-1: GFCF by client constant 2010 prices, annualised: Y-Y percentage change in South Africa (CESA, 2019)

The construction industry is vast, comprised of a variety of professional services which can either be affected or make an impact on construction economic activity (Figure 1-2). The size of the construction industry and its impact on the economy is often measured by determining the construction value added (CVA) of a country. According to scholars Ofori (1990) and Pearce (2003), the CVA is usually between 5-10% of the GDP of a country, depending on how the construction sector is measured. If the construction sector is measured in a narrow manner, only taking into account on-site assembly activities, then the contribution to the GDP of a country is around 5%. If the construction sector is measured more broadly, including all services related to the construction industry such as professional services and quarrying of materials, the CVA can reach 10% of the GDP (Snyman, 2008).

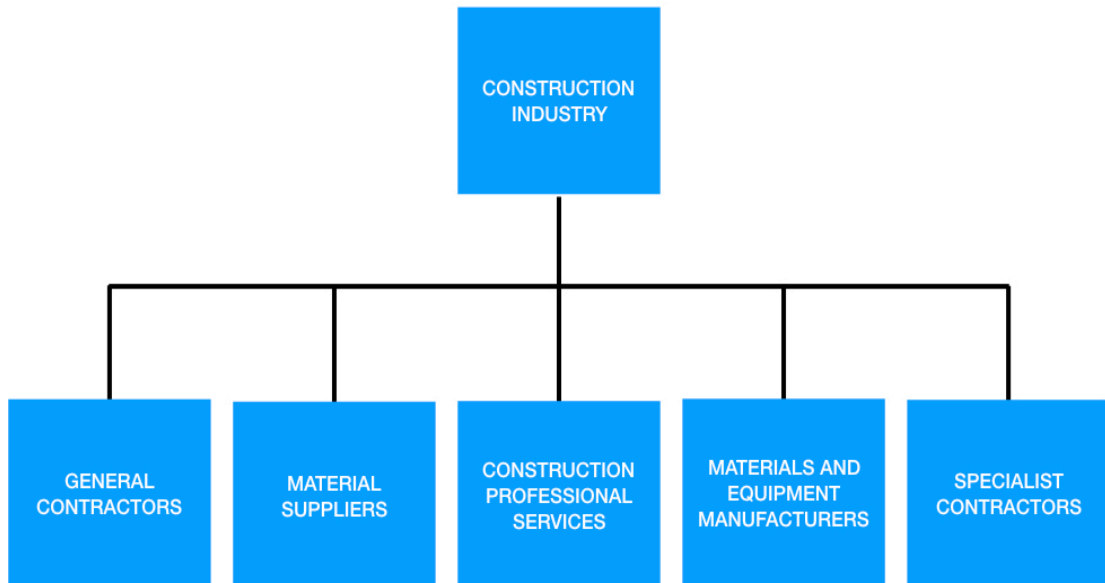
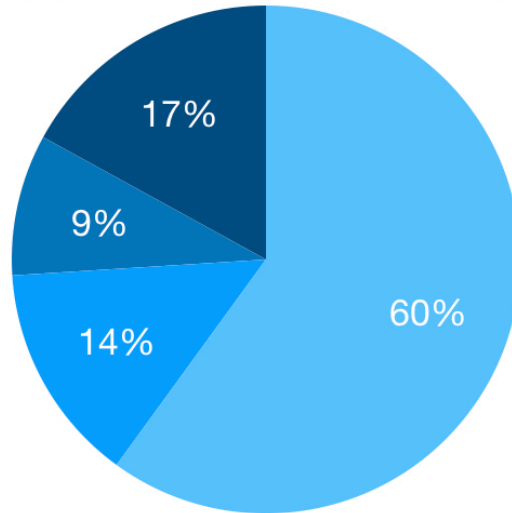


Figure 1-2: Services within the construction industry

Construction professional services (CPS), as discussed in Chapter 2, are services that include architecture, civil engineering and surveying services. These services, a crucial part of the industry, are frequently involved in the construction project from the initial stages of pre-feasibility and tender preparation, all the way to the later stages of commissioning and maintenance. Civil engineering consultants (CEC) are a part of the CPS. As stated by CESA (2017), CEC firms provide around 60% of the revenue collected by these CPS, confirming that careful monitoring of the CEC sub-sector of the construction industry is important for the construction sector and the CPS. In order to monitor the CEC sub-sector and ensure sustainability of CEC firms, the economic factors that impact the CEC firms need to be investigated (Figure 1-3).

- Civil Engineering
- Structural Engineering
- Project Management
- Other Consulting Specialities (Architecture, Surveying, etc)



**Figure 1-3: Percentage fee income of CPS
(Adapted from CESA, 2017)**

The need to enrich the existing body of knowledge pertaining to the relationship between the specific areas of construction industry and the business cycles in general was presented by Snyman (2008) who stated:

Building professionals need to take special cognisance of economic shocks, such as a sudden rise in interest rates or tighter credit conditions, because they are operating in a capital goods industry where cycles are longer and more pronounced than in other sectors of the economy. For the entrepreneur, there are opportunities aplenty; for the researcher in the built environment, there are many unanswered questions; for the practising construction economist, much research is still required concerning the interaction between business cycles and building cycles in developed and developing countries, and how these affect the formation of costs and prices.

1.3 Research problem

In order to heighten the understanding of the research problem, a few concepts regarding the relationship between general economy, construction industry and CEC industry must be highlighted.

The economy of most countries is composed of a series of sectors – mainly mining, manufacturing and construction – which contributes to the economy with the capital generated through sales and purchases, stimulating the economy. Often the economy is stimulated positively by the increase in sales of a certain industry, while in other instances, and for brief periods, the economy is negatively impacted with a reduction in sales and purchases in the various industries. A country undergoes these economic cycles quite normally.

In recent years, it has become increasingly evident that economic cycles have influenced several industrial sectors, including the construction industry and its consulting firms (Strassman, 1970 & Turin, 1973, cited in Lewis 2008, p. 37). The relationship between the aggregate economy, also known as *total economy*, and the construction industry, has been widely studied using the Granger Causality test (Ozkan *et al.*, 2012; Oladinrin *et al.*, 2014; Chiang *et al.*, 2015). This test, normally studying different time series, tests the causal relationship that a time series has with another time series. For example, this test can be used to determine if growth in total investment causes growth in construction activity.

These studies have often led to three conclusions: 1) that construction causes aggregate economy; 2) that aggregate economy causes construction activity; or 3) that there is a bi-directional relationship between construction and economy. In a bi-directional relationship, the economy can lead construction for a certain period of time, and then, for a different time period within the same data series and cycle, construction can lead aggregate economy.

In one of these studies, Ozkan *et al.* (2010), examining the relationship between the construction growth data and GDP in Turkey, found that activity in the construction sector could catalyse the economy of a developing country to exert long-term effects on the GDP. Chiang *et al.* (2015) conducted an exploratory study on the causal relationship between construction activities and economic development in Hong Kong, finding that there is a bi-directional causal link between GDP and construction

activity. The study concluded that the relationship between construction investment and economic growth is inconclusive.

Oladinrin *et al.* (2014) researched the relationship between the construction industry sector and the GDP in South Africa and Nigeria, finding that GDP often leads construction output in South Africa in the long term. The above information is insightful for CEC firms, but it does not relate directly and specifically to consultants as it does not present statistical data that relates solely to this part of the construction industry. The other factor that aggravates the problem is the minimal number of studies pertaining to South African construction economic cycles.

These studies were done with a focus on the construction industry as a whole, with no differentiation between the contracting and professional services. Furthermore, no distinction between civil engineering consultants and other professional services such as architecture and quantity surveying has been made.

To create sustainability in the CEC sub-sector, firms need to identify which factors are relevant to their specific area of expertise and how these could aid in managing a firm to ensure sustainability. The factors that must be identified might not have the same influence over the different phases of macroeconomic cycles. Therefore, the cycles during which each factor will have the highest impact on CEC firms needs to be understood.

For the reasons stated above, to ensure that consultant firms remain sustainable through different macroeconomic cycles in the long term, it is pertinent to analyse the primary economic factors affecting CEC firms through macroeconomic cycles, making recommendations to understand the effect these cycles have on CEC firms. More specifically, the research problem statement is defined as follows:

There is a need in the construction industry to understand which economic factors influence the sustainability of civil engineering consulting firms through the macroeconomic cycles in South Africa.

1.4 Research question

This research will attempt to define the economic factors that affect the financial sustainability of CEC firms by providing an answer to the following question:

Which economic factors influence the sustainability of civil engineering consulting firms in South Africa through macroeconomic cycles?

1.5 Aim and objectives

The aim of this study is to determine the economic factors that occur in macroeconomic cycles that influence the sustainability of civil engineering consulting firms. To achieve this, the following objectives are established:

- To determine the type of relationship that exists between the construction economic indicators, construction professional services total revenue and general economy indicators; and
- To identify economic factors that CEC firms need to monitor in seeking sustainability.

1.5.1 Objective 1

To determine the type of relationship existent between construction economic indicators, construction professional services total revenue and general economic indicators

Objective 1 will first identify the construction economic indicators, the construction professional service total revenue and the general economy indicators through the review of available literature. Once the indicators have been identified, econometric tests that assess the relationship of causation will determine if there is any relationship of causation between construction professional services, construction economic indicators and general economy indicators. In simple terms, this objective will seek to understand if the general economic activity and the construction industry activity have a relationship of causation with construction professional services. These indicators will be extracted from official SARB and CESA published data. The data anticipated for extraction will be the gross domestic product (GDP), gross fixed capital formation of total investment (GFCF1), construction value added (CVA), gross fixed capital formation of total construction investment (GFCF2) and construction professional services total revenue (CPS).

1.5.2 Objective 2

To identify construction economic factors that CEC firms need to monitor in seeking sustainability

Objective 2 proposes to identify the factors that affect the sustainability of CEC firms. To achieve this objective, the research will use in-depth semi-structured interviews to

explore the challenges and experiences that CEC firms and professionals deal with to ensure sustainability. As an outcome, this objective will provide the study with a list of economic factors, internal and external, that CEC firm professionals consider important for ensuring sustainability based on the previous experiences of these professionals. To accentuate this in-depth semi-structured interview, in Chapter 3 a brief comparison of the different types of interview methods used for academic research determined the appropriate type of interview method for this research. Once the method was determined, the questionnaire for the interview was drafted and then approved by the supervisor. Then, professional civil engineers occupying managerial positions in CEC firms were invited to participate in the interviews, with the interviews continuing until a saturation point was reached.

1.6 Delineation

This study will only investigate CEC firms operating in South Africa and that provide professional services for the public sector in the areas of urban planning, structures, transportation, water and sanitation. The data supplied for the statistical and econometric tests will be from the South African Reserve Bank (SARB) and the Consulting Engineers of South Africa (CESA).

1.7 Context of the research

This research will be based on concepts of the construction management discipline of civil engineering.

1.8 Expected outcomes

Overall, it is expected that this research will determine the key economic construction factors that CEC firms need to monitor throughout South African macroeconomic cycles to seek sustainability. The primary outcomes that will be attained in this study are as follows:

- *Outcome 1:* The study will determine whether general economic activity can cause an increase or decrease of the construction professional services (CPS) total revenue, fluctuation in the construction industry activity caused by the CPS total revenue, through South African macroeconomic cycles.
- *Outcome 2:* The study will list the economic factors, external and internal, that influence the sustainability of CEC firms, as well as the origination of these factors.

1.9 Significance of research

This research will prove significant for CEC firms in South Africa, as it will allow construction industry professionals to understand the scope of the entire construction industry, taking into account other services such as professional services often performed by CEC. This study will also help understand if the construction industry activity, considered to account only for on-site construction activity performed by contractors and the general economy, has a relationship of causation with the CEC industry. Ultimately, this study will provide CEC firm professionals an understanding concerning which particular economic factors affect the sustainability of consulting firms. This will be provided by grouping all of the economic factors, the causes behind these economic factors, the type of impact these on CEC firms, and in which phase of a macroeconomic cycle CEC professionals can expect these economic factors to affect the sustainability of firms. The intention is for these outcomes to assist CEC professionals in the decision-making processes needed for the sustainable management of a firm.

1.10 Overview of research methodology

For this study, the research methodology will consist of mixed methods research based on both quantitative and qualitative methods. The decision regarding the most appropriate method for each objective of the research is discussed in Chapter 3, taking into account similar studies conducted previously.

The research design of this study will be based on a concurrent triangulation approach, which means that the quantitative and qualitative methods of research can take place simultaneously (Figure 1-4).

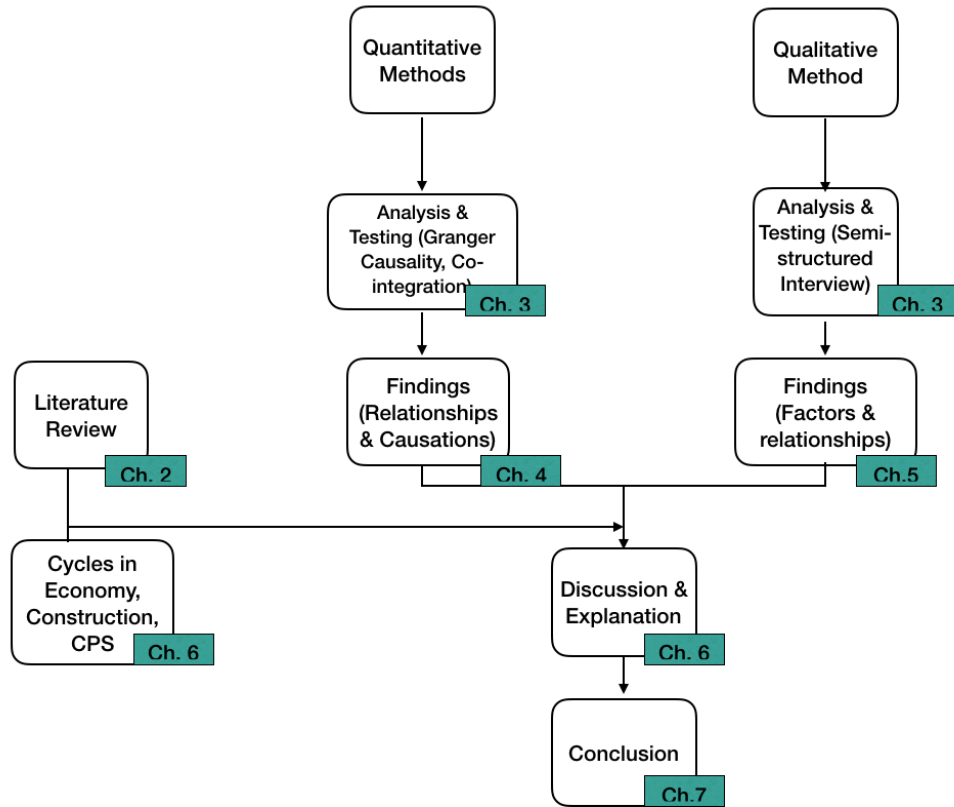


Figure 1-4: Research design

As part of the quantitative methods used in this research, a set of econometric tests will be conducted using data published by the SARB and CESA to determine statistical causation relationships between various sets of data linked directly to economy, construction and consulting engineering. The qualitative method will be semi-structured in-depth interviews with professionals who work with the CEC industry to determine a set of economic factors that the professionals interviewed believe to be the specific economic factors that affect the sustainability of a CEC firm. The findings from both methods will be discussed in Chapter 6.

1.11 Overview of thesis chapters

Figure 1-5 depicts the layout of this thesis, comprised of seven chapters.

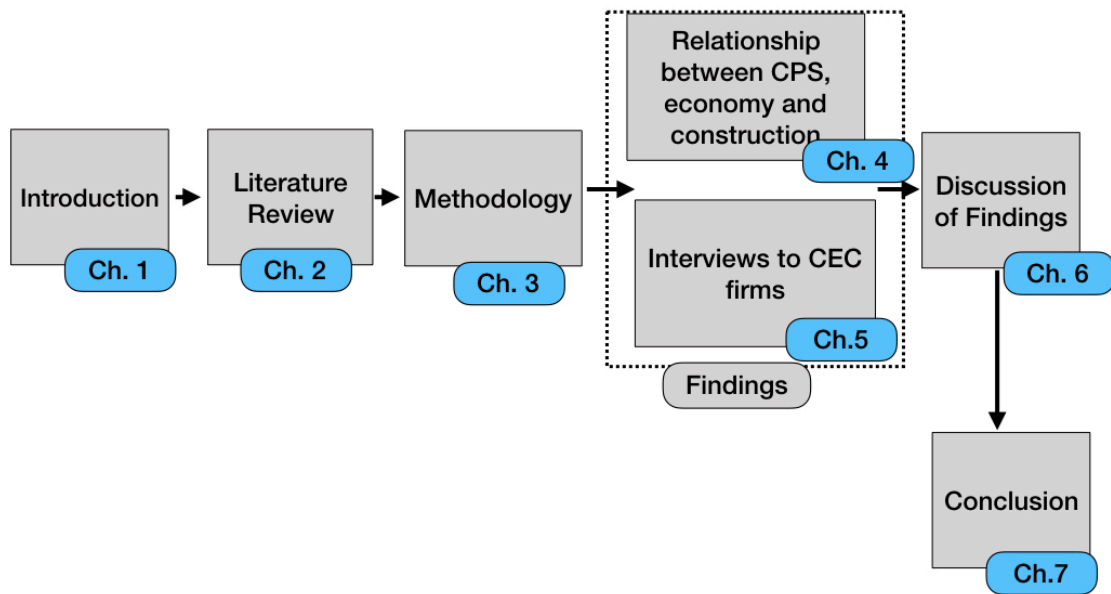


Figure 1-5: Document progress map

- **Chapter 1: Introduction**

This chapter presents the reasons behind the study, what it aims to accomplish and a brief introduction of the methodology to which the study adhered. The chapter provides details relevant to studying the economic factors that have an impact on civil engineering consulting firms' sustainability due to fluctuations of the South African macroeconomic cycles.

- **Chapter 2: Literature Review**

The first part of the chapter presents the definition and history of business cycles, the types of business cycles that occur, the concept of economic growth and the indicators of the business cycles. The second part of this chapter focuses on presenting the history of construction cycles, specifically how the economic activity of the construction industry and its cycles is measured. The final part of the chapter provides an introduction into construction professional services (CPS) and its differences in civil engineering consulting (CEC) services, the method of measurement of CPS contribution to economy and which forms part of the CEC industry total revenue. Moreover, the last part provides information on how CEC firms contribute to the GDP of a country and the type of relationship the construction industry can have with the aggregate economy.

- **Chapter 3: Research Methodology**

In this chapter, the plan for conducting the research is presented. The research design first provides a brief introduction into research methodology and the theory behind the selection of methodology used for this study. The research methodology shows how econometric tests and the use of semi-structured interviews with CEC professionals are typically conducted. Furthermore, this chapter shows how the Granger Causality test will be conducted and the set of tests necessary to be run prior to the Granger Causality test, such as co-integration tests and unit root tests, to ensure that the results are reliable. In addition to the quantitative tests, this chapter also shows how the qualitative in-depth interviews will be structured and conducted.

- **Chapter 4: Relationship of Causation Between Construction Industry Activity, Economic Activity and Construction Professional Services in South Africa**

This chapter will present the quantitative results that indicate the type of causation relationship that exists between construction industry activity, general economic activity and CPS total revenue. Using officially published data, the construction industry activity, aggregate economic activity and the CPS total revenue are tested. The tests used included Unit Root, Co-Integration and Granger Causality tests. The data sets included GDP, GFCF total investment, CVA, GFCF total construction investment and CPS total revenue. The data used is data officially published by SARB and CESA, using time series that extended for a period of 20 years. The outcome of this chapter will determine if, for example, GFCF can cause an increase in CPS total revenue or not.

- **Chapter 5: Interviews**

In this chapter, qualitative findings from the research were presented. These findings represent the responses elicited from the semi-structured in-depth interviews with participating CEC professionals with experience in managing CEC firms. The aim of these interviews was to gather qualitative information pertaining to the experiences that CEC professionals had in the industry through the various construction economic cycles and their opinions pertaining to those economic factors that most significantly affected the sustainability of the firms they manage.

- **Chapter 6: Analysis and Discussion**

The discussion of the results was conducted in this chapter by contrasting findings from the quantitative and qualitative methods. These findings were presented in terms of each research objective and assessed with the aid of the literature reviewed for this study. These discussions resulted in the compilation of economic factors that affect CEC firms.

- **Chapter 7: Conclusions and Recommendations**

This chapter, in the form of a conclusion, highlights the outcomes of the study discussed under Chapter 6, which determined the economic factors that affect CEC firms, and how these findings address the research problem. This chapter presented the limitations and strengths of the study and recommendations for future study that would considerably bolster the existent body of knowledge.

1.12 Chapter summary

Under this chapter, a brief introduction into the background of the study, followed by the presentation of the research aim and objectives, were presented.

The subsequent chapter will be based on a review of the literature concerning the three main knowledge areas of this study: business cycles; the construction industry and its cycles; and civil engineering consulting firms.

Chapter 2: Literature Review

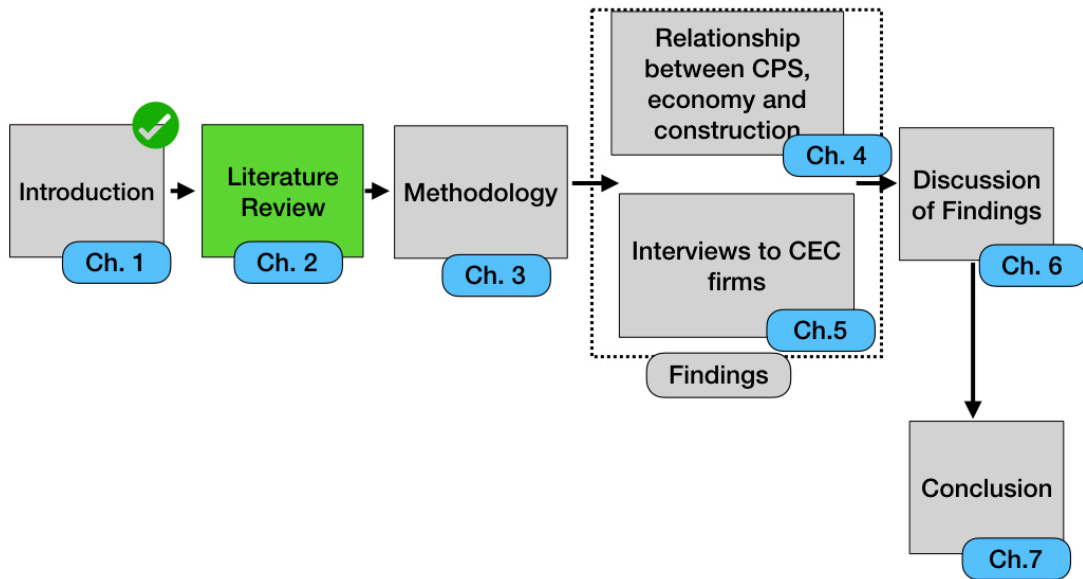


Figure 2-1: Document progress map Chapter 2

2.1 Introduction

This chapter will present the three knowledge areas for this study – economic or business cycles, construction cycles and civil engineering consulting firms (Figure 2-2). In the first section of this chapter, a definition, brief history and characteristics of economic cycles are presented according to available literature. In the second section, construction cycles are reviewed by assessing their definition, characteristics and methods of measuring such cycles. The third section makes a distinction between construction industry professional services and CEC services. In addition, this third section discusses how CEC firms provide services and make their revenue.

This review of the literature will highlight how past studies researched areas related to the construction industry and the general economy. This allows the researcher to better adapt the causation relationship study through econometric tests and the identification of economic factors through semi-structured interviews to address the research problem. This chapter further provides the foundation to assist in the selection of the appropriate research methodology for this study, as presented in Chapter 3.

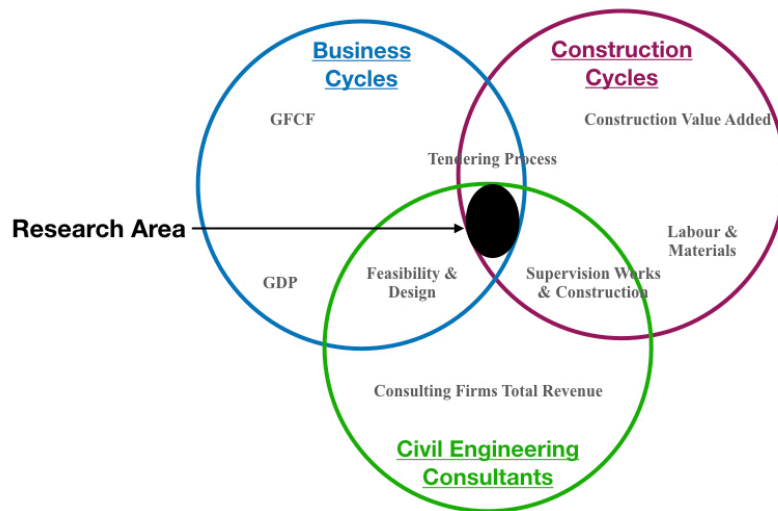


Figure 2-2: Convergence of the knowledge areas into the research area

2.2 Business cycles

To investigate the factors that affect the relationship between construction industry activities and general economic business cycles, the latter must be well understood.

2.2.1 Defining business cycles and their origin

Nowadays, the notion of fluctuations in the economy is accepted as a normal phenomenon; most recessions the world has experienced are explained through the application of theories developed by various economists. Economic cycles, often referred to as business cycles, were defined by Mitchell and Burns (1946) as follows:

...a type of fluctuation found in aggregate economic activity of nations that organize their work mainly in business enterprises: a cycle consists of expansions occurring at about the same time in many economic activities, followed by similarly general recessions, contractions and revivals which merge into the expansion phase of the next cycle.

It is generally accepted that research into the existence of business cycles began in earnest near the beginning of the nineteenth century, known as the *classical economic era*, when Jean Charles de Sismondi published his 1819 work entitled *Nouveaux Principes d'économie politique*, in English meaning *New Principles of Economic Politics*. Most economic historians agree that prior to this work the generally assumption was that economies were somehow static, with no economic

cycles, meaning that production and demand of goods were always similar, resulting in an economy that remains, essentially, in equilibrium.

At about the same time that de Sismondi was developing his theory surrounding economic cycles, an English economist, Robert Owen, publishing an 1817 *Report to the Committee of the Association for the Relief of the Manufacturing Poor*, also concluded that economy had a cyclical behaviour due to over-production and under-consumption of goods. According to Owen (1817), these were caused by wealth inequality: employees were underpaid; production continued to rise; and the elite few who accumulated wealth did not even consume the products manufactured by their countries, preferring imported luxury products instead.

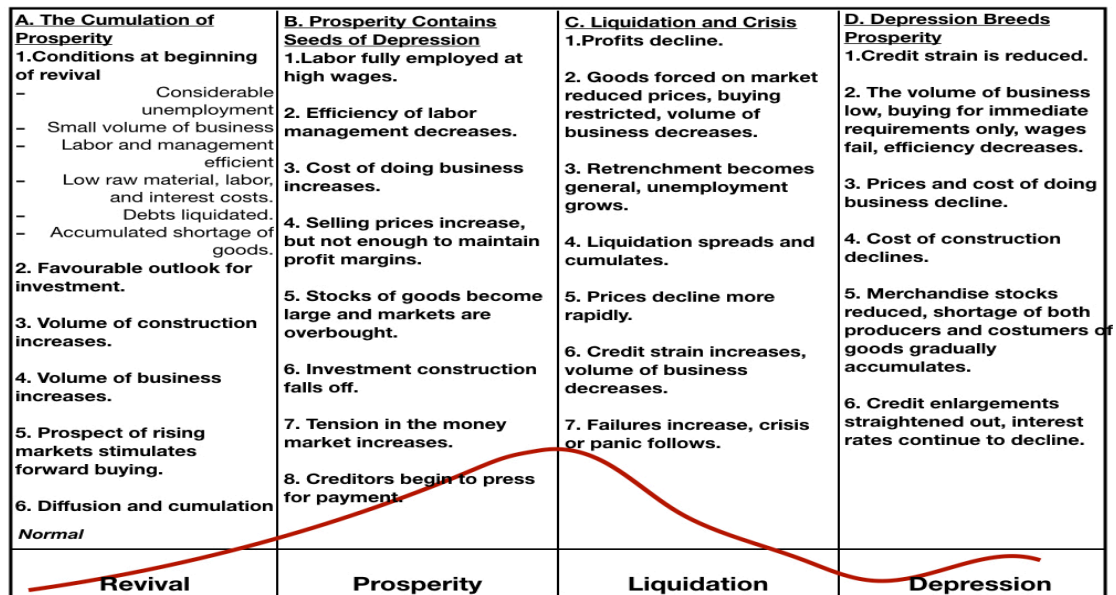
The theory of existence of economic cycles presented by de Sismondi and Owen was not immediately accepted and was only proven right and generally accepted by mainstream economists after the 1825 London stock market crash, which was the first time during peacetime that a recession happened at the height of the first Industrial Revolution. After the crash of the stock market in London, there were further economic crises in the USA during the 1830s and 1850s, and globally during the 1850s, 1870s, 1880s and 1890s. These subsequent crises pushed economists to try to prove the existence and behaviour of economic cycles, which resulted in various theories attempting to prove how economic cycles worked (Barras, 2009).

2.2.2 Phases of business cycles

As defined above by Mitchell and Burns (1946), *business cycles*, representing a series of fluctuations in economic activity, can be grouped into different phases. It is generally agreed by scholars such as Mitchell and Burns (1946), Rorty (1922) and Snyman (2008), that there are four phases to a business cycle.

Different authors use different names to address each phase of the cycle. Rorty (1922), for example, considered the phases as revival, prosperity, liquidation and depression. Mitchell and Burns (1946) identified the four phases as revival, expansion, contraction and recession. Snyman (2008) named these recovery, peak, downswing and through. Irrespective of the nomenclature, these phases essentially represent the same thing. As shown in Figure 2-3, *revival* indicates a period of recovery of the economy with factors such as favourable outlook for construction investment. The *prosperity* phase indicates a revival or peak of the business cycle with labour fully employed at high wages and construction investment beginning to

decrease. The *liquidation* phase indicates a contraction or downswing in the economy, with profits declining. The *depression* phase indicates a recession or through in the business cycle, with low business volume and cost of construction declining.



**Figure 2-3: Business cycle phases
 (Adapted from Rorty, 1922)**

2.2.3 Economic growth

Although there are different criteria affecting economic growth of a particular country, there was a need to develop a universal manner of measuring economic growth. This is achieved through the gross domestic product (GDP), a concept developed in the United States in the 1930s and 1940s, defined as follows:

an estimate of market throughput, adding together all final goods and services that are produced and traded for money within a given period of time (Constanza *et al.*, 2014).

A variety of theories has surfaced, most making use of GDP to explain economic growth. The oldest theory, developed by Malthus (1798, cited in Galor, 2011), is considered classical theory – it assumes that factors of production experience increase while technological advancement remains constant, resulting in economic growth. This theory was highly criticized by other economists such as Solow (1956) and Swan (1956). Their model, to the contrary, assumed that if capital output and worker output remain constant and GDP and technological progress increase, then

economic growth would be experienced. This theory was considered by many scholars to be an exogenous growth theory because economic growth was influenced only by external factors.

During the 1980s and 90s, new theories surfaced with Romer (1986) and Lucas (1988) at the head of these, arguing that human capital, skills and knowledge were the drivers of economic growth in a country. These contributions are considered endogenous as they are founded on the notion that the factors with the most significant effect on economic growth are of internal character (Petraikos & Arvanitidis, 2008)

In more recent years, Galor (2011) brought to the forefront the unified growth theory, which has attempted to close the gaps between all the existing theories. The unified growth theory takes into consideration the stagnation first suggested by Malthus (1798, cited in Galor, 2011), the increase in human capital as a major factor, the sustained economic growth and the divergence in income per capita of different countries.

With the knowledge of the plethora of existing and emerging theories, the debate surrounding which factors govern economic growth still rages. Petraikos and Arvanitidis (2008) state that investment, human capital, innovation, research and development, economic policies, openness to trade, foreign direct investment, institutional framework, political stability, social-cultural factors, the role of geography and demographic trends are all important factors to be taken into account when determining economic growth.

2.2.4 Types of business cycles

Various economists have identified business cycles since the mid-nineteenth century (Kwasnicki, 2008). Most cycles display a change in growth rate of the gross domestic product (GDP) over a period of years, where the difference between the types of cycles is the length of the cycle and the causes behind it: these are referred to as *growth cycles*. The so-called *classical cycles* are cycles where the GDP declines in absolute terms from peak to trough (Snyman, 2008). Generally speaking, most economists concur that the most famous types of business cycles are the Kondratieff waves, Kuznets swings, and Juglar and Kitchin cycles. According to Korotayev and Tsirel (2010), these types of cycles have been tested and repeatedly found present in the world GDP dynamics.

Juglar (1862, cited in Schumpeter, 1939) stated that *recession* was the reaction to prosperity, and vice versa, a hypothesis based on input gained from “banking figures, interest rates and prices with the support of marriage rates and other evidence” (Schumpeter, 1939). But what Schumpeter (1939) claims is that Juglar cycles, although correct in pointing to the existence of cyclical movement of the economy, the article was not correct in pointing out that this cyclical movement was all part of a single cycle. The duration of a Juglar cycle is between eight and ten years (Kwasnicki, 2008). Schumpeter, however, gives credit to Clement Juglar for being the first scholar to establish how history, statistics and theory can, together, provide immense insight into the existence of business cycles.

In 1923, several studies pointing to the presence of a minor cycle were published. One study, by Joseph Kitchin, combined the bank clearings, wholesale prices and the interest rates for the US and the UK, while at the same time contrasting with the understanding of the existence of Juglar cycles. Kitchin cycles, considered to last, on average, three years, are mainly affected by inventory fluctuations which the author of the theory believes can be used to forecast the causes of such fluctuations when used with known lags that occur between the different measurement factors such as interest rates and wholesale prices (Kitchin, 1923).

In 1925, the concept of business cycles was further developed with contributions by Nikolai Kondratieff. As Schumpeter (1939) explains, the studies and model presented by Kondratieff emerged in the late 1700s and ended around 1842, indicating the existence of cycles with long waves that last, on average, 50 years. The main factor behind these types of cycles is technological advancement, with the first being the Industrial Revolution. In relating the Kondratieff cycles (also known as K-waves) with Kitchin cycles and Juglar cycles, Schumpeter (1939) made the famous statement that “barring very few cases in which difficulties arise, it is possible to count off, historically as well as statistically, six Juglars to a Kondratieff and three Kitchins to a Juglar – not as an average but in every individual case”. This further motivates the co-existence of these cycles in the global dynamics of economics, as depicted in Figure 2-4.

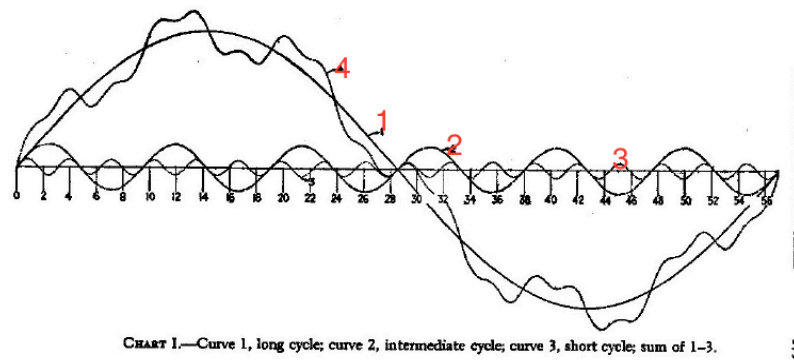


Figure 2-4: Four types of business cycles: 1 = K-Waves, 2 = Juglar cycles; 3 = Kitchin cycles; 4 = combination of all three occurring simultaneously (Shumpeter, 1939)

Kuznets (1930, cited in Kafandris, 1980 p. 293) contributed to the body of knowledge about the existence of cycles by identifying a gap between the 50-year period for K-Waves and Juglar 10-year cycles. This study took a similar approach as in Kondratieff's study, but in this case, population movements were included. Kuznets studies were criticized as these failed to bring significant cyclical relationships in other countries such as the United Kingdom and France, and in 1958, after further research, his hypotheses began to gain traction as he proved a correlation between United States of America population growth with capital formation components such as housing and railway construction (Maddison, 1991). These cycles of 15-25 years, also known as Kuznets swings or K-swings, identified the factor behind these cycles as infrastructure investment.

2.2.5 Indicators used for business cycles

As stated in section 2.2.3, business cycles were initially developed based on GDP figures as the indicators. In recent times, this approach has evolved to include more complex business indicators that take into consideration different variables. This has been done in quantitative form as well as qualitative form (Ruddock, 2008). A majority of research and development has been conducted by the National Bureau of Economic Statistics in the United States of America, and then after privatisation under the Conference Board (The Conference Board, 2001).

The leading quantitative economic indicator method is currently used in countries like the United States of America, Mexico, Spain and the United Kingdom.

Fundamentally, this quantitative stream for determining leading economic indicators has been done by the Conference Board by first selecting the leading, lagging and coincident economic indicators in efforts to determine a composite index. The selection of these indicators that ultimately contribute to the composite index is done according to findings from Zarnowitz, Boschan and Boschan (1975) who determined the criteria to select and assess the indicators, as follows:

- economic significance, with a weighted average of 16.7%;
- statistical adequacy with a weighted average of 16.7%;
- timing at revivals and recessions, with a weighted average of 26.7%;
- conformity to historical business cycles, with a weighted average of 16.7%;
- smoothness, with a weighted average of 13.3%; and
- currency or timeliness, with a weighted average of 10%.

This method of determining business cycle composite indicators is regarded as clear and convincing, since the volatility of individual components is smoothed out in accordance to the weighted average that each indicator is given. In South Africa, a similar composite indicator is also compiled by the SARB for determining business cycle recessions (Snyman, 2008).

Leading qualitative economic indicators refer to expressions of business confidence gathered through business surveys. This form of business leading economic indicators, common in Europe, has recently been gaining greater respectability and acceptance as a suitable business cycle analysis method (Snyman, 2008). The Consulting Engineering of South Africa (CESA) association generates an example of this type of survey, publishing it twice a year.

According to Strigel (1990, cited Snyman, 2008), several distinct benefits can be attained through these surveys: broader information; efficiency in terms of completeness of surveys; minimum loss of time; fuller picture of trends between production and distribution sectors of economy; awareness of limitations; flexibility of adaptable surveys to address changes in policy; and a relationship of trust between individual firms and surveying organisations. Another major advantage mentioned in Snyman (2008) is that leading qualitative indicators are more readily available before the leading quantitative indicators that often wait for the financial year-end of most organisations before publishing the macroeconomic data.

2.2.6 Understanding gross domestic product

In section 2.2.3, the concept of GDP was introduced, defined as the sum of the revenue of goods and services produced within a given period of time (Constanza *et al.*, 2014). This information provides insight into the general size of the economy and how it is performing, forming the basis for comparisons of the performance of an industry between different countries or years (Cellen, 2008).

Created during the 1930s and 1940s in the US, economists such as Simon Kuznets made an effort to clarify the meaning of GDP and clarify that GDP did not indicate the general well-being or prosperity of a country. According to Constanza *et al.* (2014), in the early years of its development, the US used this measure to prove to the public in general that they could join the Second World War and still produce all the products and services needed to maintain a good standard of living in the country. After the conflict, this measure was further developed through the newly formed International Monetary Fund (IMF) and the World Bank making use of the US dollar, its economy and economic policies to measure the economic progress of different countries.

It is critical to understand the way South Africa, as a country, deals with GDP in terms of principles of measurement, collection of data and institutions responsible for ensuring accuracy in such measurements. According to Bouwer (nd), GDP in the country is analysed using real GDP presented in two ways: the quarterly growth at a seasonal, adjustable and annualised rate; and the year-on-year quarterly growth.

Quarterly growth at a seasonal adjustable and annualised rate enables measurement of the performance of a country's economy (using real GDP) after one specific quarter, comparing it to the performance of the economy with a previous year if the economy of the year being measured had a constant rate of change of percentage from one quarter to the next for the remainder of the year. This allows decision makers to gauge their performance as the year progresses. The year-on-year quarterly growth uses the real GDP of a country to measure the performance of the economy at a specific quarter of a year with the same quarter from a previous year (**Figure 2-5**). The graph shows the fluctuations of the economy using the GDP in terms of rand. The shaded parts depict the downturn of the cycle and the unshaded parts show the periods of growth. The main difference between both methods is that the year-on-year method takes no adjustments of the quarter into account and does not assume that the percentage change for one quarter to the next will be maintained (Bouwer, n. d.).

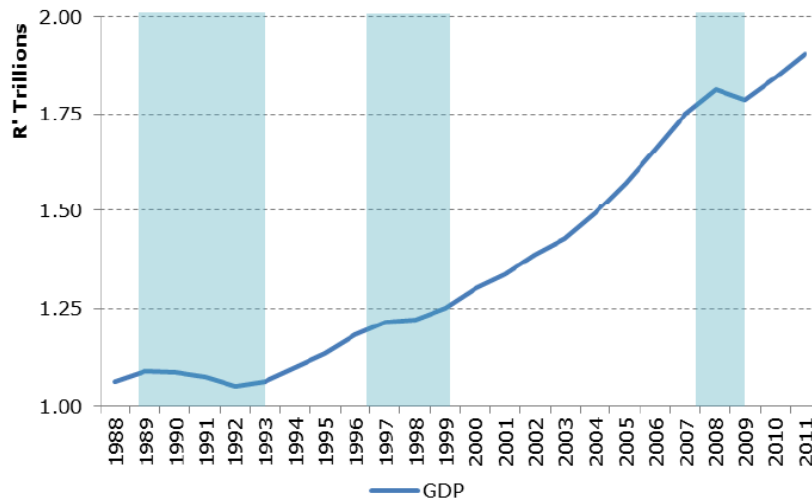


Figure 2-5: GDP and business cycles of South Africa between 1988-2011 (Gauteng Provincial Treasury n.d)

2.3 Construction industry activity and valued added to the economy

This section presents an explanation of how the construction industry activity contributes to the general economy of a country.

2.3.1 Understanding construction cycles

The construction industry value added (CVA) to the economy will vary from country to country. In developing countries, for example, where more infrastructure projects are to be built, the focus of the construction industry is on extracting construction materials and performing construction activities on site. Alternatively, in developed countries, where the essential infrastructure is already in place, the focus of the construction industry turns to the professional services and sale of end-products (Lewis, 2008).

The measurement of CVA depends on the definition of construction. There are two ways of defining construction: the broad and the narrow definition. From a narrow point of view, the construction industry consists of activities mainly occurring on-site such as excavations, concreting and hand-over of construction site. From the broader point of view, the construction industry is comprised of all the economic activities that have direct cause, depend directly or are a result of the on-site construction activities (Pearce, 2003: Ruddock & Ruddock, 2008).

Figure 2-6 shows how the different services of the whole construction industry are related to each other. Services like quarrying of materials, manufacture of construction products, sale or retailing of construction products and materials and the

on-site assembly by specialists or sub-contractors affect directly the on-site assembly services normally carried out by the contractor. The structure of the relationship shows how most of these services are dependent on the on-site assembly services. The professional services are shown to have a direct impact on the built environment in general, same as the on-site assembly services. This also shows how the professional services are less dependent on the on-site assembly services.

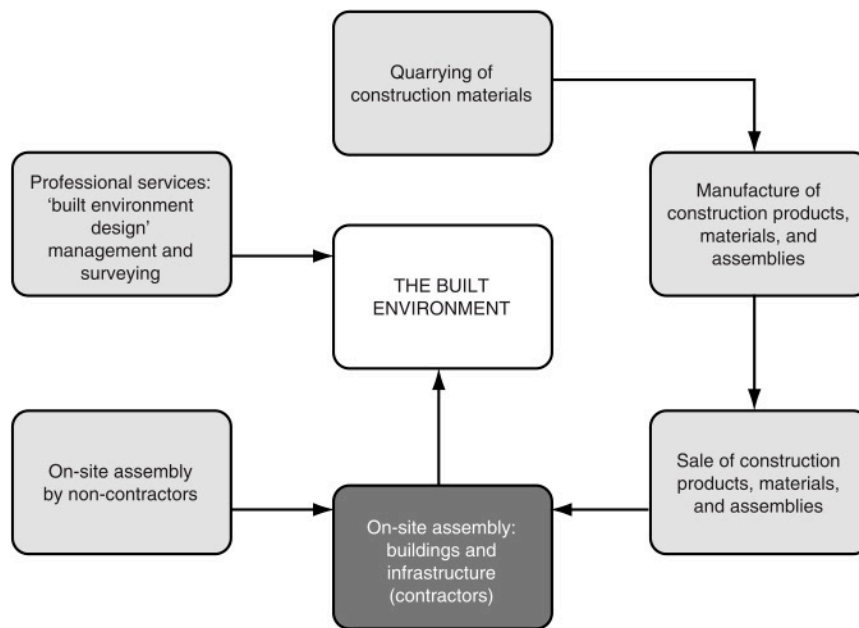


Figure 2-6: Broad and narrow definitions of the construction industry (Ruddock & Ruddock, 2008)

Based on the definition of the construction industry, the contribution the industry has to the economy can be determined. In the UK, according to Pearce (2003), the construction industry value added was determined to be 5% of the GDP if the narrow definition of the construction industry was used, and 10%, if the wider definition was used. This 5% represented the contribution of 170,000 firms, while the 10% represented 300,000 firms. Among scholars and industry experts there is a consensus that the construction industry contributes around 5-10% of the GDP in most countries, giving the industry the ability to affect the economy while simultaneously rendering it vulnerable to fluctuations of the economy. This ability to affect *and* to be impacted by the economy is enough to engender fluctuations and instability. Moreover, the industry can fluctuate because of factors that are directly related to the construction industry, such as size of firms and durability of construction (Ofori, 1990).

Kuznets (1930, cited in Kafandris, 1980 p. 293) extensively discussed the idea of a relationship between building and business cycles, as discussed in section 2.2.4. This relationship between building and business cycles is related to the over-production and over-consumption phenomenon as initially presented by Sismondi and consolidated by subsequent economists such as Mitchell (1927, cited in Kafandris, 1980 p.292) and Spiethoff (1925, cited in Kafandris, 1980 p. 292). In essence, this phenomenon sees an overall escalation in the prices of building and related trades during a period of rising prosperity, followed by a state of economy where materials and labour prices are high with an excess of capacity to carry out contracts (**Figure 2-7**). With the capacity being higher than the demand for works, prices must fall to secure contracts, forcing certain firms to cut costs and reduce their capacity to carry out a wide number of contracts (Kafandris, 1980).

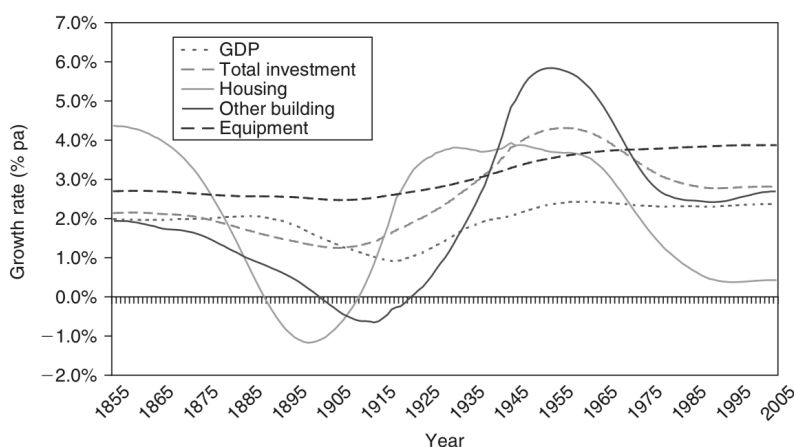


Figure 4.7 Trend rates of growth in UK investment 1855–2005.

Figure 2-7: The growth rate of investment in the UK between 1855 and 2005 (Barras 2009)

Various other economists determined similar results using similar methods to those employed by Simon Kuznets with regard to his K-Swing cycles. These authors, including Riggleman (1933, cited in Kafandris, 1980 p. 293), examined the building permits to locate long swings. Blank (1954, cited in Kafandris, 1980 p. 294) and Roos *et al.* (1934, cited in Kafandris, 1980 p. 294) who studied how rent as a factor influenced demand and incentive in the building industry, found a link between the actual and estimated volume of new buildings. Newman (1935, cited in Kafandris, 1980 p. 294) observed that building activity precedes changes in business growth through the same method of study used by Riggleman (1933) but with a few refinements, such as the land expenses (real estate cycle), cost items of the industry and activities.

Although most of these studies were fundamental to the understanding of the position that the building industry takes in the different business cycles, they presented a few shortfalls that certainly cannot be ignored. As pointed out by Kafandris (1980), the economists who conducted these studies had backgrounds that most often included no engineering industry insight. Furthermore, the cycles were measured over short periods, which Kafandris (1980) suggests might be due to the lack and apparent infeasibility of data, as these studies only investigated the building industry data while excluding other sectors such as infrastructure construction industry and the professional services industry.

More recently, there have also been studies investigating the relationship between the construction industry and the aggregate economy that made use of econometric techniques to test the type of relationship existing between these two variables. Okoye *et al.* (2016) made use of data published by the National Bureau of Statistics of Nigeria on construction sector and the aggregate GDP to investigate the impact of economic fluctuations on the growth and performance of the construction sector in Nigeria. This study, applying unit root, co-integration and Granger Causality tests, determined the long-term connective relationship between both variables, concluding that construction growth is more volatile and therefore more susceptible to impact when compared to GDP. Chiang *et al.* (2014) studied the causal relationship between construction activities, employment and GDP in Hong Kong. This study, using Granger Causality and unit root tests, found the contribution of construction activities to GDP and economic development to be statistically significant. Gostkowska-Drzewicka (2014), studying the relation between business cycles and changes in prices of factors of construction production in Poland, used government published data to determine a curve of the economic cycle as well as the indicators of changes in prices. The study concluded that changes in production factors in construction are closely related to the conditions of the construction sector, a relationship most detectable during the growth phase of the cycle. Khan (2008) studied the causal relationship between construction sector activities and the economic expansion of Pakistan, applying econometric and empirical methods such as Granger Causality, Johansen's co-integration and unit root tests. This study concluded that construction flow precedes GDP and that GDP does not precede construction, showing a unit-directional causal relationship.

In the study of a similar topic, namely Building Cycles, Barras (2009) stated:

...building cycles are characterised by a burst of investment in new stock, induced by increase in occupier demand, followed by a phase of accelerated obsolescence in the existing stock.

Therefore, it transpires that houses are built and after the economic life reaches its end, it becomes necessary to either renovate or rebuild, as a growth in demand to occupy houses is experienced. This results in growth in economy from high levels of economic activity.

Another point of contention when studying construction cycles is the duration of these cycles, with some prominent scholars such as Abramovitz (1964) and Gottlieb (1976) agreeing that construction cycles last on average between 15-20 years. Other scholars like Wheaton (1987) and Barras (1987), however, insist that construction cycles are shorter. Regardless of the duration of the cycles, it is difficult to estimate of the duration of the cycles without the aid of a large quantity of accurate historical data. Ofori (1990), going further, claims that the main factors affecting the duration of construction cycles should be of long-term nature caused by changes in the industry output and not of short-term nature caused by weather or non-availability of labour and materials.

Regardless of opposing views on construction cycles, scholars agree that a construction cycle has two extreme points: one, the increase in economic activity which can be fuelled by demand for services and products with a relative lower capacity available; and two, the decrease in economic activity when demand for services and products is lower than the capacity to provide such services and products (Ofori, 1990).

2.3.2 Performance indicators in the construction industry

For the construction industry to be acknowledged as significant to a nation's development, it is imperative to determine the important economic factors that have the ability to influence the industry. To do that, the industry should be able to quantify these factors and determine their influence to the economy by means of indicators.

Ofori (1990) identified three reasons to measure the level of production in the industry; these included the need to ascertain the performance over time, the need to facilitate comparison between different industries and the need to prepare the industry for future changes. To satisfy such needs, the industry could take on different types of measurements, such as areas of floors, lengths of roads and

numbers of bridges. However, this method would likely be inefficient as construction projects run over periods that can be considered lengthy. In addition, the type of construction would have a different degree of significance as a floor area of a school does not have, for example, the same level of significance as the area of a hospital or a convention centre. Therefore, it would be simpler to measure the impact of the industry on the economy in terms of cost.

Briscoe (2006) highlighted that measurement of output from construction is not an easy task as it can take into consideration a number of aspects such as employment, equipment, materials and other factors, concluding that although the construction industry has data from different sources, such data is not always reliable or useful in the form that it is made available. According to Ofori (1990), the most common forms of measurement used are the gross output, capital formation and value added. As mentioned above, some countries measure these differently, causing these measurements to be differently named depending on the approach used for each measurement. According to Ofori (1990), these measurements can be defined as follows:

- a) *Gross output* – measurement of the total production of the construction industry, including cost of materials and input from other industries, and costs of a new plant and its maintenance.
- b) *Capital formation* – measurement of the total value of new construction and rehabilitation works. This measurement, in particular, excludes all costs from new plant and its maintenance but includes costs for materials and services that might come from other industries.
- c) *Value added* – measurement that shows the difference between the values of the product after it has been finished and the value of all the inputs before production commences. In other words, this measurement excludes costs of components such as materials, plant and services from other industries. This measurement often contributes to the determination of the GDP of a country.

The different costs that form part of these measurements are the 'indicators'.

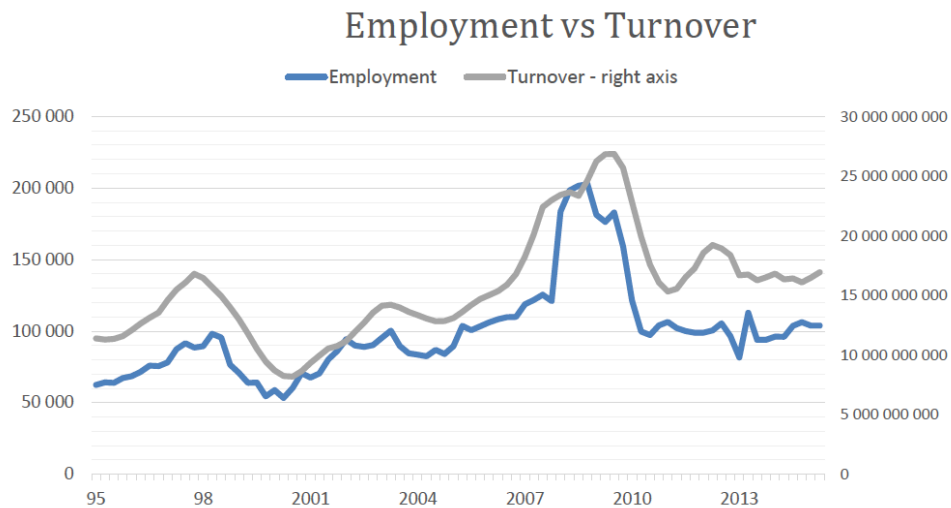


Figure 2-8: Relationship between number of employees in construction firms and the turnover rate from construction firms between 1995 and 2013 (SAFEC, 2015)

There are various types of indicators, but for the purpose of this research, we are focusing only on economic indicators. According to Nippala (2012), economic indicators can be sub-divided into three further categories: leading, lagging and coincident. Nippala further explains that a leading indicator tends to change before business economic conditions change; lagging indicators tend to change after the business economic conditions have changed; and the coincident indicators tend to change within the same period the markets start experiencing change. An example of a leading indicator would be number of building construction permits; an example of a lagging indicator would be number of unemployed labourers; and a coincident indicator example would be the price of materials. Figure 2-8 shows the lagging relationship between employment and turnover of contractor firms in South Africa. The employment clearly lags the turnover of the construction firm.

During a study of the construction economic cycle of Poland, Gostkowska-Drzewicka (2014) had as one of the aims of the study to identify the indicators of changes in the prices of construction production factors, comparing these with the curve reflecting the state of the economic cycle in the construction industry. For this study, the factors examined were prices of materials, prices of rental, labour rates and building plots for construction. The study concluded that the prices of these resources do influence the construction industry economic cycle.

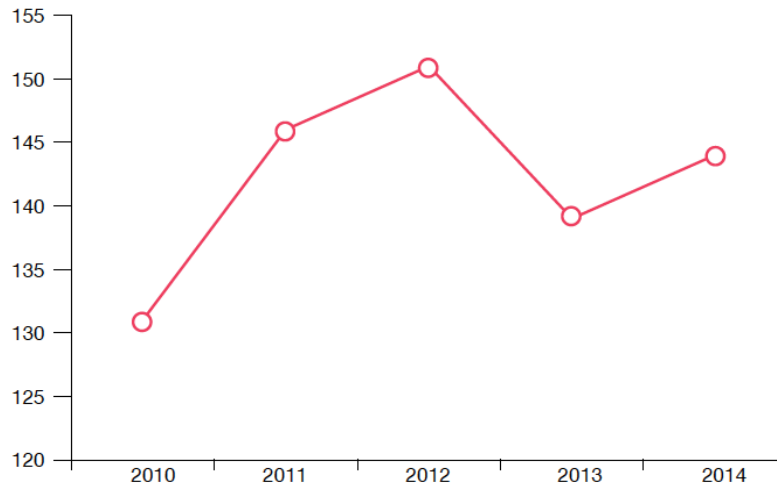


Figure 2-9: Public expenditure in new construction, land and existing buildings between 2010 and 2014 in billions of rand (PWC, 2015)

In the South African construction industry, the quarterly State of the Industry report presents economic indicators for the industry in general, such as new work tendered for, firm turnover and employment, capacity utilisation and plant and equipment management. The report, making use of available data, showed more recent data for certain indicators going back to 2012 while for other indicators, data went back as far as 1995 (SAFEC, 2015).

Another report compiled by PWC (2015) on the South African construction industry (Figure 2-9), stated that “A good indicator of industry’s performance would be the infrastructure spent by the public sector”. When looking at this indicator, it is critical to pay special attention to what percentage of this expenditure represents new construction work, as the industry normally grows with a higher percentage of new construction than with the percentage of work in renovations.

The most common measures of construction performance and contribution to the economy used for research are in terms of construction value added (CVA) in terms of GDP and GFCF (Ofori, 1990; Lopes, 2008; CESA, 2017). As stated in section 2.3.1, the level of development of the country will influence the level of relationship that these indicators – CVA, GDP and GFCF – have between each other. Lopes (2008) analysed the relationship between investment in construction and economic growth. Using data from the UN Year Book of National Accounts Statistics and World Bank, Lopes showed graphically how the three indicators, when reduced to the same

index, could show some characteristics of following a trend. However, this trend tends to differ depending on the level of development of the country.

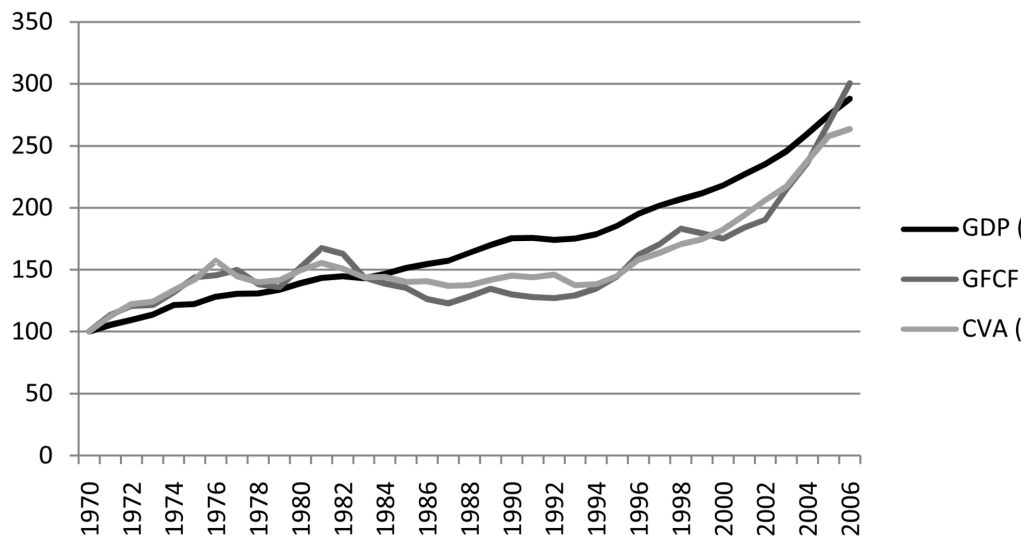


Figure 2-10: Volume of indices of GDP, GFCF, CVA in Sub-Saharan Africa at constant 1990 US\$ (1970=100) (Lopes 2008)

Figure 2-10 shows how Sub-Saharan countries have all three indicators – GDP, GFCF and CVA – following a similar set trend due to the difference in the volume of index below 50. The line graphs appear to follow the same trend, with an evident link between CVA and GFCF.

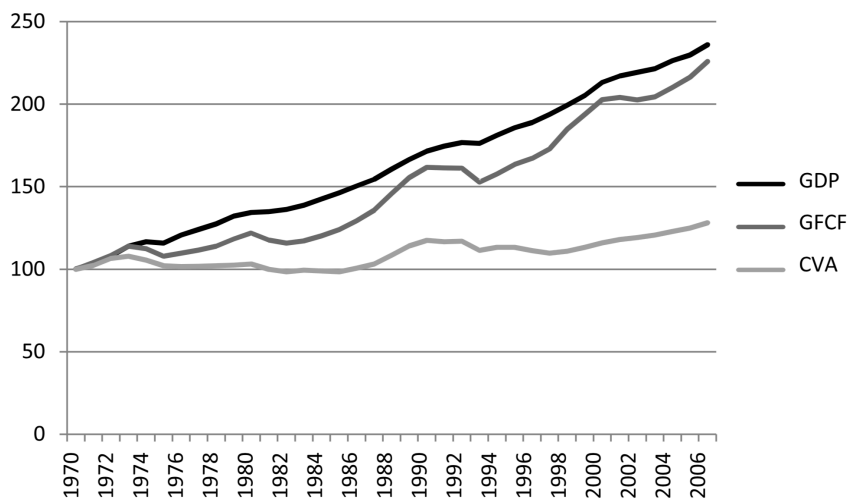


Figure 2-11: Volume of indices of GDP, GFCF, CVA in Western European countries at constant 1990 US\$ (1970=100) (Lopes 2008)

Figure 2-11 shows how countries from Western Europe have only the GDP and the GFCF following the same trend, and the CVA following a different trend, which indicates a slowdown in the growth of construction activity. The difference in volume of index depicted in Figure 2-11 tends to increase as the years pass.

2.4 Civil engineering consulting firms

This section focuses on making a distinction between the construction industry and CEC services. Making use of concepts discussed previously under sections 2.2 'Business cycles' and 2.3 'Construction industry activity and valued added to the economy', this section intensifies the importance of consulting services on the construction industry of a country and on the economy of a country.

2.4.1 Construction professional services (CPS) and their role in the industry

From the various definitions of the construction industry, Ofori (1990) provides a simple definition, that the *construction industry* is "that sector of economy which plans, designs, constructs, alters, maintains, repairs and eventually demolishes buildings of all kinds, civil engineering works, mechanical, and electrical engineering structures and other similar works". In the construction industry sector, two types of organisations, professional service consultants and building or civil engineering contractors, very often undertake these works (Ofori, 1990). It must be noted that other organisations also play important roles on the industry such as educational organisations, material suppliers and plant manufacturers (**Figure 2-12**).

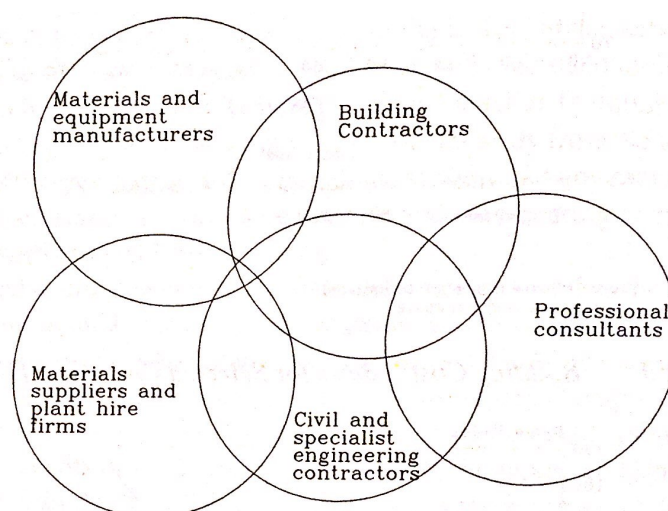


Figure 2-12: Sub-sectors of the construction industry and how sectors overlap (Ofori, 1990)

The sub-sector of the construction industry that relates to CPS also includes a variety of services, including architecture, engineering and quantity surveying (Jewell *et al.*, 2010). Due to such variety of services, numerous studies have been conducted in efforts to determine a suitable definition of these CPSs. Hill (1977, cited in Jewell *et al.*, 2010 p. 234) defined *services* as 'changes in the condition of a person or something in the possession of the customer'; Loverlock (1991, cited in Jewell *et al.*, 2010 p. 234) classified it as 'a process or performance rather than a thing'; Vargo and Lusch (2004, cited in Jewell *et al.*, 2010 p. 234) wrote about services as 'the application of specialized competences (knowledge and skills) through deeds, processes and performances for the benefit of another entity or the entity itself.' Expanding on the definitions provided above, Styles *et al.* (2005, cited in Jewell *et al.*, 2010 p. 234) classified CPSs as knowledge intensive business services that focus on their inputs of technology and human capital for the construction industry.

2.4.2 Measuring the contributions of CPSs into the economy

In most periodic economic reports produced by different countries, there is a separation between construction professional services and the construction contracting services. The professional services are often portrayed as 'other business services', typically aggregated with services such as legal consulting, financial accounting and advertising and marketing research (Jewell & Flanagan, 2012). In South Africa, construction professional services are portrayed under 'other business & miscellaneous services' (SARB, 2018). Under the construction industry sector, the GDP indicators often represent the output from contracting firms that are responsible for on-site assembly of buildings and infrastructures (Pearce, 2003). With that in mind, the selection of indicators that would represent the professional services needs to be carefully understood to avoid the use of general construction industry indicators as construction professional services indicators (**Figure 2-13**).

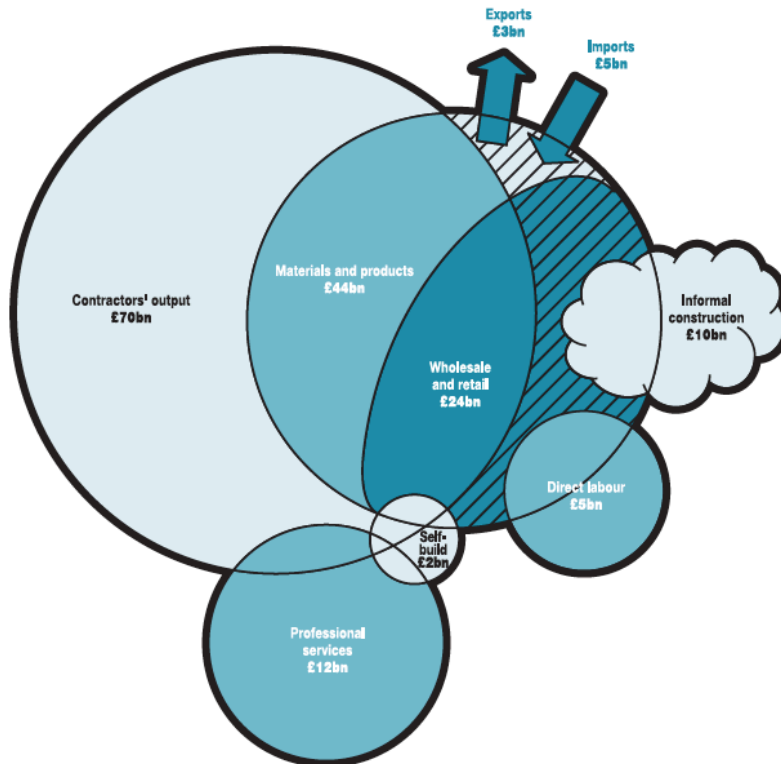


Figure 2-13: Overall gross output of the UK construction industry, with informal construction depicted as a cloud due to its uncertainty (Pearce 2003)

The CPS firms also make use of some of the indicators that the construction contracting services make: gross output, value added, employment and number of firms (Pearce, 2003). Although these are the mainstream conventional indicators used for measurement, many studies have raised a concern about the benefits that these indicators bring, specifically to the CPS firms, as the measurement data such as value added or number of firms proven to be aggregated; the values include information from various different disciplines (Jewell *et al.*, 2010).

2.4.3 The separation between CEC firms and CPS

Construction professional services (CPS) very often work together to bring a project to reality. What differentiate CPSs from each other are the tasks these services perform. The common denominator for the CPSs is the construction project on which these services agree to cooperate to bring a project to completion. Recently these services have been cooperating more with the increase in use of procurements strategies such as 'build, operate and transfer, (BOT) and 'design and build' (Jewell *et al.*, 2010).

As pointed out by Jewell *et al.* (2010), the CPS services differ from each other in the operations they perform and strategies they use. This forces each of the different services under CPS to work under different governing bodies and associations. For example, engineers and surveyors undertaking work for a road or bridge project will often not need input from architects. Such differences between engineers, surveyors and architects result in some professions charging higher fees than others do. The differences in fees come because of the different responsibilities and different ranges of services, as explained in section 2.4.4.

2.4.4 Revenue from CEC firms

According to CESA and BEPEC (2014), the civil engineering subsector of the consulting services sector in South Africa has the largest share of the total revenue of construction consulting firms, with civil engineers earning on average 50% of the total revenue of the consultancy services sector. This has been consistent with results from surveys from consultant firms, published every semester by CESA. That, among other findings, shows the average percentage share of the fee income ranging from 48% to 60% for civil engineering consulting services between 2012 and 2018 (CESA, 2019). The service with the next highest percentage share of fee income is consultancy firms on the structural sub-sector with an average of 13%, followed by project management with an average 9% (Figure 2-14). It is evident that South African CEC services have the highest share of the consulting services revenue when compared to other engineering consultancy services.

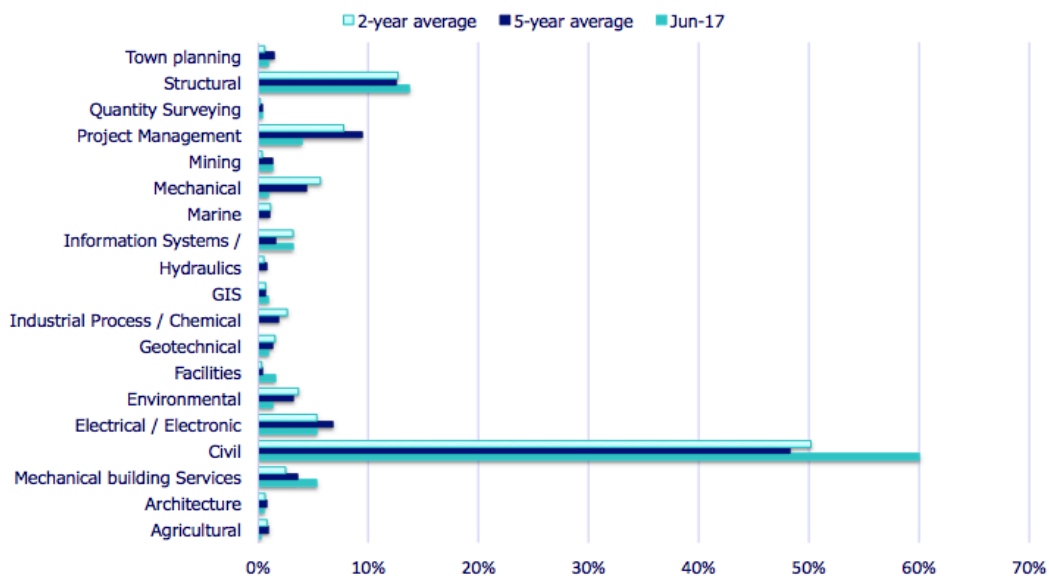


Figure 2-14: Percentage fee income from CPS firms in South Africa (CESA 2017)

The fee income of an engineering consulting firm has a contribution from the salary and wage bill that normally averages between 63% and 66%, but was recorded to be around 61% in the first semester of 2017. In December 2018, the contribution from salary and wage bill was reported at 76%. Larger firms registered a decrease to from 65% to 64% contribution from salary and wage bill between 2016 and 2017, while medium firms registered on average 50%, and smaller firms registered contributions between 42% and 48% for 2017 (CESA, 2017 & 2019).

A factor that needs to be considered when studying fee income from CEC firms is the method used to estimate such fees. In South Africa, CEC professionals can use guidelines established by the government to estimate such fees. These guidelines, prepared by ECSA, refer to professionals registered with the organisation (Republic of South Africa, 2015).

In South Africa, the first step to be taken before determining a fee should be the definition of the scope of works that can vary depending on the requirements of the client. The scope of work to be carried by the consulting engineer can be divided into three categories of services: 1) planning, studies, investigations and assessments; 2) normal services; and 3) additional services (Republic of South Africa, 2015). ACEC and APEG (2009) classified the categories of services as basic and additional services according to the stages of the project in British Columbia, Canada. These stages of the project are the advisory services, preliminary design, detailed design, final design, tender services, construction related services, resident engineer services, project management services and construction management services. Only the final design and tender services stages have the basic services category, while the remainder of the stages include the services category of additional services.

According to the Republic of South Africa (2015), planning studies, investigations and assessments are normally remunerated on a time and cost basis. These services often result in preliminary proposals and initial feasibility studies. For normal services, the Republic of South Africa (2015) determines that the nature, function and form of the project have been defined, as well as the services required by engineering consultants to take the project from start to a completion phase. Normal services performed by engineering consultants often have six stages: inception, preliminary design, detailed design, procurement and documentation, contract administration and inspection and project close out. For additional services, the Republic of South Africa (2015) divides this category into eight sub categories:

- Additional services pertaining to all stages of the project;
- Construction monitoring services, which in the case of CEC firms, are often done on a full-time basis requiring the engineering professionals to be on site at all times to perform various duties;
- Occupational health and safety act;
- Quality assurance system, normally combined with construction monitoring; the consultant here is expected to provide services related to quality assurance and quality management systems;
- Lead consulting engineering when a project has a joint venture or a team of consulting engineers of the same discipline;
- Engineering management services where a project has different consultants for different disciplines of engineering requiring the consulting engineer to act on behalf of the client as the principal consultant;
- Mediation, arbitration and litigation proceedings and similar services; and
- Principal agent of the client, whereby the engineer, in addition to juggling the normal services, will play a prominent role in project procurement.

Based on the knowledge of the scope of works a fee can be established. Methods of estimating fees worldwide are similar, with only minor differences in certain countries. For example, in Canada fees can be estimated based on time, percentage of work and fixed fee or lump sum (ACEC & APEG, 2009). In South Africa, for engineering consultant remuneration, the Republic of South Africa (2015) states four main remuneration methods known as time based fees, value based fees, percentage fee based on cost of works (Figure 2-15) and fees for services that are additional. These various estimations are applied differently, sometimes in combination depending on the stage of the project and the category of services to be provided.

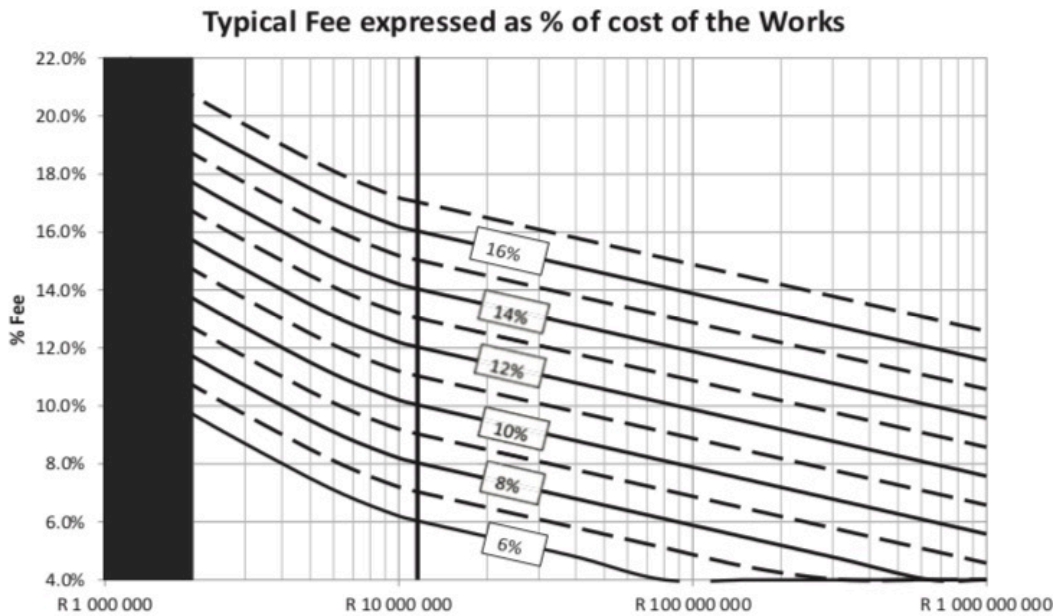


Figure 2-15: Income fee as a percentage of works in consulting engineering services (DPSA, 2003)

The fee income that consulting engineers charge to clients during positive periods tends to rise in contrast with the subsequent cyclical fall experienced in different periods. CESA (2017) states “Fee income rose to R26.6 billion, annualised at current prices at June 2017”. The subsequent fall in fee income was estimated by CESA (2019) to be at R21.5 billion, annualised, at current prices for 2018.

After a consulting firm has analysed the scope of works and has defined the fee, income-consulting engineers will generally present the fee to the potential client. How the fee is presented and negotiated with the client will depend primarily on the requirements set by the client and occasionally on the type of client with which the consulting engineers will be working, as discussed in section 2.4.5.

Under various circumstances, consulting engineering firms will need to undergo competitive tendering to secure a new contract to perform services (DPSA, 2003). DPSA (2003) encourages competitive tendering, explaining “Procurement reform pertaining to consultants focuses on promoting competitive tendering and improving the quality of consulting work and contract management”.

Competitive tendering and discounting have been known to affect the fee income from consulting engineering services. The Republic of South Africa (2015) regards “fee discounting to have a significant negative impact in the entire industry and infrastructure development of the country”, discouraging competitive bidding of

consulting engineering services based on the global discount that these firms could offer. In the instance of a discount, the Republic of South Africa (2015) advises that such discounts be based in its guidelines, as fees that are too low can impact the life cycle of a project by forcing the contractor to suffer longer operational and maintenance costs.

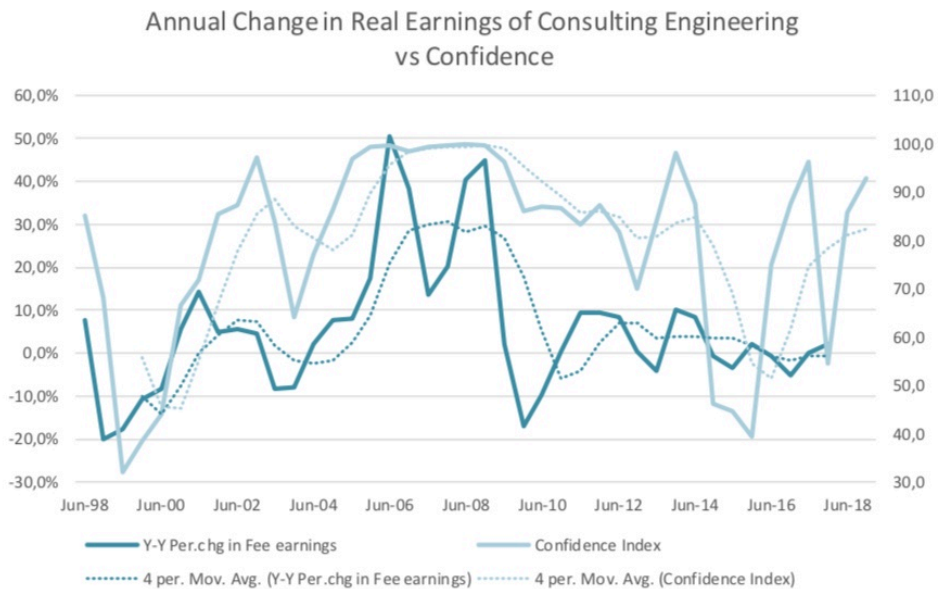


Figure 2-16: Annual change in fee income of consulting engineering firms against construction industry confidence index (CESA 2017)

Figure 2-16 reveals that there appears to be a correlation between fee earnings and confidence index, with fee earnings leading confidence index. In particular, reported growths in earnings have often deteriorated, increasing uncertainty and volatility with regard to confidence. Such confidence from the consulting engineering sector has not deteriorated at the same pace as contractors have reported. This sentiment expressed by contractors, in fact, is based on slower rollout of projects and tenders awarded by the government, with more time for these projects spent during designs phases, supporting the services supplied by consulting firms (CESA, 2017). An increase in demand for consulting engineers could lead to an increase in the pipeline of work for contractors, with a concomitant increase in works for contractors leading to a positive impact on the economic environment (Van Sante, 2008).

2.4.5 Employment of CEC firms

In addition to the earning share of CEC firms, there is the employment impact that the civil engineering sector, as a whole, has on the country. CESA and BEPEC

(2014) state “There is a correlation of 0.9788 between gross fixed capital formation (GFCF) and employment in the civil engineering sector in South Africa”, further adding that there is a 1% increase in employment in the civil engineering sector for every extra percentage spent on GFCF.

The statistics pertaining to the number of people employed by the construction industry is officially published by the state agencies, with CIDB (2017) stating that the industry contributes 10% of the employment of the country (**Figure 2-17**).

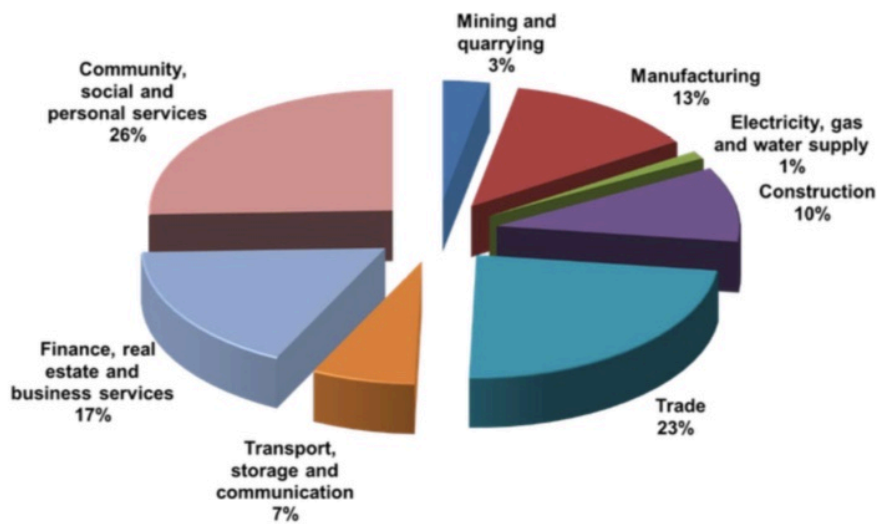


Figure 2-17: Percentage share of total employment in South Africa per sector (CESA and BEPEC 2014)

CESA and BEPEC (2014) depict the importance of the civil engineering sub-sector within the construction sector by expressing that in 2011, the civil engineering sub-sector employed around 39% of the employees of the construction industry without including the self-employed who do work in the civil engineering sub-sector. The study, however, did not clearly show if this metric combined consultants and contractors or only consultants.

The consulting services in South Africa registered with CESA employ 24 540 people (CESA, 2019). According to CIDB (2017), these professionals are mostly employed by large consulting engineering firms, as many small and micro-small firms are not registered members of CESA. From all the firms registered with CESA, there are firms that specialise in fields such as mechanical, electrical and marine engineering that should not be considered CEC firms. Consequently, the studies performed by CESA do not provide enough details to know exactly how many employees work in CEC firms in SA, but CIDB (2017) provides insight into the relationship between GFCF and fee income with the number of employees who are CESA members. The

study shows the correlation between the employees and the GFCF and fee income (Figure 2-18). This study, supported by CESA and BEPEC (2014), reveals the impact that CEC firms have with regard to the number of employees when compared to other consulting services supported by CESA (2017) that show that the highest share of fee income reported by CESA members comes from CEC firms.

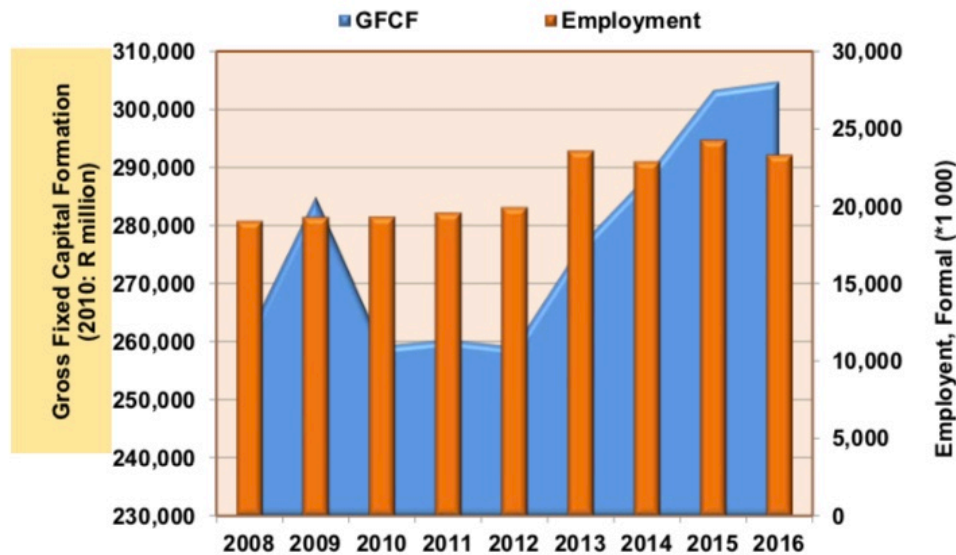


Figure 2-18: Relationship between GFCF and employment in CPS firms (CIDB 2017)

South African CEC firms have a multiplier effect on income and on job creation. With regard to income, it has been determined that for every additional R1 million spent on the construction of civil engineering structures, R1.69 million is circulated through the economy from salaries and profits (CESA & BEPEC, 2014). The job multiplier was defined at 0.64 for every additional R1 million spent in the construction of civil engineering structures in South Africa, creating an additional 0.64 job opportunities for CEC firms (CESA & BEPEC, 2014).

Statistics from the 2017 CESA report indicate a decrease in employment of engineers by consulting engineering firms in South Africa. Permanent employment fell by 13% while part-time employment increased by 24%, resulting in an overall decrease in the demand of engineers for all consulting firms (CESA, 2017). This diminished job creation can be related to two pertinent factors, the GFCF and the skills shortages. The decrease in GFCF was registered for 2016 and 2017 at -0.7% and -2.6%, with 2018 having a decrease recorded at -1.4% for the total construction industry, marking two consecutive years of decrease in investment in construction (CESA, 2017 & 2019). As stated in the beginning of this section, there is a strong

correlation between GFCF and employment in the consulting engineering sub-sector (CIDB, 2017). Another factor identified affecting the slow increase in demand for civil engineering consultants is the skills shortages. Forty four percent of CESA members reported a shortage of skills in 2016 (CIDB, 2017).



Figure 2-19: Percentage of CPS reporting shortages of engineers (CIDB, 2017)

The demand for employment in consulting engineering firms has certainly fluctuated. Between 2015 and 2017 there was a high demand for employment by consulting engineering firms, as CESA reported an increase in demand by the consulting companies up to 67% in the first semester of 2017, up from 44.9% in 2016 (CESA, 2017). In 2018, the demand plummeted to an average of 4%. This increase in demand experienced between 2015 and 2017 is likely due to the skills shortage highlighted above, while the decrease in demand experienced in 2018 might be due to a 21% decrease of fee income for consulting firms in 2018 (CESA, 2017; 2019).

The demand for employment by consulting firms has been more specifically to employ more engineers, technicians and technologists. Technologists and technicians have incurred higher demand. According to the survey conducted by CESA (2017), in June 2016, 15% of technologists were needed, but by December 2016, this figure dropped to 5%, rising again to about 72% in June 2017. The same report highlighted that the demand for technicians went from 20% in June 2016 to 10.7% in December 2016, escalating to 73% in June 2017.

In the consulting engineering sub-sector, the technical profession with the most percentage share are engineers, with 12.6% registered and 12.9% unregistered,

followed by technicians, with 10.1% being unregistered and 4.0% registered, and for technologists 5.1% are registered and 5.4% remain unregistered (CESA, 2017). The low percentage of technologists and technicians employed by consulting firms might be one of the causes for a high demand of technologists in the recent two years, as depicted in Figure 2-20.

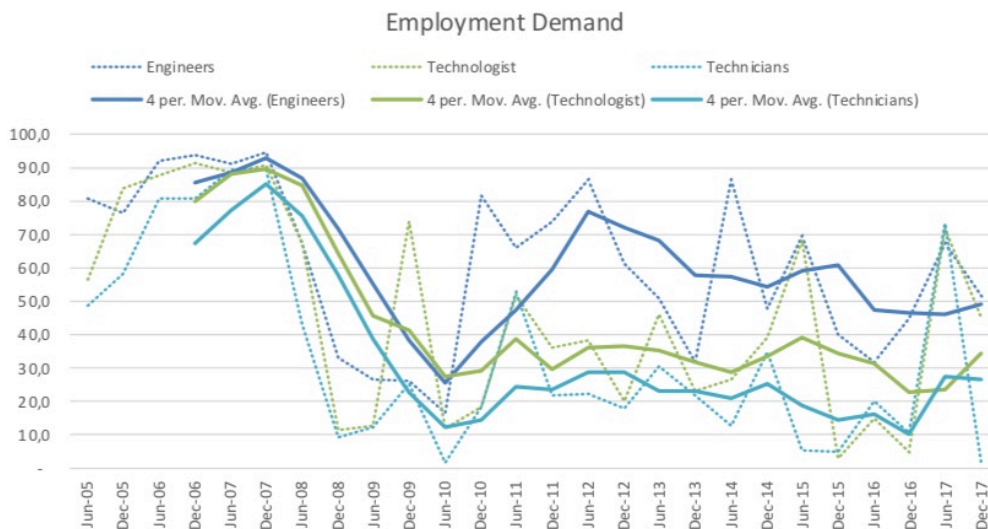


Figure 2-20: Reported employment demand for engineers, technologists and technicians in South Africa by CPS (CESA, 2017)

National professionals, such as engineers, technologists and technicians, have also been leaving South Africa in unprecedented numbers to seek employment elsewhere. According to ECSA (2014), about 10% of all professionals registered with ECSA are currently working outside of South Africa. The report does not provide specification with regard to which type of employers these professionals have, but it highlights that over 40% of these professionals do not know if they will return to work in South Africa, 23% stating that they will return at a later stage, 22% stating they will return in the near future, and 13% not planning on returning. Over 50% of these professionals left South Africa between 2009 and 2014. Of the South African registered engineering professionals who were born in the country and emigrated, 75% are qualified engineers, 14% technologists and 11% technicians. A variety of reasons spur professionals to leave South Africa, but the three main ones are job opportunities, crime and remuneration (ECSA, 2014).

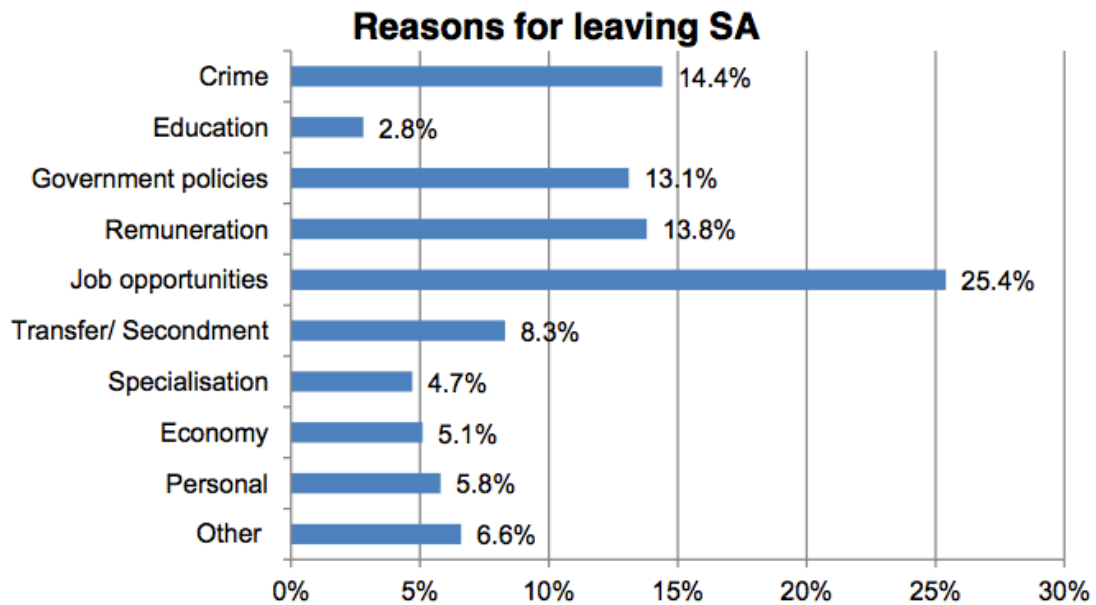


Figure 2-21: Reported reasons for engineers leaving South Africa (ECSA, 2014)

The capacity of firms as a factor has been linked with the employment and profitability of a firm. As mentioned in section 2.3, the capacity of a business or a sector directly affects the cyclical nature of an industry. Therefore, as firms do not want to run with low capacity, this means that while they have high costs, at the same time a firm does not want to run above capacity as this impacts quality. **Figure 2-22** presents consulting firms in the CESA survey of 2017 reporting that capacity utilisation has increased over the last years from a stagnant 82.5% to an 85.1%. Larger firms reported an increase of capacity utilisation to 91%, medium firms to 84.5% and smaller firms to 78.8%. Smaller and medium firms expected the capacity utilisation either to be maintained or to decline, while larger firms espouse an optimistic view concerning the increase of capacity utilisation (CESA, 2017).

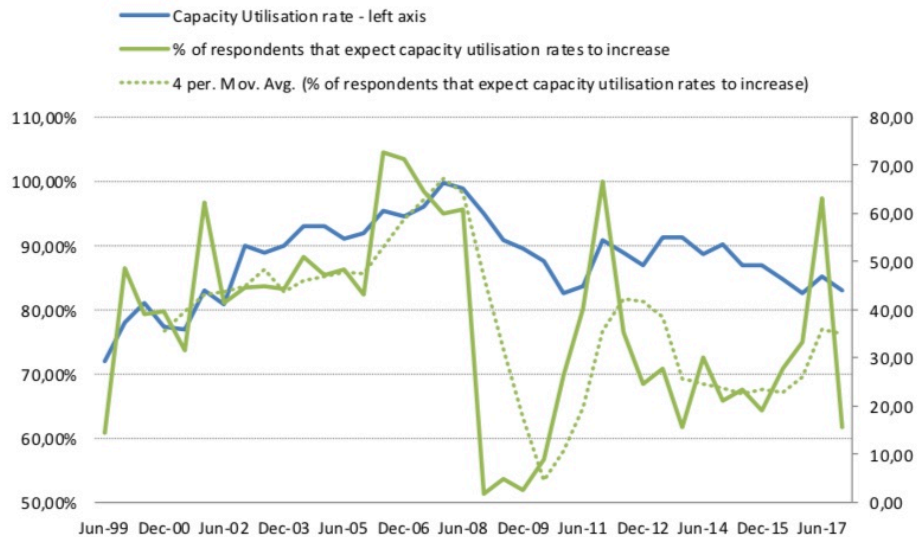


Figure 2-22: Rate of capacity utilisation by consulting firms in South Africa (CESA, 2017)

Consulting engineering firms are businesses that offer services based on their expertise, knowledge and skill, as highlighted in section 2.4.1. One of the core functions of consulting engineering is the continued training and improvement of skills and knowledge. It has been routine practice for consulting engineering firms to spend a percentage of their annual income on training of staff. Between 2012 and 2017, the direct costs of training as a percentage of salary bills have been declining to 0.6%, as evident in **Figure 2-23** (CESA, 2017). The rise in employment demand, the decrease in the investment in training, the shortage of professionals and the increase in capacity utilisation are all intimately linked. More firms will be forced to work at full capacity, lowering the firm's flexibility in terms of employing more professionals. As the fee income and the number of professionals employed are closely linked, the financial stability of a firm can be linked to employment conditions of the market.

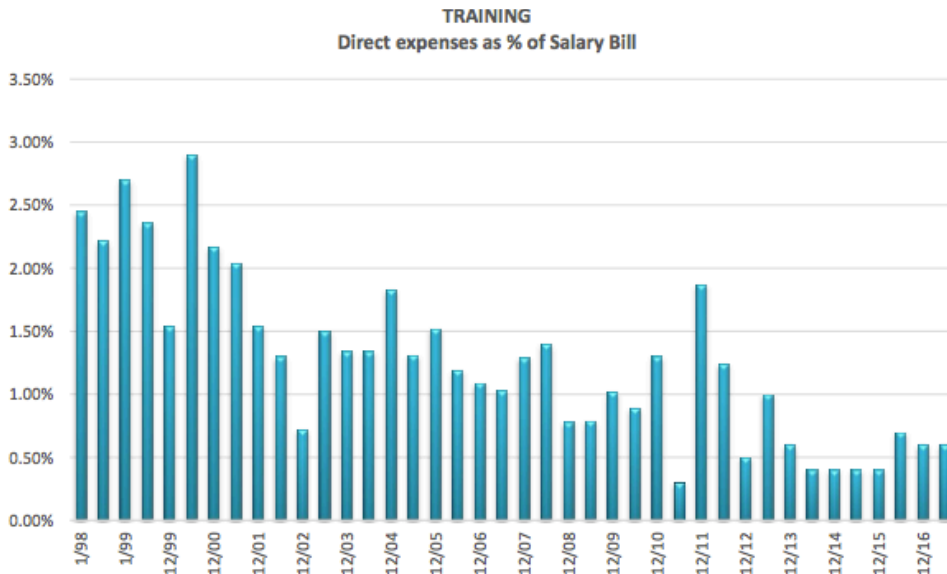


Figure 2-23: Training expenses as percentage of salary bill (CESA, 2017)

2.4.6 Public investment impact on CEC firms

It is believed that the general economic environment and construction output are closely linked to change in demand for civil engineering services. One of the reasons behind this link is related to the types of clients that contract CEC firms. These clients are normally local and national governments and private investors but can occasionally be contractors and industrial firms. The economic environment tends to affect these clients and the CEC firms every time there is volatility. Adding to that, the political situation and competition in the market further affect the clients of CEC firms (Van Sante, 2008).

South African consulting engineers normally have clients from the government, subdivided into central, provincial and local, private clients, parastatals and foreign governments (**Figure 2-24**). In general, the public sector is regarded as the biggest and most important client for consulting engineers. However, the CESA survey from last year depicted that the contribution from the private sector in the last year dropped from 67% to 51%, with an increase in the contribution by the private sector to 49% (CESA, 2017). While this could be a result of the slow economic growth of South Africa, the contribution from the government could probably increase in coming years.

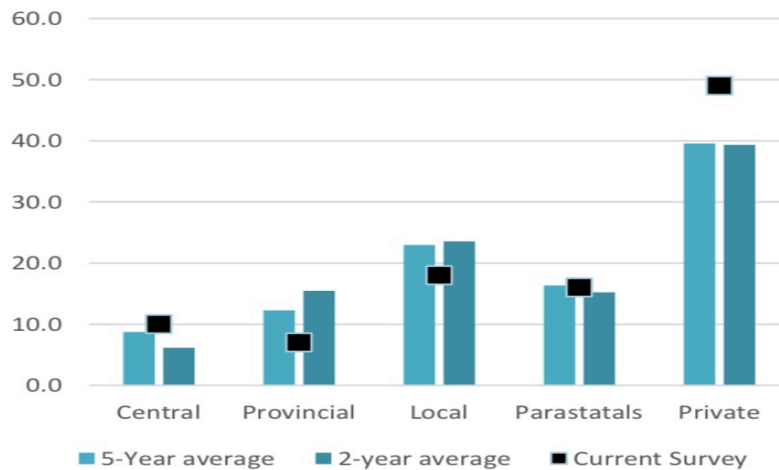


Figure 2-24: Percentage of consulting firms' fee earning according to type of client (CESA, 2017)

Perkins, Fedderke and Luiz (2005) made use of econometric and statistical research methods to study the relationship between South Africa's economic infrastructural investment and its economic growth. The study found that public sector economic infrastructure investment and fixed capital stock had a relationship with GDP. Combining the investment on the various infrastructures, there would be an effect on the GDP growth as well as the investment solely to roads. This study, aggregating the investment in infrastructure, did not distinguish on how much of this investment would go to contractors or consulting engineers.

The government of South Africa's Provincial Infrastructure Budget and Expenditure report, published by the National Treasury every six months, provides insight into the expenditure in rand and the number of projects taking place with respect to education, health and transportation, public works and infrastructure. For the transportation, public works and infrastructure part of the report, the projects that are taking place are sub-divided into planning, tender, site handover, construction, completion and others. Such sub-division can give an indication to CEC firms of just how many projects are going through the initial stages of the project, tracking this change with respect to previous quarters or even years (National Treasury, 2017).

When comparing the report published in December 2017 to December 2016, it can be noticed that on a quarter-to-quarter and year-to-year basis, there is a significant decrease in the number of projects at a provincial level. The only provinces that show a steady increase in project numbers in the planning stage are the Gauteng and the North West provinces, with an increase of 18% and 28%, respectively. But on the other hand, these two provinces registered a decrease of 56% and 48%,

respectively, of projects at tender phase. The other provinces recorded a decrease of 8% in most cases of projects in the planning stage, with the Western Cape showing the most substantial decrease with 38% (National Treasury, 2017). These reports can be used in the short term to gauge if the government has been moving in the direction of its medium to long-term goals.

The other useful information from the government is the Medium Term Expenditure Framework (MTEF), published every three years. These plans determine the areas that the different government departments should focus on, determining dates upon which government agencies and other entities should submit proposals for different types of projects, including infrastructures. Afterwards, a budget for the three-year period can be defined and institutions can collaborate to prioritise projects that benefit the country in general (National Treasury, 2018). To determine the goals that are normally set in the MTEF, the government analyses the international and national markets and then the risks that might prohibit the country from arriving at such goals and then makes assumptions about oil prices and the economic growth of the country to determine which sectors should be prioritised when budgeting for the medium-term (National Treasury, 2018). From the MTEF, the Estimates of National Expenditure (ENE) are determined, taking into account the previous years, also arriving at projections for the next three years. In this document, indicators such as the quantity of roads paved or maintained are shown in km. Such information can also be used to see where the government is intending to spend its future budget (National Treasury, 2018).

South Africa has determined to focus on infrastructure as a priority. There is a consensus in the need to allocate more investments in this particular part of the economy. In order to invest and honour such budgets, the government would need to improve its current financial conditions as public finances face growing strains and risks (National Treasury, 2018). The wage bill of the public sector has lodged difficulties onto the spending budget. Adding to this situation are poor infrastructure budget designs and ineffective project delivery that have prolonged delays in payments of bills by many government departments due to high operating deficits with insufficient allocation for maintenance (National Treasury, 2018).

Thela (2014) indicated a few challenges that the government should address in order to meet the National Development Plan developed by the National Treasury. One of these challenges highlighted was Infrastructure Investment. According to Thela (2014), what needs to be addressed includes the cyclical and inconsistent budgeted

infrastructure spending, low investment confidence that could be boosted by clearer project pipelines and policy stability, the under spending of the infrastructure budget, poor lack of maintenance of existing infrastructure, high regulatory environment, lack of technical capacity in government specifically at provincial and local government level, corruption and finally, the quality of public education (**Figure 2-25**).

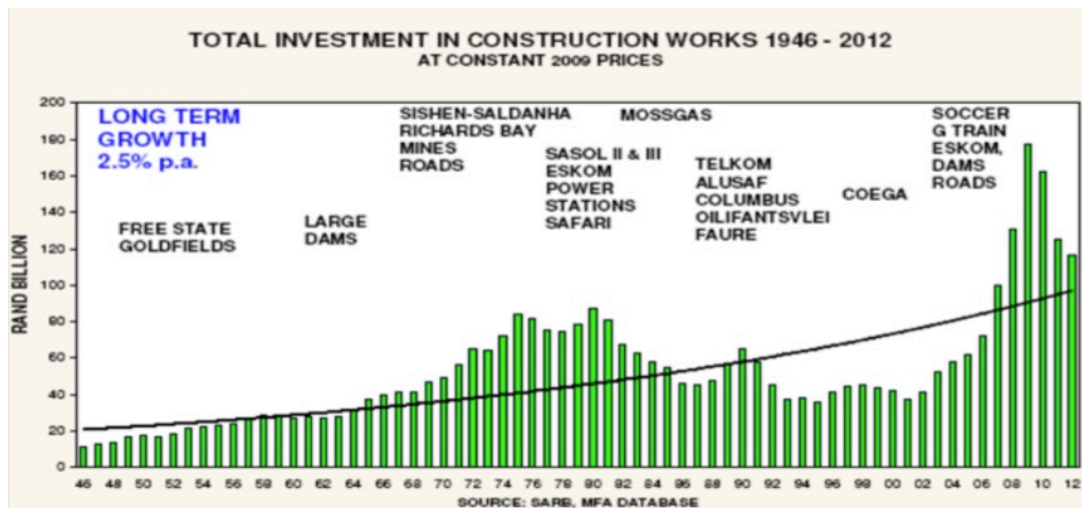


Figure 2-25: Total investment in rand (at constant 2000 prices) on construction works in South Africa between 1946–2012 (Thela, 2014)

2.4.7 Relationship between economic factors and construction

Various scholars have regularly studied the relationship between the construction industry and the economy. A number of previous studies that highlight the relationship between economic factors and the construction industry are presented next.

Turin (1978) analysed the role of construction in the world economy, basing it on data from results produced by a research from the Building Economics Research Unit, the author’s personal experience and various other statistical sources such as the U.N. Year Book of National Statistics and World Bank Atlas. Turin, in this study, made use of different indicators, some economic indicators and some construction industry indicators, to locate relationships between economic factors and the construction industry. From this study, Turin concluded that a substantial percentage of the GDP, especially in low developed countries, had a major contribution coming from the construction industry.

Similarly, Giang and Pheng (2011) reviewed studies conducted over 40 recent years, specifically between 1970 and 2010, to examine the role of the construction industry

in the economic development of developing countries. These researchers primarily analysed studies that related construction output and economic aggregate output. From these studies, Giang and Pheng concluded that most studies analysed reveal a positive statistical relationship between construction industry and economic growth in developing countries.

Nippala (2012) studied the existence of indicators that could be used to forecast the civil engineering markets. This study, using statistical and econometric tests to analyse total engineering market data from 1970-2010 in the Finnish and European civil engineering markets, led to the conclusion that no indicators can forecast changes in the overall volume of the civil engineering market development. The study further concluded that by client sectors, private and public sectors, a few key indicators could be used. For the private sector, for example, the study found that European level industrial confidence could be a key indicator, and economic development and building construction as indicators for municipal investments.

Alhawaish (2015) conducted an empirical study that investigated the relationship between economic growth and construction flow in Saudi Arabia between 1971 and 2010. The study posed two main questions to answer. The leading question was this: "Is there a relationship between construction sector and economic growth?" (Alhawaish, 2015). The follow up question was this: "And if a relationship exists, what is the direction of causality between these two variables?" (Alhawaish, 2015).

The study found a strong causality that runs from economic growth and oil revenues into the construction industry, with feedback affecting that run from the construction industry to the economic growth, indicating a bi-directional relationship. Moreover, the study determined that the construction industry did not Granger cause oil revenues in the end.

Tse and Ganesan (1997), with the objective of examining the lead-lag relationship between construction flow and GDP, identified the problem that there was no understanding as to whether the construction sector and the aggregate economy were independent or interdependent and whether construction activity contributed to economic growth or the other way around. Granger Causality tests were used to analyse data from Hong Kong. According to the results from these tests, the GDP was found to lead construction flow.

Okoye *et al.* (2016) studied the impact of economic fluctuations on the growth and performance of the Nigerian construction sector. With the use of econometric techniques such as unit root tests, Granger Causality tests as well as other statistical tests, the study determined the stationarity, causality and relationship between GDP and construction industry growth in Nigeria, finding the rate of growth of the construction sector to be more volatile when compared to the GDP as a whole.

Khan (2008) examined the contribution of the construction sector to the Pakistan economy, aiming to identify the relationship between the construction sector and economic growth and the direction of causal relationship. With the use of econometric and statistical analysis, it was found that the construction industry greatly influences the aggregate economy of Pakistan.

Jiang (2013) analysed the relationship between construction and GDP, highlighting the differences and similarities. The study used data from two countries, the United Kingdom and China. With the use of statistical and econometric tests, the study concluded construction real value added is intensely related to the GDP, as a fairly high correlation coefficient exists.

The studies presented above sought to find a relationship between different economic and construction indicators. While not all studies found a relationship, this can be due to different types of data, as certain countries where the studies were conducted were already developed while others were still developing. It can also be concluded that the degree of relationship would vary from one nation to the other. For a better understanding of the degree of relationship in a certain country, a specific study would need to be conducted using the econometric data from that specific country. Although there is some research on the construction industry as a whole, little research takes into account consulting services of the construction industry, specifically civil engineering consulting services. Therefore, this study will determine the causation relationship existent between construction professional services, construction industry activity and general economic activity. Secondly, this study will identify the economic factors that affect the financial sustainability of civil engineering consulting firms.

2.5 Chapter summary

The aim of this chapter was to present information surrounding the three areas of knowledge critical for this study. The areas were presented in three sections, with the

first focusing on business cycles, the second section focusing on construction cycles and the third one on civil engineering consulting firms.

From the literature reviewed, there are a few concepts that must be highlighted:

- The existent relationship between the construction industry and aggregate economy. In certain instances, studies have found that the construction industry Granger causes and leads GDP. In other countries, the GDP was found to Granger cause construction activity and lead it. This was presented under sections 2.3 Construction cycles and 2.4 Civil Engineering Consulting firms.
- Measurement of the construction industry contribution is often presented as gross output, gross fixed capital formation (GFCF) and construction value added (CVA), as these are the indicators most often used to monitor the construction industry.
- The construction industry measurement can be done in two ways, either from a narrow or broad point of view. From a narrow point of view, the construction industry only contributes about 10% of the GDP of developing country and about 5% of the GDP of a developed country. From a broad point of view, however, the construction contribution includes all the services of the construction industry, such as professional services and material production and retailing services, doubling the contribution of both developed and developing countries into the GDP when this broader view of 'construction' is applied.
- Civil engineering consulting firm earnings constitute about 60% of the total earnings of construction professional services (CPS).
- The fee earnings of CEC firms are largely impacted by factors such as employment and public and private investment. Fee earnings from CPS are often used as the indicator to monitor the CEC sub-sector.
- The relationship of causation between two indicators can be one of leading, lagging or coincident.

Chapter 3 will present a brief introduction into what constitutes research methodology by providing theoretical distinctions between the various methods and methodologies

available, presenting different types of mixed methods research, explaining how the data collection and analysis is normally done when using econometric tests and semi-structured interviews, and lastly, explaining how research methods and techniques will be used specifically in this study.

Chapter 3: Methodology

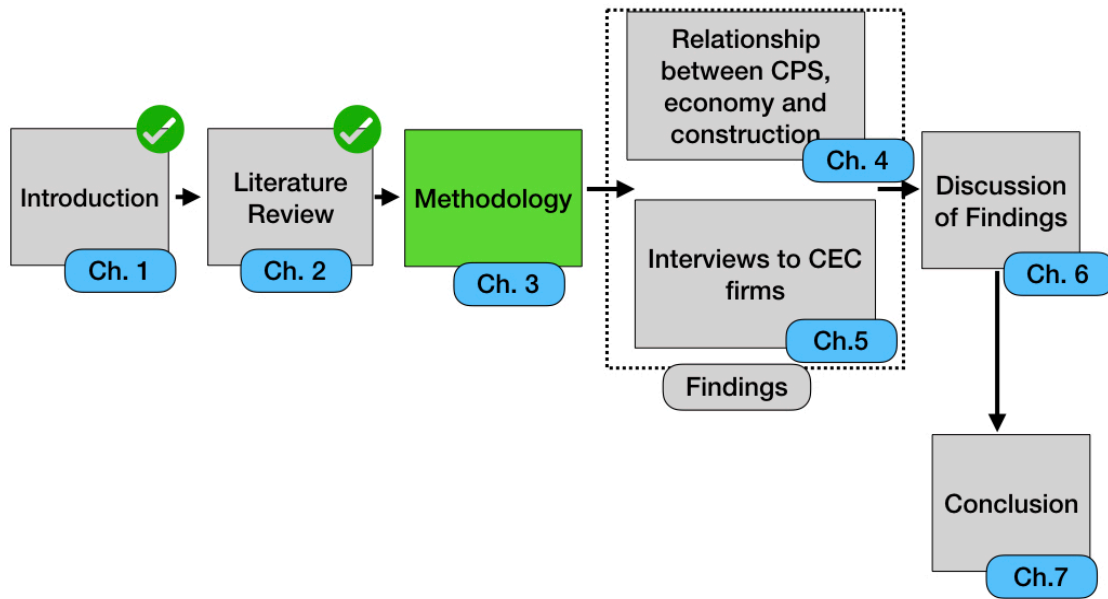


Figure 3-1: Document progress map Chapter 3

3.1 Introduction

In Chapter 2, a review of literature that highlighted the knowledge areas for this research was presented. These knowledge areas focused on economic cycles, construction cycles and CEC firms. Using the problem highlighted in Chapter 1 as a guide and the review of literature relating to similar studies in Chapter 2, it becomes important to define the best method of gathering and analysing research data for the topic of this study. In order to explain the research methods chosen for this study, a brief introduction on research methods and the various types of methodologies is presented below.

This chapter intends to present an overview of research methods and methodologies and to provide an explanation of how certain methods and methodologies will best suit this study. With the understanding of what research methods and methodologies entail, this chapter will add value to the study by explaining how each research method brought value to the study, by describing the aim and procedure of each method used and the findings that can be expected.

This chapter is comprised of sections that will present quantitative research methods such as statistical and econometric tests, and qualitative research methods such as semi-structured interviews. These methods will address objectives 1 and 2 of the

research, with the quantitative method addressing objective 1 and the qualitative method addressing objective 2, as shown in Figure 3-2.

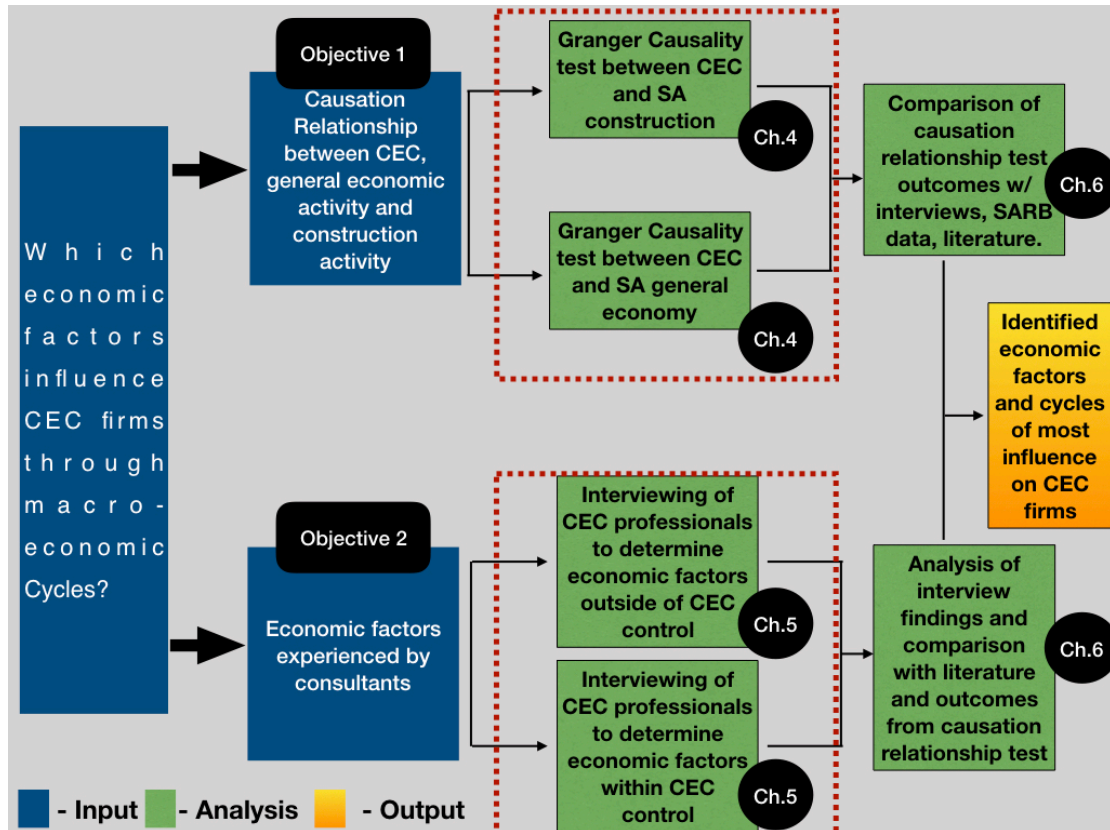


Figure 3-2: Thesis layout

3.2 Introduction to research

Research has generally been regarded as an important component to the evolutionary progress of humankind on earth. Kothari (2004) describes *research* as a search for knowledge, with this search being “scientific and systematic for pertinent information on a specific topic”. Making this search scientific and systematic creates conditions that allow the final work to do a critical assessment of a topic, removing all biases and increasing the credibility of the outcome.

Based on the motivation and the objective for the research, a method for research can be considered as qualitative, quantitative or mixed. According to Cresswell (2002, cited in Borrego, Douglas & Amelink, 2009), the choice of method should be guided by the research questions. Mixed research uses both quantitative and qualitative data in the same study to conduct a thorough analysis of the problem. Qualitative research methods make use of data in text form to conduct analysis. Quantitative research methods use data that can be organised for analysis in numerical terms such as probability or average.

If the research is qualitative, the attitudes, behaviours and opinions of certain groups are studied, typically using in-depth interviews and certain projective methods. When a quantitative approach is taken, the focus is on the generation of data that can be subjected to rigorous analysis and sometimes replicated by other researchers in different conditions (Kothari, 2004).

The civil engineering and construction management fields, like any other fields, constantly need improvement. Most often, that is done through research, which can have a different way of being conducted depending on the problem statement and the research question (Borrego, Douglas & Amelink, 2009). Common methods used in academia are quantitative method, qualitative method and the mixed method. Partly due to the nature of the engineering discipline, most frequently the styles of research method chosen are quantitative methods because of the reliability characteristics of such research. The methods of such research include laboratory or in-field testing. Tests are normally carried out on a sample size that is representative of the population, allowing other researchers to generalise or replicate the outcome and the study.

Borrego, Douglas and Amelink (2009) suggest that no particular method should be privileged over another in engineering education research. Through empirical tests,

the study found a strong preference for quantitative methods, possibly due to their technical training. The participants of this same empirical study reported a lack of understanding and acceptance of qualitative methods for research in engineering education.

3.3 Theory behind research methods and methodology

The understanding and distinction between research methods and research methodology is important for any researcher to conduct a quality research study. *Research methods* are all the techniques used by the researcher to gather information and make subsequent analysis to lead to a conclusion when conducting a study. By contrast, *research methodology* is the combination of different methods or techniques necessary to conduct a research study. If the research methods were used in isolation, there would not be a research methodology. To prepare a research methodology, it is not enough to merely group different research methods or techniques; the researcher needs to group them in a logical way such that these methods complement each other (Kothari, 2004; Kumar, 2011).

3.3.1 Research methods

Research methods are an important part of any research methodology or design. Research methods act as a type of smaller component of the research methodology such that any research methodology depends on the research methods. On the other hand, the selection of the right research method depends on the research methodology and design that are determined by the research approach, which in turn is determined by the research question and problem (Kothari, 2014).

There are a number of research methods applicable to a study. As stated before, methods are fundamentally quantitative, qualitative or mixed. These methods can then be classified into different categories such as the nature of the study, the purpose of the study and the choice of research design (Dudovskiy, 2018).

3.3.2 Research methodology

Research methodology can be developed by a researcher once there is a problem to be solved and a fair understanding of the methods that can be employed. These become the two main factors in the determination of a research methodology, as it needs to be structured in such a way that brings logic and understanding on how and why certain methods were used to address the problem. Kothari (2004) explains that

research methodology also ensures that research results can be evaluated by the researcher or anyone else who might research a similar problem. To develop and evaluate a research design, a researcher might pose the following questions:

- Why has the research been undertaken?
- How has the research problem been defined?
- In what way and why has the hypothesis been formulated?
- What data will be collected and what particular method will be adopted?
- Why has the particular method of data analysis been used?

3.4 Mixed methods research

As presented under section 3.2 Introduction to Research, there are three approaches to research: quantitative research, qualitative research and mixed methods research. As this current study will make use of a mixed methods research approach, it is therefore important to explain briefly how mixed methods research can be conducted.

Mixed methods research is research that employs both quantitative and qualitative methods, but the way quantitative and qualitative methods are combined needs to be determined by the researcher as this affects the manner in which the research problem is addressed (Borrego, Douglas & Amelink, 2009). (Creswell *et al.*, 2003) have identified six types of mixed methods research designs: sequential exploratory strategy, sequential explanatory strategy, concurrent triangulation strategy, sequential transformative strategy, concurrent embedded strategy and concurrent transformative strategy. These designs are presented in Table 3-1.

Table 3-1: Mixed Research Design Types (Borrego et al. 2009)

Design type	Timing of quan and qual phases	Relative weighting of quan and qual components	Mixing – when quan and qual phases are integrated	Notation
<u>Triangulation</u>	Concurrent	Equal	During interpretation or analysis	QUAN + QUAL
<u>Embedded</u>	Concurrent or Sequential	Unequal	One is embedded within the other	QUAN (qual) or QUAL (quan)
<u>Explanatory</u>	Sequential, quan then qual	Usually quan is given priority	Phase 1 informs Phase 2	QUAN -> qual
<u>Exploratory</u>	Sequential, qual then qual	Usually qual is given priority	Phase 1 informs Phase 2	QUAL -> quan

According to Creswell (2009), the research concurrent triangulation strategy is the most widely used design, as this concurrent design uses different methods to confirm, disconfirm, cross-validate or corroborate two or more databases. In so doing, the weakness of one method is complemented by the strength of the other method, qualitative or quantitative (Figure 3-3).

This method has certain limitations, however, such as the difficulty of comparing and analysing data that is different in nature, as one set of data will be numerical and the other not. This shortcoming might need, in certain instances, to be alleviated by collecting additional data, revisiting an original database, gaining new insight from disparity of data or developing a new project that addresses the discrepancy (Creswell & Plano Clark, 2007).

According to Creswell (2009), the presentation and structure of mixed method research is crucial and consequently needs to be chosen by the researcher in terms of the six strategies highlighted above, including, as mentioned, sequential exploratory strategy, sequential explanatory strategy, concurrent triangulation strategy and concurrent transformative strategy. The presentation for a sequential study needs to be structured in such a way that quantitative data collection and analysis is followed by qualitative data collection and analysis. These, in turn, are followed by the conclusions wherein lies the explanation of how the quantitative

findings were used to achieve the qualitative findings. In this case, the quantitative or qualitative methods can alternate, depending on the strategy of the sequential study. In the presentation of a concurrent study, the quantitative and qualitative data can be analysed in different sections, but the interpretation is combined with no clear distinction between qualitative or quantitative phases (Creswell, 2009; Borrego *et al.*, 2009).

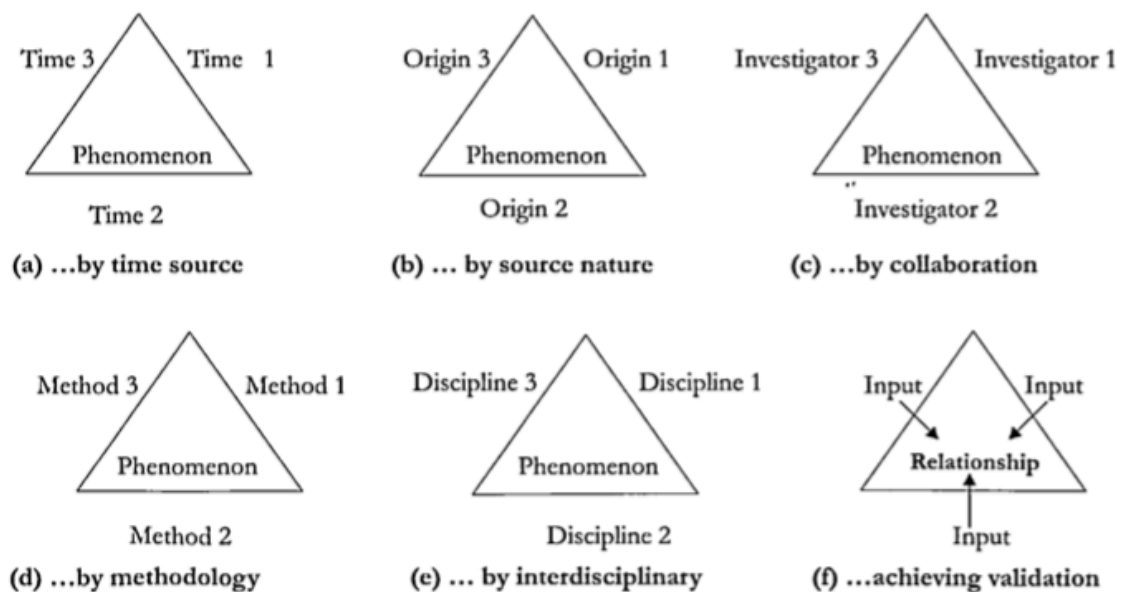


Figure 3-3: Forms of triangulation research (Love *et al.*, 2002)

3.5 Description of research methods

In this section, a brief description of the research techniques chosen for this research is presented. Furthermore, this section provides background information explaining the conditions under which these research methods best suit a particular type of study.

3.5.1 Data collection

The collection of data is an extremely important component of any research method. Otherwise solid research can produce unsatisfactory results, not only by selecting poor research methods and methodology, but also by collecting the data in an inappropriate manner (Flick, 2011).

Normally, data collection is classified into two categories, primary data and secondary data. Primary data is all data that has been gathered by the researcher

using research instruments such as questionnaires or laboratory experiments. Secondary data is data collected by others to be used by a researcher to address a problem of research even in situations where such data was collected for different purposes (Kothari, 2004).

The selection of the ideal data collection approach is dependent on the research aim, skill of researcher and resources available. The same can be said about the research instruments for collecting the data. The advantages of using primary data are that the control and knowledge of accuracy of the data is dependent only on the researcher. The disadvantage of using this, however, is that researchers do not always have the required resources to adequately address the problem due to various factors that need to be controlled (Kumar, 2011).

In some cases, it is appropriate to execute certain research methods using secondary data that was collected previously. Generally, data that has been previously collected is either published data or unpublished data. Published data is all data that has been made available by governments, private organisations or other institutions through journals, books, reports or records. Unpublished data, on the other hand, is all data that is confidential or private, which includes letters, diaries, unpublished biographies and autobiographies (Kothari, 2004).

Using data that has been published previously ushers in numerous challenges, including reliability of the data with regard to its source, suitability of the data for the specific study and adequacy of the data with regard to its level of accuracy (Kothari, 2004).

3.5.2 Introduction to statistical analysis

As stated in Kothari (2004), *statistics* is a tool used in research to design research, analyse its data and draw conclusions. Depending on the aim of the research, statistics can primarily be descriptive or inferential. When using descriptive statistics, the outcome generated is a description of the raw data in the form of indices such as measures of central tendency or measures of dispersions. Inferential statistics, when used, will be based on the estimation of population parameters and statistical hypotheses such as measures of relationships between data. The measures of central tendency include average and measures of dispersion include standard deviation. The measures of relationship often include Karl Pearson's to analyse statistics variables and Yule's coefficient among others (Kothari, 2004).

One of the other measures of statistical analysis includes the use of time series. Measures that make use of time series are typically used in research concerned with economic and business backgrounds. A time series is a succession of observations of any measurable phenomenon over equal increments of time. These times can be short or long, and the data can be regular, following a specific trend, or fluctuating irregularly (Kothari, 2004).

Under a time series, a variety of tests can be applied to ascertain the effect that various indicators can have on a time series (Kothari, 2004), including tests for unit roots, tests for co-integration and tests for causality.

3.5.3 Unit root tests

Unit root tests are often used in conjunction with Granger Causality tests to determine the existence, or lack thereof, of a causality relationship. The best way to define unit root test is to explain the need for these tests.

According to Granger and Newbold (1974), Granger Causality tests are used to determine the causality of one variable over another. This requires data that will first be studied for testing in terms of stationarity through a unit root test. The existence of stationarity data, as shown in Figure 3-4, needs to be deduced prior to proceeding to Granger causality tests in order to avoid spurious regression. Spurious regression happens when the results from the Granger Causality tests indicate a relationship of causality between variables, but this relationship only refers to contemporaneous relation rather than meaningful causal relations (Khan, 2008). An example of a spurious regression would be an implied relationship between number of storks nesting during spring season and the number of human babies born during the same season as both variables are independent and contain unit roots. It would be wrong to state that there is causation between these two variables as these variables have a relationship with weather. Because of this relationship with the weather that both variables have, there is a relationship between the two variables but with no causation between them (Höfer, Przyrembel & Verleger, 2004; Sapsford & Jupp, 2006).

There are various methods of testing the existence of unit roots; some of these methods include Augmented Dicky Fuller (ADF) and Dicky Fuller (DF) tests. The DF test is a much simpler form of the test for the null hypothesis, checking if the variable contains a unit root and if it is not stationary. The ADF test, normally conducted for

large data, takes into account the autocorrelation in the dependant variable that might occur by using lags of the dependent variable to seek unit roots in the independent variable. The challenge arises in determining the number of lags to be used, but this can be addressed by using the frequency of data or the information criteria to decide the number of lags (Sjö, 2008).

Libanio (2005) further explains that if certain data does not contain unit roots, this means that the variables studied are stationary because these variables fluctuate along a constant long run mean, making the variable a finite one that does not depend on time. On the other hand, research characterises non-stationary data as data with random nature that does not stick to a long run deterministic path and that can run along a long path approaching infinity while time approaches infinity, rendering non-stationary data dependent on time. Byrne and Perman (2006) suggest that through experience, it has been established that differentiating data and performing the unit root test will provide greater insight into whether the series is stationary or not, as many economic time series tend to present stationary characteristics after being differentiated.

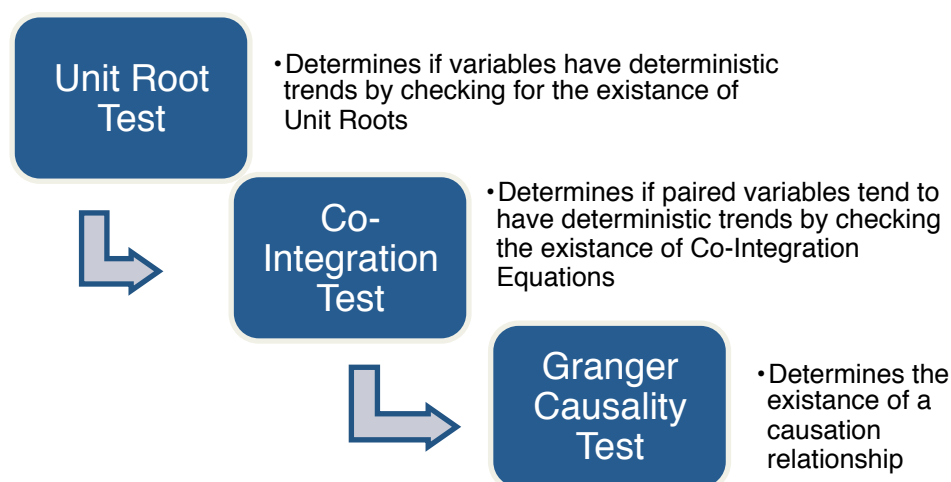


Figure 3-4: Process to test the relationship of causation

3.5.4 Co-integration tests

According to Sjö (2018), co-integration is the criteria needed to test the stationarity among non-stationary variables, necessary for certifying if the model being tested has empirical meaningful relationships. In simple terms, this means that the co-integration test checks if there is a co-integration equation between two groups of

variables (Figure 3-4). Finding a co-integration equation signifies that there is a possibility of two groups of variables having a meaningful empirical relationship, i.e. relationship of causation. While there are various tests for co-integration such as Stock and Watson (1988), Engle and Granger (1987) and Johansen (1988), their common objective is to determine the most stationary linear combination of time-series variables (Khan 2008).

The most common co-integration test used is the Johansen test as it is regarded as incorporating all the desired statistical properties (Sjö, 2018). This test is normally employed to determine the existence of a co-integrating equation that would mean the existence of a causality relationship between the variables but not the direction of causality (Alhowaish, 2015). As stated in Sjö (2018), the weakness of the Johansen test is that it needs to be used with large samples due to its asymptotic properties.

An example of the use of the co-integration test was mentioned by Engle and Granger (1987):

In a series of examples it is found that consumption and income are co-integrated, wages and prices are not, short and long interest rates are, and nominal GNP is not co-integrated with M1, M3, or total liquid assets, although it is possibly with M2.

The existence of one or more co-integration equations implies a long-term relationship between the variables, with these variables sharing a common trend, ruling out the existence of a spurious regression relationship and indicating the existence of causality between both variables (Okoye *et al.*, 2016).

3.5.5 Causality tests

Eichler (2012) considers the identification of causal relationships to be an integral part of scientific research, especially when implementing empirical findings. Determining such a causal relationship can sometimes be challenging as aspects such as temporal precedence and physical influence must be determined.

The means to determine causality have been studied by various scholars, but the most widely used approach to causality is the Granger Causality test (Eichler 2012). This test was developed by Clive Granger who studied “the relationships between certain classes of econometric models involving feedback and functions arising in

spectral analysis, particularly the cross spectrum and the partial cross spectrum” (Granger, 1969).

As shown in Figure 3-4, the Granger Causality test helps determine if two time series variables, X and Y, can cause each other, or if X causes Y only or vice versa (Granger, 1969). Normally the Granger Causality test considers only the linear area covered by the model, leaving any possible non-linear relationships undetected (Eichler, 2012).

Initially the test was developed for econometric studies, but recently it has been applied in other fields of research as well. Moreover, the test has also been used to conduct forecasting studies, deviating from the primary definition and use of the test, which is to determine the existence of evidence of causality between two variables (Eichler, 2012; Granger, 2004).

3.5.6 Interviews

The interviewing method of research is a method whereby certain study groups are presented with oral-verbal questions regarding the topic of research, and responses to these questions are given in an oral-verbal way (Kothari, 2004). According to Burns (1997:329, cited Kumar, 2011), an “interview is a verbal interchange, often face to face, though the telephone may be used, in which an interviewer tries to elicit information, beliefs or opinions from another person”. Interviews can be conducted in person or with the aid of technology such as a telephone. Although both methods of conducting the interview can guide the arrival of the intended outcome, there are advantages and disadvantages in choosing one method over the other (McIntosh & Morse, 2015).

Kumar (2011) stated that when conducting a personal interview, the researcher has to prepare in advance, determining the questions and style of the interview. According to Kothari (2004), an interview can be either structured or unstructured, and in certain instances because of being unstructured, the interview can be classified as focussed, clinical or non-directive. Structured interviews have predetermined questions organised in a set order, with limited flexibility for altering the order of questions or amending with supplementary questions. When following the order of the questions, the recording of answers needs to be in accordance with standardised techniques. This allows for comparison of interviews and suits well descriptive studies, which provide a safe basis for generalisation.

Unstructured interviews are less strict with regard to order of questions, as there might be a lack of compatibility between various interviewees, rendering these interviews ideal as exploratory or formulative interviews. These interviews, however, require a deep knowledge of the topic. Personal interviews have the advantage of providing more control over quality of sample as the respondents are carefully selected, reducing the non-response rates when compared to a questionnaire, and additional information about the respondent can be gathered adding significant value to the interpretation of results. The shortfalls of personal interviews, though, are that they can be expensive, have a certain bias from the interviewer or the respondents, be more time consuming and result in some of the respondents being unavailable for the interview. Furthermore, the interview might occasionally introduce systematic errors (Kothari, 2004).

Interviews conducted over the telephone can likewise be either structured or unstructured. This telephonic style of interviewing, however, can be beneficial as it is less expensive and faster and the interviewer has an opportunity to call back if necessary. However, the shortfalls of the telephone interview are the relative bias of the interviewer, the need for the respondent to have a telephone, and the lack of suitability of a telephone for certain questions (Kothari, 2004).

Another method of interviewing for academic research is the semi-structured interview. The semi-structured interview rests on a basic set of questions prepared and structured prior to the interview, but here the interviewer has the flexibility to ask any leading questions (Olsen, 2012). This is supported by Kallio *et al.* (2016), who argue that one of the main advantages of the semi-structured interview is the reciprocity between interviewer and participant which leaves space for the respondent to make individual verbal expressions. When compared to the unstructured interview, the semi-structured interview will make use of a recording and systematic way of registering the data, while the unstructured interview will have no pre-set questions and in certain circumstances, there is no need to record these interviews and they are not subjected to a time limit (Olsen, 2014).

According to Flick (2014), one of the advantages of semi-structured interviews is the ability that the researcher has to compare data between different respondents. Semi-structured interviews are also advantageous in finding issues that were previously unknown when compared to a structured interview, creating in-depth findings through probing and clarifications (Wilson, 2014).

According to Wilson (2014), there are also disadvantages in dealing with semi-structured interviews, including the necessity for some training and knowledge of the field of study, the fact that consistency can be difficult to maintain when there is too much flexibility in the structure of the interview and findings are not always easy to generalise. When dealing with semi-structured interviews, it is imperative to have set and controlled data such that the research question is narrow and the sample and conditions of data collection are well defined. To determine a control method for collecting data, the researcher must demonstrate a previous understanding of the study (Kalio *et al.*, 2016).

3.6 Research methodology for this study

This study will use a mixed methods research approach to the problem as this makes use of both qualitative and quantitative research methods. In terms of its nature, this research is descriptive, as the researcher has no control over variables. Based on the exploratory nature of the questions of this study, this research is regarded as exploratory research. Exploratory research includes the use of survey or interviews to seek input from knowledgeable people within the field of study.

For this present research, a triangulation design will be used as the data collection can occur concurrently, and the outcomes of the quantitative and qualitative methods will have a similar degree of emphasis, with the qualitative method being used to offset the weakness of the quantitative method, and vice versa (Borrego, Douglas & Amelink, 2009).

The quantitative methods will be of a statistical analysis nature, taking an inferential approach, as these tests will be based on causation statistical tests on data officially published by the government. The qualitative methods will be semi-structured interviews conducted with managerial staff at consulting civil engineering firms (**Figure 3-5**).

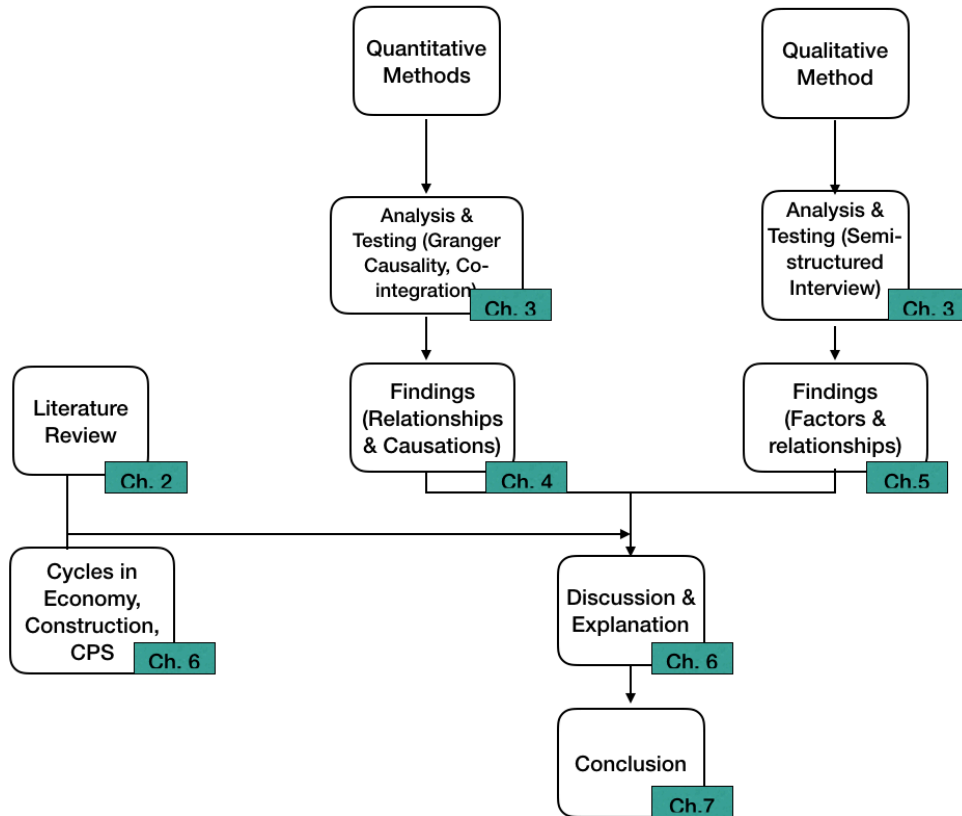


Figure 3-5: Research design

3.6.1 Testing the relationship of causation

The statistical tests to be performed for this research include ADF unit root, Johansen’s co-integration and Granger causality. The variables tested will be as follows:

- *Construction professional services total revenue (CPS)* – collected from published CESA Bi-Annual Report (CESA, 2017);
- *Gross domestic product (GDP)* – data collected from SARB annual report (SARB, 2018);
- *Gross fixed capital formation of total investment (GFCF1)* - data collected from SARB annual report (SARB, 2018);
- *Construction value added (CVA)* - data collected from SARB annual report (SARB, 2018); and
- *Gross fixed capital formation of total construction investment (GFCF2)* - data collected from SARB annual report (SARB, 2018).

These variables will initially undergo an ADF unit root test, with results presented in section 4.2.1, to test the stationary of the data. Once the data is considered

stationary, the relationship between the two variables needs to undergo testing to determine if it is stationary or not through the Johansen's co-integration test, with findings shown under section 4.3. Once the ADF and the Johansen's co-integration tests have been carried out and the results revealing that the series and the relationship between them is non-stationary, the degree of causality that one variable has over the other can be determined using the Granger Causality test, with findings presented in section 4.4.

To perform these tests, the EViews software was used: each test – the ADF unit root, Johansen's co-integration and Granger causality tests – made use of EViews.

3.6.2 Semi-structured interviews

The interviews conducted for this study were targeted specifically at staff with managerial experience in civil engineering consulting (CEC) organisations in South Africa. Based on the group to be targeted for interviews, the questions posed needed to give the respondents a chance to provide an honest assessment of their experience in management of firms in South Africa, their struggles and possible opportunities with regard to the research problem.

The interviews were comprised of questions split into two sections, the first section containing eight open-ended questions and the second section containing 22 closed-ended questions, with questions enquiring about the size of firms, years of experience of interviewees and capacity of firms. Overall, the questionnaire was designed to last one hour, as the open-ended questions meant that respondents were encouraged to elaborate on experiences and opinions with regard to the problem. The closed-ended part of the questionnaire only required 10-15 minutes of the full hour slotted for the interview.

The aim of the closed-ended questions was to keep record and control the study conditions, ensuring that the participants had adequate experience in the CEC industry. The open-ended questionnaire, shown in Table 3-2, aimed more specifically at identifying the economic factors that influence CEC firms. This questionnaire also intended to identify the possible causation relationship between construction economic activity, South African economic activity and CEC total revenue.

Table 3-2: Open-ended questionnaire

Questions
<p>Q1: <i>Do you believe that there would be any benefits in terms of financial sustainability, if there were economic data on the performance of the CEC industry?</i></p>
<p>Q2: <i>What kind of information do you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?</i></p>
<p>Q3: <i>Do you believe that obtained data relating to the construction industry economic activity could beneficially indicate if the South African economy at large is undergoing a recession or expansion?</i></p>
<p>Q4: <i>Do you believe that data obtained in relation to the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?</i></p>
<p>Q5: <i>Taking into consideration the idea that an increase in the CEC industry could possibly indicate growth in the construction industry and the general economic activity of South Africa, do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?</i></p>
<p>Q6: <i>With alternative types of procurement and contracts in the engineering and construction market becoming more common, please answer the following questions:</i></p> <p style="padding-left: 40px;">A. <i>What impacts do you see, negative or positive, in the sustainability of CEC firms? Taking into consideration that contractors will be expected to provide feasibility, design and construction quality assurance services</i></p> <p style="padding-left: 40px;">B. <i>Are you concerned with the change in role the CEC firms play in the construction industry? Taking into account that CEC firms will be employed by contractors to provide design and supervision services.</i></p>
<p>Q7: <i>For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management as the firm evolves. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?</i></p>
<p>Q8: <i>Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?</i></p>

In order to comply with research ethics, the questionnaire contained a consent form informing respondents of their rights during the duration of this research. Such rights include anonymity and the right to stop, withdraw or not answer certain questions from the questionnaire. Attached to the consent form was an introductory letter explaining the aim of the research and the expectations of the interviewees. The consent form and the introductory letter came prior to the questionnaire, all in one

document, that was sent to interviewees in advance. Interviewees were requested to sign and stamp the consent form.

To determine the number of interviews to be conducted, the saturation method was used. According to Fusch and Ness (2015), "Data saturation is reached when there is enough information to replicate the study, when the addition to obtain additional new information has been attained, and when further coding is no longer feasible". Tran *et al.* (2017) suggest that data for the saturation method generally involves research that deals with open-ended questions in qualitative studies such as interviews, focus groups or surveys. Kumar (2011) concurs that this concept is better applicable to situations where the collection of information is done on a one-to-one basis.

Fusch and Ness (2015) explain that the point of data saturation is not reached simply when all resources are exhausted, or when certain numbers are reached. The point of saturation is actually highly subjective since it is up to the researcher to determine when the saturation point is reached (Kumar, 2011). To facilitate reaching a point of saturation in interviews, researchers should structure their questions to guarantee that multiple participants can answer the same questions. If different questions are asked in a non-structured way, reaching data saturation is more difficult as the target and end goal become a 'moving target' (Fusch & Ness, 2015).

For this study, the point of saturation is applicable since it will involve one-to-one interviews and the structure of questions will be the same for all respondents, as noted above. The other aspect that renders it ideal to apply the saturation method to this study is the diversity of phenomenon being studied (Kumar, 2011). The problem of this research does not contain much diversity of outcome for CEC firms, as firms either struggle or thrive under macroeconomic cycles.

3.6.3 Conducting the semi-structured interview

As a set process needs to be followed when conducting research, there are several approaches to preparing, conducting, analysing and presenting findings. Some of these methods have been addressed by Zorn (2010), Wilson (2014) and Wengraf (2001).

This study will make use of the procedures outlined in Wilson (2014) that divides the procedures into three phases: planning and developing a semi-structured interview

(Figure 3-6); conducting a semi-structured interview (Figure 3-7); and analysing responses after a semi-structured interview (Chapter 5).

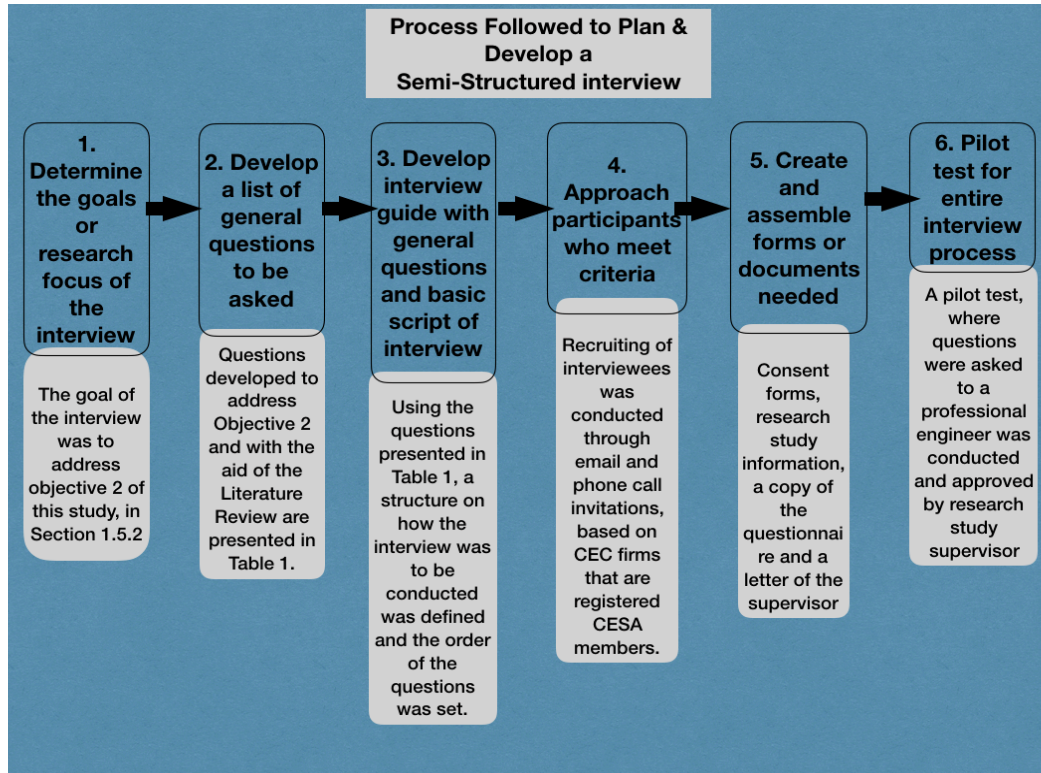
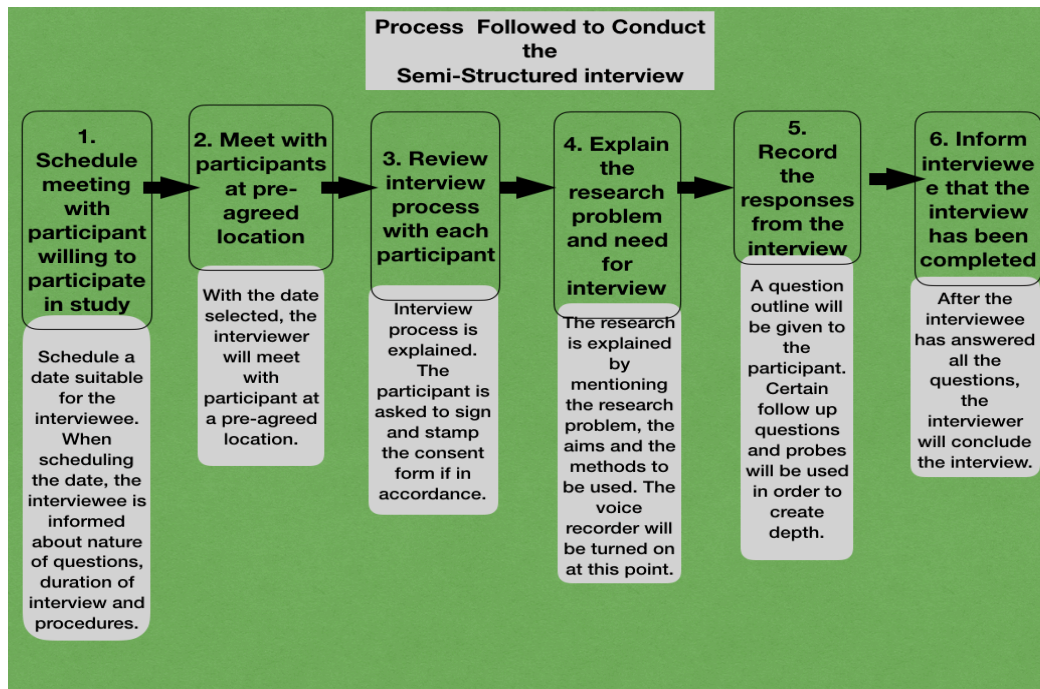


Figure 3-6: Semi-structured interview planning procedure (Adapted from Wilson, 2014)



**Figure 3-7: Procedure to conduct a semi-structured interview
(Adapted from Wilson, 2014)**

After conducting the interviews, the interviewer will need to transcribe all the necessary information (APPENDIX B:). This information will undergo an initial analysis to check that questions were answered in a satisfactory manner. If not, the interviewer will have to take note and ensure that the next set of interviews will avoid a similar problem by generating notes concerning when and which probes to use. The answers from the interviewees will be presented in summary form in Chapter 5.

As stated under Chapter 1, semi-structured interviews were conducted to address the second objective of this study, discussed under section 1.5.2, to identify the economic factors that CEC firms in South Africa must monitor in an effort to maintain sustainability.

3.7 Chapter summary

The aim of this chapter was to present the different research methods and the research methodology of this study. This included a brief introduction, review and comparison of the various research methods, techniques and methodologies that can be used when conducting academic research. This was followed by a presentation and comparison of the different mixed method research approaches, and then a more in-depth explanation of the particular research methods chosen for this study, and how these will be applied for data collection and analysis.

The methods involved in this research are of both a quantitative and qualitative nature. The quantitative method is comprised of a series of macroeconomic tests that ultimately check the existence, or lack thereof, of causation relationship between construction professional services total revenue, construction value added, gross fixed capital formation of total construction investment, gross domestic product and gross fixed capital formation of total investment. The qualitative method incorporates in-depth semi-structured interviews with civil engineering consulting professionals working in the civil engineering industry. Therefore, it was determined that the research design of this research will be of a concurrent triangulation nature.

In Chapter 4, tests on the causation relationship between the SA general economy, the construction industry economic activity and the construction professional services total revenue will be gathered. The causation relationship test will make use of econometric tests such as unit root tests, co-integration tests and causality tests.

Chapter 4: Relationship of Causation between Construction Industry Activity, Economic Activity and Construction Professional Services in South Africa

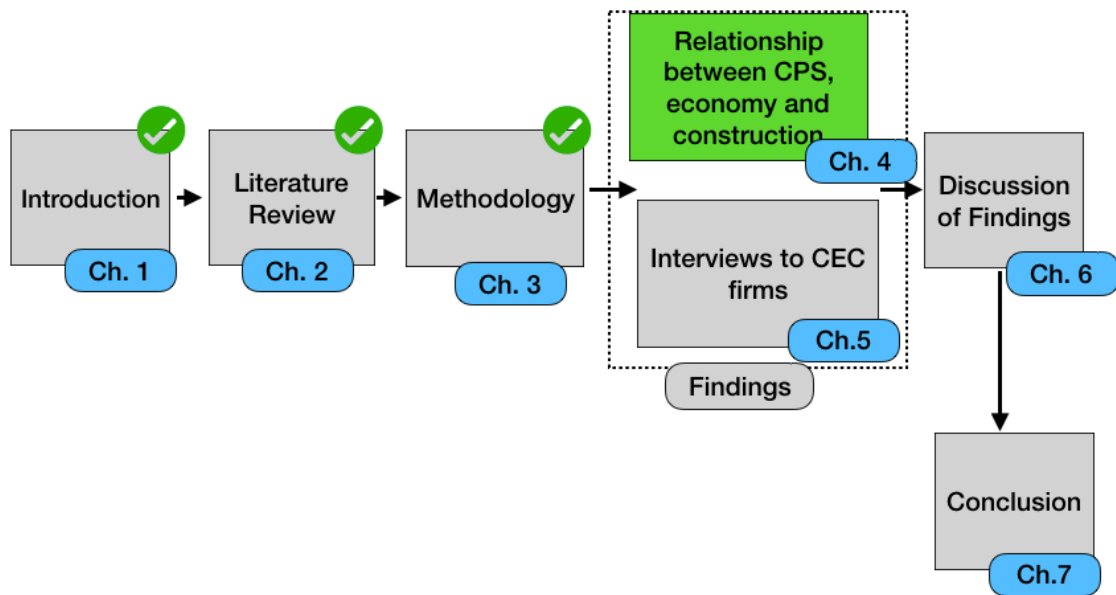


Figure 4-1: Document progress map Chapter 4

4.1 Chapter introduction

Chapter 4 focuses on the first objective, to determine the causation relationship existent between CEC, economic activity and construction industry economic activity (Figure 4-2).

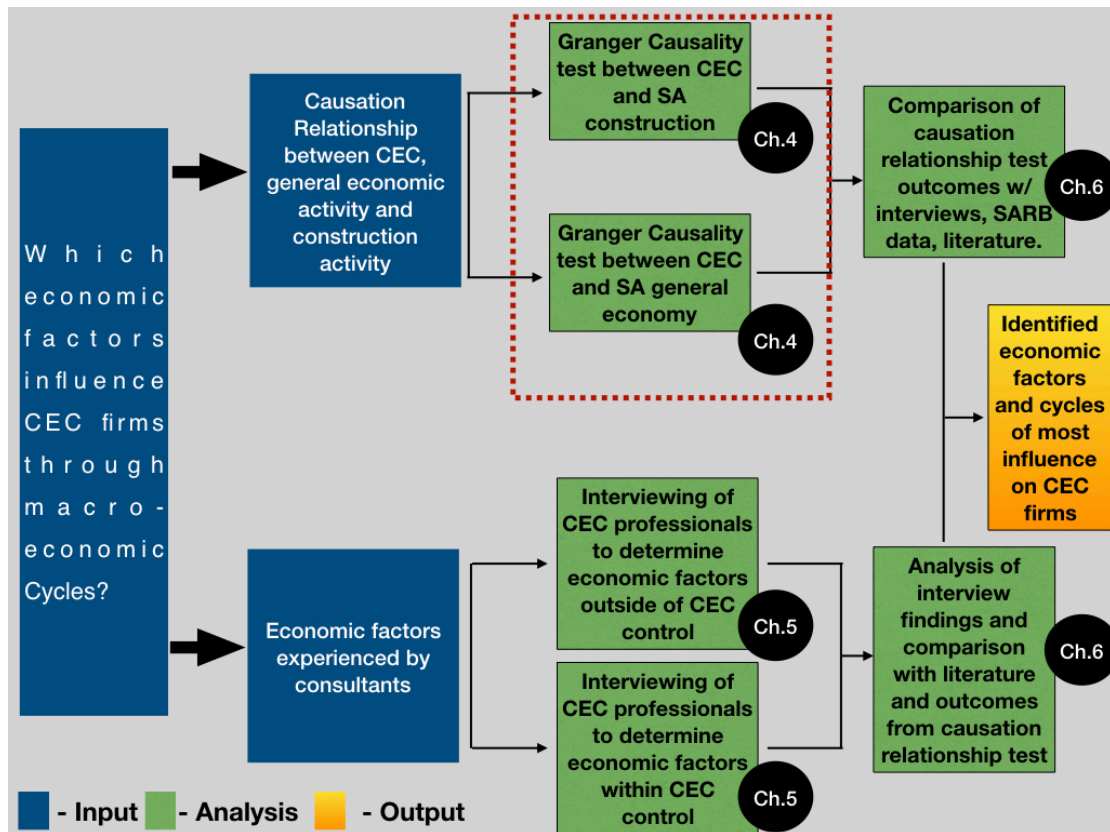


Figure 4-2: Thesis layout and Chapter 4 integration

As shown in Figure 4-3, this chapter will ultimately determine if economic activity, GDP and gross fixed capital formation (GFCF) total investment cause an increase in total revenue of construction professional services (CPS), or vice versa; and if construction activity, construction value added (CVA) and GFCF total construction investment cause an increase in total revenue of construction professional services (CPS), or vice versa. This will be done through a series of quantitative tests that determine a relationship of causation. The tests to be used are the ADF unit root test, Johansen co-integration test and Granger causality test. The ADF and Johansen tests have the outcome of determining if the data to be used is independent or not, reducing the chances of erroneous outcomes. The Granger Causality test will determine if construction industry activity and economic activity cause or tend to be caused by CPS.

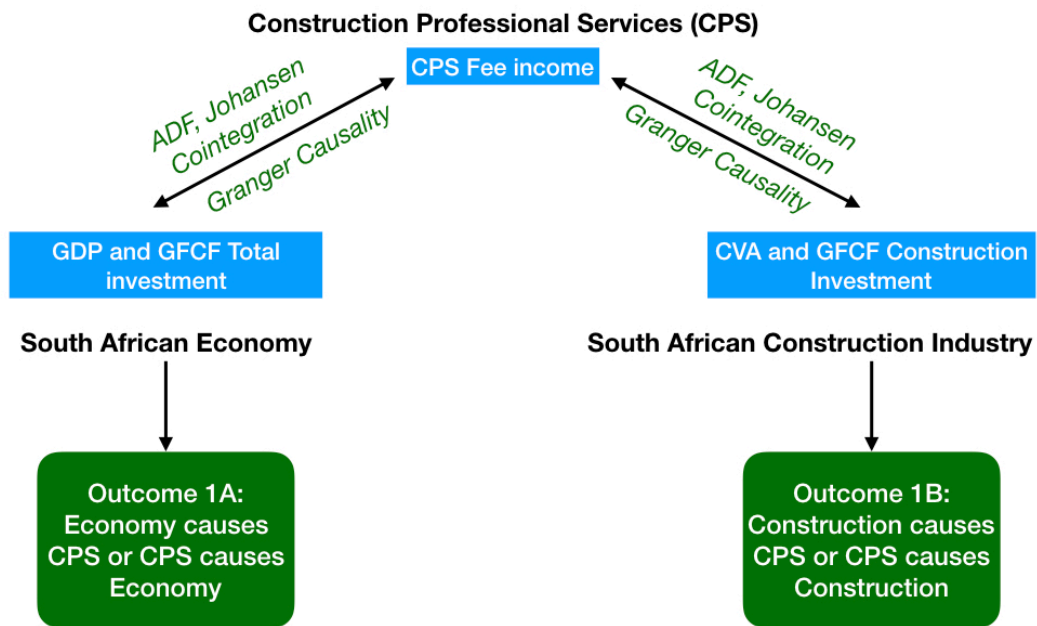


Figure 4-3: Structure of the causation relationship study between CPS, South African economic activity (GDP and GFCF Total Investment) and South African construction industry activity (CVA and GFCF total construction investment)

The tests to be applied in this portion of the research will make use of EViews software, software that is widely used to perform econometric and statistical tests in various sets of data. The results of these tests will be presented in the order shown below:

- a. *ADF test results* will determine the existence, or lack thereof, of unit roots. This indicates if the data tends to follow a trend or not. If a variable (GDP, CVA, CPS, GFCF1 and GFCF2) has one or more unit roots, the variable is occurring randomly without a set trend; if a variable does not contain a unit root, it is following a set trend. The data with unit roots will then proceed to the co-integration test;
- b. *Johansen co-integration test results* will determine the existence, or lack thereof, of co-integrating equations. This test indicates if two sets of variables follow a set trend or if these two sets of data are random. For this test, these sets of data will be GDP/GFCF1 tested against CPS, and CVA/GFCF2 tested against CPS. If co-integrating equations are found between CPS and GDP/GFCF1 and CPS and CVA/GFCF2, the relationship between the variables will be considered as not having a trend. These

variables could then be subjected to the Granger causality tests. The co-integration test will ultimately determine if the relationship between CPS and the construction or economy variables have a set trend or not;

c. *Granger Causality test results* will determine if the data that was previously tested for unit roots and co-integration equations has causation characteristics or not, more specifically, if economic activity data (GDP/GFCF1) and construction industry activity data (CVA/GFCF2) cause CPS, and vice versa, or not.

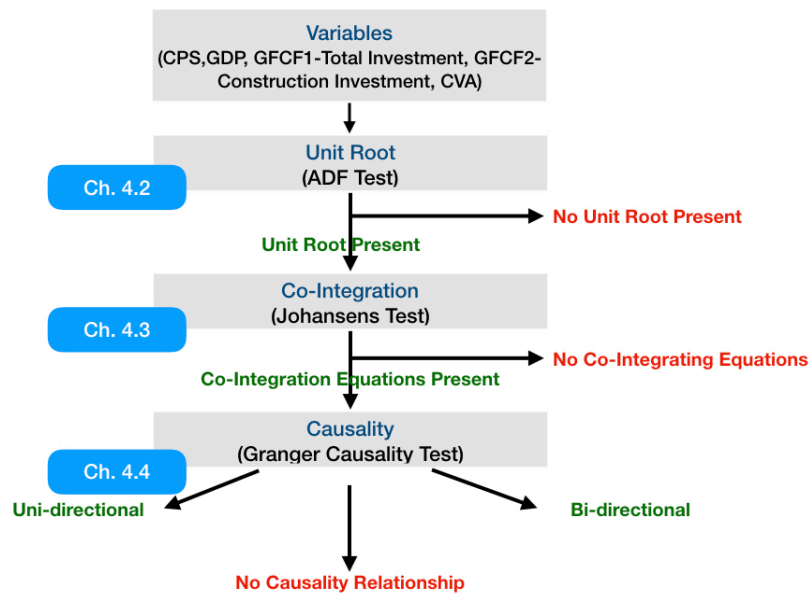


Figure 4-4: Sequence of tests to determine the causality relationship between CPS, GDP, GFCF1, GFCF2 and CVA

4.2 Unit root test

In section 3.5.3, for the explanation of the unit root test, it was mentioned that the unit root is a method used to test if a certain time-series follows a trend or not. As shown in **Figure 4-4**, this test is the first step in the process of determining if GDP/GFCF total investment causes an increase in total revenue in construction professional services (CPS), or vice versa, and if CVA/GFCF total construction investment causes CPS or vice versa. Specifically, the test will determine if the variables, shown in **Figure 4-4**, follow any set trends over time or if these variables are generally random.

The ADF unit root test is one instrument that can be used to determine if there is a unit root in the series or not. If there is a unit root in the series, the series can be

considered as non-stationary and following no trend. Variables with unit roots will qualify to be tested for co-integration, and subsequent to that, for causality.

For this research, the ADF tests made use of historical macroeconomic time series data published by the SARB on South Africa's gross value added at basic prices of all industries (GDP), gross fixed capital formation total investment (GFCF1), GFCF total construction investment (GFCF2), gross value added by construction (CVA) and construction professional services total revenue (CPS). The data referring to CPS was extracted from CESA's Bi-annual Report, which has published, since 1996, the fee income of all South African member firms.

As explained in section 2.4.3, there is no published data available on the fee income from CEC firms. However, these firms represent, on average, 60% of the income from the general construction professional services (CPS) in South Africa. Therefore, the CPS data was used to study the econometric relationship between consulting firms' data, construction economic data and general economic activity data, represented by CPS, CVA/GFCF2 and GDP/GFCF1, respectively.

To test the presence of unit root on this data, the software Eviews10 Student Version was used.

4.2.1 The ADF tests

As explained in the previous section, the ADF test will determine if the variables shown in Figure 4-4 – CPS, CVA, GDP, GFCF1 and GFCF2 – have any unit roots or not.

This section presents data analysis from EViews, the econometric and statistical software used in this study. An ADF statistic number was produced as an output from the software analysis that is compared to three different critical values at different levels of significance (1%, 5% and 10%) in efforts to determine if there is a unit root in the variables or not. If the ADF test is greater than the critical values, it can be concluded that there are unit roots present in the variables tested. These critical values were determined by EViews, based on MacKinnon (1991).

Table 4-1 and Table 4-2 show the results of the ADF test performed on CPS, CVA, GDP, GFCF1 and GFCF2 for a unit root. For all the tests performed, the null hypothesis was determined that each one of the variables (CPS, CVA, GDP, GFCF1

or GFCF2) has a unit root. As stated above, to avoid rejection of such null hypothesis, the ADF test statistic value must be greater than the critical values.

The test found that each variable – CVA, GDP, GFCF1, GFCF2 and CPS – has unit roots and has no trend. This means the variables are independent and do not follow a trend, reducing the chance of erroneous outcomes when performing the Johansen co-integration test and Granger Causality test.

In Table 4-1, the ADF test statistic is revealed as greater than the critical values at different percentage levels of significance, shown just below the ADF test statistic, making it impossible to reject the null hypothesis that CVA and GDP both have a unit root at level of the series.

Table 4-1: ADF unit root test results for CVA and GDP

	CVA at Level	GDP at Level
ADF test statistic	1.610	-0.546
Probability (P-Value)	0.999	0.863
Critical Value at 1% significance	-3.788	-3.788
Critical Value at 5% significance	-3.012	-3.012
Critical Value at 10% significance	-2.646	-2.646

Table 4-2 shows that CPS, GFCF1 and GFCF2 have unit roots, as the ADF test statistic is greater than the critical value at various levels of significance.

Table 4-2: ADF unit root test results for GFCF1, GFCF2 and CPS

	GFCF1 at Level	GFCF2 at Level	CPS at Level
ADF test statistic	-0.708	-0.560	-0.522
Probability (P-Value)	0.824	0.859	0.868
Critical Value at 1% significance	-3.788	-3.809	-3.788
Critical Value at 5% significance	-3.012	-3.021	-3.712
Critical Value at 10% significance	-2.646	-2.650	-2.646

With the results showing the presence of unit roots in the data series, it can be concluded that these variables occur randomly without following a set trend. This reduces the chances of erroneous outcomes on the tests that follow, the Johansen co-integration tests and Granger Causality tests. As shown in **Figure 4-4**, the following step will be to conduct the co-integration test.

4.3 Co-integration test

The previous section shows that all variables, GDP, GFCF1, GFCF2, CVA and CPS, have unit roots and therefore are stationary. As shown in **Figure 4-4**, the co-integration test was conducted to determine if there are co-integration equations or not on the variables tested in the previous section.

Determining if there is a co-integration equation or not indicates if the relationship between the variables follows a trend or if this relationship is random. The outcome of this section will move step a closer in determining if economic activity (GDP/GFCF1) causes CPS or vice versa, and if construction activity (CVA/GFCF2) causes CPS or vice versa by reducing the chances of unreliable results in the Granger Causality test.

Different from the ADF test that assesses each data series in isolation, the Johansen co-integration method tests data in groups of two to determine if any two sets of data series (GDP vs CPS; GFCF1 vs CPS; GFCF2 vs CPS; CVA vs CPS) have a relationship with a trend or if the relationship between both data series is random.

As explained under section 3.5.4, this test was conducted to determine if the number of co-integration equations of the variables was none, one or more. For this study, the hypothesized number of co-integration equations (CE) was determined either as “None” or “At most as 1”. The existence of a co-integration equation implies the existence of a causality relationship between variables (GDP vs CPS; GFCF1 vs CPS; GFCF2 vs CPS; CVA vs CPS), allowing a causality test to be performed and the outcomes, shown in **Figure 4-4**, to be determined.

For interpretation of these results, the following must be noted (EViews 2017):

- If the hypotheses “None” for none of the co-integration equations (CE) is rejected and the hypotheses “At most 1” is not rejected, this means that there are CEs;
- If the hypotheses “None” for CEs cannot be rejected and the hypotheses “At most 1” is rejected, this means that there are no CEs;
- If both hypotheses “None” and “At most 1” are rejected, then there are CEs;
- If both hypotheses “None” and “At most 1” cannot be rejected, then there are CEs.

Using the CVA, GFCF1, GFCF2, CPS and the GDP as variables, the test results are shown in Table 4-3, Table 4-4, Table 4-5 and Table 4-6. The data presented below is grouped into two sections – the relationship between construction professional services and the economic activity in South Africa, represented by GFCF1 and GDP, and the relationship between construction professional services and construction, represented by CVA and GFCF2.

4.3.1 Johansen’s test: CPS and economic activity

Table 4-3 failed to reject the hypothesis that there are no co-integration equations (CE) between the two variables, due to the critical value at 5% being higher than both trace statistics and Max-Eigen statistics. Furthermore, there cannot be any rejection of the second hypothesis, “At most 1 CE”, implying that there are CEs between CPS and GDP as the critical value at 5% significance level is higher than both trace statistics and Max-Eigen statistics.

Table 4-3: Johansen’s co-integration findings between CPS and GDP

Hypothesized No. of CE	Eigenvalue	Trace Statistic/ Max- Eigenvalue statistic	Critical value at 5% significance level	Probability (P-value)
Trace				
None	0.245	6.734	15.494	0.609
At most 1	0.054	1.117	3.841	0.291
Maximum Eigenvalue				
None	0.672	5.616	14.265	0.663
At most 1	0.094	1.117	3.841	0.291

Table 4-4 failed to reject both hypotheses; no CE and at most 1 CE, due to the critical value at 5% being higher than trace statistics and Max-Eigen statistics. Therefore, *there are CE between CPS and GFCF1*.

Table 4-4: Johansen’s co-integration findings between CPS and GFCF1

Hypothesized No. of CE	Eigenvalue	Trace Statistic/ Max- Eigenvalue statistic	Critical value at 5% significance level	Probability (P-value)
Trace				
None	0.302	9.252	15.495	0.343
At most 1	0.099	2.076	3.841	0.150
Maximum Eigenvalue				
None	0.302	7.177	14.264	0.469
At most 1	0.099	2.076	3.841	0.150

4.3.2 Johansen’s test: CPS and construction

Table 4-5 shows that the test failed to reject both hypotheses – no CE and at most 1 CE – due to the critical value at 5% being higher than both trace statistics and Max-Eigen statistics. Therefore, *there are CE between CPS and CVA*.

Table 4-5: Johansen's co-integration findings between CPS and CVA

Hypothesized No. of CE	Eigenvalue	Trace Statistic/ Max- Eigenvalue statistic	Critical value at 5% significance level	Probability (P-value)
Trace				
None	0.358	9.063	15.494	0.359
At most 1	0.009	0.187	3.841	0.665
Maximum Eigenvalue				
None	0.358	8.875	14.264	0.297
At most 1	0.009	0.188	3.841	0.665

Between CPS and GFCF2, a high probability of existence of CE has been determined. Table 4-6 shows that the test failed to reject both hypotheses due to the critical value at 5% being higher than both trace statistics and Max-Eigen statistics. Therefore, *there are CEs between CPS and GFCF2.*

Table 4-6: Johansen's co-integration findings between CPS and GFCF2

Hypothesized No. of CE	Eigenvalue	Trace Statistic/ Max- Eigenvalue statistic	Critical value at 5% significance level	Probability (P-value)
Trace				
None	0.352	8.938	15.495	0.371
At most 1	0.012	0.241	3.841	0.624
Maximum Eigenvalue				
None	0.353	8.697	14.265	0.312
At most 1	0.012	0.241	3.841	0.624

Johansen's co-integration tests found that the relationships between CPS and the various variables *indicate a presence of co-integration equations (CEs)* which makes the conditions ideal to test the causality between CPS and GFCF1, GDP, CVA and GFCF2. Having CE means that the relationships to be tested under the Granger Causality test (CPS vs GDP, CPS vs GFCF1, CPS vs CVA, CPS vs GFCF2) have no set trend and tend to occur randomly.

At this point, the causality relationship between the data can be tested as the existence of unit roots has been determined, through ADF test, and the existence of CEs has been determined through Johansen's co-integration tests, reducing the chances of unreliable results interfering with the outcomes.

4.4 Causality test

Using outcomes from sections 4.2 and 4.3, this test determined if economic activity causes CPS or vice versa, and if construction industry activity causes CPS or vice versa. The outcomes of the previous sections ensure that the variables have no trends; therefore, these variables have a lower probability of producing erroneous outcomes.

The degree of causality between two variables is often determined when one non-stationary variable has the ability to predict another non-stationary variable. These variables need to be non-stationary, a condition assured by the ADF test, and the relationship between these also needs to be non-stationary, which was assured by the Johansen's co-Integration test. If these variables, or the relationship between the variables, are stationary, the test results can be unreliable due to a spurious regression.

The degree of causality between the variables (GDP, GFCF1, GFCF2, CVA and CPS) was tested after the unit root and co-integration tests had been conducted to check if the data adhered to a set trend or not, minimising the chances of an erroneous result.

The results from the unit root and co-integration tests showed that there are minimal chances of a result with errors between variables since these variables have unit roots and there are co-integration equations between the variables, indicating the existence of a long running relationship with some causality between consulting income fees (CPS) and other variables. The direction of such causality can be determined through a Granger Causality test.

The findings below are grouped into two sections, the first testing the causality relationship between consulting firms' total revenue (CPS) and South African economic activity (GDP and GFCF1), and the second testing the causality relationship between consulting firms' fee income (CPS) and construction industry activity (CVA and GFCF2).

As a golden rule, the hypothesis proposed for each scenario tested below can be rejected or not, using as reference the p-values shown in the table. If the test shows a p-value lower than 0.05, then the hypothesis proposed needs to be rejected. Alternatively, if the test shows a p-value higher than 0.05, then the hypothesis proposed cannot be rejected.

4.4.1 Granger Causality test: CPS and economy

As shown below (Table 4-7), it was found that the hypothesis that "GFCF1 does not Granger cause CPS" can be rejected due to the low p-value, and that "CPS does not Granger cause GFCF1" cannot be rejected due to the p-values being higher than a 0.05 level of significance. This hints at single direction causation with GFCF1 causing CPS.

Table 4-7: Granger causality findings between CPS and GFCF1

Null Hypothesis	Observations	F-statistic	Probability (P-Value)
GFCF1 does not Granger cause CPS	20	9.600	0.002
CPS does not Granger cause GFCF1	20	1.967	0.174

Table 4-8 shows that hypothesis "CPS does not Granger cause GDP" can be rejected as the probability value is lower than 0.05, and the second hypothesis that "GDP does not cause CPS" can also be rejected as the probability value is lower than 0.05. This means that GDP can cause CPS and that CPS can cause GDP, hinting a bi-directional causation relationship.

Table 4-8: Granger causality findings between CPS and GDP

Null Hypothesis	Observations	F-statistic	Probability (P-Value)
CPS does not Granger cause GDP	20	4.098	0.038
GDP does not Granger Cause CPS	20	13.719	0.0004

4.4.2 Granger causality test: CPS and construction

Table 4-9 shows that neither hypotheses can be rejected, as the probability value is higher than 0.05 in both cases. This means that there is *no causal relationship between CPS and CVA*.

Table 4-9: Granger causality findings between CPS and CVA

Null Hypothesis	Observations	F-statistic	Probability (P-Value)
CVA does not Granger cause CPS	20	2.573	0.110
CPS does not Granger cause CVA	20	0.0208	0.980

Table 4-10 shows that neither hypotheses can be rejected, as the probability value is higher than 0.05 in both cases. This means that there *is no causation relationship between CPS and GFCF2*.

Table 4-10: Granger causality findings between CPS and GFCF2

Null Hypothesis	Observations	F-statistic	Probability (P-Value)
CPS does not Granger cause GFCF2	20	0.909	0.424
GFCF2 does not Granger cause CPS	20	2.480	0.117

From all the results presented in this chapter, and especially from the Granger causality tests, it can be concluded that the economic activity, represented by the GDP and the GFCF for total investment, tends to cause CPS total revenue. Furthermore, the tests also showed that CPS total revenue could cause GDP. The

construction activities, represented by the CVA and GFCF for construction investment, *do not cause* and *are not caused* by the CPS total revenue.

4.5 Chapter summary

This chapter focused on the quantitative aspect of this research whereby the relationship between GDP, GFCF1, GFCF2, CVA and CPS fee income was tested using statistical and econometric tests. These tests determined that there is a bi-directional causality relationship between consulting firms' total revenue and GDP, with GDP causing CPS total revenue, and CPS total revenue also causing GDP. This finding fulfils the expected outcome 1A, which states that GDP/GFCF1 causes CPS, as depicted in **Figure 4-3**.

The tests also discovered a uni-directional causality relationship between GFCF1 and CPS fees, with GFCF1 acting as a leading indicator for total revenue of consulting firms. This finding fulfils the expected outcome 1A, which states that GDP/GFCF1 causes CPS, as depicted in **Figure 4-3**.

Moreover, findings show there are no causal links between CPS and CVA and GFCF2, indicating a lack of causal relationship between CPS and construction industry activity. This finding is not in accordance with expected outcome 1B, which states that CPS causes CVA/GFCF2 or vice versa, as depicted in **Figure 4-3**.

With the findings pertaining to the South African economic activity tending to cause the consulting firms' total revenue, there appears to be no relationship of causation between consulting firm fee income and construction activity. A discussion of these findings will be carried on in Chapter 6. In Chapter 5, the qualitative method, with semi-structured interviews in particular, will address the second objective of this research, whereby participants, CEC professionals, will respond to topical questions. The interviews will seek to identify the economic factors that CEC professionals believe could affect the sustainability of CEC firms in South Africa. The findings of these interviews will be compared to the findings from this chapter. All findings detailed under Chapters 4 and 5 will be discussed and analysed in Chapter 6, with conclusions drawn and recommendations for further studies presented in Chapter 7.

Chapter 5: Interviews

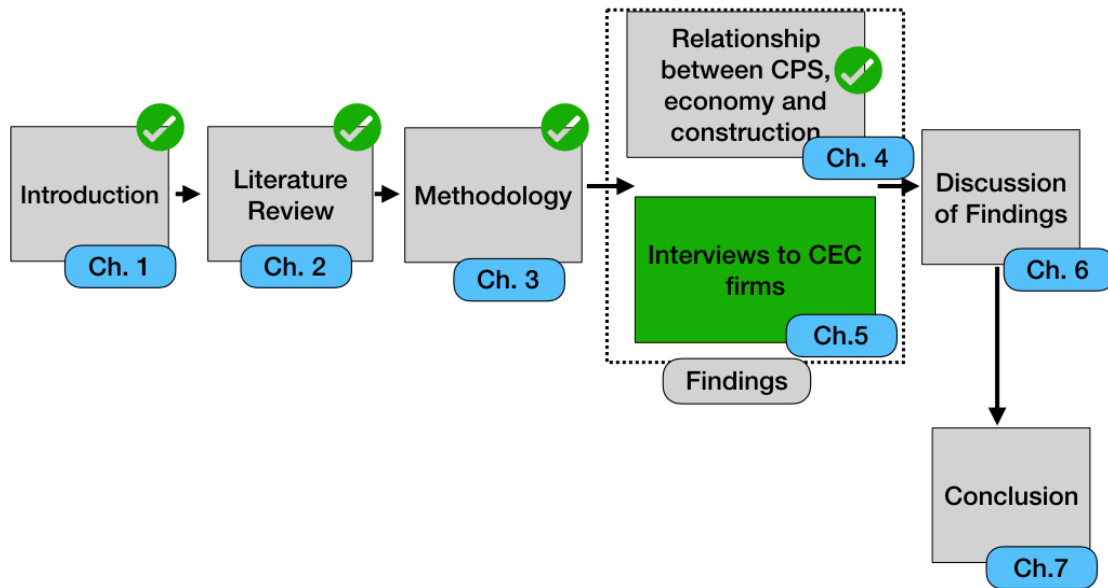


Figure 5-1: Document progress map Chapter 5

5.1 Introduction

This chapter presents findings from semi-structured interviews with the intent of addressing the second objective of the study, identifying the economic factors that affect the sustainability of civil engineering consulting (CEC) firms.

In Chapter 4 evidence revealed a relationship of causation between CPS, GDP and GFCF of total investment. As stated in section 2.4.4, concerning fee income for CEC firms, around 60% of CPS fee income comes specifically from civil engineering firms, with structural engineering firms having the second highest share of 13% and the remainder of the share of fee income of CPS split among 17 different disciplines of consulting services. To better understand the outcomes as presented in Chapter 4, it is crucial to interview CEC professionals with experience in consulting firm management. These interviews will engender an understanding of how general well-being of the economy and the construction industry, normally represented by GDP, CVA and GFCF, can have an impact on CEC firms sustainability. The findings of a quantitative nature from Chapter 4 will be discussed in conjunction with the qualitative findings from Chapter 5. This discussion, presented in Chapter 6, will attempt to answer the research question, stated again below:

Which economic factors influence the sustainability of civil engineering consulting firms in South Africa through macroeconomic cycles?

Chapter 5, therefore, comprises the objective of identifying economic factors that CEC professionals have experienced through their management of CEC firms in South Africa. To address this objective, in-depth semi-structured interviews were conducted with CEC professionals, with respondents providing insight into the common economic factors that they believe could affect the sustainability of CEC firms. The outcomes from these interviews, in conjunction with the understanding of the causation relationships tested under Chapter 4, will enhance the identification of economic factors influencing CEC firms' sustainability and recognition of how these factors are manifested in South African macroeconomic cycles (Figure 5-2).

As mentioned in Chapter 3, the interviews were conducted within organisations in the CEC industry in South Africa. Seven interviews were conducted until a saturation point had been reached. A saturation point is reached when responses from the interviews become similar and thus redundant, so interviewing more participants will not bring any significant difference to the results that have been gathered.

The interview participants included five CEC firms active in South Africa, a client and an independent association of consulting engineers. The interviewees for the semi-structured interviews were selected based on experience each participant has in terms of management of firms and construction projects for CEC firms. The respondents interviewed formed part of various firms categorised as small, medium and large CEC; findings for these firms are presented under section 5.2.

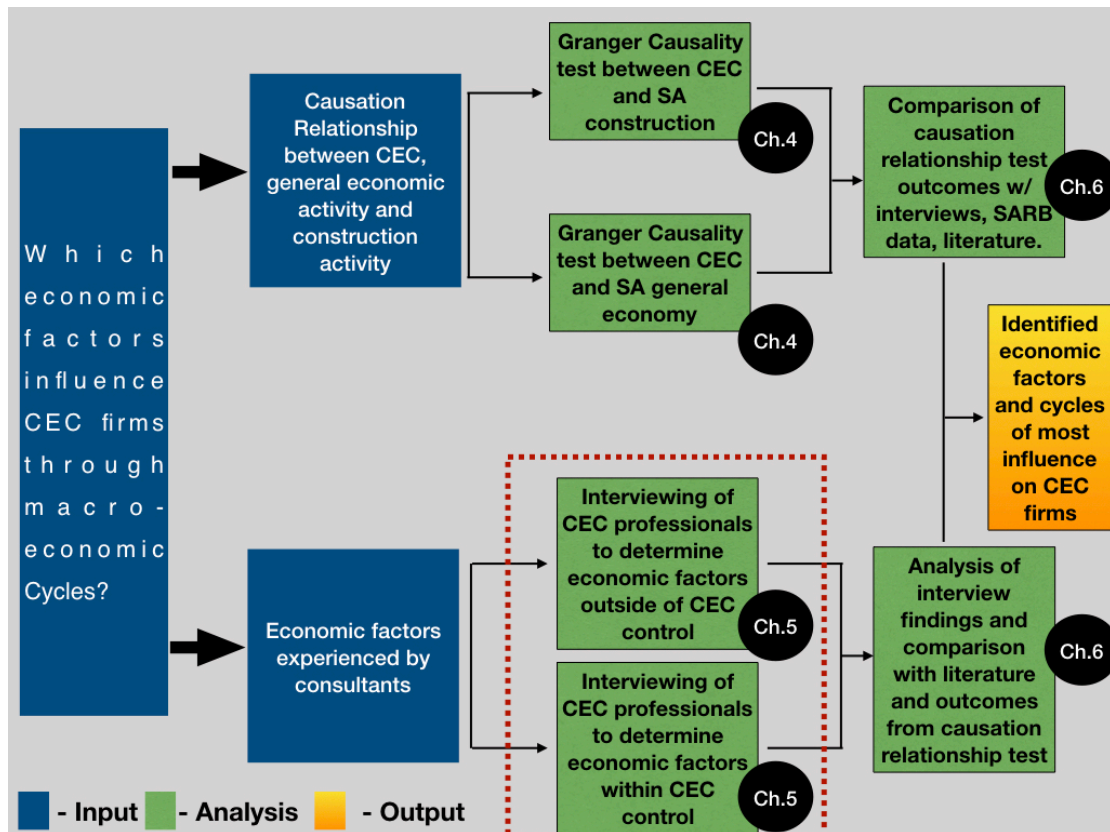


Figure 5-2: Thesis layout and Chapter 5 integration

Apart from CEC firms, two other organisations were also interviewed in efforts to validate responses from CEC firms. These organisations, SANRAL and CESA, while not CEC firms, can lend a different perspective to the study. SANRAL employs various CEC firms and CESA is an association of engineering consulting member firms. The findings showed in section 5.3 present areas in which SANRAL and CESA admit a need for improvement from CEC firms to remain sustainable.

5.2 CEC respondents

For clarity, the outcomes from the in-depth semi-structured interviews are presented on a question-by-question basis. For each interview question, the aim of the question was presented, as well as a brief overview of the answers and a table containing the responses from each participant. The full transcript of all the interviews was included in the appendices (AAPPENDIX B:).

5.2.1 Specific economic data for CEC sector

Chapter 2 showed that the way the government measures and presents economic data from the construction industry does not necessarily reap benefits, as the construction industry does not represent other services such as consulting engineering services. Findings from Jewell and Flanagan (2012) and Pearce (2003) reveal how engineering consulting services revenues are not properly presented in a manner that allows consulting firms to make use of such economic data for financially sustainability decisions. There are certain countries where such data is presented in a different manner. Van Sante (2008) shows how European countries keep track of the revenue generated by CEC firms, going as far as measuring the share percentage of CEC firms in terms of GDP and CVA. This study shows how various European countries use such information to understand the demand in the general economy and the construction industry. This allows CEC firms to manage their capacity in a sustainable way, not having to dismiss staff when the economy enters a recession that affects the firm's capacity to offer services.

To understand whether participants, South African CEC firms, would be in favour of the creation of economic data specifically geared towards CEC sector, the following question was asked in the interview:

Do you believe that there would be any benefits in terms of financial sustainability, if there were consistent economic data published on the performance and total revenue of the CEC industry?

As stated in section 2.4.2, the economic data of the construction industry excludes various components of the construction industry such as professional services and construction materials. Therefore, this initial question was presented to respondents with the aim of understanding if CEC firms identified the need for additional economic data helpful for making decisions to ensure sustainability of CEC firms. Such data would show how much revenue in terms of rand the CEC industry generates and

contributes to the GDP of the country, inviting an opportunity to study different relationships between CEC industry and other data such as employment creation, construction activity and public/private investment.

Out of the five respondents, four CEC respondents stated that having specific CEC industry economic data that related directly to the CEC sector would benefit CEC firms with regard to making decisions that ensure financial sustainability. Different reasons as for why such data would be beneficial are presented in Table 5-1, including the following:

- Respondent 4 stated that knowing the period that the order book can sustain your practice for the near future allows a firm to diversify and expand. According to respondent 5, this is dependent on a variety of factors such as the type of projects a firm undertakes and the duration of such projects, as projects such as traffic engineering appointments for traffic impact assessment take, on average, one to two months. The interviewee also made a remark that using order books to look ahead rather than at what a firm was paid in the previous year is the way forward. Using the order book of company in conjunction with the general state of the economy and political stability of the country is what is needed to know whether a company should expand or not.
- According to respondent 2, reliance on previous years' company results to forecast the next year's results does not promote reliability, as it is only based on how the leadership of the company 'feels' about the industry to assign targets based on the previous year results.

Respondent 3 was sceptical about the use of such economic data, commenting that the data available currently is not useful.

Table 5-1: Responses from CEC professionals for question 1

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>Do you believe that there would be any benefits in terms of financial sustainability, if there were consistent economic data published on the performance and total revenue of the CEC industry?</i></p>	<p>Yes, but one must bear in mind that the design and the other phase come ahead of the construction phase. Therefore, there is a different budget for planning and the construction phases.</p>	<p>Definitely yes. At the moment, what happens in most companies, if not all of them. Budgets are based on previous year's results. That will indicate what we want to get out of transport, energy and other disciplines. Are we bullish about the economy or not? If we are bullish is 10% (increase), if we are not bullish is maybe 2 or 3% (increase).</p>	<p>There are the questionnaires that we fill in for CESA that has the sorts of information for civil engineers. I do not think that data helps a lot, or else I would have been using that more if I thought that made a big difference to our company.</p>	<p>The order book is a good indicator. In my career CEC firms in general have an Order Book of about 6 months to 1 year; they are relatively in a good position. If you know that, you can keep your company going for 6 months that is the norm. Some offices in our company run on two to three months order book which is not very good window to work under. In addition, some have been operating on that window for a year now.</p>	<p>Yes.</p>

5.2.2 Gathering of CEC industry economic data by the SARB

Gathering economic data on the CEC sector or any other sector in fact, is not normally an easy task, primarily due to costs and the technical expertise to carefully manage such data and ensuring confidentiality. Jewell and Flanagan (2012) suggest that having economic data that better classifies the construction industry with regard to specific services, such as construction, consulting and supply of materials, would benefit the government *and* the CEC industry. This was identified as a possible solution for the mismatch of information provided by published government statistics and the information required by the CEC industry. Van Sante (2008) shows how gathering and accurately classifying data can directly influence decision making within CEC firms.

The first question sought to understand whether CEC firms would be interested in having access to better economic data that accurately reflects the consulting engineering sector economic activity. The majority of respondents believed that such information would be beneficial. As this study was focused primarily on firms that provide infrastructure services for the public sector, it was necessary to understand what CEC firms thought of the role of the SARB in collecting and making available economic data concerning the CEC sector availability. To understand this, respondents were asked:

What kind of information do you think that if the SARB collected and published would be beneficial to the long-term sustainability of CEC firms?

CEC firm management was asked the above question in an effort to understand how data, such as total revenue spent on design services, could better assist CEC firms prepare for a possible expansion or contraction in the market. In a case where SARB or any other organisation gathered information such as public expenditure on planning, feasibility, design or supervision of services for infrastructure made available on a consistent basis to CEC firms, these firms could likely identify the appropriate time to invest in staff training or to diversify into other services.

The majority of respondents believed that information that could directly aid CEC sectors through economic cycles does not need further regulation (Table 5-2). The reasons for this approach varied amongst respondents, with some stating the following:

- Information for the CEC sector should be gathered and regulated by an independent body. According to respondent 2, this would be the best way to control such information. This information must be used in conjunction with the information produced by the government, such as the MTEF, in a systematic analysis to forecast with a fair degree of accuracy and make insightful future decisions.
- Government already provides enough transparent information. According to respondent 4, such information can be accessed electronically, allowing decision makers to see where new projects are being implemented and how much the client is spending for services.

Table 5-2: Responses from CEC professionals for question 2

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>What kind of information you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?</i></p>	<p>It would be nice to know in advance, what kind of projects are coming up, if it was planning, feasibility studies or design. With that information, one could plan.</p>	<p>An organisation like CESA would be a better place than government for that information to sit. Therefore, the kind of information you are talking about is looking at cycles of construction in civil engineering firms. The construction cycle is cyclical. In addition, if you are using the right forecasting tools and there are some very powerful forecasting tools, you can forecast for the next 12 months.</p>	<p>That would be a total disaster because there is nothing that the government can benefit apart from the people who steal the money. As far as I am concerned, the less the government is involved the less negative thing will be for everyone. Less regulation would be welcome. Government intervention has led to R72bn losses and debt.</p>	<p>The Government is already transparent regarding the information it publishes. In SA, you can find out exactly what government institutions have as a budget, what is available for capital projects. In some cases, you can see what projects will be advertised as well. Because of our PFMA (Public Financial Management Act). Things are transparent.</p>	<p>Some sort of benchmark that firms could use to measure their sustainability against ECSA guidelines. This would allow firms to know the industry financial sustainability indicators that should be met.</p>

5.2.3 Understanding the relationship between construction industry and general economy

Different studies have proven a relationship between construction industry and the general economy (Chiang *et al.*, 2014; Khan, 2008). Mainly through econometric tests, these studies have found a consensus: there is a relationship of causation between the construction industry and the general economy in various countries. The CEC sector also needs to be aware of any existing relationship of causation between construction and economy in general, as the construction industry and the CEC industry work together with great frequency.

The relationship between the construction industry and the general economic activity in South Africa was one of the points discussed during the semi-structured interviews for this study. The aim of this discussion was to understand whether CEC professionals, through their experience in the South African construction industry, believed that there could be a significant relationship between construction industry activity and the general economic activity in South Africa, if the construction industry economic activity can indicate whether the general economic activity will continue to expand or not. An example of this relationship between construction industry activity and general economic activity was found by Turin (1978) and Alhowaish (2015), where an increase in the volume of construction activity in the country led to an increase in the overall economic activity of the country.

To understand the role that the construction industry plays for the South African economy in general, the following question was presented to interviewees:

Do you believe that data obtained relating to the construction industry economic activity could beneficially indicate if the South African economy at large is undergoing a recession or expansion?

From the responses provided (Table 5-3), the interviewees generally agreed that there is a relationship of causation between construction industry activity and general economic activity in South Africa. A minority of participants believed that construction industry is an indicator for expansion or contraction of the economy in general, while 80% of the participants stated that contraction or expansion of South African economic activity is the indicator of construction industry activity. The following responses can be highlighted:

- According to respondent 4, the planning, design and documentation stages of the construction project lead to the construction, supervision and maintenance of infrastructure. Under this construction phase, the money allocated to construction projects makes its way into the economy in general to acquire services and goods, which in turn leads to companies and individuals spending this capital in other areas, positively affecting the economy.
- According to interviewee 2, the construction industry lags the economy. The industry normally waits for jobs to be made available and only then will there be some effect on the economy coming from the industry.

Table 5-3: Responses from CEC professionals for question 3

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>Do you believe that the construction industry economic activity could indicate if the South African economy at large is undergoing a recession or expansion?</i></p>	<p>I think the construction sector cannot indicate, but the construction sector is an indicator if the government is spending money or not. If the government is not spending money, it tends to be in recession. If the government is spending money, the economy is in expansion. Government is the main employer of work.</p>	<p>Normally what happens is that there is this lag between construction and the rest of the economy. In addition, if you look at the CESA report and compare the business confidence or the construction confidence with the broader economy you will see there is a mismatch. Therefore, the construction industry is lagging way behind reality. The construction sector itself is basically just sitting and waiting for work.</p>	<p>The contractors are now having a hard time. Some of the big companies are closing down. So, the construction companies are now where consulting companies were a year ago. I have been 32 years working in this industry. And from these 32 years, last year was the worst in this business. To the point now that the contractors are now going out of business. All the big contractors are on a lot of pressure.</p>	<p>I think especially the consultants can indicate. If we do not have any work, the economy suffers. Only one year to two years after CECs have been appointed, you start seeing that money being spent on the ground such as supply of cement and steel, equipment, and labour. I think you are right; we are in the middle of the trouble right now.</p>	<p>You can see it coming. It has a lot to do with government rolling out projects. Generally speaking, yes.</p>

5.2.4 Understanding the causation relationship between CEC industry to general economy and general construction industry

There are very few studies considering the relationship of causation between CEC industry to general economy and construction industry. One of these studies is by Van Sante (2008) who states, “Demand for consulting engineering work is very closely linked to the general economic environment and the construction output”.

As stated in section 2.4.7, various studies have shown that contributions from the economic activity indicators, such as GDP, are impacted by construction industry activities. Therefore, it is imperative to understand the role that the CEC industry plays in terms of causation of both construction industry activity and general economic industry activity.

During the interviews, the relationship between the CEC industry and the general economy, and the relationship between the CEC industry and construction industry were discussed with the intention of discovering if CEC professionals, through personal experiences, believe that there is a relationship of causation between CEC industry economic activity, general economic activity and construction industry economic activity. Understanding this relationship of causation allows firms to witness opportunities for growth during the expansion or recession phases of the economy.

In a case where there would be a relationship of causation between CEC industry and construction industry, CEC industry revenues would lead to an increase in construction industry economic activity, CEC firms would be in a position to maximise revenues by ensuring that qualified and experienced staff in construction supervision can be retained. Consulting firms could begin preparations to bid for multiple projects in different phases of the construction value chain such as planning, feasibility, design and supervision services.

In order to understand the relationship of causation between CEC industry, economy and construction industry, the following question was posed:

Do you believe that data obtained in relation to the current state of the CEC industry economic activity could indicate the current, or future, state of South Africa’s general economic activity or South Africa’s total construction industry economic activity?

Apart from one respondent, all professionals interviewed stated that the CEC sector could indicate whether the construction industry will enter recession or expansion (Table 5-4). With regard to the economy in general, there was a more substantial difference in opinion as over half of the respondents stated that the CEC industry does not indicate if there will be a recession or expansion in the economy in general. The other half, however, stated their belief that the CEC industry would indicate if there would be a recession or not in the whole economy. The reason for these views can be highlighted by the following responses:

- The CEC firm normally is appointed to provide a service some years before the construction begins. The economy will normally be stimulated with public funds spent on the economy and used to buy goods from local businesses and employ local workforce. According to interviewee 2:

In practical real terms, the consultant space should be able to pick up early as the consultant's work has been done way before construction, sometimes years before. Therefore, if you have a proper handle over the consulting industry and what is happening there and the potential construction flows from that you should be able to pick up earlier than the construction side. So definitely, consultants should be able to indicate if there is going to be a recession or expansion. Therefore, the CEC industry leads the construction and the economy in general.

- Interviewee 3 stated that the CEC industry could only indicate how the construction in general could perform. The funds to appoint CEC firms are not always available; therefore, CEC firms cannot indicate if there will be a recession or expansion in the economy.

Table 5-4: Responses from CEC professionals for question 4

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>Do you believe that the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?</i></p>	<p>Not sure about it, as projects announced might not get built. For example, the water affairs has been announcing projects for years, new projects, but none of them have yet been built.</p>	<p>In practical real terms, the consultant work has been done way before construction, sometimes years before. So if you have a proper handle over the consultant industry and what is happening there and the potential construction flows from that you should be able to pick up earlier than the construction side. CEC industry leads the construction and the economy in general.</p>	<p>Not the economy, as the economy leads the CEC firms. However, it can indicate for the construction industry.</p>	<p>Yes, consultants lead the economy and industry. If we are struggling, the rest of the economy starts to struggle.</p>	<p>The CEC industry can indicate if there will be a recession in the construction industry.</p>

5.2.5 Lead and lag relationship between CEC industry and the construction industry or economy in general

The previous question intended to show the point of view of CEC professionals in terms of a possible causation relationship between CEC industry economic activity, the construction industry economic activity output and the general economic activity in the form of GDP. The interviews revealed that most respondents believe that CEC industry economic activity does not cause an increase or decrease in the general economy growth in the form of GDP, but there is a strong causation relationship between CEC fee income and construction output.

The findings from the previous question still need to be better analysed in terms of the lead/lag relationship between CEC industry fee income, construction cycles and business economic cycles. Essentially, understanding if CEC industry economic activity leads the growth in construction economic activity means evaluating whether the construction industry total economic activity tends to increase as the CEC total revenue tends to increase. This scenario would indicate that CEC total revenue tends to lead growth in the construction industry economic activity. The same can be said about South Africa's general economic activity, where a lead/lag relationship between CEC total revenue and general economic activity would essentially indicate whether the CEC total revenue tends to lead or lag an increase in the total economic output of the country.

The aim of this question was to understand if CEC industry economic activity would lead/lag the construction cycles and its growth in construction economic activity, and the business economic cycles and its growth in general economic activity. To explore this, respondents were asked:

Taking into consideration the idea that an increase in the CEC industry could possibly indicate growth in the construction industry and the general economic activity of South Africa, do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?

The respondents stated that the CEC industry total fee income leads the construction industry and its cycles. With regard to the general South African economy, two respondents stated that they believe CEC industry fee income leads the general economic growth and its business economic cycles, and two others stated that CEC

industry fee income normally lags the business economic cycles (Table 5-5).

Responses included the following:

- The CEC industry normally leads both construction and the economic cycles. This is due to the services that frequently need to be done ahead of time to determine the budgets in a systematic way to remove corruption or misuse of funds. Such a system takes time and creates a lag between the CEC industry and the rest of the economy and the construction sector.
- The CEC industry total fee income leads the construction industry cycles and lags the economic cycles. The argument presented by respondent 3 is that the funds allowing the CEC industry to operate come from different sources such as tax collections or foreign investments.

Table 5-5: Responses from CEC professionals for question 5

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>Do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?</i></p>	<p>Lags the cycle. Taking into account that services one by CEC firms comes before the construction begins and even though one would know that there are potential projects coming, there is no certainty because firms know as government is announcing the projects. However, very little are being built even though these have been announced. There is huge uncertainty from government on what will be built.</p>	<p>The engineering consulting is definitely ahead of the curve. Then construction picks up way after that. It would be sort of consulting, than economy in general and then the construction.</p>	<p>The consultants lead the contractors. The amount of tenders in recent years has been decreasing and that has resulted in high discounting of service fees, as there are not enough tenders available for consultants. The contractor takes, on average, six months to a year to catch up with the consultant. The CEC sector lags the economy in general as the jobs and tenders are launched whenever money is available through the different sources. It takes also six months to a year for the economy to overtake you and the CEC to start feeling the harder times.</p>	<p>The economy normally lags one to two years the CEC firms industry due to the process of planning, designs, tender documents, put out the tender and all processes that have been put in place to take out any corruption take time.</p>	<p>The CEC industry lags the economy in general but leads the construction industry.</p>

5.2.6 Role of alternative procurement and contract types on the future of CEC industry

As stated under sections 2.4.6 and 2.4.4, the procurement of services for the CEC industry are often awarded to different firms based on the outcome of a rigorous tender submission and evaluation process. This process has some inefficiency; however, such as the time it takes between tender submission, appointment and commencement of works. That often contributes to the volatile fee income that CEC firms receive as firms cannot always plan and rely on income from works that have been awarded to the firm but for which engineering activity has not yet started.

Apart from the traditional and not always efficient procurement strategy, there have been some clients seeking to use alternative procurement methods. Some of these strategies, including Build-Operate-Transfer (BOT) and Engineer Procure and Contract (EPC) Turnkey, minimise the role of the CEC firm as the client's agent and result in CEC firms employed by contractors to design and inspect the quality of the work. This could mean a change in roles and responsibilities in a construction project. Consequently, it is important to understand how the CEC firms see this change in the industry.

This question was aimed at understanding from the CEC professionals as to if the industry sees these alternative contract methods as a threat or opportunity for the sustainability of CEC firms. The interviewees were asked about the financial impact that alternative methods of procurement could have on CEC firms. To elicit the respondents' perspective, the following questions were asked:

With alternative types of procurement and contracts in the engineering and construction market becoming more common, please answer the following questions:

- A. What impact do you see, negative or positive, in the sustainability of CEC firms, taking into consideration that contractors will be expected to provide feasibility, design and construction quality assurance services?*
- B. Are you concerned with the change in role CEC firms play in the construction industry, taking into account that CEC firms will be employed by contractors to provide design and supervision services?*

All respondents agreed that the use of alternative procurement and tender processes would benefit CEC firms (Table 5-6). The responses included the following:

- The CEC firms will benefit from these turnkey projects as these would reduce the tendering time and minimise the process, create opportunity for diversification into other services and engender a stronger relationship with contractors as they most often do not have the expertise that an engineer has.
- According to interviewee 2, these contracts will require engineers to adapt new services. Such adaptation is not a strong quality of most CEC firms in SA, which might result in a negative impact.

Table 5-6: Responses from CEC professionals for question 6

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>With alternative types of procurement and contracts in the market becoming more common, please answer the following questions:</i></p> <p>A. <i>What impacts do you see, negative or positive, in the sustainability of CEC firms?</i></p> <p>B. <i>Are you concerned with the change in role the CEC firms play in the construction industry?</i></p>	<p>I do not think that BOT negatively affect CEC. Firms need to be flexible enough to adapt to new forms of contracts available. I would assume that bigger firms would adapt more easily. But I am not sure, as it depends on government particularly. As they provide majority of the percentage of work in the country particularly related to civil engineering works. Building works and mines are more privates.</p>	<p>I think it is definitely going to impact. Clients are moving towards a more turnkey solution. They do not want to hear about the separation of professional services from delivery. They want one person to go to if there is a problem. And we have, the industry being disrupted by technology, severely.</p>	<p>Can only have a positive impact. The normal procurement process takes too long and it is not always working. If they can cut that process down to where they say this is Turnkey project where the contractor tenders and brings his own consultant that is going to streamline the project and bring down the time it takes to execute it. The normal tender process leads to huge inefficiencies in the system due to the time it takes.</p>	<p>Not if you are a resilient company. If you are aware of where the market is going and you position yourself than we will just be working for the contractors. You know the contractors do not have any CEC expertise, so they will either buy us or work with us to BOT or Design and Build, or we will be working for all the contractor companies and they will be our clients. We have done similar projects before.</p>	<p>Would not affect the industry negatively. CEC firms just need to change the way they work.</p>

5.2.7 Mistakes related to financial stability made by CEC firms

In order for any business to improve, it must learn from previous mistakes. It becomes important, therefore, to understand some of the mistakes CEC firms tend to make, and shortlist some of the lessons learned from the professionals interviewed. Identifying the mistakes made by CEC firms allows the study to show how poor management of certain economic factors can lead to these mistakes.

To shortlist mistakes made previously by the CEC industry, the question asked was as follows:

For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management as the firm evolves. What are some of the mistakes related to the sustainability of a firm that you have seen or still see many CEC firms making that need to be addressed?

Apart from one respondent, all other participants mentioned a few mistakes being made by CEC firms (**Figure 5-3 & Table 5-7**), including the following:

- Poor decision making, which is not always based on research, especially when it comes to planning budgets, growth and investments. Interviewees 1 and 2 highlighted this.
- A politic of hiring and firing staff, which is only based on the current market and what is available. Interviewees 1, 2 and 4 highlighted this.
- According to interviewee 4, the mistakes include improper marketing of the business, poor branding, and a weak ratio of employees to income, resulting in either too much capacity or too little capacity for what jobs the firm is getting.
- Interviewee 3 stated that there are not many mistakes that CEC firms are making, but they acknowledged that CEC firms must learn to diversify.

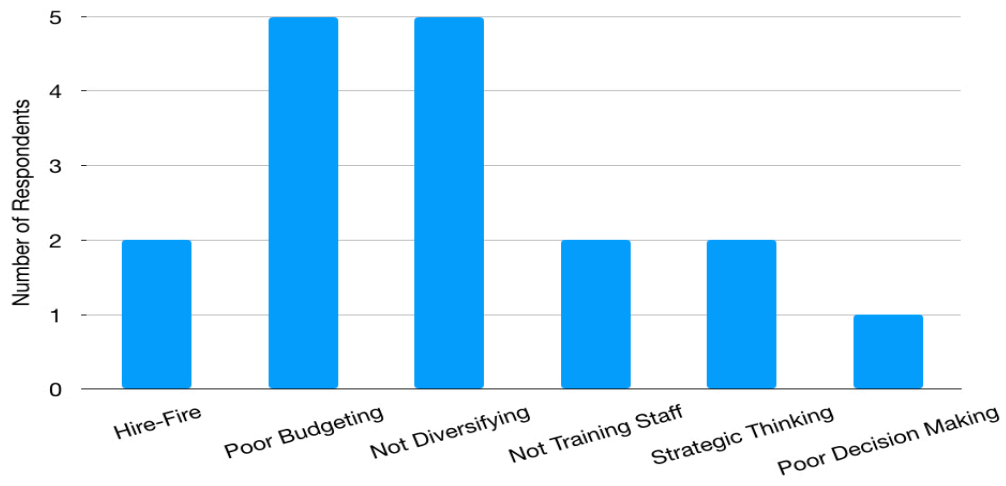


Figure 5-3: Most common mistakes seen by respondents in the CEC industry over the years

Table 5-7: Responses from CEC professionals for question 7

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?</i></p>	<p>Take this firm, it was apparently booming, and everybody was being squashed. So what was done to solve it? A new building was built and it has been standing empty for 4 years now. I think it was a bad decision making. We could have stayed squashed a bit longer or hire an accommodation. The other problem that has become a trend is the hire-fire. You bring in people and then you fire them. Probably that has been the impact. In terms of financial stability just long term planning helps. Many consultants are working internationally. To a certain extent gives financial stability. It takes two years to be appointed; this is a long time and makes long-term employment difficult</p>	<p>I think that the biggest mistake is that we do not think systemically. We are trained to think analytically and we process things the way they must happen. And so the world right now, all professions are being disrupted. And so you need, within that coming disruption, to think systemically about the future. Therefore, I think one of the biggest problems is that CEC do not know how to think about the future. And probably many businesses, they live in the past.</p>	<p>I do not see any mistakes that the CEC firms are doing. The Consultants should diversify yes, but that comes with a risk of getting involved in businesses that you have no expertise, which leads to inconsistencies in the system. But that is what needs to be done in order to pay salaries</p>	<p>Engineers are not very outgoing although they are very good at what they do. There are many reasons for financial instability. It could be poor marketing of firms, not having the right people, branding or the way you manage your company such as having too many people according to the ratio that you should have in terms of the income that you produce and the people you have. There is a ratio, better or worse, but there is always a ratio of people and income with regard to CEC firms. You have to understand, where you add value, which projects have the shortest life span, how do you cross subsidize to create sustainability. I have been doing it for 23 years.</p>	<p>Some of the mistakes that I have seen include high overheads specifically with big companies, availability of training professionals, not having a good relationship with clients, and multinational companies not understanding how to do business in South Africa.</p>

5.2.8 Identifying economic factors influencing the sustainability of CEC firms

The sustainability of a CEC firm can be intensified by carefully managing several economic factors, divisible into two groups, internal factors and external factors. External factors are all the factors caused by events that are out of control of the CEC industry and its consulting firms. Internal factors refer to all the factors that are manageable by CEC firms.

As part of the questionnaire, respondents were asked about the economic factors that, through their experience, they believed impacted the sustainability of CEC firms in South Africa. To identify the possible economic factors that affect the sustainability of CEC firms, respondents were asked the following:

Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?

From the responses presented, the interviewees pointed to certain similar external and internal economic factors. The answers presented showed the following:

- Firms need to look at external factors such as political policies implemented, government budgets, the need for services in other countries, potential new clients, economic indicators and business confidence indexes, foreign debt and tax income. Table 5-8 shows the factors consistently mentioned by respondents.

Table 5-8: Economic factors affecting CEC firms defined as external

ECONOMIC FACTORS INFLUENCING CEC	CAUSE
Business Confidence	South African economy
Corruption	South African economy
Tender Process	South African construction industry
Government Expenditure	South African economy
Foreign Investment	South African economy
Training of Government Staff	South African construction industry
Late Payments	South African construction industry
Public Budget for Construction	South African construction industry

- Looking at firms from an internal point of view, firms need to look at their order books to see how long they can keep a positive cash flow in the firm. Firms also need to understand the need for diversification in the industry (Table 5-9).

Table 5-9: Economic factors affecting CEC firms defined as internal

ECONOMIC FACTORS INFLUENCING CEC	CAUSE
Order Books	Poor risk management, poor short and long term planning, lack of monitoring
Number of Employees	
Capacity of Firm	
Decision Making	
Diversification of Services	
Training of Staff	

Table 5-10: Responses from CEC firms for question 8

Question	Interviewee 1 (Consultant, Former Director)	Interviewee 2 (Director)	Interviewee 3 (Managing Director)	Interviewee 4 (Director)	Interviewee 5 (Project Manager, former Director)
<p><i>Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?</i></p>	<p>Government expenditure is the biggest factor from the government point of view. Tends to be dominated by major projects, certainly for the bigger firms. As I said, one does not have an advanced warning of the economic position in the country because the government is budgeting from year to year and from project to project. The future decision-making is very short.</p>	<p>You need to think systemically and not based on what is the head count and how many people I need to keep in the firm. Systemically you look at the economic, resources, environmental, political factors, and from the economic side if you looking at the public sector. It is, again, understanding the restraints within the public sector.</p>	<p>CEC firms are not stable. Car sales go down, total debt increase, capital expenditure reduction, investor confidence, stock market, standard living, tax income, foreign debt</p>	<p>You need to understand the political economic situation of the country, depending on who you work for (public or private sector) or if you have a balance between the two. I think if you can diversify your service offer that gets you work, shields you of bad times and gives you sustainability and economic resilience. In SA, we have problems and the government has been trying to solve. We have school, roads, hospitals, public transport, to improve. By diversifying your services, you can bridge these bad economic times. Economic factors would be how the company is doing, what they are spending money on, and the order book.</p>	<p>The government spending, the economic and political situation of countries in the region and the level of corruption.</p>

5.3 SANRAL and CESA Interviews

The aim of interviewing SANRAL and CESA was to elicit input from organisations that work frequently with CEC firms in the construction industry. SANRAL normally employs CEC firms and provides insight into which particular economic factors have an impact on consulting firms' financial sustainability in South Africa from a perspective of a client putting out tenders for work (Table 5-11).

Some of the significant findings from these interviews include the following:

- Consulting firms can lead the construction industry and the economy in general due to the leading role these firms occupy in the development agenda of any country by creating a solution for a problem, presenting costs to implement such solution, providing guidance to the government on the investment needed and helping the government implement the developed plan with a contractor.
- CEC firms suffer from delays on the part of employers due mostly to poor scope definition, lack of qualified staff and corruption.
- It is imperative to establish a healthy relationship with the private sector, where the private sector knows, in advance and in real time, the plans to roll out projects, allowing firms to plan accordingly for proposals and the order book.
- CEC firms make certain mistakes that do not allow them to become sustainable, mistakes that include not adapting to change, not using resources appropriately, not investing in graduate engineers and poor risk management.

Table 5-11: Responses from SANRAL and CESA

Question	Interviewee 6 (Project Manager at SANRAL)	Interviewee 7 (CEO at CESA)
<p>1. Do you believe that there would be any benefits in terms of financial sustainability, if there was consistent economic data published on the performance and total revenue of the CEC industry?</p>	<p>Not sure what that data would be since all the information that is put on the market is in terms of tenders and competition. To create new data this needs to be done at a very high level, policy creation. In terms of SANRAL, we put out the potential jobs for the year giving an indication to CEC firms and this provides an understanding whether the market will be positive or not. By sharing this information, it allows the consulting companies to be prepared to propose for a share of the jobs that will be rolled out. A good relationship with the industry is what we believe can help the CEC by sharing information.</p>	<p>Yes. The CESA survey already does this. But firms need to look to diversify into other sectors and other countries. Going into other countries comes with risks that need to be understood such as outstanding payments, therefore CEC firms need to do risk profiling where they are not yet present and do not know the market.</p>
<p>2. What kind of information you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?</p>	<p>Our institution shares the numbers and plans for the year with all the CEC firms. Keeping them informed constantly of all the potential jobs that will be pumped out and expected cost is what we constantly do.</p>	<p>There is GFCF and Medium Term Expenditure, which provide guidance in terms of capital and projects available and under planning. The Medium Expenditure Framework budget helps with this.</p>
<p>3. Do you believe that the construction industry economic activity could indicate if the South African economy at large is undergoing a recession or expansion?</p>	<p>In normal circumstances, our institution should be putting out jobs continuously, but that is not always the case. The construction industry cannot indicate if the economy will expand or go into recession. Recession/expansion is a consequence of cash injections.</p>	<p>No. This is outside of the control of the construction industry. Government needs to use industry better as market grows very slowly, corruption prevails, tax revenues are not met, dialogue with firms on how to advise on how to achieve targets with less money, CEC bid for work based only on cost and the various government departments possesses limited knowledge in procurement.</p>
<p>4. Do you believe that the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?</p>	<p>The CEC firm can yes indicate if there will be recession/expansion in construction and possibly in the economy. If a firm has to start borrowing money to pay salaries and defaulting in payments this is a strong indication that there will be a poor year ahead.</p>	<p>The CEC sector cannot indicate a recession/expansion in the economy, but can indicate in the construction industry.</p>

Question	Interviewee 6 (Project Manager at SANRAL)	Interviewee 7 (CEO at CESA)
<i>activity cycles?</i>	capacity.	such as pre-feasibility and feasibility.
<p>6. With alternative types of procurement and contracts in the market becoming more common, please answer the following questions:</p> <p>A. What impacts do you see, negative or positive, in the sustainability of CEC firms?</p> <p>B. Are you concerned with the change in role the CEC firms play in the construction industry?</p>	<p>If there is an increase in BOT and other contracts that would be beneficial for CEC firms. However, there needs to be a definition of output specifications and of the risk transfer. Before the work starts, the CEC firms can know the budget that the client has allows the consultant to know how to approach the project. In a traditional tendering process, the CEC firm normally does not know the budget of the client.</p>	<p>Currently this is difficult to be achieved in the industry as there needs to be a separation of roles, assessment and management of risks, client is not always knowledgeable enough leaving space for poor quality, projects become expensive and removing the independence of stakeholders.</p>
<p>7. For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?</p>	<p>CEC firms do not always know how to manage change. They need to start adjusting themselves by having a visionary approach to understanding the environment and being proactive.</p> <p>Other mistakes include poor risk assessment, focus and nature of business, misuse of resources, investing in graduate engineers.</p> <p>Not all blame is with CEC firms as the procurement systems also need to be improved.</p>	<p>Bidding prices not sustainable, resource base too high needing to fire people, heavy discounting and the cost of doing business</p>
<p>Additional question: What are the causes of delay from the Client side? And how can these be solved?</p>	<p>Delays have a negative impact and are being caused by poor scope definition and lack of qualified staff, poor ability to implement, indecisiveness, and corruption. For projects to be delivered faster there needs to be a safe environment that has stakeholders that are proactive, accountable and professional and have integrity.</p>	

5.4 Chapter summary

Chapter 5 focused on the qualitative research by presenting the findings gathered through semi-structured interviews conducted with professionals working within the CEC industry. These interviews were conducted with five professionals who have experience managing CEC firms, one interview with a project manager who works for SANRAL as a respondent, and another interview with the CEO of CESA. The interviews carried on until the responses from the participants were essentially the same, meaning a saturation point had been reached.

The objective of this chapter was to identify construction economic factors that CEC professionals have experienced in the management of CEC firms in South Africa. The outcomes showed professionals consensus on the following: that the economic data regarding the construction industry barely reflects the inputs from CEC sector; the construction industry lags the CEC sector; the implementation of different methods of tendering and contracts would suit the CEC sector; and firms are not innovating quickly enough when it comes to varied services and products offered to clients. Interview responses clarified the economic factors that impact CEC firms: government expenditure, employment of qualified staff under the client and consultant firms, size of order books, diversification, foreign investment, capacity of firms, business confidence, strategic planning, decision making, tendering process and corruption. In addition to the factors identified, the interviews also provided reasonable insight into the relationship of causation that exists between construction industry activity, economic activity and CEC industry activity. This was elicited through questions 3, 4 and 5, and summarised in Table 5-12.

Chapter 6 will discuss and analyse these results using the information from the literature review presented in Chapter 2, in an effort to address the aim of the study.

Table 5-12: Summary of responses from semi-structured interview questions 1-6

Questions	R1	R2	R3	R4	R5	Outcome
Q1: CEC firms should have specific economic data	Agree	Agree	Disagree	Agree	Agree	4 out of 5 Agree
Q2: CEC economic data should be gathered by SARB	Agree	Disagree	Disagree	Disagree	Agree	3 out of 5 Disagree
Q3: Construction industry can indicate SA economic growth	Disagree	Agree	Agree	Agree	Agree	4 out of 5 Agree
Q4.1: CEC industry can indicate economic growth	Disagree	Agree	Disagree	Agree	Disagree	3 out of 5 Disagree
Q4.2: CEC industry can indicate construction growth	Disagree	Agree	Agree	Agree	Agree	4 out of 5 Agree
Q5.1: CEC firms lead economic growth	Disagree	Agree	Disagree	Agree	Disagree	3 out of 5 Disagree
Q5.2: CEC firms lead construction growth	Disagree	Agree	Agree	Agree	Agree	4 out of 5 Agree
Q6: Procurement procedures such as turnkey, BOT and Design and Build are beneficial to CEC firms	Agree	Agree	Agree	Agree	Agree	5 out of 5 Agree

Chapter 6: Discussion of Findings

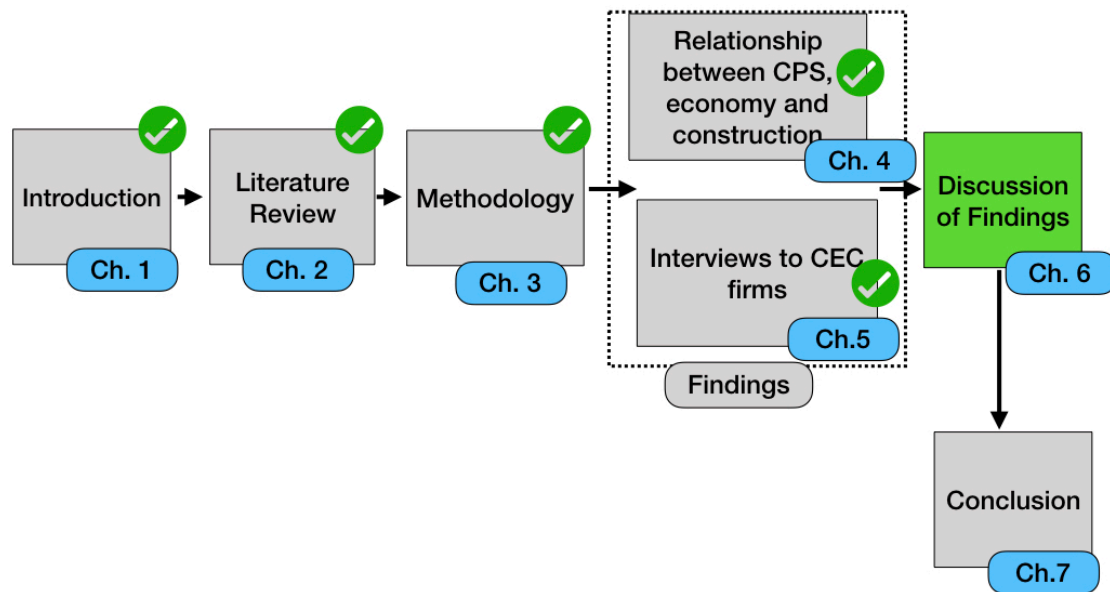


Figure 6-1: Document progress map Chapter 6

6.1 Introduction

This chapter presents a discussion on all findings gathered throughout the document so far, namely: qualitative findings from semi-structured interviews; quantitative results from macroeconomic statistical tests; and literature from similar studies covering the three main knowledge areas relevant to this study.

The findings gathered through macroeconomic statistical tests, presented in Chapter 4, showed the existence of a causation relationship between different South African economic activity, construction industry indicators and consulting engineering professional services. Through in-depth semi-structured interview conducted with seven professionals working on the CEC sub-sector, Chapter 5 presented the economic factors, grouped as internal and external factors that affect the sustainability of CECs (Figure 6-2).

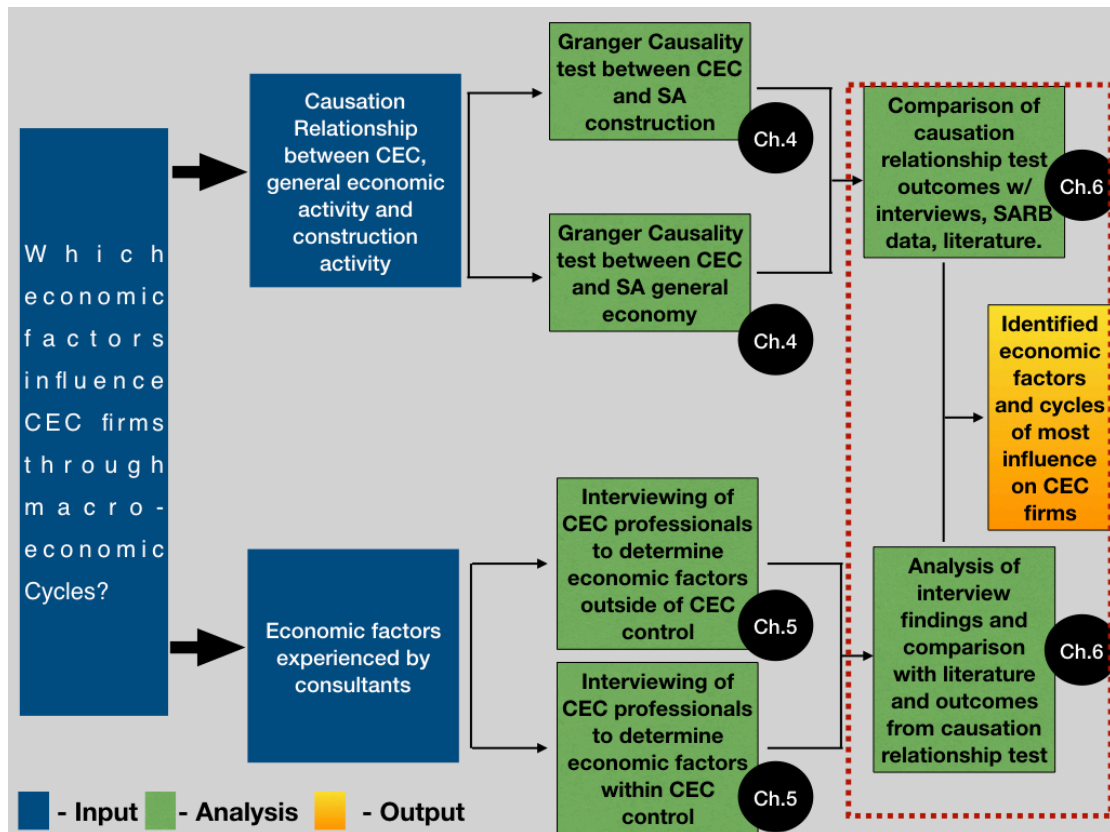


Figure 6-2: Thesis layout and Chapter 6 integration

This chapter intends to analyse and discuss the causation relationship that exists between the economy, construction and consulting services. This will be followed by an analysis and discussion of the economic factors gathered through the semi-structured interviews, which will result in the identified factors being grouped in terms of the three main areas of this study (Figure 6-3).

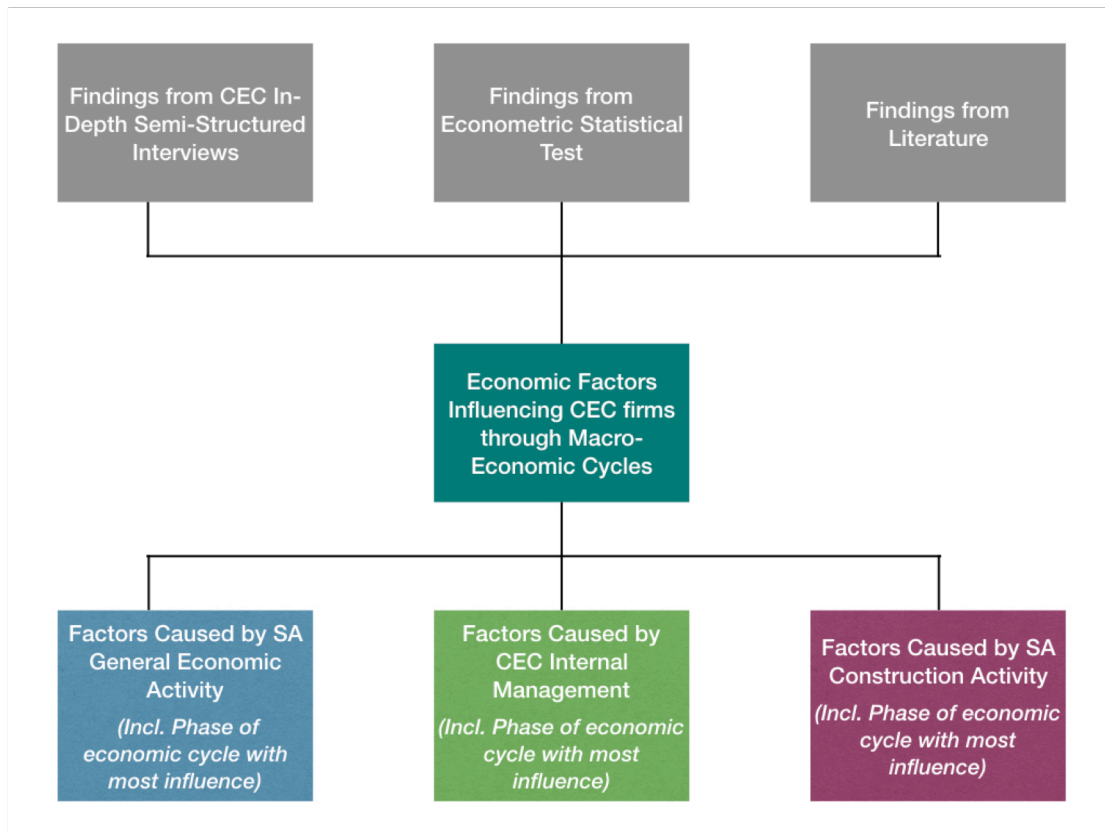


Figure 6-3: Overview of methods used and final research outcomes

6.2 Relationship of causation between construction professional services, construction industry activity and economic activity

The overall focus of this study concerns an understanding of those economic factors affecting CEC (civil engineering consulting) firms through the different macroeconomic cycles in South Africa. In order to determine the economic factors affecting CEC firms, there needs to be an understanding of the current existent relationship of causation between CEC industry, construction industry activity and economic activity.

To begin grasping the existent relationship of causation between CEC industry, the construction industry activity and general economic activity, the following questions will be answered through the course of this section:

- Does the construction industry activity in South Africa, as defined under section 2.3, have any causation relationship with the total revenue of the construction professional services, as defined under section 2.4.4?
- Does the economic activity in South Africa, as defined under section 2.2 have any causation relationship with the total revenue of the construction professional services?

Certain aspects regarding the availability of data need to be understood before answering these questions. As stated by Jewell and Flanagan (2012), the data that is gathered and published normally excludes consulting firms and companies that provide materials and services specific to the construction industry. Data from these sub-sectors is frequently mixed with data from other industries. An example is construction professional services data mixed with data from other professional services such as accounting and legal consulting, rendering it difficult to estimate accurately in terms of revenue and the size of the total built environment industry in South Africa. In addition to this, it is difficult to understand how the various stages of a typical built environment project are aligned in terms of cost and time, and if there are gaps between the different stages performed by different types of firms providing services for the industry.

The following sub-headings, 6.2.1 and 6.2.2, investigate the SARB published data for the construction industry activity indicators (construction value added and gross fixed capital formation for total investment in construction), the economic activity data (gross domestic product and gross fixed capital formation of total investment) and the

fee income of construction professional services in South Africa published by CESA to answer the questions introduced under this part of the chapter.

6.2.1 Construction industry activity and construction professional services

To analyse quantitatively the relationship between CPS and construction industry, under Chapter 4 section 4.4.2, two sets of data series representing the construction industry were selected: construction value added (CVA) and gross fixed capital formation of total investment in construction (GFCF2). The expected outcome at the initiation of the study was that CPS sector tends to indicate and lead construction industry activity and growth. In the following paragraphs, the findings from Chapter 4 will be discussed and analysed in comparison to the qualitative findings from Chapter 5.

Chapter 4, Table 4-8, shows that CPS services do not Granger cause CVA, and that CVA does not Granger cause CPS. In simple terms, this means that construction professional services fee income (CPS) and construction value added (CVA) indicators have no relationship of causation between them. Not finding any relationship between these two data series was not the expected outcome. Under normal circumstances, the consulting industry leads to an increase in revenue for the construction industry, as CPSs normally need to conduct services from the onset of a construction project, such as pre-feasibility and design services, to the later stages of the project with supervision services. These services often determine the price expected for the project and determine the type of contractor that should be selected. CPS firms perform some services earlier and therefore expect to receive some payment before contractors. As mentioned by Gross (2012) in a report on the global consultancy market, a majority of the fee income from consulting services comes from construction supervision works, not from design services. Therefore, there *should be* a causation relationship between CVA and CPS.

The unexpected outcome might be justified by other variables that were not evaluated separately for this study:

- late payments from clients and effect on CPS firms and contractors;
- difference in payment methods used for a CPS firm and a contractor, where the CPS firm will be paid for invoices submitted monthly and the contractor may be remunerated every three months for a percentage of work

- completed. In addition to this, contractors tend to receive a substantial amount retained by the client six months to a year after completion of work;
- availability of more CPS fee income data that goes back in time three or four decades; and
 - inconsistent rollout of tenders with gaps stretching a few years between the different stages of the project such as feasibility studies, design and supervision of works.

In Chapter 5, sections 5.2.4 and 5.2.5, respondents of the in-depth semi-structured interview were asked if they believed that CEC firm industry could indicate how well the construction industry is doing and if the CEC industry could lead or lag the construction industry activity. The answers from respondents showed that 80% of the respondents believe that CEC industry and its firms can indicate and lead the construction industry activity. This statement can be supported by the traditional tendering process, presented under section 2.4.4, generally adhered to in construction projects, whereby the feasibility and design services of the project take place before construction starts. The contractor can start working on the project after the feasibility, design and tendering processes of the project have been completed. Therefore, if consulting services start conducting more work for the initial phases of the project over a certain time, contractors can expect to receive some appointments for work in the short term. This means that if a CEC firm begins generating income for the initial stages of the project, then the contractor anticipates receiving remuneration for the construction part of the project.

Depending on the type of project and contract, the contractor can receive an advance payment shortly after being appointed. This advance payment is paid by the employer, public or private, representing 10-20% of the project cost and issued within four weeks of signing the contract between the employer and the contractor (CIDB, 2008). This further supports the idea that an increase in revenue by CEC professionals should lead to the increase in the economic activity of the construction industry.

Figure 6-4, plotting the CVA published by SARB and the CPS fee income published by CESA, shows that CPS fee income tends to have cycles similar in duration to the cycles from CVA. The graph also shows the appearance of lags between the cycles from both variables, as CPS total revenue peaked around 2008 and the CVA peaked in 2010. This lag was expected, based on the reports by CESA (2014) and on the outcomes from the semi-structured interviews. In addition to the similar duration and

lag of cycles, it can be noted that the CPS fee income cycles appear more volatile than the CVA as the CPS curve shows more fluctuations over shorter periods than the CVA curve.

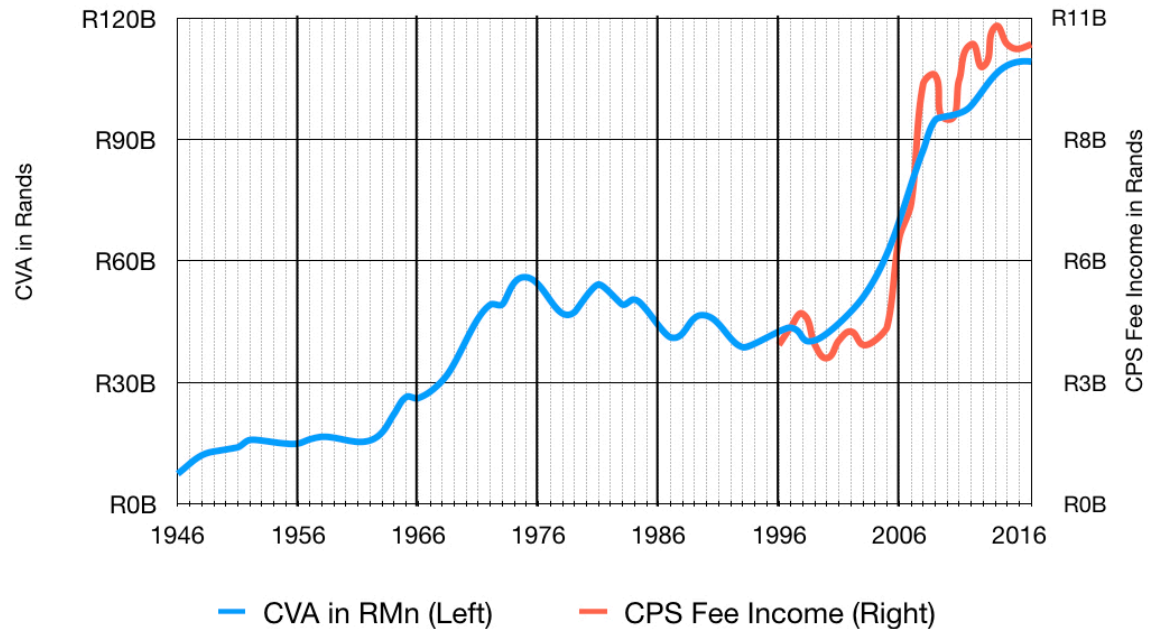


Figure 6-4: CVA in rand vs CPS in rand

The results in Table 4-10 show that CPS does not Granger cause GFCF2, and that GFCF2 does not Granger cause CPS. This outcome from the quantitative test shows that there is no causation relationship between construction professional services total revenue and gross fixed capital formation for total construction investment.

This outcome was not expected. In the beginning of the study, it was expected that the GFCF for total construction investment be caused and led by the CPS total revenue. The work done by consultants, for which they are paid and which form part of the fee income, is normally a basis to perform investment decisions on the viability of certain projects. An example of this would be in a situation where the client needs a new road. This would require a preliminary study conducted by the CEC firm, where the firm would determine aspects such as initial estimations in terms of number of cars that will use the road and the most suitable preliminary road alignment. After a CEC has provided such information, the client will be able to make decisions based on the expected cost of the project, and from these decisions, a tender for design, supervision and construction of the project will be launched. This means that an increase in CPS should lead to an increase in GFCF2.

The findings from the in-depth semi-structured interviews showed that the CEC, which forms part of the CPS with a contribution to the total revenue of CPS of 60%, leads the construction industry. A majority 80% of the respondents agreed that consulting firms normally lead or cause the construction industry, and that the construction industry is dependent on work by the consulting firms to make tender proposals and subsequently execute contracts awarded by the client based on the work previously done by consultants. To support these findings from the interviews, studies such as van Sante (2008) and Thela (2014) show that construction industry and the economy in general benefit from the work done by consultants, as these professionals normally provide a pipeline of works that allows contractors to remain active in industry, resulting in a growth of economic output of the country.

Figure 6-5 shows the GFCF of total construction investment published by SARB and the CPS total revenue published by CESA. This graph shows an evident existence of a relationship between the GFCF total construction investment cycles and the CPS total revenue cycles. The duration of the cycles appears to be similar for both lines, and there seems to be minimal lag between both line graphs.

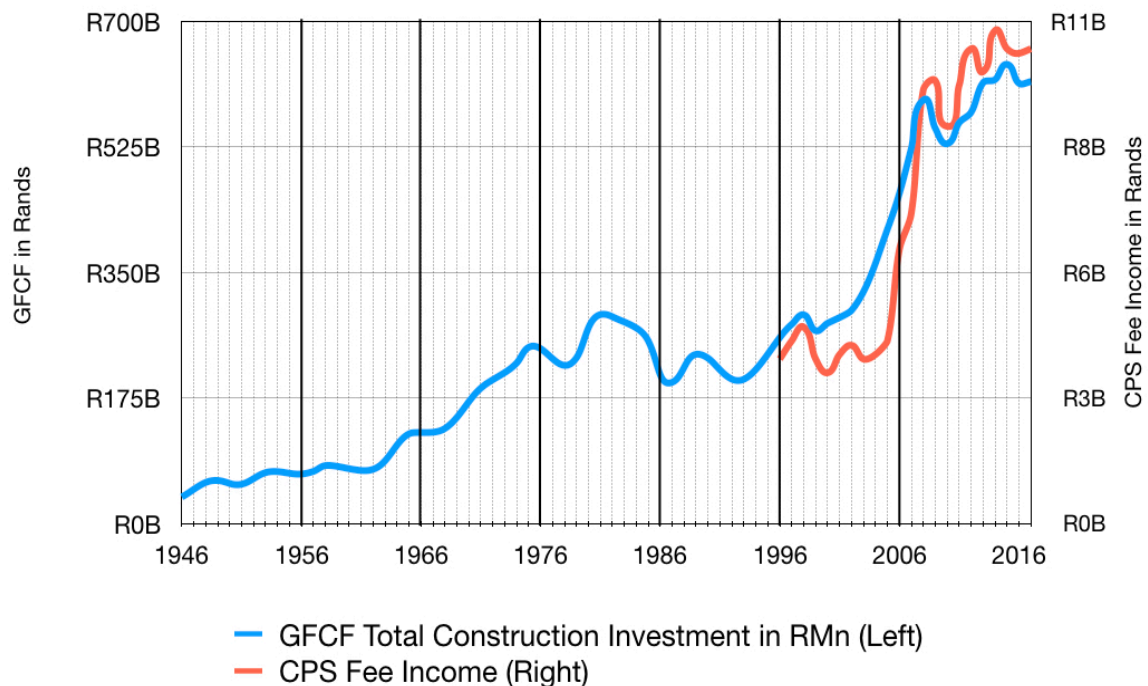


Figure 6-5: GFCF of total construction investment in rand vs CPS fee income in rand

From an analysis of the results from both methods, quantitative and qualitative, the outcome of the quantitative method is unexpected, especially when compared to the result from the qualitative method. The quantitative method had certain restrictions

such as restricted availability of CPS and CEC economic data, as the data used to conduct these econometric tests came only from firms that are CESA members.

Based on findings from Chapters 4 and 5, the aim of this section of the chapter was to determine the likelihood of a causation relationship between construction industry and construction professional services. From a qualitative approach, a causation relationship between construction industry activity and CPS was evident, based on the outcome from a semi-structured interview, visual analysis of the construction cycles of SARB, CESA statistical data and the available literature. From a quantitative approach, no causation links between construction industry activity and CPS were evident, based on the outcome from econometric tests performed using statistical data published by SARB and CESA.

6.2.2 Economy and construction professional services

This part of the chapter focuses on understanding the existence, or lack thereof, of a causation relationship between CPS and the general South African economic activity. The aim of this chapter is to understand if economic indicators such as GDP and GFCF of total investment can cause the construction consulting industry total revenue to increase or not. Therefore, this part of the chapter will answer the following question:

- Does the economic activity in South Africa, as defined under section 2.2, have any causation relationship with the total revenue of construction professional services?

To best answer this question, quantitative econometric tests on the relationship between CPS and economic activity were conducted, with outcomes analysed in conjunction with the outcomes from the qualitative in-depth semi-structured interviews with CEC professionals. The quantitative tests used gross domestic product (GDP) and total gross fixed capital formation (GFCF1). As explained in Chapter 2 section 2.2.2, the GDP represents an estimate of the addition of all the goods and services traded for money inside a country within a given time period. As presented in section 2.2.3, GFCF represents the investment that a country, both public and private sector, is making into new fixed assets over time.

Figure 6-6 shows how these two indicators, GFCF and GDP, operate within an economy. Looking at 2008 to 2010, it can be seen that the GDP was contracting, indicating a period of recession, and that the GFCF1 was expanding, indicating a

period of expansion. This shows that although South Africa was beginning to experience the effects of the global economic crisis that affected its GDP, there was still an GFCF occurring with investments into the 2010 World Cup infrastructure and other fixed assets, demonstrating how both concepts – domestic product and capital formation – need clarity with regard to CPS total revenue.

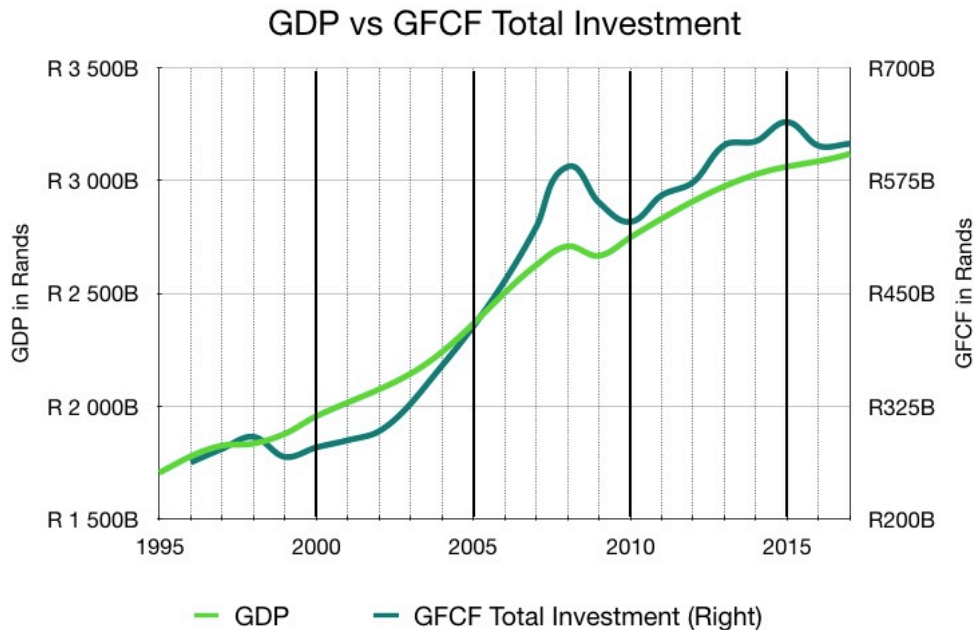


Figure 6-6: GDP in rand vs GFCF of total investment in rand

Figure 6-7 shows how the GFCF of total Investment and CPS total revenue fluctuate over a 20-year period. The shape of both graphs is similar, revealing that if the GFCF of total Investment increases then the CPS fee income will increase in the subsequent one or two years.

The results from the quantitative tests show a causation relationship between GFCF1 and CPS. Under 4.4.2, it was found that the hypothesis that GFCF1 does not Granger cause CPS should be rejected as the probability value was below 0.05. The second hypothesis, that CPS does not Granger cause GFCF1, for the same test, could not be rejected, meaning that GFCF1 has a causation relationship with CPS total revenue and can indicate if the CPS sector will perform well or not based on the growth that it is experiencing. This is an expected outcome, as literature (CESA, 2017) has already shown a relationship between GFCF of total investment and CPS fee income. This finding can be further supported by answers gathered under Chapter 5, where 60% of CEC professionals stated that the CEC industry is led and caused by the manner in which the general economic activity is performing. As stated

by Interviewee 3, tax revenues and foreign investments open the door for an increase in spending in infrastructure and all other associated services. As shown under section 2.4.7, similar outcomes were found by Okoye *et al.* (2016), Alhowaish (2015) and Tse and Ganesan (1997).

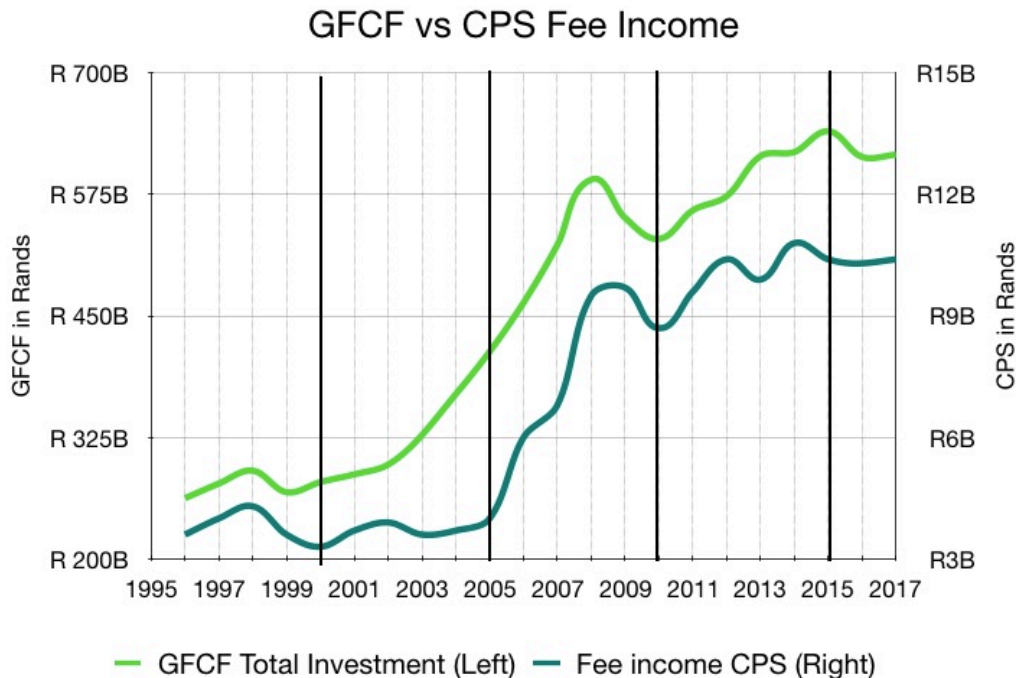


Figure 6-7: GFCF total investment in rand vs CPS fee income in rand

Another outcome from the econometric tests discussed in Chapter 4 show a causation relationship between CPS total revenue and GDP. According to the findings in section 4.4.2, GDP can cause CPS total revenue, and vice-versa. As shown in Table 4-8, the causality test between GDP and CPS did not reject the hypothesis that CPS does not Granger cause GDP, also did not reject the hypothesis that GDP does not Granger cause CPS. These outcomes mean that with the increase in the economic activity, more specifically GDP, the CPS fee income also tends to increase and vice-versa.

The outcomes from the interviews show that 60% of the respondents state that the economic activity normally leads the CEC industry while 40% state that CEC industry leads the economic activity in general. The argument from the interviewees that believe that the CEC industry leads South African economic activity is that normally the works undertaken by the CEC firms need to be completed before funds are approved to develop the new design and then to build these designs developed by

the firms. In addition to this, some respondents stated that budgets from clients are often formulated after the CEC firm has started developing a project.

Based on the outcomes from section 4.4.2, the argument made by 40% of the respondents that CEC firms' fee income leads the economic activity of the country can also be deemed to be acceptable. In accordance with section 2.4, it must be noted that these initial services normally have a very low fee for several reasons: first, the low number of experts that a firm assigns to perform the task for all the preliminary work; and second, the assignment period for feasibility studies. As stated in section 6.2.1, the consulting firm will generate a larger percentage of its income during the supervision phase of the project, which requires the cooperation of a higher number of professionals as compared to other phases. Therefore, although CPS firms will assist governments in determining the expenditure plan for the year, the total revenue from CPS firms will most likely be caused by an increase or decrease in economic activity of the country.

Figure 6-8 shows how the GDP and the CPS fee incomes fluctuate over 20 years, with the line graphs showing that if the country's GDP is rising, then the CPS fee income tends to lag behind. Once the GDP has reached its growth turning point, the CPS fee income increases until the GDP reaches its recession turning point.

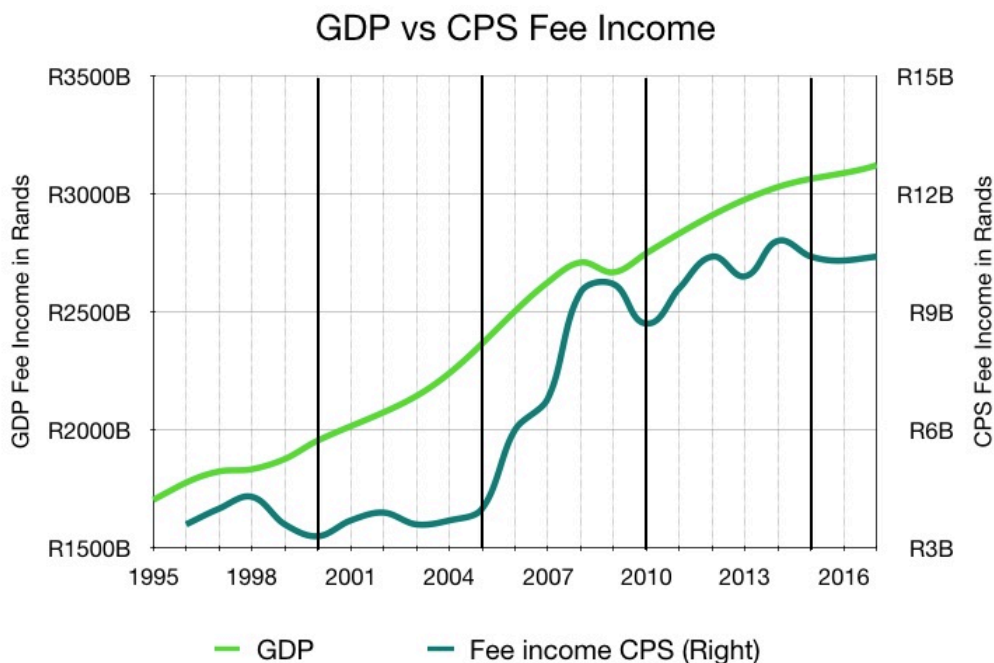


Figure 6-8: GDP in rand vs CPS fee income in rand

Therefore, **Figure 6-8** shows that South Africa spends more on new construction and engineering projects when the economic growth rate is high, and that the CPS total revenue will follow the flow of economic growth.

These results correspond to the question of whether or not South African economic activity, represented by GDP and GFCF of total investment, has a causation relationship with CPS total revenue. When considering results from both approaches, quantitative and qualitative, as well as available literature, it can be said that GDP and GFCF of total Investment have a causation relationship with CPS total revenue. GDP and GFCF will cause an increase in CPS total revenue, and in certain instances, as supported by the quantitative results, the CPS total revenue will cause the economic activity to increase.

6.3 Identified economic factors impacting CEC firms

The overall aim of this study is to determine the economic factors that affect CEC firms in South Africa through the different macroeconomic cycles. In order to understand the economic factors that influence consulting firms' sustainability in South Africa, the first step was to understand the factors causing the fee income of a firm to increase or decrease. This was analysed under section 6.2, where it was concluded that economic activity indicators, GDP and GFCF total Investment, will lead to an increase or decrease of CPS total revenue, and vice-versa, and that construction economic activity indicators, CVA and GFCF total construction investment, will likely be led by CPS total revenue.

Proceeding from the discussion presented under section 6.2, and using findings from the semi-structured interviews, economic factors affecting the sustainability of the CEC firms were identified and grouped in three sections: factors caused by CEC firms; factors caused by the South African construction industry activity; and factors caused by South African economic activity. The factors arising from CEC firms are factors that have an internal nature because these can be managed by the CEC firms. The factors arising from South African economic activity and construction industry activity are factors that have an external nature because these cannot be managed by the CEC firms (**Figure 6-9**).

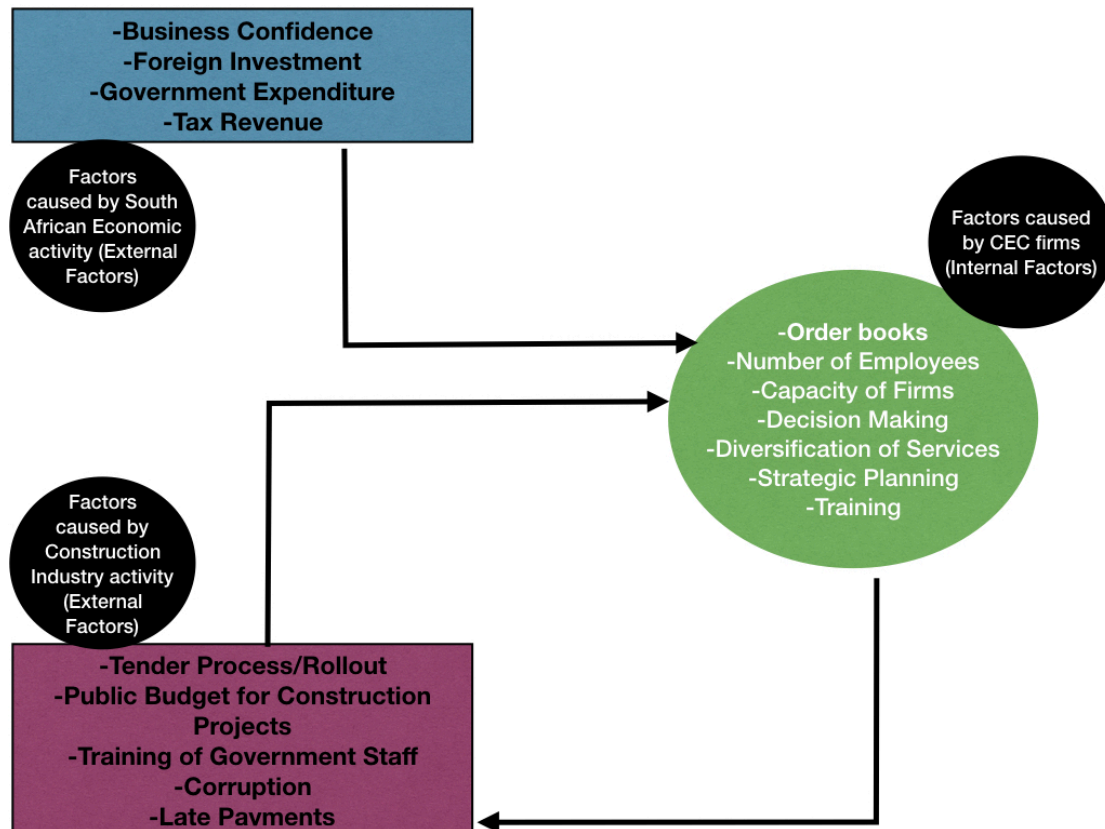


Figure 6-9: Identified economic factors that affect CEC firms

Figure 6-9 presents the factors identified during the course of the study that have an impact on the sustainability of the firm. These factors were determined from the responses emanating from the semi-structured interviews in which respondents admitted which factors have been influential in their experiences managing CEC firms. A number of factors – number of employees, training, tender process/rollout, corruption and late payments – have been highlighted by other studies such as van Sante (2008) and CESA (2014; 2017) which validate the outcome from the semi-structured interviews.

Taking into consideration the outcome from the econometric statistical tests that South African economic activity has a causation relationship with consulting firms' total revenue, it can be said that the factors caused by South African economic activity will affect the sustainability of CEC firms, as shown in **Figure 6-9**. An example of this impact is how a factor such as business confidence or foreign investment could lead to the diversification of services by CEC firms. As highlighted by multiple respondents, when South African economy is not performing well, consulting firms will not have as many tenders available. Due to restricted economic conditions, firms then offer services in other sectors such as information technology.

The outcome from section 6.2 showed how the consulting services industry is likely to have a relationship of causation with the construction industry. This indicates, as shown in Figure 6-9, that the economic factors caused by CEC firms can influence the construction industry. An example of such a case would be that a decrease in the CEC revenue could lead to a slow rollout of tenders in the construction industry. The internal CEC factors will then in turn affect factors caused by the South African construction industry by determining the public budget for construction projects and training of government staff.

In Table 6-1, the factors identified above were grouped according to the three main areas of this study: South African economic activity, South African construction industry activity and CEC firms. Using the responses from the interviews, the table also shows the type of impact expected from each factor on the sustainability of the CEC firm. In addition to the description of impact expected on CEC firms, the final column presents the phases of a macroeconomic cycle in which each factor has the highest impact on CEC firms.

Based on the factors shown in Table 6-1, Figure 6-10 shows how these factors could influence a typical macroeconomic cycle. This figure, adapted from Rorty (1922) presented under section 2.2.2, includes a typical macroeconomic cycle line and the four typical phases that this line manoeuvres through during the macroeconomic cycles. For each of these phases, as shown in Figure 6-10, the characteristics of the phases, identified by Rorty (1922) that can be expected are also shown. Figure 6-10 further depicts those economic factors present at each distinct phase, elucidating a clearer understanding for CEC firms regarding when they should monitor each one of these factors to ensure sustainability.

Table 6-1: Economic factors impacting sustainability of CEC firms in SA

Origin of Factors	Factors	Impact on CEC Firms	Phases with highest Impact on CEC
South African Economic Activity	Business Confidence	Indicates if there will be a need for CEC services regarding the creation of new assets such as new offices or factories, affecting the firm's revenue, diversification and order book.	Recovery phase
	Foreign Investment	Indicates if CEC firms can expect an influx of new business opportunities and clients, impacting the firm's revenue, diversification and order book.	Recovery phase
	Government Expenditure	Indicates if Government will be putting out new Tenders or not. Affecting the firm's number of employees, revenue, order book, diversification, strategic planning and decision-making.	Recovery phase
	South African Tax Revenue	Indicates to CEC firms how much capital the government has to spend on the year's budget.	Recovery phase
Civil Engineering Consulting Firms	Order Books	Provides an indication of income expected in the short term	Peak, downswing, through
	Number of Employees	Provides an indication of expenses to be expected in the short term, and of capacity of firm to take on new projects	
	Capacity of Firms	Allows firms to decide on how many new projects can be taken	
	Decision Making	Allows firms to make sustainable decisions based on risk analysis and strategic plan alignment	
	Diversification	Provides firms with additional sources of income through other types of services	
	Strategic Planning	Allows firms to monitor the future in the medium to long-term	All phases
	Training	Aids firms in achieving sustainable growth and improvement of services	Peak
South African Construction Activity	Tendering Process and Roll out of Tenders	Tenders tend not to be adequately phased; this creates periods of scarcity of work, affecting the order books of a firm.	Peak, downswing
	Budget for Construction Projects	Reduction in expenditure leads to firms having to downsize. Affecting the firm's number of employees and capacity.	
	Late Payments	Late payments result in firms having cash flow problems and inconsistent order books.	
	Corruption	Firms can lose opportunities to secure projects. Affecting the firm's decision-making and order books.	
	Training of Government Staff	Employers become unable to make decisions that ensure integrity of projects, leading to firms neglecting training of staff.	All phases

Identified Economic Factors	<ul style="list-style-type: none"> - Business Confidence - Foreign Investment - Government expenditure - SA Tax Revenue - Strategic Planning - Training of Government Staff 	<ul style="list-style-type: none"> - Order Books - Number of Employees - Capacity of firms - Decision making - Diversification - Training - Strategic Planning - Tender Process/ Roll out - National Construction Budget - Late Payments - Corruption - Training of Government staff 	<ul style="list-style-type: none"> - Order Books - Number of Employees - Capacity of firms - Decision making - Diversification - Training - Strategic Planning - Training of Government Staff 	<ul style="list-style-type: none"> - Strategic Planing - Training of Government Staff
Characteristic of Phases	<p>At beginning of this phase there is considerable unemployment, small volume of business, low raw material, labor and interest costs. Favorable for construction investment, volume of construction increases.</p>	<p>Labour fully employed at high values, efficiency of labour and management decreases, cost of doing business increases, selling prices increase, tension in the money market increase, stocks of goods become too large.</p>	<p>Profits decline, goods forced on market at reduced prices, unemployment grows, prices decline, liquidation increases.</p>	<p>Credit strain is reduced, the volume of business is low, prices and cost of doing business declines, cost of construction declines, interest rates continue to decline.</p>
	Recovery	Peak	Downswing	Through

Figure 6-10: Macro-economic cycles integrated with identified CEC economic factors

6.4 Chapter summary

This chapter discussed the findings from the qualitative and quantitative tests conducted in Chapters 4 and 5.

These discussions were grouped into two major sections that relate directly to the objectives of the study: the relationship of causation between CPS, South African construction industry activity and South African economic activity; and the economic factors affecting CEC firms. From these sections, the summary of the chapter as follows:

- The examination of the relationship of causation between CPS and construction industry deviated from the expected outcome. The quantitative econometric tests showed *no relationship of causation* between CPS and construction industry activity, namely CVA and GFCF2. The qualitative semi-structured interviews showed that all CEC professionals interviewed believe that there *is* a relationship of causation between construction consulting services and construction industry. The findings from the qualitative method are supported by literature consulted under this study. From the results of both qualitative and quantitative tests, it has been determined that CEC services will influence construction industry activity, although further econometric investigation is necessary.
- There *is* a relationship of causation between CPS and South Africa's overall economic activity. The quantitative tests found that GFCF1 can cause CPS and that GDP can also cause, and be caused by, CPS. The qualitative findings show a split in opinion from the CEC professionals, with 60% of the respondents claiming that South Africa's overall economic activity can cause and lead CEC services, with the remaining 40% expressing that CEC services can cause economic activity. From the results from both qualitative and quantitative tests, it can be said that the overall economic activity has a higher influence over CEC services.
- The economic factors, highlighted through the semi-structured interviews, literature and the econometric tests (Figure 6-3), were grouped in terms of the three main areas of the study: South African economic activity, South African construction industry activity and CEC firms.

Chapter 7: Conclusion and Recommendations

This study was conducted with the intent of more clearly understanding the economic factors affecting civil engineering consulting (CEC) firms' sustainability in South Africa. As stated in section 1.3, addressing this research problem would bring about an understanding of the economic factors influencing the sustainability of CEC firm, which would result in CEC professionals improving their methods of managing CEC firms. These economic factors could lead to less vulnerability in the CEC industry to macroeconomic fluctuations. Therefore, this document was prepared with the aim of addressing the research question presented under section 1.4 as follows:

Which economic factors influence the sustainability of civil engineering consulting firms in South Africa through macroeconomic cycles?

In this chapter, the answer to the research question will be formally presented, based on the outcome of the discussions carried out under Chapter 6. Moreover, this chapter will present the limitations and strengths of this study. Furthermore, this section of the study will offer recommendations for future research, which could improve this study and the existing body of knowledge.

7.1 Conclusions

The presentation of the conclusions shown below is divided into two sections, one listing all conclusions gathered from findings, and the second answering the research question and the outcome of objectives set out for this study.

From the literature studied and the research conducted, the following conclusions were reached:

- a. The construction industry can be defined in two ways. The narrow way of defining *construction*, while also the most common one, states that *construction* refers only to on-site assembly activities normally conducted by the contractor. The broad way of defining construction states that *construction* refers to all the economic activities essential to the construction of a new project, with services including professional services, quarrying for materials, and manufacturing and sale of construction products. The narrow definition and measurement of construction services applies in

South Africa, where services such as construction professional services are regarded by the SARB as “other business & miscellaneous services”.

- b. The information regarding income from construction professional services (CPS) is published by CESA in the bi-annual survey report. This valuable information could provide better insight if each discipline knew the total revenue it generates. This information only refers to CESA member firms and as such does not account for any other firm that is not a CESA registered member.
- c. There is a dearth of studies monitoring the causation relationship and the lead-lag relationship between CPS firms or CEC firms and construction industry in terms of economic activity. These types of relationships between construction economic activity and general economy have been studied in various countries, based on their level of development.
- d. In South Africa, the total revenue of CEC firms represents 60% of the total revenue from CPS.
- e. Certain developing countries have the whole construction industry leading the general economy since these countries typically spend relatively more funds to provide basic infrastructure than developed countries, where the focus is on maintenance of the existing infrastructure.
- f. The gross fixed capital formation of total investment (GFCF1) has a strong causation relationship with CPS total revenue, meaning that fluctuations in the GFCF of total investment can indicate whether a CPS firm will see an increase or decrease in the total revenue. This outcome is supported by the econometric tests, the interviews and the literature study.
- g. The gross domestic product (GDP) has a strong bi-directional causation relationship with CPS total revenue, meaning that fluctuations in the GDP can indicate whether a CPS will have an increase or decrease in total revenue, and vice-versa. This outcome is supported by the econometric tests, the interviews and the literature study.
- h. Based on the results from the Granger Causality test, construction value added (CVA) and GFCF of total construction investment were determined as having no relationship of causality with the CPS total revenue. The qualitative findings, in-depth interviews and literature study demonstrated a strong relationship of causation. Therefore, more econometric investigations need to occur into the causation relationship between construction economic activity indicators, CVA and GFCF2, and

CPS total revenue. This should be done using data from multiple sources and possibly with various testing methods.

- i. This study found that economic factors influencing the sustainability of CEC firms could be caused by South African general economy, South African construction industry and by the CEC industry and its firms.
- j. Based on the discussions of the outcomes from the quantitative and qualitative methods, the factors caused by SA general economy can lead and influence the economic activity of CEC firms.
- k. Based on the discussions of the outcomes from the quantitative and qualitative methods, the economic factors caused by SA construction industry tend to lag and be influenced by CEC firm fluctuations in economic activity.

Concluding this study on the economic factors affecting the sustainability of CEC firms in South Africa, it has been determined that the research question presented under Chapter 1 and the questions that initiated the objective of this study were answered. Figure 7-1 shows how the research question was answered by addressing first the two main objectives of the study through qualitative and quantitative research methods. Through these methods, it was found that the CEC industry and its firms have economic factors that affect their sustainability, and that these factors are caused by the general well-being of the South African economy, the general economic activity and operations of the general South African construction industry, and by the internal management of CEC firms.

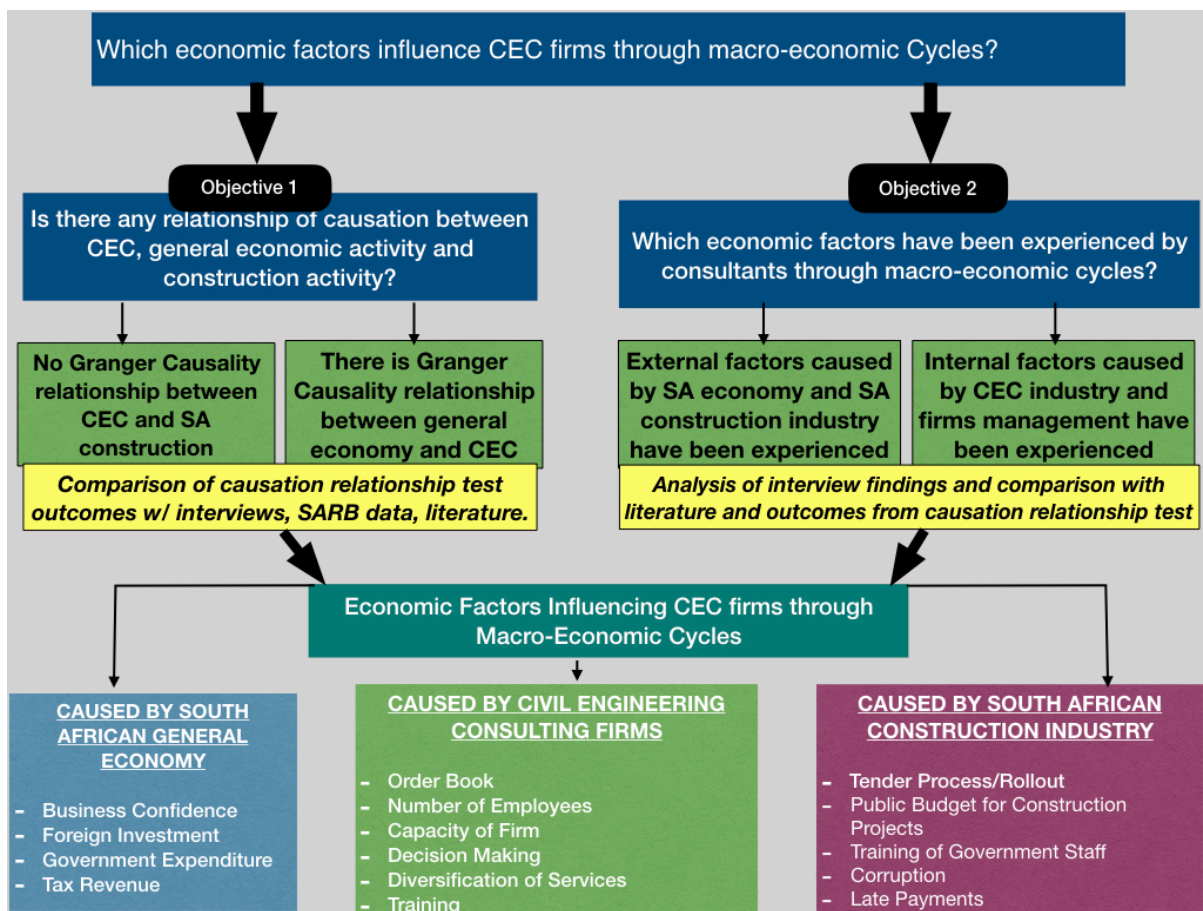


Figure 7-1: Integration of research question, research objectives and research findings

The factors shown in Figure 7-1 tend to have a greater degree of impact depending on the phase of the macroeconomic cycle. This study determined the following:

- During the recovery phase, the factors caused by the general South African economy will have the sharpest impact on CEC firms, since this phase of the macroeconomic cycle has considerable unemployment and presents favourable conditions for construction investment due to low interest and material rates.
- During the peak phase of macroeconomic cycles, the economic factors caused by the SA construction industry and by the CEC industry and its firms tend to have more impact on the sustainability of the CEC firm.
- During the downswing phase of the macroeconomic cycle, the economic factors caused by CEC industry and its firms will have the highest impact on the sustainability of CEC firms.

- During the through phase of the macroeconomic cycle, economic factors such as strategic planning of CEC firms and industry will have the strongest influence on the sustainability of CEC firms.

7.2 Limitations and strengths of the study

This research study has determined economic factors that have an impact on the sustainability of CEC firms in South Africa. The factors identified through the study were grouped based on the cause behind each factor. Using the findings on the relationship of causation, the interviews and the literature study, these factors were then reorganised in terms of the macroeconomic cycle under which they could cause the biggest impact on the sustainability of a CEC firm, as shown in Figure 6-10. This will enable a CEC professional to understand quickly which factors to monitor and when exactly these factors should be monitored to ensure sustainability of the firm.

Literature on CEC firms' economic factors and the subsequent relationship with macroeconomic cycles is unfortunately still limited in South Africa. Therefore, in-depth interviews aided in identifying which economic factors CEC firms and professionals have experienced before and during macroeconomic fluctuations. The interview responses do not necessarily represent the whole South African CEC industry in terms of statistical significance, but through the saturation method, the responses collected can certainly lend an understanding of the general point of view of South African CEC professionals in terms of economic factors affecting CEC firms in South Africa.

The interview with the CEO from CESA can also reinforce this general view, as this profession requires direct contact with the majority of CEC firms active in South Africa in order to most accurately represent the concerns that CEC firms have in South Africa. In addition, the interview conducted with a CEC client organisation, SANRAL, providing extra validation to the interview findings as many of the responses provided by the CEC professionals expressed similar outcomes.

Due to the scarcity of similar studies, this present research could not provide a benchmark of findings, especially with regard to econometric tests and findings. Therefore, the outcomes from econometric tests had to be analysed and cross-validated using outcomes from qualitative findings such as the in-depth structured interviews and the literature study.

7.3 Recommendations and areas for further research

- a. The measurements and representation of all construction professional services in South Africa are currently reported in a way that does not help CEC firms and other CPSs distinguish the exact total revenue that these services contributed to the economy in any given year. Nor does it allow clients of the CEC firms to accurately determine if additional investment is needed in the built environment sector of the economy. Therefore, a new method of measurement and reporting of CEC and CPS firms' total revenue is recommended.
- b. The influence that the CEC industry has over the construction industry is only understood from a perspective of a macro point of view. Understanding the influence that the CEC industry and the construction industry have on each other, from a micro point of view, could accelerate insight into the exact multiplying effect that CEC firm revenue could have over the total revenue of the construction industry, and even of the different types of services. This would allow a construction professional from any part of the value chain of construction services to accurately forecast how the specific sector of operation would be affected by fluctuations on the CEC industry. A detailed study of causation relationships between the different construction industry services is recommended.
- c. The influence that the economic factors have on CEC firms of different sizes can also be measured in the future. Therefore, it is recommended that each economic factor identified here should be studied individually to determine the difference on the degree of impact that these factors can have on CEC firms with different sizes.
- d. Diversification of services that a CEC firm has was reported often by different consultants as a way of remaining sustainable in the long term. Therefore, a study into the process of diversification of services of CEC firm would be recommended for future study.
- e. The sustainability of any firm is also dependent on the policies that a country implements. This is the case in the construction industry, where economic volatility is high. Therefore, it is recommended that the political factors that affect the construction industry and the CEC industry be studied.

7.4 Chapter summary

This chapter presented conclusions to the study pertaining to the economic factors that influence the sustainability of CEC firms in South Africa through macroeconomic cycles. These conclusions showed causation links between consulting engineering services and the general economy, with gross fixed capital formation (GFCF) being a reliable indicator for changes in total revenue of consulting services. The chapter also outlined the economic factors that affect the CEC industry sustainability by first presenting the causes behind these factors, which could be the general South African economy, the South African construction industry and the CEC industry. Based on these three causes, the factors can be government expenditure and foreign investment in the case of SA general economy, tender process and late payment in the case of SA construction industry, and diversification and order book in the case of CEC firms. The identified factors need to be considered in terms of the macroeconomic cycle phase. Therefore, factors such as government expenditure and foreign funding will have the highest impact on CEC firms during the recovery phase of the macroeconomic cycle, and factors such as capacity of firms and tender process will have an impact during the peak and downswing phases of the macroeconomic cycles.

Through the careful management of CEC firms, CEC professionals need to understand the economic activity fluctuations of the general economy, the construction industry and the CEC industry by monitoring a variety of factors such as government expenditure, foreign investment, tender rollout, late payments, firm capacity and number of employees. For the broad construction industry, there are still many opportunities for improvement, such as measuring and reporting of total revenue of CEC; understanding the impact of different business and construction industry policies on CEC firms; understanding the scale of impact that different economic factors have on CEC firms of different sizes; and a study into the process of service diversification by a CEC firm.

REFERENCES

- Abramovitz, M. (1964) *Evidences of Long Swings in Aggregate Construction Since the Civil War*. NBER. Available at: <http://www.nber.org/books/abra64-1>.
- ACEC and APEG (2009) *Architectural and Engineering Suggested Fee and Scope Services Reference*.
- Alhawaish, A. K. (2015) 'Causality between the Construction Sector and Economic Growth: The Case of Saudi Arabia', *International Real Estate Review*, 18(1), pp. 131–147. Available at: <http://search.ebscohost.com/login.aspx?direct=true&db=bth&AN=103359852&site=ehost-live>.
- Barras, R. (1987) 'Technical Change and the Urban Development Cycle', *Urban Studies*, 24(1), pp. 5–30. doi: 10.1080/00420988720080021.
- Barras, R. (2009) *Building Cycles: Growth and Instability*. London: John Wiley and Sons.
- Borrego, M., Douglas, E. and Amelink, C. (2009) 'Quantitative, Qualitative, and Mixed Research Methods in Engineering Education', *Journal of Engineering Education*, (January), pp. 53–66.
- Bouwer, G. (no date) *Measuring South Africa's economic growth*. Pretoria. Available at: [https://www.statssa.gov.za/economic_growth/15 Measuring GDP.pdf](https://www.statssa.gov.za/economic_growth/15%20Measuring%20GDP.pdf).
- Briscoe, G. (2006) 'How useful and reliable are construction statistics?', *Building Research and Information*, 34, pp. 220–229.
- Byrne, J. and Perman, R. (2006) 'Unit Roots and Structural Breaks: A Survey of the Literature'.
- CESA (2017) *Bi-Annual Economic and Capacity Survey*. Johannesburg.
- CESA (2019) *Bi-Annual Economic and Capacity Survey*. Johannesburg.
- CESA and BEPEC (2014) *Application for Designation of the Civil Engineering Sector within the Built Environment Professional Services in Terms of the Preferential Procurement Policy Framework Act August 2014*. Johannesburg.
- Chiang, Y. H., Tao, L. and Wong, F. K. W. (2015) 'Causal relationship between construction activities, employment and GDP: The case of Hong Kong', *Habitat International*. Elsevier Ltd, 46, pp. 1–12. doi: 10.1016/j.habitatint.2014.10.016.

- CIDB (2017) *Construction Monitor: Supply and Demand*.
- Constanza, R. *et al.* (2014) 'A Short History of GDP: Moving Towards Better Measures of Human Well-being', *The Solutions Journal*, 5(1), pp. 91–97. Available at: <https://www.thesolutionsjournal.com/article/a-short-history-of-gdp-moving-towards-better-measures-of-human-well-being/>.
- Creswell, J. and Plano Clark, V. (2007) 'Choosing a mixed method design', in *Designing and conducting mixed methods research*. doi: 1412927927.
- Creswell, J. W. *et al.* (2003) 'Advanced mixed methods research designs', in *Handbook of Mixed Methods in Social and Behavioural Research*.
- Creswell, J. W. (2009) *Research Design: Qualitative, Quantitative and Mixed Methods Approaches*. SAGE Publications.
- DPSA (2003) *Guide on Hourly Fee Rates for Consultants*. Pretoria.
- Dudovskiy, J. (2018) *The Ultimate Guide to Writing a Dissertation in Business Studies: A Step-by-Step Assistance*.
- ECSA (2014) *National Engineering Skills Survey*. Available at: <https://ezp.lib.unimelb.edu.au/login?url=https://search.ebscohost.com/login.aspx?direct=true&db=aci&AN=96683472&site=eds-live&scope=site>.
- Eichler, M. (2012) 'Causal inference in time series analysis', in *Causality: Wiley Series in Probability and Statistics*. doi: 10.1002/9781119945710.ch22.
- Engle, R. F. and Granger, C. W. J. (1987) 'Co-Integration and Error Correction : Representation, Estimation, and Testing', *Econometrica*, 55(2), pp. 251–276. doi: 10.2307/1913236.
- Flick, U. (2011) *Designing Qualitative Research, Designing Qualitative Research*. London: SAGE Publications. doi: 10.4135/9781483329659.n5.
- Fusch, P. and Ness, L. (2015) 'Are we there yet? Data saturation in qualitative research', *The Qualitative Report*, 20(9), pp. 1408–1416. Available at: <https://nsuworks.nova.edu/>.
- Galor, O. (2011) *Unified Growth Theory*. Princeton University Press.
- Giang, D. T. H. and Pheng, L. S. (2011) 'Role of construction in economic development : Review of key concepts in the past 40 years', *Habitat International*, 35, pp. 118–125. doi:

10.1016/j.habitatint.2010.06.003.

Gostkowska-Drzewicka, M. (2014) 'The economic cycle in Polish construction', *Ekonomika*, 93(1), pp. 98–116.

Gottlieb, M. (1976) 'Long National Residential Building Cycles', in *Long Swings in Urban Development*. NBER, pp. 191–222. Available at: <http://www.nber.org/chapters/c3790>.

Granger, C. W. J. (1969) 'Investigating Causal Relations by Econometric Models and Cross-spectral Methods', *Econometrica*. doi: 10.2307/1912791.

Granger, C. W. J. (2004) 'Time Series Analysis, Cointegration, and Applications', *American Economic Review*, 94(3), pp. 421–425. doi: 10.1257/0002828041464669.

Granger, C. W. J. and Newbold, P. (1974) 'Spurious regressions in econometrics', *Journal of Econometrics*, 2(2), pp. 111–120. doi: [https://doi.org/10.1016/0304-4076\(74\)90034-7](https://doi.org/10.1016/0304-4076(74)90034-7).

Gross, A. C. (2012) 'The global engineering consultancy market', *Business Economics*, 47(4), pp. 285–296. doi: 10.1057/be.2012.29.

Höfer, T., Przyrembel, H. and Verleger, S. (2004) 'New evidence for the Theory of the Stork', *Paediatric and perinatal epidemiology*, 18, pp. 88–92. doi: 10.1111/j.1365-3016.2003.00534.x.

Insight, I. (2010) *CESA Biannual Economic and Capacity Survey*.

Jewell, C. and Flanagan, R. (2012) 'Measuring construction professional services exports : a case for change', *Building Research and Information*, 40, pp. 337–347.

Jewell, C., Flanagan, R. and Anaç, C. (2010) 'Understanding UK construction professional services exports : definitions and characteristics', *Construction Management and Economics*, (March), pp. 231–239. doi: 10.1080/01446191003587729.

Jiang, Q. (2013) 'Analysis on the Relationship between GDP and Construction Based on the Data of UK and China', in *Proceedings of the 2013 Conference on Education Technology and Management Science*, pp. 1296–1299. doi: 10.2991/icetms.2013.369.

Johansen, S. (1988) 'Statistical analysis of cointegration vectors', *Journal of Economic Dynamics and Control*, 12(2), pp. 231–254. doi: [https://doi.org/10.1016/0165-1889\(88\)90041-3](https://doi.org/10.1016/0165-1889(88)90041-3).

Kafandris, S. (1980) 'The Building Industry in the Context of Development', *Habitat*

International, 5(3), pp. 289–322.

Kallio, H. *et al.* (2016) 'Systematic methodological review: developing a framework for a qualitative semi-structured interview guide', *Journal of Advanced Nursing*, 72(12), pp. 2954–2965. doi: 10.1111/jan.13031.

Khan, R. A. (2008) 'Role of Construction Sector in Economic Growth : Empirical Evidence from', in *First International Conference on Construction In Developing Countries*, pp. 279–290.

Kitchin, J. (1923) 'Cycles and Trends in Economic Factors', *The Review of Economics and Statistics*, 5(1), pp. 10–16.

Korotayev, A. V and Tsirel, S. V (2010) 'A Spectral Analysis of World GDP Dynamics: Kondratieff Waves, Kuznets Swings, Juglar and Kitchin Cycles in Global Economic Development, and the 2008–2009 Economic Crisis', *Structure and Dynamics*, 4(1).

Kothari, C. (2004) *Research Methodology: Methods and Techniques*, Vasa. doi: <http://196.29.172.66:8080/jspui/bitstream/123456789/2574/1/Research%20Methodology.pdf>.

Kumar, R. (2011) *Research Methodology: A step-by-step guide for beginners*. Third. SAGE Publications.

Kwasnicki, W. (2008) 'Kitchin, Juglar and Kuznetz Business Cycles Revisited', *Institute of Economic Sciences*.

Libanio, G. a. (2005) 'Unit roots in macroeconomic time series: theory, implications, and evidence', *Nova Economia*, 15(3), pp. 145–176. doi: 10.1590/S0103-63512005000300006.

Lopes, J. (2008) 'Investment in Construction and Economic Growth: A long-term perspective', in Ruddock, L. (ed.) *Economics for the Modern Built Environment*. First. London: Taylor & Francis, pp. 94–111.

Love, P., Holt, G. and Li, H. (2002) 'Triangulation in construction management research', *Engineering, Construction and Architectural Management*, 9(4), pp. 294–303.

Lucas, R. E. (1988) 'On the mechanics of economic development', *Journal of Monetary Economics*, 22(1), pp. 3–42. doi: [https://doi.org/10.1016/0304-3932\(88\)90168-7](https://doi.org/10.1016/0304-3932(88)90168-7).

MacKinnon, J. G. (1991) *Critical Values for Co-Integration Tests*, *Queen's Economics Department Working Paper*. Ontario. doi: 10.1111/1468-0084.61.s1.14.

Maddison, A. (1991) *Dynamic Forces in Capitalist Development: A Long-Run Comparative View*. New York : Oxford University Press. Available at:
<https://books.google.co.mz/books?id=Lk6NAAAIAAJ>.

McIntosh, M. J. and Morse, J. M. (2015) 'Situating and Constructing Diversity in Semi-Structured Interviews', *Global Qualitative Nursing Research*, 2. doi:
10.1177/2333393615597674.

Mitchell, W. C. and Burns, A. F. (1946) *Measuring Business Cycles*. National Bureau of Economic Research. Available at: <http://www.nber.org/chapters/c2982>.

National Treasury (2017) *2018 MTEF Technical Guidelines for National Departments*.

National Treasury (2018) *Estimates of National Expenditure*, RP:02/2018

Nippala, E. (2012) 'Leading indicators for forecasting civil engineering market development', in *Management of Construction: Research to Practice*. Montreal.

Ofori, G. (1990) *The Construction Industry: Aspects of Its Economics and Management*. Singapore: NUS Press.

Okoye, P. U. et al. (2016) 'Imperatives of Economic Fluctuations in the Growth and Performance of Nigeria Construction Sector', *Microeconomics and Macroeconomics*, 4(2), pp. 46–55. doi: 10.5923/j.m2economics.20160402.02.

Oladinrin, O. T., Ogunsemi, D. R. and Aje, I. O. (2014) 'The causal relationship between construction growth and economic growth: a comparative study of Nigeria and South Africa', *Proceedings of the CIB W107 2014 International Conference*, (January 2015), pp. 83–96.

Olsen, W. (2012) 'Data Collection: Key Debates and Methods in Social Research'. London: SAGE Publications Ltd. doi: 10.4135/9781473914230.

Ozkan, F., Ozkan, O. and Gunduz, M. (2012) 'Causal relationship between construction investment policy and economic growth in Turkey', *Technological Forecasting and Social Change*. Elsevier Inc., 79(2), pp. 362–370. doi: 10.1016/j.techfore.2011.04.007.

Pearce, D. (2003) *The Social and Economic Value of Construction: The Construction Industry's Contribution to Sustainable Development*. London.

Perkins, P., Fedderke, J. and Luiz, J. (2005) 'An analysis of economic infrastructure investment in South Africa', *South African Journal of Economics*, 73(2), pp. 211–228. doi: 10.1111/j.1813-6982.2005.00014.x.

Petrakos, P. G. and Arvanitidis, P. (2008) 'Determinants of Economic Growth', *Economic Alternatives*, (1), pp. 11–30.

PWC (2015) *SA construction 3rd Edition*.

Republic of South Africa (2015) *Government Gazette*. South Africa.

Romer, P. M. (1986) 'Increasing Returns and Long-Run Growth', *Journal of Political Economy*. University of Chicago Press, 94(5), pp. 1002–1037. Available at: <http://www.jstor.org/stable/1833190>.

Rorty, M. (1922) *Some Problems in Current Economics*. Chicago: A. W. Shaw Company.

Ruddock, S. and Ruddock, L. (2008) 'The Scope of the Construction Sector: Determining its Value', in Ruddock, L. (ed.) *Economics for the Modern Built Environment*. First. London: Taylor & Francis, pp. 79–91.

SAFEC (2015) *State of the South African Civil Industry*. Bedfordview.

Sapsford, R. and Jupp, V. (2006) *Data Collection and Analysis*. SAGE Publications (Published in association with The Open University). Available at: <https://books.google.co.mz/books?id=J9tF7sblwJwC>.

SARB (2018) *Online statistical query (historical macroeconomic timeseries information)*. Available at: <https://www.resbank.co.za/Research/Statistics/Pages/OnlineDownloadFacility.aspx> (Accessed: 10 April 2018).

Schumpeter, J. A. (1939) *Business cycles*. McGraw-Hill.

Sjö, B. (2008) *Testing for Unit Roots and Cointegration, Department of Management and Engineering (IEI)*. doi: 10.1016/S0377-2217(02)00774-9.

Snyman, J. (2008) 'From the Short to the Long Term: History and Development of Leading indicators and building cycles', in Ruddock, L. (ed.) *Economics for the Modern Built Environment*. First. London: Taylor & Francis, pp. 130–142.

Solow, R. (1956) 'A Contribution to the Theory of Economic Growth', *The Quarterly Journal of Economics*, 70(1), pp. 65–94.

Stock, J. H. and Watson, M. W. (1988) 'Variable Trends in Economic Time Series', *Journal of Economic Perspectives*, 2(3), pp. 147–174. doi: 10.1257/jep.2.3.147.

Swan, T. W. (1956) 'ECONOMIC GROWTH and CAPITAL ACCUMULATION', *Economic Record*, 32(2), pp. 334–361. doi: 10.1111/j.1475-4932.1956.tb00434.x.

The Conference Board (2001) 'Business Cycle Indicators Handbook', *The Conference Board*, pp. 1–156.

Tran, V. T. *et al.* (2017) 'Predicting data saturation in qualitative surveys with mathematical models from ecological research', *Journal of Clinical Epidemiology*. Elsevier Inc, 82, p. 71–78.e2. doi: 10.1016/j.jclinepi.2016.10.001.

Tse, R. Y. C. and Ganesan, S. (1997) 'Causal relationship between construction flows and GDP: Evidence from Hong Kong', *Construction Management and Economics*, 15(4), pp. 371–376. doi: 10.1080/014461997372926.

Turin, D. A. (1978) 'Construction and Development', *Habitat International*, 3(3), pp. 33–45.

Van Sante, M. (2008) *The Consulting Engineering Sector in Europe*.

Wengraf, T. (2001) 'Qualitative Research Interviewing'. London: SAGE Publications, Ltd. doi: 10.4135/9781849209717.

Wheaton, W. C. (1987) 'The Cyclic Behavior of the National Office Market', *Real Estate Economics*, 15(4), pp. 281–299. doi: 10.1111/1540-6229.00433.

Wilson, C. (2014) *Interview Techniques for UX Practitioners: A Use-Centered Design Method*. Morgan Kaufmann Publishers.

Zarnowitz, V., Boschan, C. and Boschan, C. (1975) 'New composite indexes of coincident and lagging indicators', *Business Conditions Digest*, 20(November).

Zorn, T. (2010) *Designing and Conducting Semi-Structured Interviews for Research*.

APPENDICES

APPENDIX A: INTERVIEW DOCUMENT

Institution: CAPE PENINSULA UNIVERSITY OF TECHNOLOGY

Course program: Masters of Engineering in Civil Engineering

CONSENT FORM

Title of Project: *Economic factors that impact civil engineering consultants due to national construction economic cycles in South Africa*

Please initial all boxes

1. I voluntarily agree to participate in this research study.
2. I understand that I am free to withdraw at any time or to refuse to answer any questions, without any consequences of any kind.
3. I have had the purpose and nature of the study explained to me in writing and I have had the opportunity to ask questions about the study.
4. I understand that I will not benefit directly from participating in this research
5. I understand that all information I provide for this study will be treated confidentially.
6. I understand that in any report on the results of this research my identity will remain anonymous
7. I understand that I am free to contact any of the people involved in the research to seek further clarification and information

Name of Participant Date Signature

Name of Company Position

Name of Researcher Date Signature

**Department of Civil Engineering
and Surveying**

**LETTER OF INTRODUCTION
FOR PARTICIPATION IN ACADEMIC RESEARCH**

Title Of The Study:

Economic factors that impact civil engineering consultants due to national construction economic cycles in South Africa

Researcher:

Sabaka Muianga, Masters of Engineering student at Cape Peninsula University of Technology
Email: kappa.muianga@gmail.com

Supervisor:

Coenraad Nel, Lecturer at Cape Peninsula University of Technology
Email: nelco@cput.ac.za

You are cordially invited to participate in an academic research study due to your experience and knowledge in the research area, namely → Management of Civil Engineering Consulting Firms. Each participant must receive, read, understand and sign this document *before* the start of the study.

- **Aim of the study:** The aim of this work is to determine the economic factors that cause the most impact on Civil Engineering consultant firms through the different construction economic cycles and how these factors can be dealt with in order to seek financial stability of the firm.
The results of the study may be published in an academic journal. You will be provided with a summary of our findings on request. No participants names will be used in the final publication.
- **Duration of the study:** The study will be conducted over a period of 12 months and its projected date of completion is 30th November 2018.
- **Research procedures:** The study is based on surveys, interviews and statistical analysis tests on official public financial data.
- **What is expected of you:** From you is expected a honest and free willing answer to the attached questionnaire. In answering this questionnaire, the study will get an insight from the industry management professionals on how they experience and navigate the different construction economic cycles.
- **Your rights:** Your participation in this study is very important. You may, however, choose not to participate and you may also stop participating at any time without stating any reasons and without any negative consequences. You, as participant, may contact the researcher at any time in order to clarify any issues pertaining to this research. The respondent as well as the researcher must each keep a copy of this signed document.
- **Confidentiality:** All information will be treated as confidential, with respondents names and their organisations kept anonymous. Access to the raw data will only be given to the University for academic purposes. The relevant data will be destroyed, should you choose to withdraw.

APPENDIX B: INTERVIEW TRANSCRIPTS

Questions	Answers
Q1: Do you believe that there would be any benefits in terms of financial sustainability, if there were economic data on the performance of the CEC industry?	Yes, but one must bear in mind that the design and the other phase come ahead of the construction phase. So there is a different budget for planning and the construction phases. But if the data was relevant and one knew in advance what projects may be coming up in the budget. It would be nice to know in advance what kind of projects are coming up, if it was planning, feasibility studies or design. With that information one could plan.
Q2: What kind of information do you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?	
Q3: Do you believe that obtained data relating to the construction industry economic activity could beneficially indicate if the South African economy at large is undergoing a recession or expansion?	I think the construction sector cant indicate, but the construction sector is an indicator if the government is spending money or not. If the government is not spending money it tends to be in recession. If the government is spending money, the economy is in expansion. government is the main employer of work.
Q4: Do you believe that data obtained in relation to the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?	
Q5: Taking into consideration the idea that an increase in the CEC industry could possibly indicate growth in the construction industry and the general economic activity of South Africa, do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?	Lags the cycle. BUT EVEN TAKING INTO ACCOUNT THAT CEC DESIGNS COME BEFORE CONSTRUCTION STARTS?[eventhough one would know that there are potential projects coming] There is no certainty because firms know as the projects are being announced by government. But very little are being built eventhough these have been announced. So there is huge uncertainty from government on what has been built or what will be built. For example the water affairs have been announcing projects for years new projects but none of them have yet been built. If there was more veracity in information than that would be useful.
Q6: With alternative types of procurement and contracts in the engineering and construction market becoming more common, please answer the following questions: A. What impacts do you see, negative or positive, in the sustainability of CEC firms? Taking into consideration that contractors will be expected to provide feasibility, design and construction quality assurance services B. Are you concerned with the change in role the CEC firms play in the construction industry? Taking into account that CEC firms will be employed by contractors to provide design and supervision services.	I don't think that BOT negatively impact CEC. Firms need to be flexible enough to adapt to new forms of contracts available. I would assume that bigger firms would adapt more easily. But im not sure. Depends on governement particularly. As they provide majority of the percentage of work in the country particularly related to civil engineering works. Building works and mines are more privates. The NRA and the water boards are also a big provider of works. ACCORDING TO THE REPORT PUBLISHED BY CESA IN 2017, THE AMOUNT OF FEE INCOME REPORTED BY CONSULTANTS SHOWS THAT PRIVATES HAVE RISEN IN THE LAST YEAR, WHILE THE PUBLIC EMPLOYMENT DROPPED BY ALMOST 10%. I think that depends a lot on the economic cycle and government in particular. The big problem I see is that SA Government has become a. less capacitated,I think capacity in government has reduced eventhough the numbers of employment in government have increased. I dont think the government is as technically competent as I think they were previously. One of the problems is I think government is not employing engineers. Now the department of water affairs has 50 engineers when previously they had something like 300.Enginers are no longer managing the project. There is a drop in engineering competence within government. Perhaps you could possibly follow that up as a reason within the problem. Government is employing a huge number of administrative staff instead of technical staff doing the work, causing the costs to go up.Maybe what is driving engineers away and making bigger firms are start to look at other countries to for work are the BEE ratings as a requirement from clients for firms to get work. And universities in SA have a majority of white students being graduated making it difficult for certain firms to meet the BEE rating 1 required often. b.
Q7: For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management as the firm evolves. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?	Take this firm, it was apparently booming. I am not part of those decisions, I am only a consultant for the firm. They thought that this growth which our department was going through. And everybody was getting squashed. So what was done to solve it? A new building outside was built and it has been standing empty for 4 years now. I think it was a bad decision making. I think we could have stayed squashed a bit longer or higher an accomodation. The other problem that has become more a trend is the hire and fire. You bring in more people and then you get rid of them. Probably that has been the impact. Thats probably why engineers is leaving the country to find other options. I know the australian system, this company is linked to australia. They are more a hire and fire type of management. In terms of financially stability just long term planning helps. Many consultants are working internationally, and not only in SA. Which to a certain extent gives a financially stability. But it takes 2 years to get an appointment which is a long time. So long term employment is kind of difficult. Which savours the hire and fire kind of mentality. We worked with a french firm, they dont have staff. They have very limited staff. When they focus on a contract they nominate people to work on their contract which are independent practitioners. so it changed their whole nature of , they dont have a big organisation with a lot of staff. Obviously they have a key management staff. Which might change the way firms operate in the future. I think they will have a 20% contracted and 80% permanent. Just because of the nature that the est of the work is done. The feasibility study work is done differently, contracts are awarded on your speciality. You get different points if you are a MSc or a PhD. This is for international contracts, SA has not gone as far as that. Normally for projects funded by World Bank or AfDB. The big mistakes are not good in predicting the future. There is a lot of uncertainty to be able to do that. As contracts are awarded in terms of pricing and BEE. I think what has happened also, this industry has become a claims industry. Some firms come with a very low price. And claim on everything. I think that is not a very healthy relationship. For example, in the past the municipality used to have a group of consultants who knew as much of the water supply as the town engineer, and we were able to provide drawings about 20 - 30 years ago. Now that piece is built by different consultants, and most of the municipalities dont have an institutional memory to know what was built by different stakeholders have built. Which I think is a huge concer. I think the City of Cape Town is well placed in terms of technical staff which the other municipalities dont have people with this knowledge. I think we are going to see a real long term problem with the management.
Q8: Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?	Government expenditure is the biggest factor from the government point of view. Tends to be major projects dominated. Certainly for the bigger firms. As I said, one does not have an advanced warning of the economic position in the country because the government is budgeting from year to year and from project to project. The future decion making is very short. Thats maybe one reason why consultants are only contracting staff reather when they need them. Long term economic cycle which is supposed to bring in more money to the government from taxes. There are long term predictions from business buerou of economic research are doing predictions and business confidence prediction and business actual growth. We are still very low running at 2%, and places like China are running at 11%. Maybe what you should be doing is looking at other countries to see if you could plot the engineering activity there. Maybe there is information out there. Do you think that these confidence indexes and the construction indexes are reliable? As these are surveys. I think is uncertainty from government. Thats why these industries are highly subjective on how people see the future. I think that business confidence index A large number of contractors ar no longer here or have reduced in size because of the impact of the economic cycle on them. Its very high risk business to play it correctly and get the tender is a very high risk business. Also to get them in a clean basis. The bigger consulting firms would be doing better.

1. Sex	M	F				Can't disclose
2. Age	<30	30-40	40-50	50<		Can't disclose
3. Years of experience in the industry	<5	5-10	10-20	20<		Can't disclose
3.1 Qualification	BSc	Beng	Btech	Masters	Doctorate	
3.2 Registration	Pr Eng	Pr Technologist	Candidate Eng	Candidate Technologist	None	
4. Position currently held at firm	Managing Partner	Director	Department Manager	Project Manager	Other (Consultant)	Can't disclose
5. Area of expertise of the firm	Transportation	Structures	Water & Sanitation	Urban planning and development	Other	Can't disclose
6. Area of Activity of the firm	Transportation	Structures	Water & Sanitation	Urban planning and development	Other	Can't disclose
7. Number of employees of the firm	<10	10-50	50-100	100-150	150<	Can't disclose
8. Types of clients that the firm has	Private	Public	Project developers			Can't disclose
9. Are you satisfied with the traditional Tendering system for jobs?	Yes	No				Can't disclose
10. How many years of experience with tenders?	<3	3-5	5-10	10-20	>20	Can't disclose
11. Roughly, what is the ratio of tenders won/loss?	1/1	1/2	1/3	2/3	<1/4	Can't disclose
12. What is the ideal capacity of Projects you can operate simultaneously?	1	2	3	4	5<	Can't disclose
13. What is the lowest number of projects you can operate simultaneously?	1	2	3	4	5<	Can't disclose
14. What is the highest number of projects you can operate?	1	2	3	4	5<	Can't disclose
15. Do you have plans of diversifying your areas of expertise?	Yes	No (the firm is already well diversified)	Maybe			Can't disclose
16. How many times have you diversified before?	Once	Twice	Thrice or more	Never		Can't disclose
17. In how many countries other than South Africa do you operate?	1	2	3	4	5<	Can't disclose
18. How often do you plan for the future of your firm?	Every 6 months or less	Every year	Every two years	Every three years	Never	Can't disclose
19. What financial information you use to asses if the market is good enough to expand, plan diversify?	Construction Indicators	Investment forecasts	Governments 5-10 year plan	Company 3 year financial performance	Other (Please state) Tenders submitted/Likely to be submitted in future	Can't disclose
20. What financial information, that would help you make financial decisions and is not available, you would like to be collected and made available?	None	Construction professional services GDP contribution	Construction professional services growth	Other Public Investment		Can't disclose
21. What financial information, that would help you make financial decisions, have you used previously during recession periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other Accurate roll out of tender		Can't disclose
22. What information, that would help you make financial decisions, you used previously during growth periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other 3 year financial performance		Can't disclose

Questions	Answers
<p>Q1: Do you believe that there would be any benefits in terms of financial sustainability, if there were economic data on the performance of the CEC industry?</p>	<p>I think Definitely will benefit. At the moment what happens in most companies, if not all of them. Budgets are based on previous years results. That will indicate what we want to get out of transport, energy and other disciplines. Are we bullish about the economy or not? If we are bullish is 10%, if we are not bullish is maybe 2 or 3%. That is our next target, that gets locked in and that is what people works toward. There is very little forecasting done. When I talk about forecasting i am talking about real analytical forecasting based on proper research. So we see that lag between construction and consulting as well. Just be the confidence the industry has compared to other industries in SA as there seem to be a lag there (between consulting and construction). So at the moment, if there was readily available information for consultants to make better informed decisions, definitely [would benefit].</p>
<p>Q2: What kind of information do you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?</p>	<p>I am not sure if it needs to be government controlled and published. There are certain industry bodies out there, in the engineering consulting industry there is CESA. They publish a report every year, they have got about 550 member firms, so a substantial part of the engineering consulting firms are part of CESA. So an organisational like that would be a better place than government for that information to sit. So the kind of information you are talking about is looking at cycles of construction in civil engineering firms. The construction cycle is fairly cyclical. And probably if you are using the right forecasting tools and there are some very powerful forecasting tools as i am sure you know, you can do it quite good forecast for the next 12 months. And you can do it per industry weather is energy or transport. So I think industry specific information for trends would be very useful. Because at the moment is very broad. It is just broad information about construction. And so how that is broken down would be very useful. BECAUSE THE PROBLEM IS THAT ALL THE INFORMATION IS VERY AGGREGATED. CAN MEDIUM TERM EXPENDITURE BUDGET COULD BE USED TO FORECAST, WHAT ARE YOUR THOUGHTS ON THAT? MTEF is definitely a good source, as government is a big employer. A lot of jobs come from government, 60%. So having that locked in, definitely that would help. If government is committed to spending an amount of money, than it does help. But obviously the private sector is dependant on the broad economy. So they take their cue from what is happening in the economy. A LOT OF TIMES THE BUDGET FOR THE MTEF IS NOT BEING MET, IS THAT ALSO A CONCERN FOR YOU? These things are very complex, and in any complex situation you need to think systemically. So systemically there are things that impact on all those businesses including the civil engineering space. And those broad things including politics, resources, environments, economics; so when the country goes through a certain phase those will impact on the budgets that have been set. so if you have a very powerful forecasting tool, all the civil engineering spaces will pick up all those certain things. what we have been saing at the moment id [general CEC] say is 'oh the government is not spending money'. But if you had all the right forecasting tool than you would know what the political situation is, or what the global situation is, and weather the resources are impacting, and how that will impact on how government is building. Because you can do that forecast over the next 12 months. Because at the moment is all reactive. All budgets, i am not aware of any company in the engineering space that is using any forecasting tools to do their budgets. And thats where the problem is. It is all based on last year scenario, so it is all backward looking scenario. You look at how many people you need to feed and thats how much work i need to win. Its a wrong approach. It is an inward looking approach based on 'I have so many people and I [this is how much work i should get]', instead of being the other way around.</p>
<p>Q3: Do you believe that obtained data relating to the construction industry economic activity could beneficially indicate if the South African economy at large is undergoing a recession or expansion?</p>	<p>Normally what happens is that there is this lag between construction and the rest of the economy. And if you look at the CESA report and compare the business confidence or the construction confidence with the broader economy you will see there is a mismatch. So the construction industry is lagging way behind reality. The construction sector itself, is basically sitting and just sitting waiting for work. To answer your question, I think it is at the tail end of the [cycle]. Lagging.</p>
<p>Q4: Do you believe that data obtained in relation to the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?</p>	<p>In practical real terms, the consultant space should be able to pick up early as the consultant work has been done way before construction. Sometimes years before. So if you have a proper handle over the consultant industry and what is happening there and the potential construction flows from that you should be able to pick up earlier than the construction side. So definitely consultants should be able to indicate if there is going to be a recession or expansion. SO YOU THINK BOTH FOR THE CONSTRUCTION IN GENERAL AND FOR THE ECONOMY? Absolutely.</p>
<p>Q5: Taking into consideration the idea that an increase in the CEC industry could possibly indicate growth in the construction industry and the general economic activity of South Africa, do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?</p>	<p>The engineering consulting is definitely ahead of the curve. Than construction picks up way after that. So it would be sort of consulting, than economy in general and then the construction. DO YOU THINK THAT THE CEC WOULD LEAD THE OTHER CONSULTING ENGINEERING SECTORS? I dont think so. They are pretty much aligned.</p>
<p>Q6: With alternative types of procurement and contracts in the engineering and construction market becoming more common, please answer the following questions: A. What impacts do you see, negative or positive, in the sustainability of CEC firms? Taking into consideration that contractors will be expected to provide feasibility, design and construction quality assurance services B. Are you concerned with the change in role the CEC firms play in the construction industry? Taking into account that CEC firms will be employed by contractors to provide design and supervision services.</p>	<p>I think it is definitely gonna impact. Clients are moving towards a more turnkey solution. They don't want to hear about the separation of professional services from delivery. They want one person to go to if there is a problem. And we also have, the industry being disrupted by technology, severely. So now you have technology type companies like EOH, specified into technology but now they have more engineers than us. And they provide engineering services. So you cannot compete with them. Because they will go to the client and they will say 'we will do all your data centre and we will install the equipment and we will run it for you'. And we want to say that we will do [only] the consulting, that is already happening in the building sector quite a lot, so if you take that from the building space and you look at what is gonna happen in cities development, from a city development perspective with all these things coming such as smart cities, and thats what clients are gonna be looking for. And so the disruption that is coming is real, its here already and CEC firms are not responding quickly enough to it. They are saying 'we will stay where we are'. Consultants are just lying within consulting profession, we dont align ourselves with any technology. And that is wrong because that is the future. As far as i am concerned, the future is going to be one where the client says 'can you design, build, finance, manage this thing for me'. And with the technology business is going to move towards tech, coming into infrastructure. And engineering consulting companies are very conservative. They are not agile enough to be able to respond to this disruption. And so once all vehicles are autonomous and driverless or online, then what are we gonna do with our traffic engineers? Or do we own the system that runs the traffic for the city? Now the traditional consulting company will struggle with owning the software. Tech companies then come and take it over. So if you look at what is happening across industries whether it tech businesses or whether it financial services, I was talking to an FNB employee and he was telling me that they have got more engineers than C.N.s. I had a graduate that was here, she was very smart, she was here for one year then she went to europe for 2 years and then she came back and joined Investec. I mean, this is a very technical highly competent masters student. So we gonna see that engineering consulting companies cannot compete with technology and finance businesses. They are on another level. we are sort of on the bottom of the food chain. So the consultant space is extremely vulnerable right now, the disruption that is coming from tech businesses or finance business will go more towards that turnkey style. They dont need an engineering consulting company, they can do it themselves. So the CEC space is gonna shrink. DO YOU THINK THAT THIS WILL SHIFT THE INDUSTRY MAKING IT LESS REGULATED WITH THESE NEW TECH AND BANKING BUSINESSES STARTING TO DO PORTIONS OF THE CONSULTING WORK? I think if you look at where the spend is, the big infrastructure stuff. That sits with mature clients like Transnet and Eskom. So for them to be able to deal with this new thing. They have got to adapt to that. So you got a problem on the municipality side. At a municipal level, I think the minister yesterday was saying 'only 7% of municipalities are running efficiently'. Does that mean that civil engineers will end up there? In order to provide services for the municipality? Because on the higher end you not competing anymore, for transnet and eskom. Yes there is still in this phase a separation between construction and consulting. But we see in this phase the likes of Transnet and Eskom moving towards the BOT. So once you put the technology behind that then we are nowhere in the CEC space. And the technology is gonna drive the disruption. Whoever owns the technology will disrupt the companies who operate the technology. Because they will go straight to the banks. DO YOU THINK IF THE CEC TOOK THE APPROACH OF PUTTING TOGETHER PROPOSALS AND PARTNERING UP WITH ALL THESE COMPANIES TO DEVELOP INFRASTRUCTURE AHEAD OF THE DISRUPTION, AND ALONG SECURING LINES OF FINANCE, WOULD HELP THE CEC FIRMS STAY RELEVANT? This can happen, but knowing the space and being in the space for a very long time, this is conservative space, extremely conservative. So for these companies to go into those spaces, the jump is just too huge because of the risk you need to take. There is too much risk, but the risk can be managed. We are so hardcore in our analytical approach to managing risk that you cant be part of the BOT as a owner. CEC firms are part of the BOT but we are sitting at the bottom of the food chain in the BOT arrangement. You have your funder, the developer, service provider and the consultant right at the bottom. So you really you have got no power, and you have to accept whatever they want to pay you. And that is because consultants are not prepared to take on the risk to take ownership. We really grapple with that as an industry, and because of that conservative state which comes with engineering mindsets, as far as overdesign, that is playing too much close to the edges. Its a culture change that needs to take place but we are not thought that at university. We are very good at what we do from a technical perspective, but engineers are not realizing that the disruption that comes is gonna come quick. Right now we are busy with the tallest building in the world, in Dubai. We have a lot of experience in tall buildings. And we were asked about what was the most difficult thing to deliver. I was expecting him to talk about the sway of the building or the structure. But he told me no, the most difficult thing is concerning the lifts as these need to go a kilometer high. His biggest problem is how the people using the lifts dont get motion sickness. Now its a structural engineer that needs to speak to a doctor about motions. Because the technical side that we are so good at has been done by artificial intelligence. So analytics of the structure, AI is going to do. So the stuff that we are really good at, analytics and algorithms, AI is going to take care of. So whats left? we need to start playing with is innovation and creativity. And engineers struggle with that, blending well the technical into the creative world. If we can blend that we can unlock real innovation. So thats why, we are very innovative and thats innovation within the silos, which is technical innovation. So whats required is how to take technology and disrupt the space. Because we are not doing that and things like BOT and IT companies are coming and disrupting us. We are not disrupting anyone. We tend to be on our safe space, and say that there is always going to be a need for engineers.</p>
<p>Q7: For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management as the firm evolves. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?</p>	<p>I think the that the biggest mistake is that we don't think systemically. We are trained to think analytically and we process things the way they must happen. And so the world right now, all professions are being disrupted. And so you need to whitin that disruption that is coming you need to think systemical about the future. So I think one of the biggest problems is that CEC dont know how to think about the future. And probably many businesses, they live in the past. Because you always looking back to say 'I made 100 millions turnover last year and this year I want to make 110 million'. Based on what? It is based on your head count, because we are not saying. Okay what is happening in the economy and what is happening globally, in politics, where is the resources going to. How are those things going to impact on what my forecast needs to be for the next 12 months. So you have this big thing of big dips that happen in construction where people are hired and fired, and you dont get that smooth curve. Because it is a reactive thing all the time, based on the past. Because if you look at what is happening ahead of you, what is happening in our country and globally, you can do a 12 months prediction fairly accurate. There are some fairly good tools out there, for forecasting. Fairly accurately, in our industry we have got records that go way back per sector: civil, electrical, transport, etc. And those are very good figures. And if you got good figure you can do forecasting, using analytics. And that is probably the biggest, maybe not only in consulting engineering or CEC, maybe its in a number of industries as well. But we are not in a technology space where we are looking to improve all the time, and where it is about what is the future or what is the next thing. Our future is based on our past. So that becomes very dangerous. Everything we do and plan is based on what happened in the past.</p>
<p>Q8: Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?</p>	<p>You need to think systemically and not based on what is the head count and how many people I need to keep in the firm. Systemically you look at the economic , resources, environmental, political factors. from the economic side if you looking at the public sector. It is again understanding what are the restraints within the public sector. And those restraints are very so if you understand that youll make a more informed decision. Then you look at the continental and the global level. Stuff like resources and resource sectors and what is happening globally. How many companies in SA do you think even looked at that global market to understand the impact that that is gonna have in Africa and in South Africa? Do we as CEC industry do those? I dont think so, at least I know we [firm] dont do those. But it should be done. SO understanding the business of the world is important and understanding how economic is impacted by this other things has becomes very critical. We just dont do it. I think for me CESA is the perfect vehicle for that, but it is a neutral body and been running for a long time. It has its own issues where it is not believed that it represents all companies and backgrounds, although the board has been transformed to represent all the different backgrounds. But that could be a perfect vehicle to add value into the space because it is independant and so if you go to such a vehicle and say 'let us set up a unit that can do this'. Because that is it what you need, you need people that will understand forecasting tools and that will do analytics. So that is a unit within CESA that does this report and everybody has access. Even the big companies could do that on their own, but if you do that for everybody. Than everyone could benefit.</p>

1. Sex	M	F				Can't disclose
2. Age	<30	30-40	40-50	50<		Can't disclose
3. Years of experience in the industry	<5	5-10	10-20	20<		Can't disclose
3.1 Qualification	BSc					
3.2 Registration	Pr Eng					
4. Position currently held at firm	Managing Partner	Director	Department Manager	Project Manager	Other	Can't disclose
5. Area of expertise of the firm	Transportation	Structures	Water & Sanitation	Urban planning and development	Other Innovation	Can't disclose
6. Area of Activity of the firm	Transportation	Structures	Water & Sanitation	Urban planning and development	Other	Can't disclose
7. Number of employees of the firm	<10	10-50	50-100	100-150	150<	Can't disclose
8. Types of clients that the firm has	Private	Public	Project developers	Other	outside RSA	Can't disclose
9. Are you satisfied with the traditional Tendering system for jobs?	Yes	No				Can't disclose
10. How many years of experience with tenders?	<3	3-5	5-10	10-20	<20	Can't disclose
11. Roughly, what is the ratio of tenders won/loss?	1/1	1/2	1/3	2/3	<1/4 1 in 10	Can't disclose
12. What is the ideal capacity of Projects you can operate simultaneously?	1	2	3	4	5< 40	Can't disclose
13. What is the lowest number of projects you can operate simultaneously	1	2	3	4	5< 40	Can't disclose
14. What is the highest number of projects you can operate?	1	2	3	4	5< 40	Can't disclose
15. Do you have plans of diversifying your areas of expertise?	Yes	No	Maybe			Can't disclose
16. How many times have you diversified before?	Once	Twice	Thrice or more	Never		Can't disclose
17. In how many countries other than South Africa do you operate?	1	2	3	4	5<	Can't disclose
18. How often do you plan for the future of your firm?	Every 6 months or less	Every year	Every two years	Every three years	Never	Can't disclose
19. What information you use to asses if the market is good enough to expand, plan diversify?	Construction Indicators	Investment forecasts	Governments 5-10 year plan	Company 3 year financial performance	Other (Please state)	Can't disclose
20. What financial information, that would help you make financial decisions and is not available, you would like to be collected and made available?	None	Construction professional services GDP contribution	Construction professional services growth	Other		Can't disclose
21. What financial information, that would help you make financial decisions, have you used previously during recession periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other		Can't disclose
22. What information, that would help you make financial decisions, you used previously during growth periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other 3 year financial performance		Can't disclose

Questions	Answers
<p>Q1: Do you believe that there would be any benefits in terms of financial sustainability, if there were economic data on the performance of the CEC industry?</p>	<p>There are the questionnaires that we fill in for CESA that has the sorts of information for civil engineers. I don't think that data helps a lot, or else I would have been using that more if I thought that made a big difference to our company. What you must understand is that when they send in these forms they say, how many people in top management, how many people in middle management, how many people in bottom management. And here we are about 30 people, and there is no ties, no door, no sirs. We only have one manager. So all of these statistics maybe make more sense for bigger firms. Make less sense for us. At the moment we are busy with 3 jobs. Apart from that the management of HR, financing, Tax, transport or anything else is only just done by one person. The CESA Bi Annual report is a management tool. It is good to show you where your company fits in the industry. But it doesn't provide good enough information for Consulting Engineers on whether the economy is doing good or bad. There are other surveys as well. There surveys that you do every month for the USB where they ask you about your turnover, about prospects, weather space or capital is a That would be a total disaster. Because there is nothing that the government can be of benefit apart for the people who steal the money. As far as I am concerned, the less the government is involved the less negative thing will be for everyone. Less regulation would be wellcome. Government intervention has lead to R72bn losses and debt. And this will keep going until there is absolutely nothing left to be managed. Let me give you an idea of what happens.</p>
<p>Q2: What kind of information do you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?</p>	<p>The contractors are now having a hard time. Some of the big companies are closing down. So the construction companies are now where consulting companies were a year ago. I have been 32 years working in this industry. And from these 32 years, last year was the worst in this business. To the point now that the contractors are now going out of business. All the big contractors are on a lot of pressure. Only companies that are not under a lot of pressure are companies that have most of their exposure outside of South Africa. Which means they can still survive under all of this. So the government is not understanding how industry works. They are not understanding how to manage the flow of the economy. There is either too much or too little. And the problem now is that there is too little business.</p>
<p>Q3: Do you believe that obtained data relating to the construction industry economic activity could beneficially indicate if the South African economy at large is undergoing a recession or expansion?</p>	<p>No. as the economy leads the CEC firms.</p>
<p>Q4: Do you believe that data obtained in relation to the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?</p>	<p>The consultants lead the contractors. If we see better times the contractors will also do better. The amount of tenders in the last years has been decreasing and that has resulted in high discounting of service fees as there are not enough tenders available for consultants. Takes the contractor on average 6 months to a year to catch up to the consultant. The CEC sector lags the economy in general as the jobs and tenders are only launched whenever there is money available through the different sources. It takes also 6 months to a year for the economy to overtake you and the CEC to start feeling the harder times. This is due to the public jobs and having a project load and projected income that allows you to keep having an income even though the economy has started to decrease. Luckily we haven't had situations where they stopped paying while the job was still running. But in the private sector this sometimes happen where for example project developers stop the project because they might see that no one is buying certain units of a development. A percentage of the income is still tied up to retention and that comes sometimes a year later for contractors. So this creates a scenario where you know the bad times are coming even though these are only coming in 6 months or a year later.</p>
<p>Q5: Taking into consideration the idea that an increase in the CEC industry could possibly indicate growth in the construction industry and the general economic activity of South Africa, do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?</p>	<p>Can only have a positive impact. The normal procurement process takes too long and it is not always working. If they can cut that process down to where they say this is Turnkey project where the contractor tenders and brings his own consultant that is gonna streamline the project and bring down the time it takes to execute it. The normal tender process leads to huge inefficiencies in the system due to the time it takes and it is also cumbersome. There are a lot of opportunities for consultants when it comes to operating projects for a client. We are a dedicated road designing company. We had no intention in getting anything other than this. But we can see that we are not going to be able to keep the turnover we have or to even grow if we do not start doing these services. We are going to have to find other ways of making money. We can see consultants getting involved with project finance, other types of studies and not only infrastructure design, doing all sorts of other services. Contractors are also starting to diversify and getting out of construction as the industry in South Africa is crumbling and becoming very risky.</p>
<p>Q6: With alternative types of procurement and contracts in the engineering and construction market becoming more common, please answer the following questions: A. What impacts do you see, negative or positive, in the sustainability of CEC firms? Taking into consideration that contractors will be expected to provide feasibility, design and construction quality assurance services B. Are you concerned with the change in role the CEC firms play in the construction industry? Taking into account that CEC firms will be employed by contractors to provide design and supervision services.</p>	<p>I don't see any mistakes that the CEC firms are doing. The Consultants should diversify yes, but that comes with a risk of getting involved in businesses that you have no expertise which leads to inconsistencies in the system. But that is what needs to be done in order to pay salaries.</p>
<p>Q7: For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management as the firm evolves. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?</p>	<p>CEC firms are not stable. Car sales go down, total debt increase, capital expenditure reduction, investor confidence, stock market, standard living, tax income, foreign debt</p>
<p>Q8: Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?</p>	

1. Sex	M	F				Can't disclose
2. Age	<30	30-40	40-50	50<		Can't disclose
3. Years of experience in the industry	<5	5-10	10-20	20<		Can't disclose
3.1 Qualification	BSc					
Registration	Pr Eng					
4. Position currently held at firm	Managing Partner__	Director__	Department Manager__	Project Manager__	Other__	Can't disclose__
5. Area of expertise of the firm	Transportation__	Structures__	Water & Sanitation__	Urban planning and development	Other__	Can't disclose__
6. Area of Activity of the firm	Transportation__	Structures__	Water & Sanitation__	Urban planning and development	Other__	Can't disclose__
7. Number of employees of the firm	<10	10-50	50-100	100-150	150<	Can't disclose
8. Types of clients that the firm has	Private	Public	Project developers	mines	outside RSA	Can't disclose
9. Are you satisfied with the traditional Tendering system for jobs?	Yes__	No__				Can't disclose__
10. How many years of experience with tenders?	<3	3-5	5-10	10-20	<20	Can't disclose
11. Roughly, what is the ratio of tenders won/loss?	1/1	1/2	1/3	2/3	<1/4 in 10	Can't disclose
12. What is the ideal capacity of Projects you can operate simultaneously?	1	2	3	4	5< 40	Can't disclose
13. What is the lowest number of projects you can operate simultaneously	1	2	3	4	5< 40	Can't disclose
14. What is the highest number of projects you can operate?	1	2	3	4	5< 40	Can't disclose
15. Do you have plans of diversifying your areas of expertise?	Yes__	No__	Maybe__			Can't disclose__
16. How many times have you diversified before?	Once	Twice	Thrice or more	Never		Can't disclose
17. In how many countries other than South Africa do you operate?	1	2	3	4	5<	Can't disclose
18. How often do you plan for the future of your firm?	Every 6 months or less	Every year	Every two years	Every three years	Never	Can't disclose
19. What information you use to asses if the market is good enough to expand, plan diversify?	Construction Indicators	Investment forecasts	Governments 5-10 year plan	Company 3 year financial performance	Other (Please state)	Can't disclose
20. What financial information, that would help you make finncial decisions and is not available, you would like to be collected and made available?	None	Construction professional services GDP contribution	Construction professional services growth	Other		Can't disclose
21. What financial information, that would help you make finncial decisions, have you used previously during recession periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other workload and money		Can't disclose
22. What information, that would help you make financial decisions, you used previously during growth periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other workload and income		Can't disclose

Questions	Answers
<p>Q1: Do you believe that there would be any benefits in terms of financial sustainability, if there were economic data on the performance of the CEC industry?</p>	<p>The order book is a good indicator. In my career CEC firms in general have a Order Book of about 6 months to 1 year, they are relatively in a good position. If you know that you can keep your company going for 6 months that is the norm. Some offices in our company run on 2-3 months order book which is not very good window to work under. And sometimes have been operating on that window for a year now. It also depends on the kind of sector that you are in. Traffic engineering for example has projects with small duration projects. Normally when you doing a TIA is a month and a half and you are out. Or sometimes 2 weeks and is over. Which differs from a road project which can run for 2 years. So it is important that you diversify your company. Also part from being regional manager, I am also responsible for roads and highways in the western cape. In roads and highways, it was very important for me to deliver from traffic transportation, geometric design, documentation, supervision, so that you can cross pollinate or cross subsidize whatever the case may be otherwise you dont have that sustainability. But I have been fortunate in my career, I have seen order books of about 2 years plus. At the moment I am sitting at order books of 2 years plus, which is fantastic. Which is why I am confident that we will be able to bridge the difficult periods. Some of our other offices in the country sit in a 6-8 months order book, which is ok. But it does not give you a lot of confidence that you will be able to maintain the business. Obviously you cant do well when you thinking about letting people go or about people that are thinking of going to leave for someone else and you tend to not replace them because there is uncertainty. So, if the order book grows, you get more certainty and you can concentrate on new technology and training of people, and thinking of improving your company if you have a view on the order book of about 2 years. THAT IS GOOD OVERVIEW FOR THE COMPANY IN ISOLATION, BUT IF YOU HAD TO LOOK AT THE WHOLE INDUSTRY OR ECONOMY? If you look at the economy in conjunction to what you have got in your books in terms of... what is in the past is in the past, and the money that you have earned last month is in the past. The important thing is how many orders do you have for new work, that together with the political economic state of the country tells me if you expand, do I expand aggressively, do I go in a holding pattern to see how does everything is going before I go into new projects and markets, or expanding my service offer. You might find that electrical department, maybe we should have that to our firm. It is also important that in difficult times you look into other clients. Diversify your clients. During the 1999 and 2000's bad times where a lot of people were retrenched from this company, and we were basically a roads firm. Now we have 10 different areas of expertise where we do mining, we do urban developments, bunding structures, electrical, so on top of that and everything that we have done we have got management and advisory services. So we have a diverse portfolio. We were forced to diversify in order to find other businesses. I remember that in the freestate we did a lot of roads for the provincial state, and one day they just called us in just saying that for all the road projects just start putting in all your accounts and like that all our road projects were done. Ofcourse a lot of people left, but all of a sudden we started going into other projects. We started going into sanitation and water projects. Stuff that we have not done before. We went into taxi rank and bus studies. Luckily we were able to change. So in SA you need to be aware of the political landscape and also of the needs of the people out there. And there is a big drive to provide people with hpusing in SA. So that is definitely a market that we are in. So you need to position yourself to where the need is. You have to diversify, but companies dont like that.</p>
<p>Q2: What kind of information do you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?</p>	<p>The Government is already transparent regarding the information it publishes. In SA you can find out exactly what government institutions has got what budgets. What is available for capital projects. In some cases you can see what projects are gonna be advertised as well. Because of our PFMA (Public Financial Management Act), things are much more transparent. There is a website for instance where you can see exactly all the municipalities, local and district municipalities in SA where you can see what each of these municipalities have got in terms of money from the government if any, money from taxes, even fines. you can see their incomes streams is. You can see how much money they actually spend on projects whether it is management projects, capital projects or something else. So I think generally in SA stuff is transparent enough. We as CE we can get access to that data, whether we use that opportunity and understand our markets, well it is not so clear. What I like to do in the western cape for instance is understand. Where the market is and where I can position myself, that is what I constantly try to find out.</p>
<p>Q3: Do you believe that obtained data relating to the construction industry economic activity could beneficially indicate if the South African economy at large is undergoing a recession or expansion?</p>	<p>I think specially the consultats can indicate. If we don't have any work, the economy suffers. Only 1 year to 2 years after CEC have been appointed you start seeing that money being spent on the ground such as supply of cement and steel, equipment, and labour. I think you are right, we are in the middle of the trouble right now. If you look at the JSE numbers of the construction industry you will see that a lot of conctruction companies have just gone bust. NMC, Group 5 and others. The ones that are left is Raubex construction and WBHO. And Raubex was clever and they bought all these quarries and so on, so they did very well because they secured that materials portion of the business being able to do work cheaper than anybody else. Which is not good, even if the government comes tomorrow and says that they have a billion bucks to spend on projects in the western cape and want to put a tender as soon as possible, where are we going to find the contractors? Are we going to scale up? Because there are only a few contractors that can do the job and will be a scenario of 'take it or leave it'. Can you see the problem that we sit with. I am not sure that the people that need to understand the position that we are in, understand that.</p>
<p>Q4: Do you believe that data obtained in relation to the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?</p>	<p>Yes consultants lead the economy and industry. If we are struggling the rest of the economy starts to struggle.</p>
<p>Q5: Taking into consideration the idea that an increase in the CEC industry could possibly indicate growth in the construction industry and the general economic activity of South Africa, do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?</p>	<p>The economy normally lags 1-2 years the CEC firms industry due to the process of planning, designs, tender documents, put out the tender and all these processes that have been put in place to take out any corruption take time.</p>
<p>Q6: With alternative types of procurement and contracts in the engineering and construction market becoming more common, please answer the following questions: A. What impacts do you see, negative or positive, in the sustainability of CEC firms? Taking into consideration that contractors will be expected to provide feasibility, design and construction quality assurance services B. Are you concerned with the change in role the CEC firms play in the construction industry? Taking into account that CEC firms will be employed by contractors to provide design and supervision services.</p>	<p>Not if you area resilient company. If you are aware of where the market is going and you position yourself than we will just be working for the contractors. You know the contractors don't have any CEC expertise, so they will either buy us and work with us to BOT or Design and Build, or we will be working for all the contractor companies and they will be our clients. We have done similar projects before. Our structure department has completed a bridge for a contractor in Australia. And that is something that is not new in Australia. SA is one of the few countries that is still working like we do. Consultants do the work up front. Then we go for tender, then we proceed to construction. There are reasons for it, but other countries like to design and build. But BOT means privatisation, and I am not really sure this country is ready to privatize. So they like to still keep some of the interest in their projects. As soon as you start privatizing you can make the government much smaller. At this moment the government is the biggest work creator. Although it gets funded by the taxpayer. I dont think we will necessarily disapear but our client base will change a little bit.</p>
<p>Q7: For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management as the firm evolves. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?</p>	<p>Engineers are not very outgoing although they are very good at what they do. So the biggest problem is the personality. The reason why firms are financially unstable could be various. It could be that they are not marketing their company well, they have not got the right people in terms of the work that they have produced, branding or the way you manage your company such as having too many people according to the ratio that you should have in terms of the income that you produce and the people that you have. There is a ratio that can be allittle bit better or a little bit worse but there is always a ratio of people and income with regards to CEC firms and other businesses as well. You have to understand, where do you add value, which projects have got the shortest life span, how do you cross subsidize so that you create sustainability for your sector. I have been doing it for 23 years now.</p>
<p>Q8: Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?</p>	<p>You need to understand the political economical situation of the country. Depending on who you work for (public or private sector, or if you have a balance between the two. I think if you can diversify your service offer that gets you work, shields you of bad times and gives you sustainability and economic resilience. In SA we have got problems and the government has been trying to solve. We have got school, roads, hospitals, public transport, to improve. By diversifying your services you can bridge these bad economic times. Economic factors would be how the company is doing, what they are spending money on, order book.</p>

1. Sex	M	F				Can't disclose
2. Age	<30	30-40	40-50	50<		Can't disclose
3. Years of experience in the industry	<5	5-10	10-20	20<		Can't disclose
3.1 Qualification	BSc					
3.2 Registration	Pr Eng					
4. Position currently held at firm	Managing Partner__	Director__	Department Manager__	Project Manager__	Other__	Can't disclose__
5. Area of expertise of the firm	Transportation__	Structures__	Water & Sanitation __	Urban planning and development__	Other__MANAGEMENT & ADVISORY, ELECTRICAL	Can't disclose__
6. Area of Activity of the firm	Transportation__	Structures__	Water & Sanitation __	Urban planning and development__	Other__MANAGEMENT & ADVISORY, ELECTRICAL	Can't disclose__
7. Number of employees of the firm	<10	10-50	50-100	100-150	150<	Can't disclose
8. Types of clients that the firm has	Private	Public	Project developers	mines	outside RSA	Can't disclose
9. Are you satisfied with the traditional Tendering system for jobs?	Yes__	No__				Can't disclose
10. How many years of experience with tenders?	<3	3-5	5-10	10-20	<20	Can't disclose
11. Roughly, what is the ratio of tenders won/loss?	1/1	1/2	1/3	2/3	<1/4	Can't disclose
12. What is the ideal capacity of Projects you can operate simultaneously?	1	2	3	4	5< 40	Can't disclose
13. What is the lowest number of projects you can operate simultaneously	1	2	3	4	5<	Can't disclose
14. What is the highest number of projects you can operate?	1	2	3	4	5< DEPEND ON SIZE	Can't disclose
15. Do you have plans of diversifying your areas of expertise?	Yes__	No__	Maybe__			Can't disclose
16. How many times have you diversified before?	Once__	Twice__	Thrice or more__	Never	MANY TIMES OVER	Can't disclose
17. In how many countries other than South Africa do you operate?	1	2	3	4	5<	Can't disclose
18. How often do you plan for the future of your firm?	Every 6 months or less	Every year__	Every two years__	Every three years__	Never	Can't disclose
19. What information you use to asses if the market is good enough to expand, plan diversify?	Construction Indicators	Investment forecasts	Governments 5-10 year plan	Company 3 year financial performance	Other (Please state)	Can't disclose
20. What financial information, that would help you make financial decisions and is not available, you would like to be collected and made available?	None	Construction professional services GDP contribution	Construction professional services growth	Other__MARKET ANALYSIS		Can't disclose
21. What financial information, that would help you make financial decisions, have you used previously during recession periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other__ORDER BOOK OF THE COMPANY		Can't disclose
22. What information, that would help you make financial decisions, you used previously during growth periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other__ORDER BOOK OF THE COMPANY/MARKET ANALYSIS		Can't disclose

Questions	Answers
<p>Q1: Do you believe that there would be any benefits in terms of financial sustainability, if there were economic data on the performance of the CEC industry?</p>	<p>Yes</p>
<p>Q2: What kind of information do you think that if the SARB collected and published, would be beneficial to the long-term sustainability of CEC firms?</p>	<p>Some sort of benchmark that firms could use to measure their sustainability against ECSA guidelines. This would allow firms to know the industry financial sustainability indicators that should be met.</p>
<p>Q3: Do you believe that obtained data relating to the construction industry economic activity could beneficially indicate if the South African economy at large is undergoing a recession or expansion?</p>	<p>You can see it coming. It has a lot to do with government rolling out projects. Generally speaking, yes</p>
<p>Q4: Do you believe that data obtained in relation to the current state of the CEC industry economic activity could indicate the current, or future, states of South Africa's general economic activity or South Africa's total construction industry economic activity?</p>	<p>The CEC industry can indicate if there will be a recession in the construction industry.</p>
<p>Q5: Taking into consideration the idea that an increase in the CEC industry could possibly indicate growth in the construction industry and the general economic activity of South Africa, do you believe that CEC industry economic activity normally leads or lags South Africa's macroeconomic activity cycles and South Africa's total construction industry economic activity cycles?</p>	<p>The CEC industry lags the economy in general but leads the construction industry.</p>
<p>Q6: With alternative types of procurement and contracts in the engineering and construction market becoming more common, please answer the following questions: A. What impacts do you see, negative or positive, in the sustainability of CEC firms? Taking into consideration that contractors will be expected to provide feasibility, design and construction quality assurance services B. Are you concerned with the change in role the CEC firms play in the construction industry? Taking into account that CEC firms will be employed by contractors to provide design and supervision services.</p>	<p>Would not affect the industry negatively. CEC firms just need to change the way they work.</p>
<p>Q7: For any type of business to progress, the mistakes that influence the sustainability of a firm need to be identified, understood and corrected by management as the firm evolves. Therefore, what are some of the mistakes related to the sustainability of a firm that you have seen or still see many of the CEC firms making that need to be addressed?</p>	<p>Some of the mistakes that I have seen include high overheads specifically with big companies, availability of training professionals, not having a good relationship with clients, and multinational companies not understanding how to do business in South Africa.</p>
<p>Q8: Which economic factors do CEC firms in South Africa need to take into consideration to maintain financial sustainability through the different macroeconomic cycles?</p>	<p>The government spending, the economic and political situation of countries in the region and the level of corruption</p>

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Qualification	BSc					
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4. Position currently held at firm	Managing Partner	Director	Department Manager	Project Manager	Other	Can't disclose
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6. Area of Activity of the firm	Transportation	Structures	Water & Sanitation	Urban planning and development	Other MANAGEMENT ADVISORY, ELECTRICAL	Can't disclose
7. Number of employees of the firm	<10	10-50	50-100	100-150	150<	Can't disclose
8. Types of clients that the firm has	Private	Public	Project developers	Other mines etc	outside RSA	Can't disclose
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21. What financial information, that would help you make finncial decisions, have you used previously during recession periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other		Can't disclose
22. What information, that would help you make finncial decisions, you used previously during growth periods?	None	Construction professional services GDP contribution	Construction professional services growth	Other		Can't disclose