A STUDY ON THE IMPACT OF OBSOLESCENCE ON PUBLIC PRIVATE PARTENERSHIP PROJECTS

FOCUS ON HOSPITALS

SCHOOL OF CONSTRUCTION ECONOMICS & MANAGEMENT

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DECLARATION

I hereby confirm that this dissertation is my work and has been submitted in partial fulfilment of the requirements of the MSc in Building in the field of Project Management in Construction (by Coursework and Research Report). I certify that the research contained herein is my own work and all sources used have been acknowledged.

28 January 2020

Brighton Mukuvari Date

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DEDICATION

I dedicate this research report to my father Godfrey Mukuvari, who advised me to take up postgraduate studies. He unfortunately passed away on the 05th of May 2017 while I was doing postgraduate studies. To a life well lived, a father, a friend and my number one fan.

ACKNOWLEDGEMENT

I would like to express my sincere gratitude to the following people:

- Dr Nthatisi Khatleli for his time, effort and knowledge he shared with me as my supervisor;
- My mum Ellah Mukuvari and my sisters Edith and Mercy for their support during the difficult times;
- Most importantly, God Almighty, The Creator of Heaven and Earth for providing me with the resources, strength and blessings to carry out and complete this research.

ABSTRACT

In 2002, South Africa embarked on type contract procurement known as the Public Private Partnership. The method of procurement was pioneered on the Inkosi Albert Luthuli Hospital in Kwazulu Natal. The government of South Africa decided to use this method of procurement on the basis that it would provide value for money on infrastructure projects to nation. PPPs were presented as the panacea to all the ills suffered during infrastructure development, lifecycle management right up to disposal. However, this has not been the case, PPP projects especially in the delivery of hospital facilities have suffered from obsolescence. The objectives of this research are to assess the current understanding of obsolescence, to compare the South African legislation to international best practice on the subject of obsolescence, to investigate the current challenges caused by obsolescence, to provide remedies that can be used to curb obsolescence in hospital PPPs. The study goes on to use the descriptive research method, however taking advantage of both quantitative and qualitative methods of data collection. The data is then presented as information in chapter four using pie charts, bar graphs, tables etc. The data is then analysed to test the hypotheses using the Chi – Square goodness of fit test. The research findings are then presented, and they include lack of political will to support PPPs by the South African government in the past 10 years and lack of skilled and honest personnel to enforce PPP legislation during the life of the hospital facility. The research goes on to conclude that there is a need for politicians to support PPPs to ensure that PPPs are successful. The research further concludes that there is also a need to train government personnel on the management and enforcement of PPP legislation to ensure concessions stick to the agreed deliverables in terms of hospital infrastructure management. Penultimately, the research recommends that there be contractual flexibility for PPPs to also take into consideration unknowns that arise during the contract period. Lastly, it is important

to carry out and complete this study as the subject of obsolescence in PPP projects especially in hospitals is still in its infancy within the South African context.

Keywords: Obsolescence, Hospitals, Lack of Political will, Skilled Personnel, Contractual Flexibility.

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CHAPTER ONE – INTRODUCTION

1.1 INTRODUCTION

Governments around the world rank infrastructure policy among their greatest concerns (DBSA 2012). The modernisation of infrastructure is seen as being critical to future economic competitiveness and crucial to accommodating expanding populations in urbanising environments (Miller,2011). Based on this knowledge, Kateja (2012) and Jerome and Ariyo (2004) state that adequate physical infrastructure is a key element of a sound investment climate. Iselin and Lemer (1993) concur though they expressed it differently when they stated that public facilities are valuable assets that can provide decades of high-quality service if utilised effectively. Kateja (2012), Jerome and Ariyo (2004) further state that historically, provision of infrastructure has been entrusted on government monopolies but with the increasing gap between infrastructure needs and resource availability, governments around the world can no longer meet the demand. According to Barrows, MacDonald, Supapol et al (2012), the cost to deliver healthcare in both developed and developing nations has been rising exponentially. To narrow the infrastructure deficits governments have increasingly turned to PPPs, which once used to be rare and limited to a handful of countries and infrastructure sectors (Adair et al 2011 and Kateja 2012).

Public Private Partnerships (PPPs) have over the years become the norm for infrastructure development in many countries, as they have emerged as a preferred mode of financing infrastructure (Kateja, 2012 and Adair et al 2011). According to the German Federal Department of Transportation, Construction and Real Estate (2003), PPPs are a long-term, contractually regulated co-operation between the public and private sector for the efficient fulfilment of public tasks in combining the necessary resources such as operational funds, capital and personnel of the partners and distributing existing project risks according to the risk management competence of the project partners. However, Hall (2015) contends with the assertion that PPPs provide value for money to the governments when he states that experience in the last 15 years shows that PPPs are expensive and inefficient way of financing infrastructure.

PPPs have proven to be a good procurement method for infrastructure projects in developing and developed nations, the National Treasury of South Africa (2007) also favours the use of

PPPs and states that the main objective of PPPs all over the world is to ensure the delivery of well maintained, cost effective public infrastructure or services by leveraging private sector expertise and transferring risk to the private sector. Van Herpen (2002) agrees and states that the interest in PPPs is growing, notably due to the growth in demand for infrastructure, limited public funds to meet current and future needs and acceptance for the private sector in the provision of infrastructure. The partnership combines the efficiency, expertise, and innovation etc. of the private sector as well as appropriate risk allocation between both public and private sectors. This method also provides an alternate avenue for capital needed for infrastructure projects. The financing options provided through PPPs make this method increasingly popular due to the current global financial crisis.

According to Thomsen and Van der Flier (2011), obsolescence on the other hand is a serious threat for built property as most buildings are immobile, long lasting, capital intensive and have societal and cultural significance. Obsolescence is defined more generally as the loss of a building's performance over time and or the last phase resulting in the end of the service life most often demolition (Nutt et al, 1976, Iselin and Lemer 1993).

The purpose of this research is to analyse the impact of obsolescence in hospitals that are implemented using the PPP agreements and to recommend necessary actions and precautions to be taken to ensure successful implementation. According to Iselin and Lemer (1993) any facility can become obsolete, but those type of facilities that serve more rapidly changing activities such as hospitals, laboratories and schools are particularly susceptible to the problems of obsolescence, therefore this research will focus on hospitals.

1.2 BACKGROUND

According to the Public Private Infrastructure Advisory Facility (PPIAF 2009) the use of private innovation and finance in public infrastructure is not a new concept but rather an old tradition experiencing a new revival. The PPIAF (2009) elaborate further when they make the assertion that the beginnings of partnerships between private and public sectors can be traced as far back as the Roman empire 2000 years ago in Europe. However, this procedure disappeared with the fall of the Roman empire and re-appeared only during the Middle ages for the construction of new fortified towns during the 12th and 13th century. PPPs ceased being used in the 1st World War, in the period from the end of World War II to the late 1970s.

The dominant economic and political orthodoxy was Keynesian type that promoted a state interventionist approach (Bourdieu 1998; Callicinos 2003; Esping-Andersen 1999; Harvey 2005). Hearne (2009) went further to state that PPPs were introduced as part of the neo-liberalisation process firstly in 1992 in the United Kingdom by the Conservative government and subsequently expanded across the world.

On the other hand, the problem of obsolescence in infrastructure projects emerged in America in the 1920s and it solidified in the 1950s as a dominant paradigm that required comprehension and managing (Abrahamson, 1963). Abrahamson (1963) further states that at first Architects reacted to obsolescence by denial, only to acknowledge its relevance and significance at a later stage. Currently infrastructure obsolescence is a major problem and in developed markets it is highest in Japan and European a percentage of stock basis.

According to Yelland (2015) obsolescence is a major problem in South Africa even though the government has invested large amounts on the construction of new power plants. Yelland (2015) goes on to say that the South African government has invested in the construction of the Medupi and Kusile coal to curb the negative effects of power cuts as the existing power plants are obsolete in terms of their capacity to generate power. The expansion of the freeways in Gauteng, Western Cape and KwaZulu Natal to curb traffic congestion, building of dams, installation of water supply pipes, building hospitals schools, prisons etc. by the various entities of government to meet the demands of the increasing population in the country.

1.2.1 State of South Africa's Infrastructure

According to Mescht (2006) South Africa has had increased awareness and concern amongst the public about deteriorating road network, the stark reality was that the life cycles of roads had been significantly shortened by the increasing number of heavy vehicles. The DBSA report (2012) contends and it states that there is strong evidence showing that most of the infrastructure of both pre and post 1994 vintage, is not being properly maintained thus rendering it obsolete. According to Nene (2015) the former Minister of Finance, South Africans regularly experience other kinds of infrastructure failure, mainly unreliable water supplies, roads that are impassable when it rains, trains that break down or poor communication linkages, therefore there was a need for the nation to improve its

infrastructure. The assertion by Nene (2015) shows that either the existing infrastructure cannot meet current user demands due to its design capacity or it has aged and cannot meet its initial design capacity. Nene's (2015) remarks are backed by Dhlomo (2016) commenting on the state of KwaZulu Natal Hospitals. Dhlomo (2016) asserts that over the years there has been a sharp deterioration in health care at hospitals and clinics in KZN, marked by shortages of medicines, collapsing infrastructure, broken equipment, and inadequate provision of staff. It is in-light of such evidence that the research can therefore assume that some of the infrastructure in South Africa is in a state of obsolescence. There is therefore a need for further study in the area of obsolescence so as to circumvent its negative effects on the quality of life of people as well as the prosperity of the nation.

1.3 PROBLEM STATEMENT

There is an endemic problem of obsolescence in infrastructure projects in South Africa despite credible interventions to mitigate obsolescence in PPPs. According to UNICEF (n.d.) the government of South Africa is spending billions of rand (R183billion for the 2017/18 financial year) annually to ensure that hospitals meet the required National Standards. Obsolescence appears to be a worrying problem particularly in hospitals where both hospital staff and patients can no longer cope. There is therefore a need for a thorough investigation to be made on the prevalence of obsolescence in PPP projects with a focus on hospitals

1.4 SUB- QUESTIONS

1. What is the current understanding of obsolescence?
2. How does the South African legislation compare to international best practices with regards to obsolescence?
3. What challenges are caused by obsolescence in infrastructure projects?
4. What remedies can be used to curb obsolescence in Health PPP infrastructure projects?

1.5 AIM

This research aims to investigate the current treatment and appreciation of obsolescence in PPPs.

1.6 OBJECTIVES

1. To assess the current understanding of obsolescence.
2. To compare the South African legislation with international best practices with regards to obsolescence.
3. To investigate the current challenges caused by obsolescence
4. To investigate the remedies that can be used to curb obsolescence in Health PPP infrastructure projects.

1.7 HYPOTHESIS

Hypothesis 1: The lack of political will is the major contributor of obsolescence in PPP hospitals

Hypothesis 2: Changes in population demographics have a serious impact on obsolescence in PPP hospitals

1.8 JUSTIFICATION

According to the Department of Health (n.d), South Africa faces numerous challenges in health care costs and services. The introduction of PPPs in South Africa has been one of the more significant health care reforms in recent years in accelerating the efficient delivery of health care services at costs that are affordable (Shuping and Khabane n.d). Due to the growing population in South Africa, there is a need for Government to continue building new and maintaining existing infrastructure. The use of PPPs to deliver quality at minimum cost infrastructure has gained momentum since the beginning of the new millennium. Van Herpen (2002) agrees though he put it somehow differently when he states that the interest in PPPs is growing, notably due to the growth in demand for infrastructure, limited public funds to meet current and future needs and acceptance for the private sector in the provision of infrastructure. However, for South Africa to provide quality infrastructure it is therefore imperative that an investigation into obsolescence especially in PPP infrastructure projects be carried out so as to come up with solutions to reduce or mitigate its effects.

Previous studies on infrastructure obsolescence have been carried out in other countries particularly in developed countries such as America, England and Australia, they focused on the causes of infrastructure obsolescence procured through the traditional route but there is limited research in the area of study in developing countries, South Africa included, particularly obsolescence in Public Private Partnerships. According to the Van Niekerk (2013) one of the key stipulations in their Public Private Partnerships contracts though referring to roads is that the roads will be returned to SANRAL in a predetermined condition and able to handle a specified traffic capacity. This shows that at least when the infrastructure is handed over to the government or municipality it should be free from obsolescence for several years post hand over.

1.9 JUSTIFICATION OF THE SELECTION HOSPITALS

Hospital PPPs are complex contracts that really need to be investigated as so many of them have failed or have had to be bailed out. Hall (2015), a fierce critic of PPPs states that PPPs are an expensive and inefficient way of financing infrastructure and services. Duckett (2013), although commenting on the Australian landscape contends with Hall (2015) when he stated that PPPs have a chequered history and many such arrangements had collapsed. The National Department of Health (n. d.) in its publication on the National Health Insurance (NHI) states that South Africa is facing numerous challenges when it comes to healthcare costs and services. There is therefore a need for an investigation to be carried in Hospital PPPs considering that South Africa is in the process of laying out the framework for universal health care for South Africans. An investigation into the procurement of hospitals through PPPs will go a long way in providing solutions for the continued use of PPPs in hospital procurement.

1.10 SUB- PROBLEMS

Sub- Problem 1:

South Africa lacks the political will to support PPPs.

Sub- Problem 2:

South Africa is experiencing a surge in population growth.

Sub- Problem 3:

South Africa lacks the skilled personnel to manage PPPs.

1.11 ASSUMPTIONS

- The research assumes by the research participants are honest and truthful,
- Parties to the PPP contract, that is government and the private sector are mainly driven by political gain and profit respectively,

1.12 RESEARCH OUTLINE

This dissertation consists of five chapters which are structured to present the development of the research and data analysis along with the presentation of results, key findings and conclusions.

1.12.1 Chapter One

This chapter consists of the introduction to the research background information on obsolescence in PPP projects, definition of key terms such as obsolescence and PPPs, the problem statement, aim, various objectives, hypotheses, justification, study, conceptual framework and finally the research outline.

1.12.2 Chapter Two

Concentration was on reviewing existing literature on obsolescence particularly in PPP projects, statistics and reports, institutional documents, journals magazines, textbooks etc. The literature will focus on the definitions, various forms of PPPs. The literature review will also focus on the various types of obsolescence that infrastructure suffers from with the passage of time. This literature will be used to address the research objectives as outlined in chapter one.

1.12.3 Chapter Three

Focus was on methodologies that were used during the research process. This chapter identifies the nature of the knowledge to be researched as well as the tools that will be applied when gathering such data and it will conclude with the methods of data analysis as well as presentation.

1.12.4 Chapter Four

The detailing of all the findings obtained during the research was done and the findings analysed in relation to the body of existing knowledge discussed in chapter two.

1.12.5 Chapter Five

The last section of the dissertation rounded up the research by outlining the conclusions, implications of the study on the construction industry, limitations of the study and recommendations.

CHAPTER TWO - THE REVIEW OF THE RELATED LITERATURE

2.0 Objectives of the Literature Review

According to Naoum (2013) literature review thus:

- Defines, delimits, clarifies and refines the research problem,
- Establishes what other researchers have done within the broad field of interest,
- Summarises previous work to inform the reader of the current state of research,
- Helps the researcher to find new lines of inquiry,
- Assist the researcher through their unique experience and background to discover a facet of the problem that others have not seen,
- Helps identify relationships, gaps, contradictions and inconsistencies thereby assisting the researcher to discover research possibilities that have been overlooked,
- Suggests the next methods in solving the research question,
- Helps the researcher to avoid duplicating previous research,

2.1 Introduction

The aim of this section is to critically analyse the relevant literature regarding the prevalence of obsolescence in PPP infrastructure projects, the consequences thereof to the various stakeholders, principally those in South Africa. Other areas of focus include the current understanding of obsolescence in South Africa, the challenges brought about by obsolescence. The chapter will wind with a summary on the prevalence of obsolescence in the South African infrastructure.

2.2 Obsolescence and its causes

The Oxford Dictionary, Iselin and Lemer (1993) define obsolescence as the state of becoming old fashioned and no longer useful. The obsolete facility is not necessarily broken, worn out, or otherwise dysfunctional (Iselin and Lemer 1993). Rather the facility simply does not measure up to current needs. Thomsen and Van der Flier (2011) went further and stated that obsolescence can have a wide range of causes, the available literature shows a confusing variety of categorisations like physical, economic, financial, functional, locational,

environmental, political, market, style and control obsolescence. However Butt et al (2010) provided a diverse line of reasoning when they stated that factors that cause obsolescence are not only conventional such as aging, wear & tear, but rather contemporary factors including energy consumption efficiency, environmental pressures such as reduction of carbon or greenhouse gas emissions, legislations or regulations, change of use, clean and waste water management, water quality and resources, land use, land contamination, soil quality, changing occupier or end user demands, sustainable waste management, ecological concerns, health and safety, and climate change. Figure 2.0 below illustrates conceptually the progression of a facility's performance during its service life (following completion of construction). Through the passage of time the overall performance of a facility starts to diminish slowly due to factors like wear and tear, aging and functional change. After the minimum acceptable performance, the facility is deemed to be obsolete.

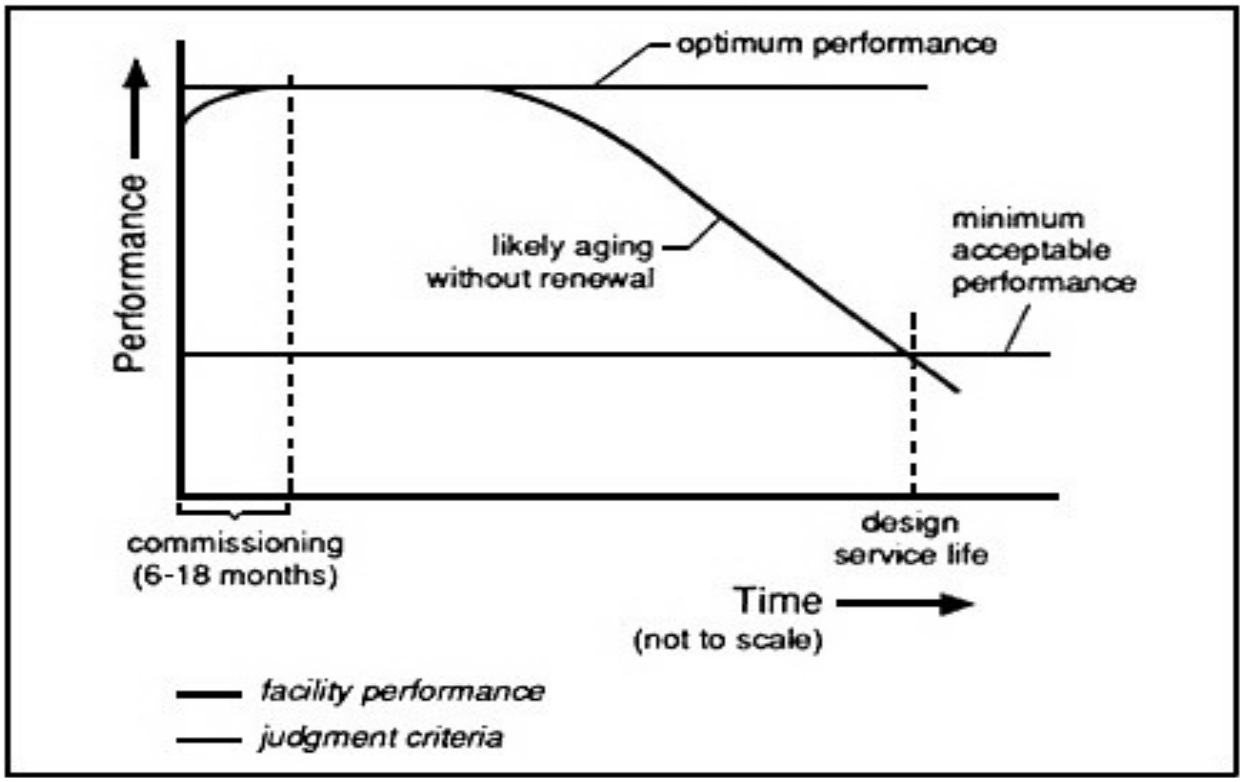

Figure 2.0*: Performance of a service facility over its life cycle*

(Source: Iselin and Lemer 1993)

From the above literature it is therefore clear that obsolescence is caused by external and internal factors.

2.2.1 Internal Obsolescence

According to Butt et al (2010) irrespective of whether obsolescence is in value or function or both, internal obsolescence in a component or built asset is due to factors that exist within the component or built asset.

2.2.1.1 Functional obsolescence

Reilly (2002) defines functional obsolescence as being caused by the property's inability to perform the function for which it was originally designed or intended for. This type of obsolescence has two components which are:

- The functional component
- The technological component

However, Salway (1986) differed with Reilly (2002) when he defined functional obsolescence as the product of technological changes in occupiers' requirements impinging upon both layout and facilities offered implying that functional obsolescence is caused by the functional component only. According to Voss (2012) there are 5 types of Functional Obsolescence and they are:

- Curable functional obsolescence caused by a deficiency requiring an addition (installation) of a new item.
- Curable functional obsolescence caused by a deficiency requiring the substitution (replacement) of an existing item.
- Curable functional obsolescence caused by a component of real property that is not necessary and therefore adds no value to the current of anticipated use (i.e. super adequacy that is economically feasible to cure).
- Incurable functional obsolescence caused by a deficiency
- Incurable functional obsolescence caused by a super adequacy.

There are 3 types of methods used to measure functional obsolescence mainly the cost approach, market approach and the income-based approach. The functional requirements of buildings are subject to change over time (Iselin and Lemer 1993). Changing consumer expectations, for example, may promote new functionality that older equipment cannot accommodate, or enhancements to new generations of equipment (Voss 2012). Though Voss (2012) was referring to equipment, his assertion can be applied to buildings in the sense that as new designs come up, buildings have become much smarter and their performance has improved in issues of energy consumption and appearance.

There are many forms or causes of functional obsolescence making it difficult to separately quantify the loss in value of each cause (Voss 2012). Some of the causes of functional obsolescence are:

- Regulatory changes
- Increased competition
- Changes in market conditions
- Improved efficiency of new equipment (demand & expectations)
- Lower prices of new equipment
- Increased functionality of new equipment
- Greater capacity of new equipment
- Other technical changes

Each of these items contribute to the level and rate of Functional Obsolescence and will ultimately either directly or indirectly lower the utilization of the subject property.

2.2.1.2 Physical deterioration

This is as a result of wear and tear as well as the aging of the facility (Lemer 1996 and Butt et al 2010). Reilly (2002) stated that the consequence of physical deterioration from a cost approach was that it results in a decrease in value due to the property's physical condition. Examples of physical deterioration are damage from termites or other wood destroying organisms, cracks in plaster or wallboard, deterioration of roof shingles causing leaks and discolouration of ceilings, cracks in concrete foundations due to uneven settling and a general wearing out mechanical systems in the house due to use over time (Voss 2012).

According to Voss (2012), physical deterioration is either curable or incurable depending on the costs of repairing or replacing the deteriorating items in the structure. If the repair cost is less than or equal to the increase in the structure's value after the repairs, the physical deterioration is curable. Voss (2012) goes on to say that if the cost of repairing exceeds the increase in value consequent upon that repair then the physical deterioration is incurable. Under incurable physical deterioration it is advisable for the owner of the property to consider demolishing it and building a new structure. Figure 2.1 depicts a typical deterioration curve for a building, if there is little or no maintenance the building's useful life is significantly shortened. In order for a building to function optimally to its design parameters it needs to be regularly refurbished.

Typical deterioration curve

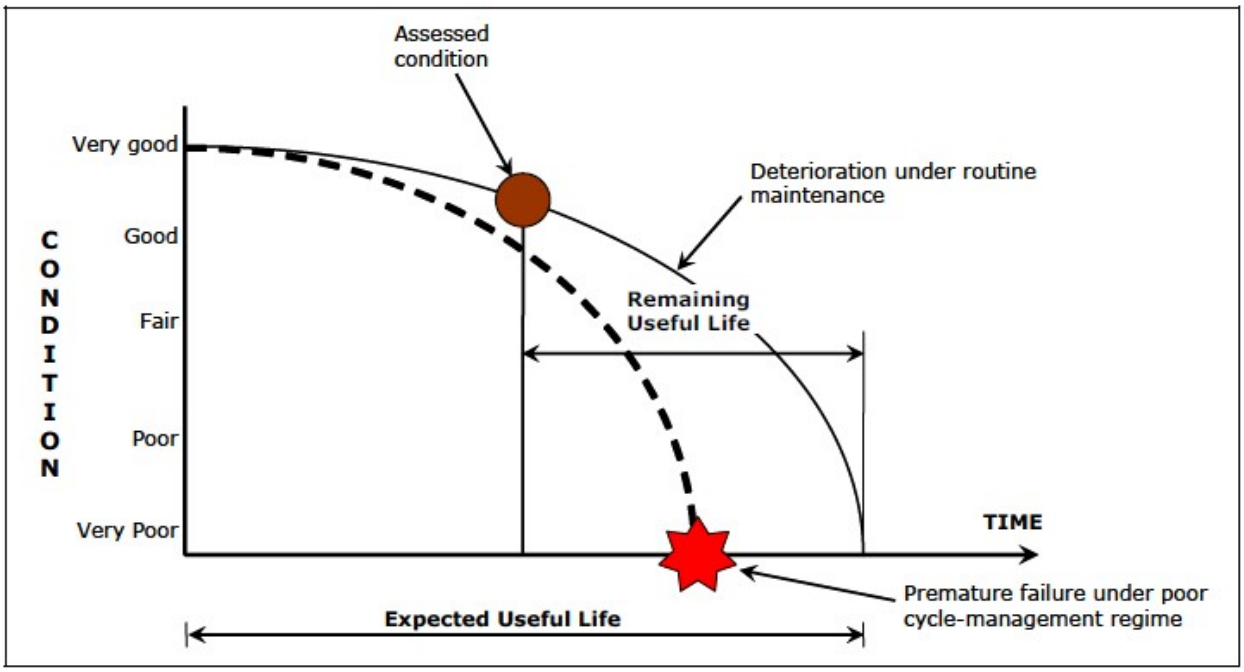

Figure 2.1: (Extracted from the Guidelines for Infrastructure Management page 65)

2.2.2 External Obsolescence

Butt et al (2010) went further to define external obsolescence as a temporary or permanent impairment in value or usefulness of a built asset due to factors outside the system such as change in existing or advent of a new environmental legislation; social forces / pressure groups; arrival of new technology; fluctuation in demand; inflation of a currency etc.

2.2.2.1 Locational Obsolescence

It often relates to changes in neighbourhood conditions related to the subject property site (Voss 2011 and Reilly 2002). The performance of the infrastructure is affected by the location in which it is found. Voss (2011) goes further to state that this type of obsolescence though from a property sector view assumes that the property is located in an inharmonious location such as an industrial area changing to a commercial development. One can therefore conclude that this type of obsolescence is nothing more than a bad location.

2.2.2.2 Economic obsolescence

Voss (2012) states that economic obsolescence occurs when interest rates increase, at that point supply moves ahead of consumer demand therefore a property may suffer a decline in value due to the market's inability to cover construction costs.

2.2.2.3 Climate Induced Obsolescence

This kind of obsolescence is caused by extreme weather conditions caused by global warming. Specifically, for the United Kingdom, by the year 2050 they are expected to experience increases in average summer mean temperatures (predicted to rise by the 3.5 degrees Celsius) and frequency of heat waves/ very hot days and increases in winter precipitation (of up to 20%) and possibly more severe storms (Hume et al 2002). Finch (1996) suggests that the changing climate will accelerate the rate at which a built asset becomes obsolete requiring greater performance improvements from maintenance and refurbishment options and a foreshortening of maintenance and refurbishment cycles, the Institution of Civil Engineers (ICE)in the UK agrees with Finch (1996). Butt et al (2010) then concluded by asserting that the greater collective consequence of these factors will be greater than expected life cycle costs.

2.2.2.4 Obsolescence induced by Sustainability

According to Reed and Myers (2010), the concept of sustainability has evolved from a radical green sector to a broad term which is accepted in and embedded throughout all facets of our society. The study by Reed and Myers (2010) goes on to reveal that it has become almost impossible to make a property related decision without taking into consideration the issue of sustainability.

There are numerous green building councils around the world. South Africa has the Green Building Council of South Africa (GBCSA). The GBCSA is a non – profit organisation that was formed in 2007 to lead the greening of South Africa's commercial property sector. According to the Green Building Council of Australia (GBCA), their mandate is to provide green star ratings to properties. They do this in order to assist the industry in reducing the environmental impact of buildings, fit-out and communities, improve occupant health and productivity and achieve cost savings.

The Green Star ratings assess four keys areas, and they are:

1. Greenhouse gas emissions
2. Operational energy usage
3. Operational water consumption and;
4. Demolition and construction waste.

A study that was carried out by Myers (2009) revealed that investors are devaluing non-sustainable properties as they perceive them as an increased risk and obsolescence. Myers (2009) goes on to conclude that non- sustainable buildings are less competitive on the property market as they are easily being shunned by the public.

2.3 Obsolescence in Infrastructure

2.3.1 Obsolescence in America's Infrastructure

According to Behrer (2016), American roads and bridges are crumbling, the airports are out of date and the vast majority of seaports are in danger of becoming obsolete. He goes on to assert that the sweeping scale of the problem is not always foremost because infrastructure (power grids, water and sewer systems etc.) is largely hidden from the naked eye.

The American Society of Civil Engineers (ASCE) report of 2013 detailed the level of disrepair and showed how infrastructure plays into almost every day to day life. The report was summarised as follows:

- **Roads**- Forty two percent of America's major urban highways remain congested, costing the economy an estimated $101 billion in wasted time and fuel annually. Currently the Federal Highway Administration estimates that $170 billion in capital investment would be needed on annual basis to significantly improve conditions and performance (ASCE, 2013). The Business Roundtable (2015) concurs the ASCE (2013) report though they did not state actual percentages of deterioration when they inferred that much of America's infrastructure had fallen victim to neglect, under-appreciation and `the natural erosion that comes with age.
- **Bridges-** Over two hundred million trips are taken daily across deficient bridges in America's 102 largest metropolitan regions. In total 1 in 9 of America's bridges are rated as structurally deficient while the average of the nation's 607 380 bridges is currently 42 years old. The challenge Federal, State and Local governments have is to increase bridge investments by $8 billion annually to address the identified $76 billion in needs for deficient bridges across America (ASCE 2013 and Business Roundtable 2015).
- **Drinking Water-** At the dawn of the 21st century, much of America's drinking water infrastructure is nearing the end of its useful life. There are at least 200 000 water main breaks per annum in the whole of the United States of America. If we assume that every pipe would be replaced, the cost over the coming years could easily cost more than a trillion dollars according to the American Water Works Association (2015).
- **Public Transportation-** According to the Business Roundtable (2013), America's public transit infrastructure plays an important role in their economy, connecting hundreds of millions of people who are employed, medical facilities, schools, shopping and recreation. Public transport is critical to one third of Americans who do not drive. Although investment in transit has increased tremendously, deficient and deteriorating transit systems cost America at least $9 billion in 2010 as many transit agencies are struggling to maintain aging obsolete fleets and facilities. The 2007 financial crisis did not do any favour as well since a lot of funding has been reduced, forcing service cuts and fare increases.

2.3.2 Obsolescence in the United Kingdom's Infrastructure

According to the Institution of Civil Engineers (2014) in their state of the nation infrastructure report, the United Kingdom government will have to build more infrastructure to meet rising demand triggered by a growing population as well as replace existing infrastructure which is suffering from obsolescence as a result of age. The report painted a gloomy picture of the situation of the economic powerhouse. The report was summarised as follows:

- **Energy-** the Institution of Civil Engineers (2014) stated that over the next decade around a fifth of the United Kingdom's electricity generating capacity both nuclear and fossil would be expected to be retired putting further pressure on D- rated capacity margins, meaning that if no action was to be taken, the United Kingdom would experience power cuts.

- **Strategic Transport-** According to the Institution of Civil Engineers (2014) and Wilson (2018), if action is not taken the costs of congestion could more double between 2005 and 2025 to over three billion pounds. Railway passengers travelled of over 59 billion kilometres in 2010/2013 an increase of almost fifty percent stretching the capacity of the existing network. In aviation delays in the United Kingdom are above the European average with significant capacity challenges in the South East of England likely without new runways.

2.3.2.1 Obsolescence in the UKs PPP projects

The UK has encountered major problems and risks in their experiments with PPPs. They are one of the leading countries in the use of PPPs in the world and this has come at a significant cost. The Jubilee Debt Campaign (ND) state that brickwork façade of Oxgangs Primary school collapsed during a storm. Their findings reveal that the construction firm on the Edinburgh school's partnership (Miller Construction) was allowed to certify their own safety standards. The norm is that building inspectors visit sites and observe work; however, this wasn't the case on the Oxgangs School project therefore quality was compromised.

This school and many others are a clear indication that obsolescence in PPP projects is real and needs to be addressed to ensure that tax payers get value for money. The rest of the European Union has also not been spared and has suffered the same fate (European Court of Auditors 2018). According to the European Union (2013) little attention is given to the very high risk of adaptability and flexibility. They assert that there is a need for PPP projects to meet the ever-changing needs of hospitals over their lifecycle. These needs are:

- Elasticity to cover changes in volume and demand
- Functionality to meet changes

2.3.4 Obsolescence in Nigeria's infrastructure

According to Foster and Pushak (2011), Nigeria's infrastructure is in real bad shape however the government has made significant inroads in the development of infrastructure especially the state highways and telecommunications. Oyedemele (2012) agrees with Foster and Pushak (2012) when he states that most of the infrastructure in Nigeria is now decayed and needs repair, rehabilitation or replacement particularly the housing situation which is in a 'sorry' state both quantitatively and qualitatively. Foster and Pushak's (2012) reported as follows:

- **Roads -** Nigeria has a developed an extensive national road network, both paved and unpaved road network densities are more than twice as high as those of peer group of resource- rich African countries, although still only half of the levels found in Africa's middle-income countries. According to Foster and Pushak (2012), rural accessibility remains a serious problem in Nigeria for agricultural and rural development.
- **Rail -** Nigeria has one of the most extensive national rail networks in Africa, second only to South Africa. Despite Nigeria's potentially significant demand for rail, traffic volumes have all but collapsed. Nigeria's large population and economy create substantial demand for intercity passenger traffic as well as freight movements but due to deficient performance and erratic service. Traffic volumes have been on a long-term decline from 3 million tonnes in 1960 to fifteen thousand, equivalent 15 trucks per day. Similarly, passenger traffic has declined from three million to five hundred

thousand passengers per year over the same period- equivalent to about twenty-five buses. Odeleye (2000) seems to agree with Foster and Pushak (2012) when he states that the railway transport in Nigeria is inefficient and has hardly developed at all over the past 100 years compared to railways in the world.

Odeleye (2000) however blames the neglect on the railway infrastructure on the 100% ownership by the government. Odeleye (2012) on his latest research went further to assert that in the last thirty years, in the 1970s precisely the profile of the NRC (Nigerian Railway Corporation) has continuously revolved around negative attributes such as obsolescent technology, snail like train speed, derailment, maladministration, corruption, workers unrest, abandoned projects, financial constraints, low morale of staff, staff downsizing and or right sizing to mention a few contribute to the corporation's delivery of erratic services that rarely meet the customers satisfaction and needs, over time and space.

2.4 Actions and Strategies for Avoiding Obsolescence

According to Iselin and Lemer (1993) there are many ways of mitigating the occurrence or the effects of obsolescence and they include but are not limited to the following:

- Making flexibility a design goal- experience with various facility types demonstrates that flexibility or adaptability to change, no matter how it is achieved is a valuable characteristic that helps delay or avoid obsolescence.
- Actions in construction- failure to achieve the quality in construction that is envisaged in design can lead to a more rapid decline in facility performance and earlier onset of obsolescence. Iselin and Lemer (1993) go on to say that effective construction quality assurance will enhance the likelihood that obsolescence is avoided or delayed.
- Actions in operations and maintenance- management action to avoid or delay obsolescence becomes practically important in the facility's operations and maintenance stages of the lifecycle. Iselin and Lemer (1993) further state that it is during the post construction stage that the owner and user can act to identify external changes that may signal the onset of obsolescence, while at the same time operating and maintaining the facility to achieve performance according to design intent.

- Using Post Occupancy Evaluation in the facility management- it can help with delaying obsolescence and extending an existing building's service life when this after-the-fact assessment is used to make adaptations in the facility or its operations.
- Adapting for reuse- when the 'fit' between facility and user deteriorates, changing the facility's use is often a reasonable strategy for dealing with this type of obsolescence. This 'adaptive reuse' of obsolete structures has become increasingly popular in the USA (Iselin and Lemer 1993). Anecdotal evidence shows that adaptive reuse is also being implemented in central Johannesburg to convert previous offices into housing flats and supermarkets as a way of addressing the excess accommodation demand in the CBD.
- Making do- When obsolescence does occur in a facility subsystem, the user or owner typically pursues the strategy of 'making do' for a period of time. Making do often involves finding low cost ways to supplement performance that is no longer adequate and there are a variety of products designed to support this approach to reducing the costs of obsolescence. Examples include installing a clear polymer sheet over windows which reduce energy loss and using portable electric heaters can make work areas tolerable in facilities with obsolete or otherwise inadequate climate control systems.

2.4 Obsolescence in Public Private Partnership projects

2.4.1 Public Private Partnerships

Public Private Partnerships are primarily a contractual approach to the delivery of infrastructure goods and services traditionally provided by the public sector or by private operators' subject to tight 'command and control' regulation, such as public utilities (Menard 2013 and Hall 2015). The private partner finances, builds and operates a project on behalf of government. The private company then gets paid over an agreed period either through payments through charges to end users or through payments from the public sector or a combination of both. PWC (2017) somehow clarified the definition of PPPs though focusing on the Australian policy guidance when they stated that there are basically two kinds of PPPs.

1. The social infrastructure PPPs because this model is applied on schools, hospitals, prisons and other social (non- income generating) infrastructure.
2. The 2nd is where the private partner's primary source of revenue takes the form of charges to end users of the infrastructure. A perfect example would be the construction of a road where drivers are charged toll fees for using that particular road. This model is mostly used on projects such as roads, railways, utilities such as power and of late desalination plants for water supply.

The National Treasury of South Africa (2007) posits that international experience on PPPs indicates that it likely offers value for money in those major capital projects. Menard (2013) and Hall (2015) go on to state that PPPs have been high on the agenda of public decision makers, think tanks and consulting firms since 1990s. However, Hall (2015) and Prior (2017) gives a different view on PPPs, and states that PPPs are used to conceal public borrowing, while providing long term state guarantees for profits to private companies.

Hall (2015) differs with Menard (2013) and the South African National Treasury (2007) when he concludes by stating that PPPs are an expensive and inefficient way of financing infrastructure and services as they suffer from a fair amount of corruption and are often used to conceal public borrowing, while providing long term state guarantees for profits to private companies. Prior (2017) concurs though he put it somehow differently when he posits that the problem isn't really the PPP construct. Prior (2017) goes on to say that the problem lays with individuals who apply the PPP construct in circumstances where it does not fit. The perfect example being that it is mainly used to take expenditure off a nation's balance sheet, rather than to optimise a value for money solution. In the last couple of years PPPs have suffered a myriad of challenges particularly in the health and military sectors (Prior 2017). Figure 2.2 below clearly shows the various types of PPP models and the level of risk associated with each one them.

The various types of PPP models and the risk allocation

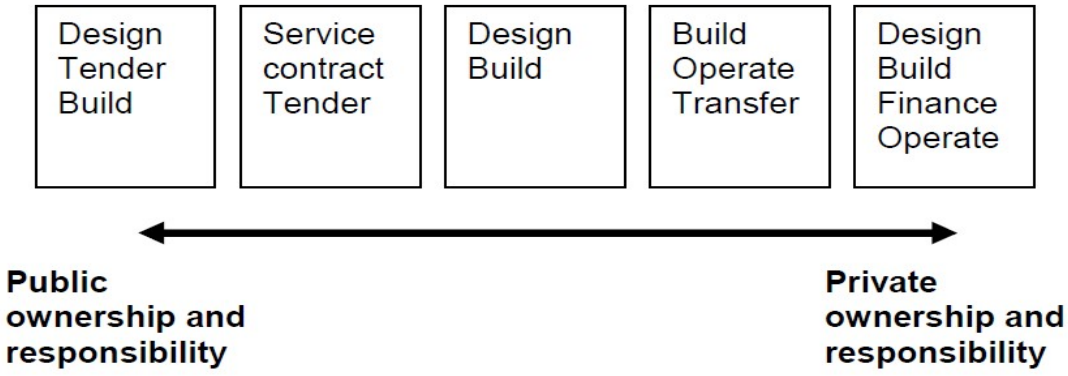

Figure 2.2 - Source: Alexanderson and Hulten (2007)

A PPP project will only be really successful if it is able to generate net profits for the private sector participants Alexanderson and Hulten (2007). When the projects instead result in losses, the private sector will ultimately withdraw, leading to a termination of the project unless the public sector steps in and increases the payments to the private partner or reclaims the responsibility to complete the project. However, some PPP hospitals in Australia are run by non-profit-making organisations such as the Catholic church and Non- Government Organisations (NGOs) (McKell Institute,2014). Their main objective is not to make a profit but to provide affordable health care to the public.

According to Hall (2015), PPPs have come at a huge expense to governments as he claims that they are largely more expensive compared to projects procured through the traditional route. This is against one of the main reasons why governments justify their use that is value for money. Hall (2015) goes on to assert that PPPs originated as an accounting trick. Hall (2015) further explains that PPPs are used as a way around the government's own constraints on public borrowing.

Figure 2.3 below depicts the PPP typical structure showing the various stakeholders that are involved in a PPP in one way or another.

Typical PPP Structure

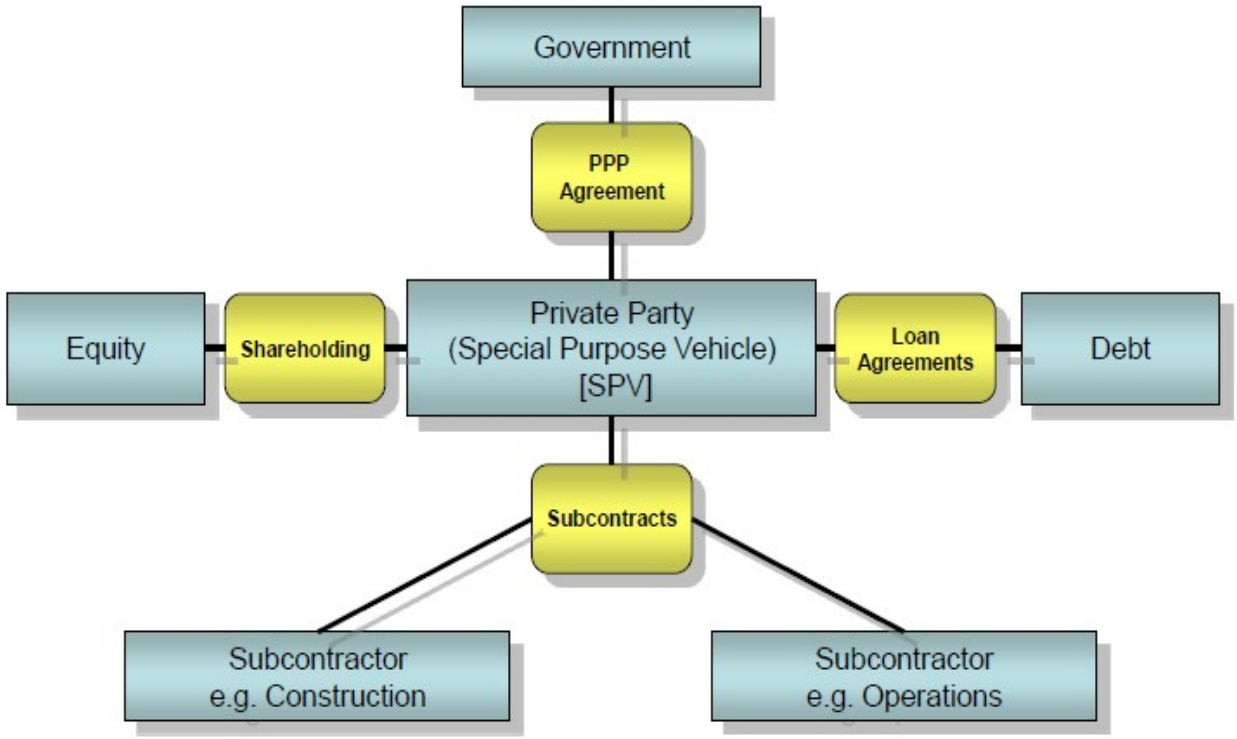

Figure 2.3 - Source: PPP Unit (2004) page 8, Risk Management in Public Private Partnerships.

2.4.2 South African Legislation on PPPs compared to international best practice.

South Africa has a detailed legislative framework to govern the use of PPPs at all levels.

These are:

- Public Finance Management Act
- PFMA Legislation 16
- Municipal Finance Management Act
- Local Government: Municipal Systems Act
- Municipal PPP regulations
- Government Immovable Asset Management (GIASM) Act No 19,2007

The above legislation cuts above all levels of government, from municipal level to national government. It is clear that South Africa has enough legislation to ensure the successful carrying out of PPP projects.

The main legislation in South Africa that really deals with infrastructure management is the GIASM Act No 19 of 2007. The objectives of the act are as follows:

- To provide uniform immovable asset management framework to promote accountability and transparency within government;
- To ensure the effective immovable asset management within government;
- To ensure coordination of the use of immovable assets within service delivery objects of a national or provincial department;
- To optimise the cost of effective use of service delivery by:
    i. Ensuring accountability for capital and recurrent works;
    ii. The acquisition, reuse and disposal of an immovable asset;
    iii. The maintenance of existing immovable assets;
    iv. Protecting the environment and the cultural historic heritage, and;
    v. Improving health and safety in the working environment

Of interest to PPP infrastructure management is Clause 5(a) of the same act which is as follows:

a) Notwithstanding section 19(1), The Accounting Officer of a user is the designated custodian in the case of a PPP relating to an immovable asset, from the date of signature of the PPP concession agreement and for the duration thereof.
b) Upon termination or expiry thereof of the PPP concession agreement, the ownership or custodianship of that immovable asset is transferred or reverts to the custodian referred in section 4(1).

On the other hand, developed countries like Australia, England and America also have legislation that caters for the proper management of immovable infrastructure i.e. hospital buildings, government offices etc.

2.4.2.1 Stages of carrying out PPPs in South Africa

Before a PPP can be carried out by any government parastatal, department or municipality, the Accounting officer responsible has to carry out an extensive feasibility study to demonstrate the following:

- Value for money
- Affordability

There are various stages in the PPP cycle, and they were clearly explained by the South African PPP Unit (2004) as shown in Figure 2.4 below:

Figure 2.4: *Extracted from the South African National Treasury: Module 2 – Code of Good Practice for BEE in PPPs, page II*

2.4.2.1.1 Inception Stage of the PPP Cycle

At this stage the Institution registers the project with Treasury and appoints a Project Officer. According to the Treasury Regulation 16, the inception stage of the PPP cycle is the stage where the Project Officer determines whether the proposed project is in the best interest of the institution.

2.4.2.1.2 Feasibility Study

The feasibility study is a dynamic process, it is done primarily to decide whether or not to proceed with the PPP method of procurement (South African National Treasury, 2004). The South African National Treasury (2004) goes on to state that should the PPP procurement choice be made, then the feasibility study should also be used throughout the phase of procurement. This is for continuous tracking of risk, to ensure that value for money at Treasury Approval IIB (TAIIB) and Treasury Approval III (TAIII) and to check for affordability at Treasury Approval III. The feasibility study comprises of six sections and they are:

1. The Needs Analysis
2. Options Analysis
3. Project Due Diligence
4. Value Assessment
5. Economic Evaluation
6. Procurement Plan

2.4.2.1.2.1 Stage 1 - The Needs Analysis

This stage defines the proposed project, it also prepares the way for the solution options analysis in Stage 2

2.4.2.1.2.2 Stage 2 - Options Analysis

Carrying out an Options Analysis sets out the range of possible, legal, financial and technical options of delivering the proposed project specifications. This enlightens the government

institution when comparing the options, so that they can make a 'good choice'. The Solutions Analysis consists of 3 steps, that is:

Step 1 – Listing all the possible options that would have been considered by the Institution.

Step 2 – It involves the evaluation of each option listed in step 1. The sole purpose of this is to:

- Identify the pros and cons of each solution option,
- To examine the benefits and risks on government of each solution option,
- Identify solution options that can be procured via PPP.

Step 3 – Choosing the best option. In step 2 all the available options would have been evaluated including the initial assessment of its potential as a PPP. Usually the institution will use a Matrix approach to weigh up the evaluation of each option. Should the preferred option that looks likely to be procured through a PPP provide the best results, then the option will have to be fully tested in Stage 4 of the feasibility study. Notably the preferred option may change after the test in stage 4.

2.4.2.1.2.3 Stage 3 - Project Due Diligence

This stage is an extension of the solution options analysis stage. The main aim of this stage is to unearth any unforeseen issues in the preferred solution. It involves the following steps:

Step 1- Legal issues – Previous experience has shown that any issues that aren't resolved in the feasibility study phase of the PPP cycle tend to creep up later. These issues cause delays during the negotiations and in some they have been significant impediments to the conclusion of a PPP agreement. At this stage the institution investigates any issues that have a potential impact on the private party's ability to deliver the project as agreed. The legal issues include but are not limited to the following:

- Sector regulations such as airport licensing, health standards, building codes etc.
- Competition legislation (South Africa has a Competition Commission)
- Financial legislation
- Foreign exchange legislation
- Heritage and environmental legislation
- Labour legislation

- Tax legislation

Step 2 - Site Enablement Matters

On this step the institution needs to specify preferred site, nominate a definite site, or they can choose to leave the issue of the location open to the tenderers. Should the institution nominate a specific site, it will have to proceed and identify, compile as well as verify all the required approvals. The reason for this is to identify any issues that may have a negative impact on the project's value for money and affordability. The institution therefore needs to establish the following:

- Environmental issues
- Geo- Technical issues
- Heritage council issues
- Zoning issues
- Integrated Municipal development plans

Step 3- BEE and other socio- economic matters

This step is mainly identifying BEE conditions applicable to the proposed sector project. It also involves identifying socio- economic factors in the proposed project's location. However, the socio- economic factors will be addressed in the project's design.

2.4.2.1.2.4 Value Assessment

This is the fourth stage of the feasibility study. It assists the institution deciding whether the PPP procurement route would be the best choice for the project. Treasury Regulation 16 prescribes that before a PPP is chosen, three tests need to be done. They are:

- Affordability
- Risk transfer from the Institution to the private party
- Value for money

To carry these out, the institution makes a comparative assessment between delivering the same service using the 'Traditional Method' of procurement. The Institution uses a risk adjusted public sector comparator (PSC) model to compare the Traditional model to the PPP reference model.

According to the PPP Unit (2004) a PSC model is costing of project which has specified outputs with the public sector as the supplier. The base PSC model represents the total costs that the Institution will incur should they prefer to procure the preferred solution using the Traditional Method of procurement. On the other hand, the risk- adjusted PSC model includes a breakdown of all the costs associated with the risk factor. The key functions of the PSC model are:

1. Promotion of full pricing at an early stage
2. Key tool used by management during the procurement process to aid them to stay focused on the specified outputs, risk allocation and associated costs.
3. Is scientifically and reliable way of demonstrating the project's affordability.
4. It is used as a benchmark and a tool for evaluation.

Once the Institution has compared the two models (Traditional procurement model vs PPP model). Figure 2.5 below denotes Affordability and value for money.

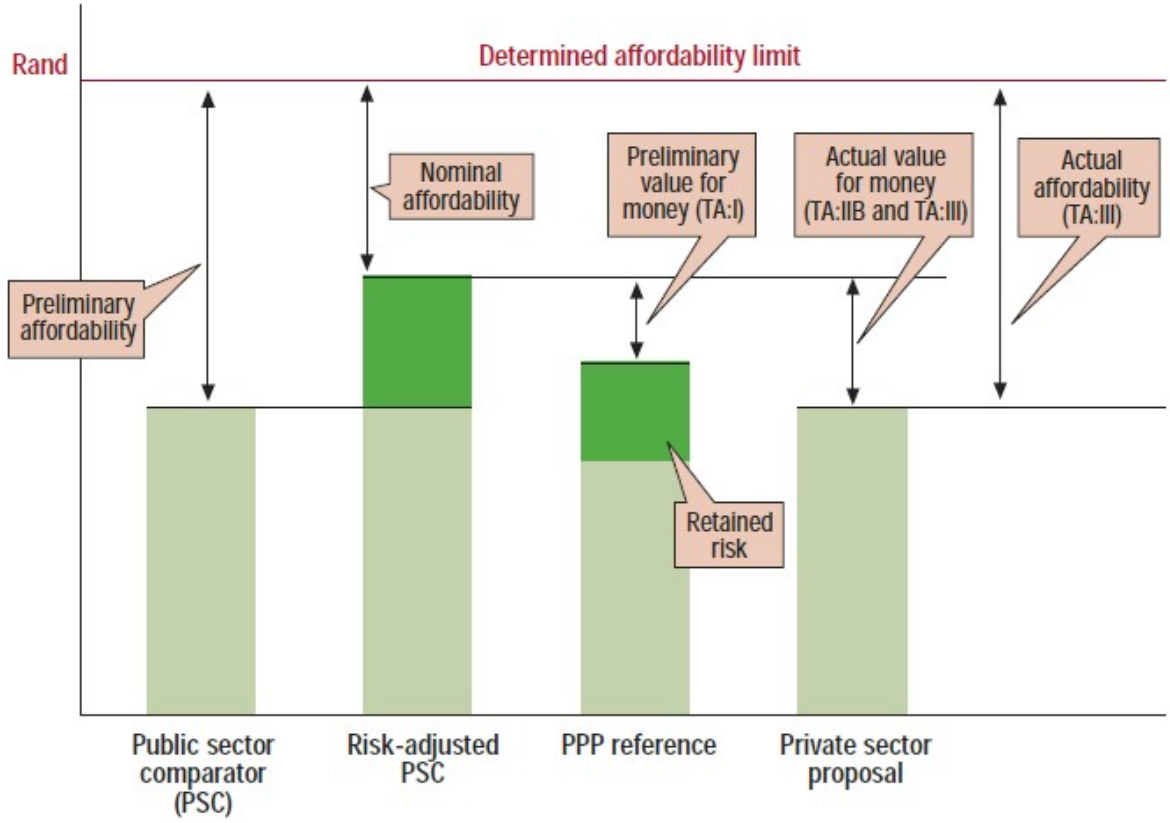

Figure 2.5 - Extracted from The National Treasury PPP Manual Practice Note page 18

2.4.3 Case Study- Channel Tunnel Project

The Channel Tunnel is a PPP that connects the French high-speed railway network with the British high-speed railway to London. The private partner (Eurotunnel Company) accepted to keep interest rates fixed for a fifty-year period instead of renegotiating the debt at agreed intervals. The managers for the Eurotunnel Company were relying on the continued high inflation rate in the United Kingdom and France that would enable them to raise prices as fast as or faster than the interest rate. Alexanderson and Hulten (2007) argue that this was a questionable forecast in light of the slowing down of the inflation in the 1980s and early 1990s and turned out to be impossible to fulfil. Alexanderson and Hulten (2007) go on to conclude that politicians and regulators have been passive bystanders as the Eurotunnel system has been underutilised and overpriced and wealth has been redistributed from mostly French private shareholders to the same financial institutions that locked-in the future of the company and took the shareholders as hostages.

In light of the above evidence the researcher can therefore connect the dots and assert that the Eurotunnel is functionally obsolete. As the common indicators of functional obsolescence are clearly evident, which are excess operating expenses and excess capital costs.

2.4.4 Models of Public Private Partnerships in Hospital Provision

According to Mckee et al (2006) there are various models that have been used in developed countries like Australia, who have vast experience on the application of PPPs. In fact, they have a vast range of models with differing versions in several states. However, in Britain they use the Design Build Finance and Operate (DBFO) model.

The DBFO model consists of a company that is usually in the construction sector that goes on to create a special purpose vehicle to bid for a contract with a health authority. The bid will be for a contract to build and provide clinical services to a hospital. The successful contractor enters into three types of contracts and they are:

i. Contract with banks to finance the project

ii. Contract with the builder who will be responsible for the actual construction of the hospital.

iii. Contract with a facilities management company to manage the hospital for the lifetime of the contract, usually 30 years.

Mckee et al (2006) further states that over the lifetime of the contract, the health provider undertakes to pay a defined amount from its revenues and the contractor undertakes to maintain the fabric of the hospital in good order and (depending on the agreement) manage facilities. The government then makes unitary payments to the concession on agreed intervals (Hall 2015).

However, there is still relatively little experience with these models of hospital provision compared to the models used for provision of utility infrastructure such as power stations, roads etc. According to the findings from Mckee et al (2006), there are key issues that have emerged in the provision of health care and they are:

- Cost- There are huge costs associated with the preparation of bids in the PPP project. Another factor is the high interest rates charged by financing institutions. The consequence of this is that the cost of borrowing money is higher for the concessions than it would be for governments.

  This in turn means that the annual charges for buildings constructed under the PPP arrangements may be higher than the cost associated with hospitals built and run using the conventional procurement methods.

- Quality- Mckee et al (2006) state that when problems arise in any procurement exercise, there are trade-offs between 3 variables and that is cost, time and quality. They assert that with time and cost seeming to be fixed in PPP models, concerns arise on the quality of the project, with many of the hospitals (in the UK) built using this model experiencing significant problems.

- Flexibility- There seems to be a rapid shift in the delivery of health care on a global scale, partly in response to the altered demands on health care systems, such as shifting patterns of disease and rising public expectations. PPPs contracts are often specified and there is little or no room for variations under this procurement method.

  In some instances, parties are even fined for introducing change to the project. According to Mckee et al (2006), it is this lack of flexibility that has resulted in hospitals being out of date before they are even opened.

- Complexity

Perhaps Montagu and Harding (2012) painted a much clearer picture on the various types of PPPs used in the procurement hospitals. Their explanation posits that there are mainly two groups of PPPs and they function as follows:

1. The first group has a background in infrastructure PPPs and their objective is to bring the various benefits of the PPP model to the health sector. As discovered earlier in this chapter that the advantage of infrastructure PPP is that the capital expenditure used to finance the construction of a hospital can be recouped by direct billing of services to end users. Thereby bypassing government budgets entirely.
2. The second group comes to PPP from the health services sector and is only involved with PPPs as a means to bring private management expertise, care delivery and flexibility models to hospital operations.

A Typology of Hospital PPPs

Model	Description
Franchising	Public authority contracts a private company to manage existing hospital
DBFO (design, build, finance, operate)	Private consortium designs facilities based on public authority's specified requirements, builds the facility, finances the capital cost and operates their facilities
BOO (build, own, operate)	Public authority purchases services for fixed period (say 30 years) after which ownership remains with private provider
BOOT (build, own, operate, transfer)	Public authority purchases services for fixed period after which ownership reverts to public authority
BOLB (buy, own, lease back)	Private contractor builds hospital; facility is leased back and managed by public authority
Alzira model	Private contractor builds and operates hospital, with contract to provide care for a defined population

Figure 2.6 - Source: Montagu D; Harding A; ND; 'A zebra or a planted horse? Are hospital PPP Infrastructure Partnerships with stripes or a separate species? Page 16; Volume 48

As shown in Figure 2.6 above there are 4 categories of PPPs used in the procurement of hospitals. They are as follows:

- Services

- Facility/ Finance
- Combined
- Co-location

According to Montagu and Harding (2012), there are six key areas that make hospital PPPs different from their infrastructure homonyms and they are:

1. The government not end users is the primary purchaser of outputs – As stated earlier, infrastructure PPPs commonly collect fees from end users. These include drivers on a highway, railway passengers, water and electricity consumers etc. In contrast hospital PPPs receive all their income from government in the form of payments made in agreed periods. This however is a risk to the income stream of private operators in hospitals.

2. Partnership risks are political and not market related – Due to the fact that government is the primary purchaser of outputs as stated above. The risk is as a result of uncertainty in long term compliance with payment obligations rather than market demand. This therefore means costs of capital in hospital PPPs are higher compared to their infrastructure counterparts.

3. Measurability of output – Infrastructure PPPs deliver measurable outputs, unlike healthcare PPPs. Inpatient care services are immensely varied based on the condition.

4. Variability of outputs over time – Due to changes in the demographics of a country or region where the health care PPP is located. The medical service mix is immensely affected.

5. Variability of technology and organisational configuration over time – New technology has led to changes in diagnostic and treatment protocols, and care shifting from doctors to nurses to physician assistants. A combination of the unpredictability shifts together with the high proportion of overall project cost that is due to operations is unique to hospitals.

6. Ratio of Investment capital to operating capital – For the lifespan of a hospital, medical services represent over sixty five percent of annual operating costs and another seventeen percent for ancillary services such as food, support and

information technology. However, of infrastructure operations, design costs, cost of finance and maintenance costs are the large chunk of total costs.

Major differences between Infrastructure PPP and Hospital PPPs

	Infrastructure PPPs	Hospital PPPs	Implications
Government vs Private purchaser of output	• Private buyers/payers • Government does not enter into long-term service purchasing relationship as part of transaction	• Government (or social health insurers) buy all or most services • Government enters into long-term service purchasing relationship as part of transaction	• Substantial risks to government payer as a result of long-term funding "lock in" obligation • Substantial political risks to private partners in hospital PPP
Business risk vs Political risk	• Borrowing costs reflect estimated risk of demand for infrastructure services by total market of potential payers	• Borrowing costs reflect risks associated with single (or multiple) government payer agencies	• Cost of finance (and therefore capital) higher for hospital facility investment
Measurability	• Comparators for benchmarking cost of facility availability services are somewhat limited	• Comparators for benchmarking cost of services often extremely limited	• Probability of that payment contract will set excessive rates is higher for hospitals
Variability of outputs over time	• Products stable over time	• Products highly variable due to volatility in demographics and disease	• Risk to private partners necessitating either higher return contingencies, or flexibility in contract modification • Risk to government due to "locked in" commitment to hospitals/ configuration that may not be needed in the future
Variability of technology over time	• Service delivery technology and organizational models change slowly	• Service delivery technology and organizational models change rapidly	• Risks to government and private partners as a result of lost flexibility to adapt service organization; or cost of unpredictable adjustments to technology, systems and staffing
Ratio of onvestment to operating capital	• High ratio of capital to operating costs	• Low ratio of capital to operating costs	• Efficiency gains from private finance/ design/ construction and operation of hospital PPPs lower than for infrastructure PPPs

Figure 2.7 – Differences between Infrastructure PPPs and Hospital PPPs

Source: Montagu and Harding (2012)

Therefore, private sector involvement in design, construction and maintenance has a lower potential for efficiency gains than in infrastructure projects. Perhaps the defining aspect of hospital PPPs is the relationship between private and public partners which cannot be clearly defined in advance. In light of this knowledge, contract management challenges are much greater in hospital PPPs. Again, benefits to government accrue from the private participation in finance and facility provision are much less predictable in hospital PPPs than in infrastructure PPPs.

2.4.5 Problems with PPP hospitals in the United Kingdom and Australia

2.4.5.1 Problems with PPP hospitals in the United Kingdom

The United Kingdom is one of the leading countries in the world where public hospitals have been procured using the PPP model. However, these have come with a litany of problems that include high costs and poor quality. According to Bank Watch (ND) between 1997 and 2010, the British government had signed over one hundred and two health sector PPP contracts with thirty-five only publicly funded during the same period. In the year 2010, reports stated that projects with a capital cost of 11.3 billion pounds would have to be paid back at a total cost of 65.1 billion pounds over the lifeline of the contracts, an amount which includes catering, cleaning and maintenance.

Bank Watch (ND) goes on to say that these PPPs are binding and there was nothing the British government could do about reducing the costs. Pollock (2018) dismissed such high costs as nothing but extortionate as they undermined the British health system as well endangered its citizens. There are various case studies which depict a gloomy picture on the use of PPPs in the health sector and they are:

1. **Cumberland Infirmary, Carlisle**: Due to the biased and flawed economic assessment that was carried out. The total cost of the hospital almost doubled during the process of procurement. The maintenance costs where astronomic and this created a problem for the government in the millennium when governments around the world are advocating for lean spending.
2. **Royal Edinburg Infirmary**: According to Bank Watch (ND), this hospital is home to a litany of problems. It is associated with high costs and a biased public sector comparator. In the period between March and April 2012, Consort (the private owner) was heavily criticised for failure to contain the power cuts as the hospital suffered two power cuts. At some point the surgeons had to continue operating on a patient by torchlight.

2.4.5.2 Problems with PPP hospitals in Australia

Australia is one of the few countries that mostly use PPP procurement in the acquisition of hospital infrastructure. However, this has come with a lot of headaches for the various state

governments. There are various case studies which clearly outline problems experienced in these hospitals. The problems are as follows:

1. Bathurst Base Hospital- It was built in New South Wales, Australia for $98 million. Barely a year after its completion doctors stated that some parts of the hospitals would have to be demolished to meet basic patient safety standards. The new hospital is at least twenty percent smaller than the old facility. According to the medical professionals who were employed at the hospital at the time, they were not consulted during the design of the hospital. Meagher (2008) who was the Minister of Health during that time, stated that the facility was not built according to what had been specified in the tender documentation.

The reason for the Minister and the medical professionals for making such bold statements was because the hospital had a lot of problems and they included but not limited to the following:

- Inadequate emergency, alarm system or back up.
- Sewage seeping through the ceiling onto a patient's bed
- Areas in intensive care, emergency, paediatrics and general surgery were too small and therefore did not meet Australian Health Facility Guidelines.

2.5 Obsolescence in South African Infrastructure

South Africa just like any other developing nation has not been spared by the negative effects of obsolescence in infrastructure most of which was built by the colonial government. The current government is faced with providing infrastructure for a growing population which has almost doubled in the last 20 years from 38.2million in 1994 to 54.96 million in 2015 (Statistics South Africa 2015). The report by the South African Institute of Civil Engineers (SAICE) in 2011 gives a gloomy situation in South Africa, it reported as a follows:

- **Water -** Much of South Africa's bulk water infrastructure has reached the end of its life and will require upgrade or replacement. The report further states that the water infrastructure has a weighted average of 39 years which is subject to ageing effects associated with internal and external stresses as well as other impacts. The

Department of Water Authorities (DWA) is struggling with serious capacity and funding problems which cannot be overstressed, with an estimated R 1.4 billion required to maintain current infrastructure.

- **Roads -** South Africa's road network consists of 747 000km. The road condition data is available for 82% of provincial roads, but exploration suggests that well over half of these roads have exceeded their design life, rendering them highly susceptible to rapid costly deterioration in many sections. The SAICE report (2011) further states that Municipal roads are not well managed with road condition data available for only 4% of these, and much confusion regarding municipal coordination and responsibility. The report indicates that the lack of data suggests serious management problems and the possible inability of many municipalities to maintain and extend their road networks.
- **Airports -** Major airports are managed by the Airports Company of South Africa (ACSA) a profitable company mostly owned by the Department of Transport. ACSA has an appropriate, qualified technical staff and operates on the principle of regular maintenance and replacement, prioritising safety and regulated equipment in order to preserve its infrastructure in the most efficient manner.
- **Rail Network -** The national rail network is managed by the Department of Public Enterprises and the Department of Transport, the former in charge of Transnet and the latter in charge of the state-owned enterprise the Passenger Rail Agency of South Africa (PRASA). The report concludes the railway section with the view that South Africa's rail infrastructure is in a declining state of rolling stock, lack of maintenance and under investment has resulted in Transnet losing market share to roads annually.
- **Electricity -** Electricity is generated by Eskom a state-owned enterprise. The report paints a gloomy future for South Africa as it states that Eskom is the best example of the dangers of inadequate staff capacity and neglect of infrastructural maintenance as seen in the unplanned blackouts (or load shedding). The average age of South Africa's coal fired power stations is 30 years. The infrastructure is very old and obsolete and therefore require frequent maintenance and repairs as Eskom regularly experiences plant failures.

According to the Department of Public Works (DPW), Construction Industry Development Board (CIDB) and the Council for Scientific and Industrial Research (CSIR 2006), South Africa has a National Infrastructure Strategy which gives substance to present legislation.

The main aim of the National Infrastructure Strategy was to help reduce obsolescence in government's immovable infrastructure.

South Africa has numerous but complimentary pieces of legislation that are used to address the issue of obsolescence in infrastructure.

2.6 Hospitals built using the PPP model in South Africa

There are various hospitals in South Africa that have been built or revamped using the PPP financing model. They include but are not limited to the following:

- Inkosi Albert Luthuli Hospital (IALH) KwaZulu Natal Department of Health
- Universitas and Pelonami Hospitals co-location Free State Department of Health.
- Humansdorp District Hospital Eastern Cape Department of Health
- Polokwane Hospital Renal Dialysis
- Eastern Cape Department of Health Port Alfred and Settlers Hospital.
- Phalaborwa Hospital

2.6.1 Inkosi Albert Luthuli Hospital Case Study Background

According to the IALH, to attain a new level of excellence of service, the KwaZulu Natal Department of Health (DoH) specified a single source management solution for a newly constructed 846 bed hospital. The multi-billion-rand contract which took effect in 2002 ran for 15 years.

Scope of the project

The IALH further states that the DoH contracted Impilo consortium to ensure that the public receives clinical services that achieve and maintain the highest standards. Impilo were therefore required to perform the following functions:

- Supply and replace medical equipment and information management and technology systems so that these remain state of the art throughout the contract period.
- Provide integrated facilities management services including maintenance and replacement of fixed plant and equipment.
- Supply and replace non-medical equipment assets

- Provide all services necessary to manage the projects and assets in terms of best industry practice.
- Provide and procure consumable and surgical instruments
- Manage all utilities (Electricity, water, etc.)

The Inkosi Albert Luthuli was the first project in South Africa to be procured through the PPP model.

2.6.2 Universitas and Pelonomi Hospitals Co-Location

There we two academic hospitals in Bloemfontein and the Free State Department of Health (FSDOH) did not have enough funds to refurbish them as they were considered obsolete. The FSDOH contracted a private partner to refurbish the existing hospitals (Universitas and Pelonomi). The private partner was also required to maintain functional facilities at both hospitals for the duration of the contract.

The parties signed a sixteen and half year contract in November 2002. When the contract expires, the private partner will be required to return to the FSDOH this also includes the facilities that were upgraded for private use.

2.7 Conclusion

From the above reports it seems infrastructure is a global problem and cuts across levels of economic development, from the developed countries to emerging countries (from the United States of America to Nigeria). As reported above, infrastructure obsolescence is a major problem as it inconveniences people and businesses from functioning efficiently. The causes of obsolescence in South Africa however seem to differ with America and the UK having to be affected by physical deterioration as most of their infrastructure was built in the late 1940s during the economic boom. However, the situation is different in developing countries particularly those in Africa like Nigeria as infrastructure reaches obsolescence due to failure to maintain infrastructure due to shortage of funds as well poor governance which has been the order of the day since attaining independence from colonial rule.

2.8 Research Gap

Available literature justifies the need for an investigation to be carried out in South Africa so as to build up depth knowledge on the subject matter as well as come up with specific measures to address the problem in the South African situation. A one size fits all approach will therefore not work in this scenario.

The literature review also unearthed the various forms of PPP models used in hospital procurement. It also brought into light the various types of obsolescence experienced in hospital PPPs. Of interest was the fact that obsolescence is still a problem even in countries that have huge experience in hospital PPPs, Australia in particular. It seems the problems keep recurring in the developed countries.

Finally, the literature review also showed that South Africa has adequate legislation in place to address the issue of PPPs. In the next chapter the research will base some of the questions on the experiences from the developed countries.

CHAPTER THREE – RESEARCH DESIGN METHODOLOGY

3.1.1 Research Strategy

According to Naoum (2013) research strategy can be defined as the way in which the research objectives can be questioned. This research used descriptive research. According to Leedy and Ormond (2005) the term descriptive research involves identifying the distinctiveness of an observable fact or delving into possible parallels in the midst of two or more phenomena. In agreement with Glass and Hopkins (1984) the Association for Educational Communications and Technology (AECT 2001) state that descriptive research does not fit neatly into the definition of either quantitative or qualitative research methodologies but instead it can utilize elements of both, often within the same study. Descriptive research can either be quantitative or qualitative, it can involve collections of qualitative information that can be tabulated along a continuum in numerical form, such as scores on a test or the number of times a person chooses to use a certain feature of multimedia program. It can describe categories of information such as gender or patterns of interaction when using technology in a group situation. It is in light of this knowledge that descriptive research will address the research questions using the strengths of both qualitative and quantitative research. The research questions are:

1. What is the current understanding of obsolescence?
2. How does the South African legislation compare to international best practices with regards to obsolescence?
3. What challenges are caused by obsolescence in infrastructure projects?
4. What remedies can be used to curb obsolescence in infrastructure projects?

3.1.2 Quantitative Research

Quantitative research is ‘objective’ in nature (Naoum 2013) and goes on to define quantitative research as an inquiry into a social or human problem. It is based on testing a hypothesis or a theory composed variables, measured with numbers and analysed with

statistical procedures, in order to determine whether the hypothesis or the theory holds true (Cresswell 1994). Moreover, quantitative research attempts to deal with complexity by reducing and simplifying situations to the point where they can be examined, measured and tested (South African Council of the Quantity Surveying Profession, 2013). In a nutshell, a quantitative methodology attempts to adopt an objective, detached approach of observing phenomena and conducting experiments (SACQSP 2013). It then uses the results from the data collection process to support or expand existing theories, or to establish new theory. Figure 3.0 below clearly depicts the process of the quantitative research cycle.

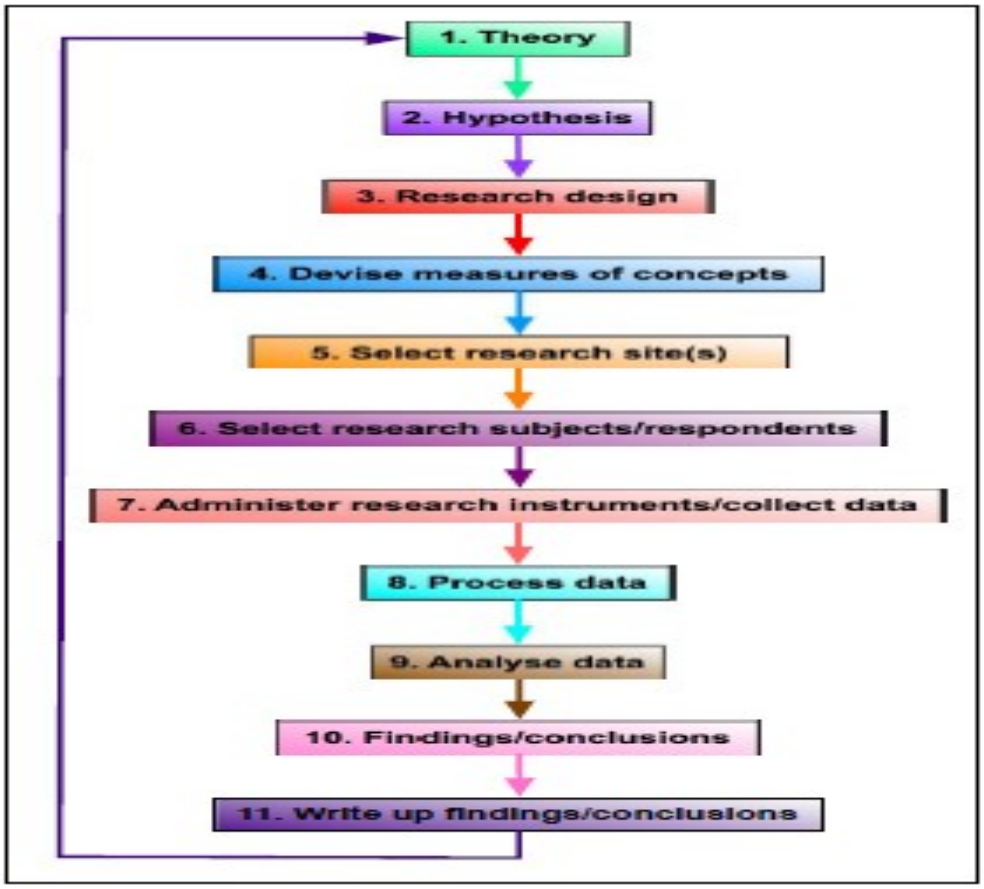

Figure 3.0: The Process of Quantitative Research

(Source: The SACQSP module 18, 2013, p26)

3.1.3 Qualitative Research Methodology

Qualitative research methods focus on discovering and understanding the experiences, perspectives and thoughts of participants (Harwell 2011). It is based on the notion that the social world can only be understood from the point of view of the individuals who are involved in the activities to be investigated (SACQSP 2013).The unique interactions between the researcher and the participants imply that different results could be obtained from the same participant depending on who the researcher is since results are created by a participant and researcher in a given situation. The SACQSP (2013) further states that the qualitative approach differentiates itself from the quantitative approach by being purely inductive in nature. The inductive nature means that conceptualisations, explanations and theories are developed from empirical observations of the real world under investigation (Bryman and Bell 2007 and Harwell 2011). Figure 3.1 below shows the main steps to be followed when carrying out qualitative research.

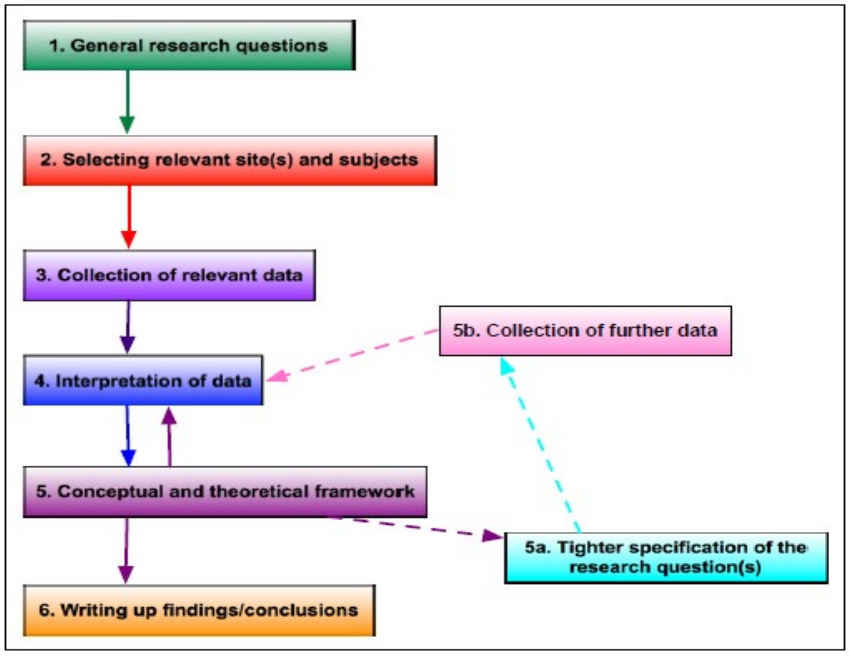

Figure 3.1: The main steps in Qualitative Research - (Source: The SACQSP module 18, 2013, p26)

3.1.4 Pilot Study

The research conducted a pilot study consisting of a convenience sample of clients (government departments and municipalities), architects and project managers based in Gauteng. The main advantage of carrying out a pilot study is that it gives an advance warning about where the main research project could fail (Van Teijlingen 2001). Van Teijlingen (2001) further states that a pilot study also gives an early warning where research protocols may not be followed, or whether proposed methods are inappropriate or too complicated. A total of 8 respondents were asked to complete a questionnaire sent via email. Naoum (2013) states that the objectives for the questionnaire used in the pilot study will be to ensure:

- The testing of the wording of the questions
- The identification of ambiguous or incoherent questions
- Testing of the technique that the researcher would have used to collect the data.
- The measuring of the effectiveness of the standard invitation to respondents

3.1.5 Data Collection Techniques

Secondary data used in this research was obtained from the following sources

- The internet
- Reports, newspapers and articles
- Textbooks, journals and conference papers

1st Phase: The feasibility data that was used in this research was collected through a questionnaire sent via email. A list of all the signed PPP projects as at October 2015 in South Africa was obtained from the PPP unit via email. The list contained contact persons as well as their contact details which were requested upon agreement and written approval of the questionnaire by the Supervisor and the School of Construction Economics and Management (SCEM) ethics board.

2nd Phase: This drew down to the physical location of respondents and investigating whether they are still using the same contact details. The process therefore included removal of firms

as well as individuals that are no longer operational and looking for substitutes that are in operation.

3rd Phase: As stated earlier, a total of 8 questionnaires were issued in the pilot study. The 8 respondents consisted of 2 project managers, 2 architects, 2 Facilities Managers and 2 clients. All the questionnaires were administered via emails. The researcher then contacted the respondents via telephone to introduce themselves, the institution they are from and the research area. Respondents were asked if they were willing to take part in research for ethics reasons, upon agreement then an email of the questionnaire was be sent to them. Emails were chosen for the pilot study because of their fast turnaround time, low distribution and processing costs (Zikmund 2003).

4th Phase: Due to the low response rate to research articles by construction professionals (Crafford 2007) the researcher sent a reminder to the respondents a week before the deadline via email to remind them of the looming deadline. As experienced by other researchers in the past to reduce the non-response rate, the researcher went further and contacted those respondents who had not responded and tried to give them additional time.

3.1.6 Sampling

According to Fellows and Liu (1997) the objective of sampling is to provide a practical means of enabling the data collection and processing components of research to be carried out while ensuring the sample provides a good representation of the population as a whole. The term sample means a specimen or part of a whole population which is drawn to show what the rest is like. There are 5 types of sampling designs which consist of the following:

- Non-random accidental sampling
- Non-random purposive sampling
- Simple random sampling
- Systematic random sampling
- Stratified random sampling.

However, Chaturvedi (2009) states that two general approaches to sampling are used in social science and they are probability sampling and non-probability sampling.

3.1.6.1 Probability Sampling

A probability sampling scheme is one which every unit in the population has a chance (greater than zero) of being selected in the sample and this probability can be accurately determined (Chatuverdi (2009). Chatuverdi (2009) further states that when every element in the population has the same probability of selection, this is known as an 'equal probability of selection' EPS design.

3.1.6.2 Non-probability sampling

Any sampling method where some elements of population have no chance of selection or where the probability of selection cannot be accurately determined. It involves the selection of elements based on assumptions regarding the population of interest, which forms the criteria for selection.

3.1.6.3 Snow-ball sampling

Snow balling consists of identifying respondents who are then used to refer researchers on to other respondents (Atkinson and Flint 2001). Atkinson and Flint (2001) further state that although the use of snow balling violates the principles of sampling it provides a means of accessing vulnerable and more impenetrable social groupings. Snow balling was used to identify the professional consultants that were used on the selected PPP projects. The researcher contacted the consortiums that were/ are responsible for executing the project. They would in turn give the researcher the names and contacts of the rest of the professionals. This sampling technique came in handy as the respondents that were involved in PPP projects in South Africa are still very few.

3.1.7 Sample Size

Zikmund (2003) as quoted in Moyo (2010), states that there are 3 factors to consider when determining the sample size and they are:

1. Variance or heterogeneity,
2. Magnitude,
3. Confidence level,

According to Walliman (2011), sample size is a statistical concept that involves determining the number of observations or replicates. He further outlines the equation for calculating the sample size for finite population as:

Finite population: $$n' = \frac{n}{1 + \frac{z^2 \times \hat{p}(1-\hat{p})}{\varepsilon^2 N}}$$

where
z is the z score
ε is the margin of error
N is population size
p̂ is the population proportion

Extracted from https://www.calculator.net/sample-size-calculator.html

The researcher received a list of hospitals procured through the PPP model from the Government of South Africa PPP Unit which works within the Ministry of Finance. The list revealed that South Africa has only procured 7 hospitals to date through the PPP model. The researcher then selected four (4) respondents per project which consisted of the Project Manager, Architect, Facilities Manager and the Client which gives a sample size of 28. The researcher chose these four personnel solely on the basis that they are directly involved with issues to do with obsolescence beyond Practical Completion. The researcher therefore used all the projects and to get contacts of the other respondents, the researcher therefore used snowball sampling. From inputting the population of 28 at a 95% confidence interval in the formula, the sample size was 27.

3.1.7 Questionnaire Design

According to Naoum (2013) questionnaires have been widely used in descriptive analytical surveys in order to find out facts, opinions and views on what is happening, who, where, how many and how much. The advantage of the questionnaire is that it has a relatively wide coverage, low cost, and the anonymity of the respondent may allow disclosure of more

confidential data. The SACQSP (2013) goes further and states that there four types of questions that can be used namely:

- Open ended questions- they encourage free expression by the respondent and provide an opportunity to gather 'richer data'. However, the negative side of open questions is that they tend to be ignored by respondents therefore the analysis and interpretation of the answer may be difficult.
- Multiple choice questions- generally ask respondents to select one or more answers from a given list. It allows for more specific responses to questions than either open or dichotomous questions. Lastly, they are relatively quicker to analyse.
- Dichotomous questions- are styled in such a way that there are only two possible answers. They are usually short, with a clear meaning, easy to answer and analyse.
- Declarative questions are like multiple choice questions, but the question offers a statement or series of statements and the respondent is required to rate and or rank the statements.

3.1.8 Research Questionnaire

The intention of the questionnaire was to include the various impacts of obsolescence on PPP projects that were acknowledged during the review of the related literature and the pilot study. The questionnaire consisted of:

- Open-ended questions to allow the respondents to freely express themselves so as to get in-depth information on the subject matter which the researcher would have otherwise over-looked. Of interest in this research is the fact that there is little information of obsolescence in hospitals procured through the PPP process. Therefore, this would aid in the researcher gathering more information from the respondents. The main reason why there is little information on PPPs is the 'commercial secrecy' policy that is advocated for by the private partner(s) (Hall 2015).

- Closed-ended questions which give the respondent the question scope. This assists those respondents with limited knowledge on the subject matter, as it gives response hints and pointers.

3.1.9 Interviews

According to Naoum (2013) the personal interview is a face to face interpersonal role situation in which an interviewer asks respondents questions designed to elicit answers pertinent to the research hypothesis. Due to its flexibility, an interview is a useful method of obtaining information and opinions from experts during the early stages of the research project (Walliman 2005). Interviews can take 3 forms that is structured, semi- structured and unstructured. Semi- structured interviews will be conducted with top level management in clients to discuss the occurrence of obsolescence, current knowledge and comparison of South African legislation against best international practice.

3.1.10 Comparative research technique

To respond to research question number four which seeks to compare South African legislation with international best practice. The researcher will use the evaluation technique, to compare the local pieces of legislation that deal with obsolescence. According to Walliman (2011), comparative research can either be used for comparing past and present or different situations especially where the researcher is not in control of the events.

3.2. Data Analysis

According to Naoum (2013) in order to be able to select the appropriate method of analysis, the researcher needs to understand the level of measurement. Analysis will therefore be dependent on the nature and form that the data would have been recorded. Since the data would have been recorded using the descriptive approach which caters for both qualitative and quantitative data. The data will therefore be analysed through qualitative and quantitative methods. The analysis irrespective of whether the data is qualitative or quantitative, may:

- Describe and summarise the data
- Identify relationships between variables
- Compare variables
- Identify the difference between variables
- Forecast outcomes

3.2.1 Exploratory data analysis (open ended questions)

According to Naoum (2013) this type of data analysis refers to research about people's lives, their stories and behaviour. It can also be used to examine organisations, relationships and social movements.

3.2.2 Coding open ended questions

Open ended questions can be used in postal questionnaires as well as interviews. The usual reason for using open ended questions is that the researcher has no clear hypothesis regarding answers which will be numerous and various. Naoum (2013) therefore states that the best way to analyse open ended questions is to code the information in terms of ideas and themes. Naoum (2013) further states that the purpose of coding such questions is to reduce the large number of individual responses to a few general categories of answers that can be assigned a numerical code.

3.2.3 Statistics

After recording data, the field of statistics can be applied to the raw data so that some kind of interpretation and discussion can be made on the results. Naoum (2013) states that there are two methods that can be used to analyse data, that is the descriptive statistics method and the inferential statistics method (also known as the bivariate statistical analysis method)

3.2.4 The descriptive statistics method

It is the simplest method of analysis, which provides a general overview of the results. The descriptive statistics method will either analyse the response in percentages or contain actual

numbers. There are 3 formal terms which are used to describe aspects of a group of data: these are frequency distribution, measurement of central tendency and measurement of dispersion.

3.2.5 Frequency distribution

It is useful to distribute large numbers of raw data into categories or classes and to determine the number of individuals or cases belonging to each category. This category is called frequency, it can also be presented in the form of tabulation, a bar chart, a pie chart or graph.

3.3 Ethical Considerations

According to Bryman and Bell (2007) the following ethical considerations have to be made when carrying out a research. When carrying out this research, the researcher will take the following issues into consideration:

1. Ensure that research participants are not subjected to harm in any ways whatsoever. Therefore, all information regarding research participants will be a guarded secret to maintain their anonymity.
2. Make sure that the respect for the dignity of research participants is prioritised.
3. Ensure that full consent should be obtained from the participants prior to the study, this will be done through issuing a consent form to be signed by each research participant.
4. The protection of the privacy of research participants has to be ensured through non – disclosure of the names of the research participants and the organisations they work for.
5. Anonymity of individuals and organisations participating in the research will be ensured by making it compulsory for all the research participants not to disclose their names or organisation. An integral part of this will be the use of the Qualtrics platform. Unlike emails, it is almost impossible to know the individual that participated in the research.
6. Any deception or exaggeration about the aims and objectives of the research must be avoided.

7. The researcher declared all forms of affiliations in any forms, sources of funding, as well as any possible conflicts.
8. Any type of misleading information, as well as representation of primary data findings in a biased way must be avoided.
9. Any type of communication in relation to the research should be done with honesty and transparency.

Mathers, Howe and Hunn (1998) went further to explain the principles of ethics to be applied during research and they broke them down as follows:

1. Autonomy

   Our duty as researchers is both to recognise someone's capacities and perspectives and their right to make choices about whether or not they take part in any research project. In research, autonomy is protected by ensuring that any consent to participate in the study is informed or real. Mathers et al (1998) further state that it is therefore not enough for the researcher to explain something about the project to a research participant, but the key issue is the understanding and free choice whether or not participate.

2. Non-Maleficence

   The principle states that researchers may not inflict harm on or expose people to unnecessary risk as a result of their research project.

3. Veracity

   This deals with honesty and therefore requires all subjects in a research project to be told the truth. Mathers et al (1998) further state that there is no justification whatsoever for lying, however this is not the same as non-disclosure of information, should it, in particular, invalidate the research.

3.4 Section Summary

This section identified various sampling techniques used to collect data from respondents. The section also aided the researcher in coming up with bespoke research instruments to siphon data from the industry. The section also came up with the justification for choosing the research instruments. Most importantly, the section also laid out the ethical considerations to be implemented while carrying out the research. The researcher therefore is confident that the chosen methods or combinations of data collection meets the minimum requirements of generating reliable results. Table 3.1 below summarises the research objectives and sub-

questions, research methods, data collection methods and data analysis methods adopted for each.

Item	Research Objectives	Sub-Questions	Research Methods	Data Collection Methods	Data Analysis Methods
1	To assess the current understanding of obsolescence	What is the current understanding of obsolescence?	Qualitative Research	Questionnaire	Qualitative Data Analysis
2	To compare the South African legislation with international best practice	How does the South African legislation compare with international best practice with regards to obsolescence?	Comparative Research	Researcher comparing legislation manually.	Qualitative Data Analysis
3	To investigate the current challenges caused by obsolescence.	What are the challenges caused by obsolescence in infrastructure projects?	Qualitative Research	Questionnaire	Qualitative Data Analysis
	To investigate the remedies that can be used to curb	What remedies can be used to curb	Qualitative Research	Questionnaire	Qualitative Data Analysis

	obsolescence in health PPPs.	obsolescence in health PPPs?			

Table 3.1: Summary of Research Objectives, sub- questions, research methods and data analysis methods adopted.

CHAPTER FOUR – FINDINGS AND DATA ANALYSIS

4.1.1 Questionnaire Response

A total of 28 questionnaires were sent to the professional consultants and clients. Seven questionnaires were to Project Managers, seven to Contractors, seven to Facilities Managers and the last seven to clients (government departments). To tackle the problem of low response rate, the researcher sent research questionnaires via emails and through an online survey. That way respondents had a choice to either answer online or download the questionnaires and answer at a time convenient to them.

Upon expiry of the deadline date 11 questionnaires were answered and returned to the researcher. This was after numerous emails were sent even after the deadline to try not only to give the respondents more time but to persuade them to take part in the research. As a follow up, the researcher contacted those that had not answered the questionnaires and the following reasons were given:

- Inadequate time;
- Lack of knowledge about obsolescence in PPPs;
- Confidentiality reasons, even though they had been assured that their responses were confidential.
- Power cuts hindering access to emails.

Table 4.1 below shows the response rate.

Sector	Maxium Possible Respondents	Actual Response	Actual Response %
Project Managers	7	3	43%
Facilities Managers	7	2	29%
Contractors	7	4	57%
Clients	7	2	29%
Total	**28**	**11**	**39%**

Table 4.1 – Response Rate

Table 4.1: Response Rate of the respondents

Table 4.1 above depicts a 39% effective response rate. According to Zikmund (2003), the researcher has to endeavour to use as many techniques as possible to improve the response rate. As stated above, the researcher did try by all means to follow up as well as provide ample time for the respondents to answer the questionnaires. For reasons already stated some research participants did not to take part in the research.

4.2 Demographic Distribution of the Respondents

Figure 4.1 below shows the sector distribution of the responses. Professionals (Project Managers and Facility Managers) were the major respondents as the constituted 45% of the respondents. Contractors came second as they constituted 36% of the respondents. Last on the response rate was the project clients (Public Sector) constituting 18% of the respondents.

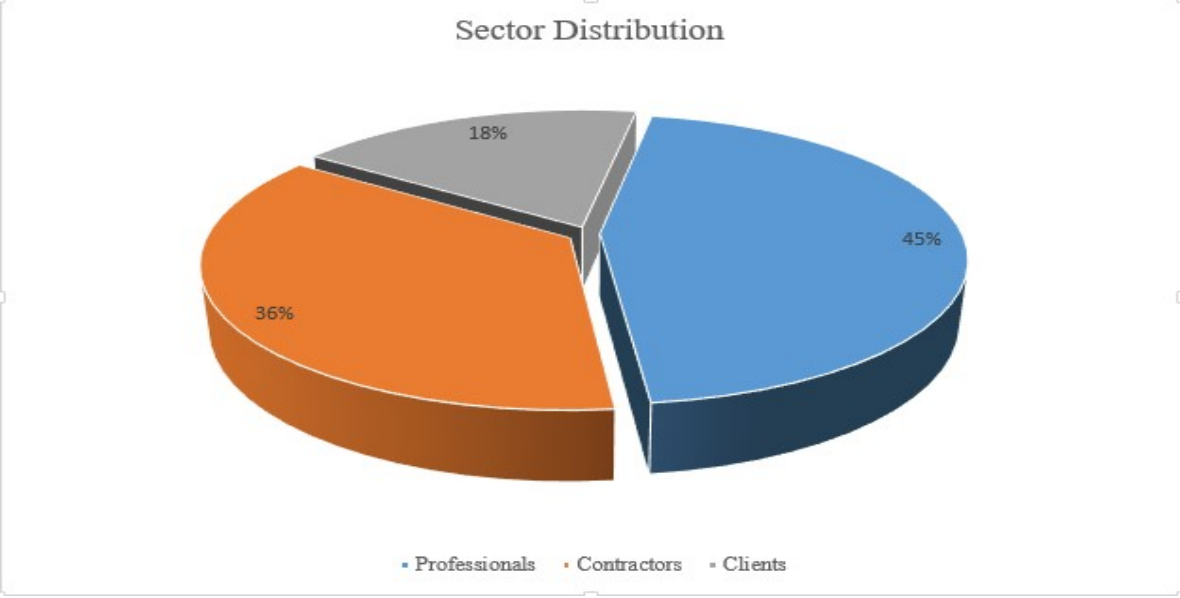

Figure 4.1: Sector distribution of respondents

4.2.2 Respondents Age

Figure 4.2 below depicts the age distribution of the respondents. The figure below indicates that most of the respondents are between 45 and 54 years old.

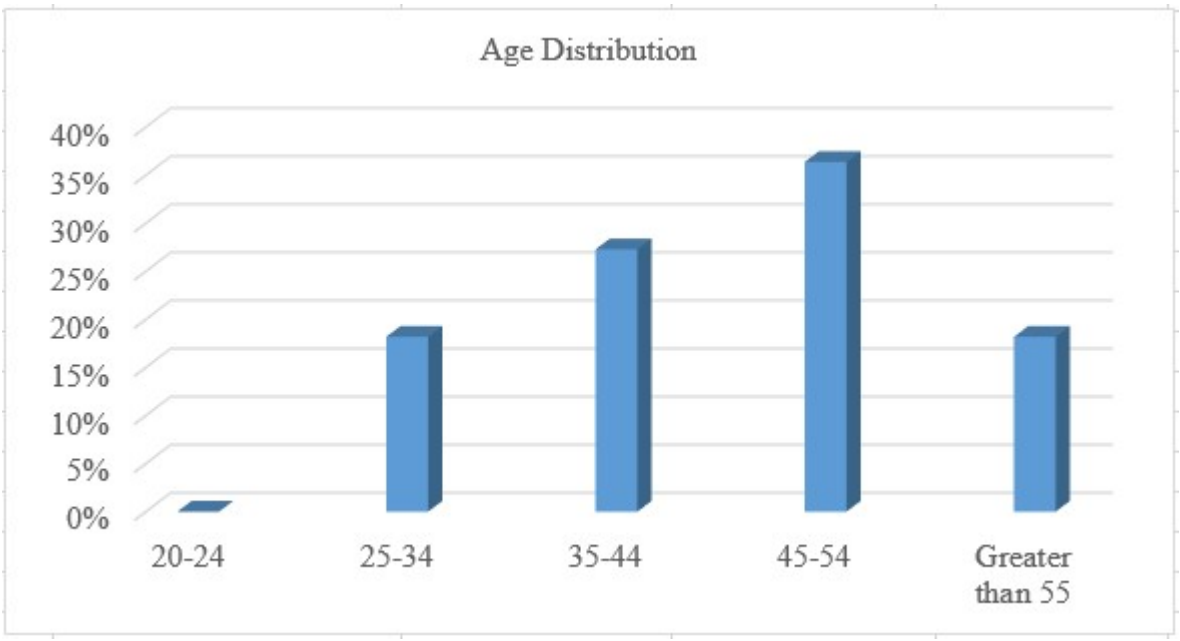

Figure 4.2: Age distribution of the respondents

4.2.3 Respondents Gender

Figure 4.3 below shows an almost perfect balance in the gender of the research respondents.

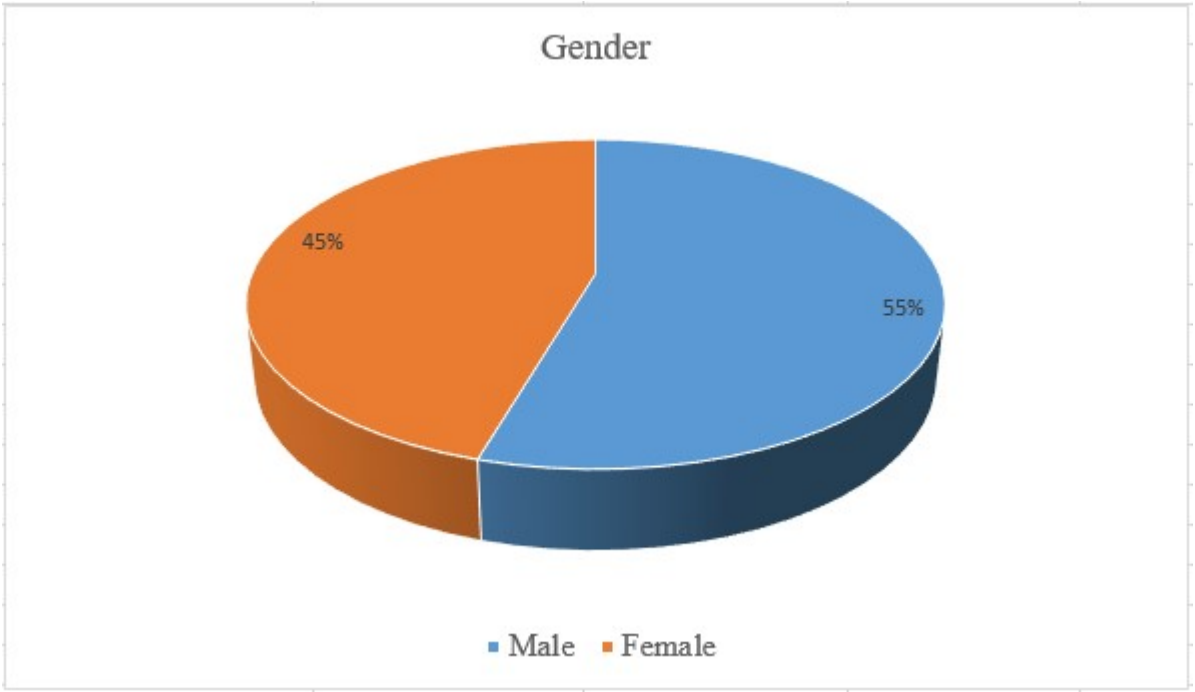

Figure 4.3: Gender distribution of the respondents

4.2.4 Years of experience

Figure 4.4 below shows a spread of the range of the respondents work experience that is fair. Those with work experience ranging from 15 to 19 years work experience are highest with 36 percent.

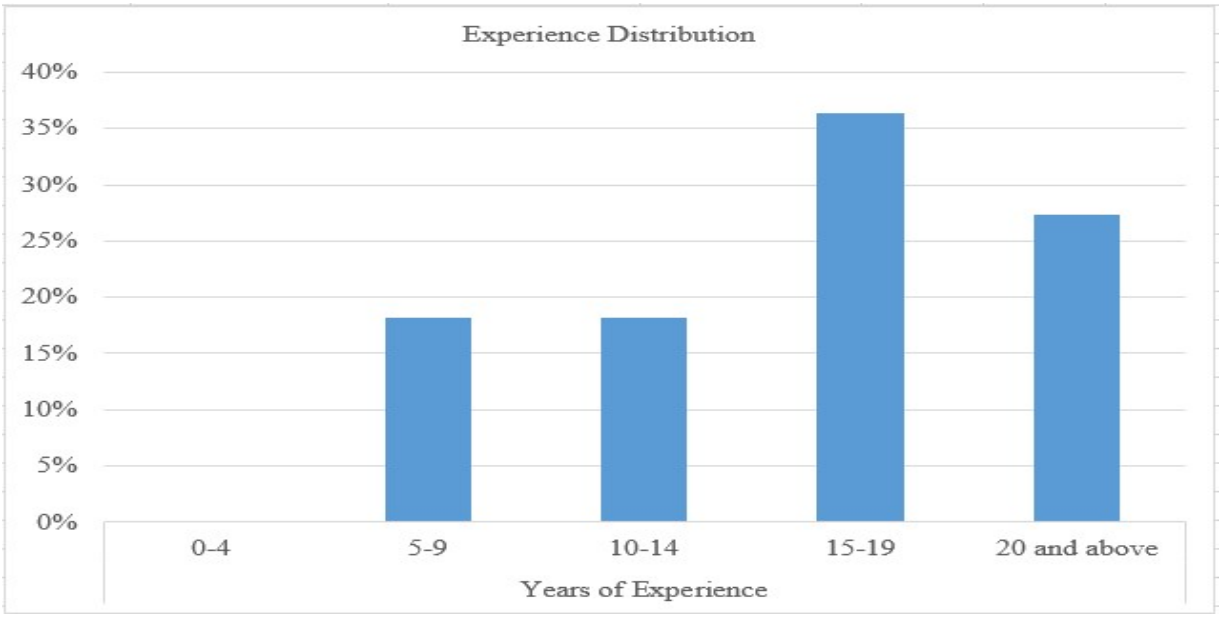

Figure 4.4: Construction industry experience distribution

4.2.5 Highest Qualifications

Figure 4.5 below shows the qualifications distribution of the respondents. Apparently 45% of the respondents had an undergraduate degree qualification. None of the respondents had a qualification higher than a postgraduate degree.

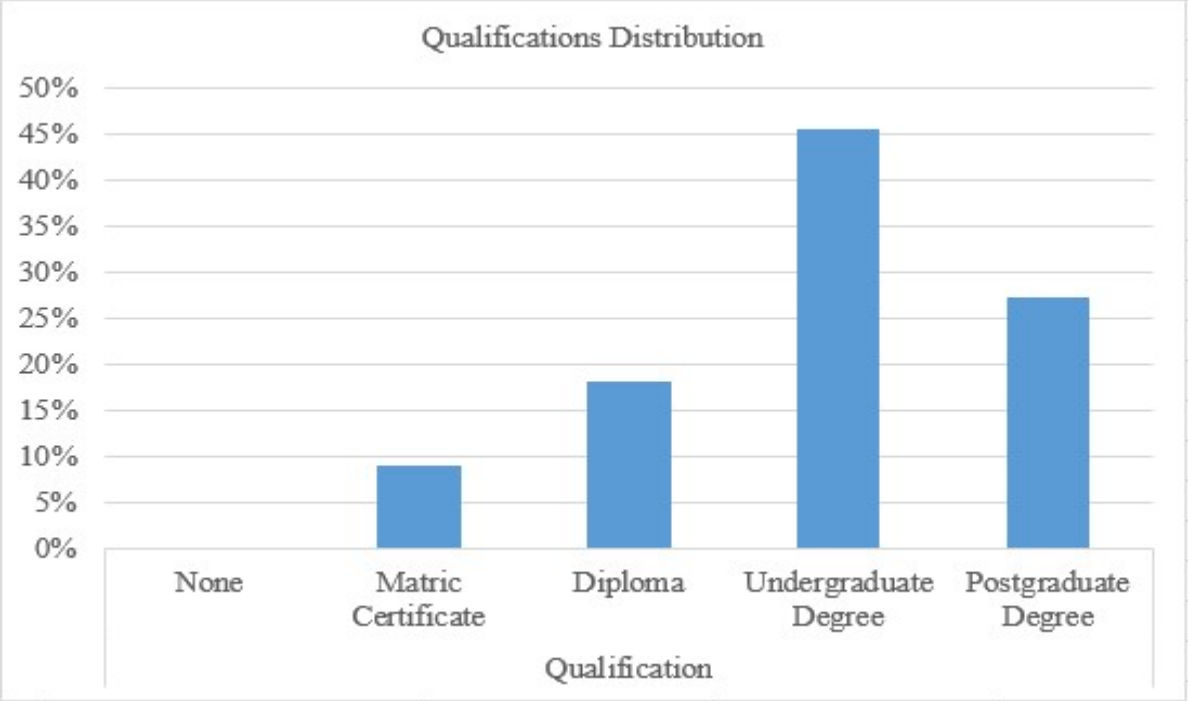

Figure 4.5: Qualification Level

4.2.6 Occupational Status

Figure 4.6 below shows that the majority of the respondents were Directors followed by senior staff and junior staff. Apparently, there were no trainees that responded to the research.

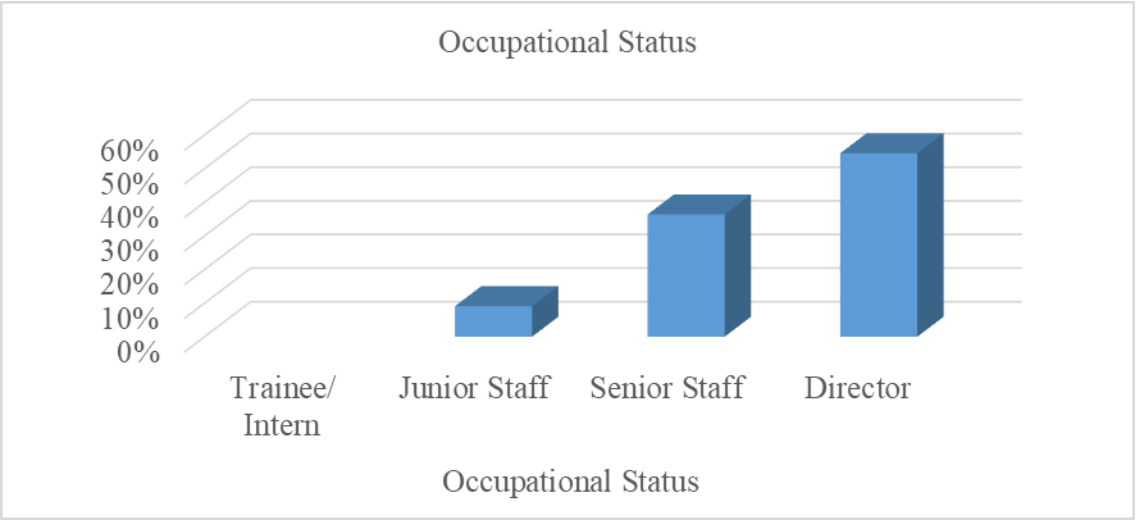

Figure 4.6 – Occupational Status

4.2.7 Association of Demographic Data

Table 4.2 below depicts the demographic variables that are associated with each other in terms of significant and not significant. There is a 60% significant association out of its 10 relationships identified.

Demographics	Sector distribution	Respondents Gender	Experience	Highest Qualifications	Occupational Status
Sector distribution	-	-	-	-	-
Respondents Gender	Not Sig	-	-	-	-
Experience	Not Sig	Sig	-	-	-
Highest Qualifications	Not Sig	Sig	Sig	-	-
Occupational Status	Sig	Not Sig	Sig	Sig	-
Total	1	2	2	1	0

Table 4.2 Association of Demographic data

4.3 Assessing the current understanding of obsolescence in infrastructure projects.

The main focus for objective number one was to assess the current understanding on the subject of obsolescence in the South African context. This included finding out the main causes of obsolescence with a bias towards Hospitals. The results are illustrated in Table 4.3 below.

Current understanding of obsolescence	No of respondents	Percentage
Yes	2	18%
Maybe	8	73%
No	1	9%
Total	**11**	**100%**

Table 4.3 - Current understanding of obsolescence

Table 4.3 above shows that the majority of respondents are not clear on their understanding of the subject of obsolescence, with a few either sure or not knowledgeable on the subject of obsolescence.

Most of the research subjects stated that they are aware of physical wear and tear in the form of depreciation and not in obsolescence. It seems the term ‘obsolescence’ is not a well-known subject in South Africa. However, are aware of the various types of obsolescence with physical wear and tear being the most common.

4.3.1 Testing the lack of political will and changes in population hypotheses using the rescaling method.

According to Crafford (2007) while citing Brendixon and Sandler, researchers need to rescale the data when using the Likert scales. This enables the researcher to decipher the data easily. It is in compliance with this school of thought that rescaling of data was conducted.

Questionnaire reference	Descriptions	Percentage (%)	Rank
8.12	Lack of political will to support hospital PPPs.	76%	1
8.13	Variability of output over time. Changes in population demographics over time.	68%	2
8.2	Increased competition from private hospitals, which are better maintained and have the latest technology	64%	3
8.5	Greater capacity of new infrastructure	60%	4

Table 4.4 Prospective cause of obsolescence

Table 4.4 above shows that lack of political will is the largest cause of obsolescence in PPPs, followed by changes in demographics over time. We therefore accept both hypotheses that were tabled in chapter 1 of this research.

4.3.2 Comparison of South African legislation with international best practice on the subject of obsolescence

According to Mckee et al (2006) the two leading countries in terms of procuring infrastructure projects through PPPs are Australia and the United Kingdom. Mckee et al (2006) goes on to assert that these two countries have developed the most diverse range of models with differing versions in several states. It is in light of this knowledge that the researcher chose to compare South African legislation to the Australian and British legislation on the subject of obsolescence. Table 4.5 below shows the comparison between

South African legislation with regards to obsolescence and the Publicly Available Specification (PAS 55-1:2008) published by the British Standards International.

Item	Type of Obsolescence	South African Legislation	International legislation	Comments
1	All types of obsolescence	To effectively manage assets, South Africa has a standard prepared by the CIDB called the *CIDB Maintenance Management Standard.*	Internationally there is the International Asset Management Plan. Publicly Available Specification (PAS 55-1:2008)	
		Core requirements of the *CIDB Maintenance Management Standard*	***Core requirements of the Publicly PAS 55-1: 2008***	
2	All types of obsolescence	Asset Care Objectives, strategies and planning	Asset Management strategy, objectives and plans	Similar in nature
3	All types of obsolescence	Maintenance of the value vested in immovable asset portfolios	Asset Management enablers and controls	Similar in nature
4	All types of obsolescence	Maintenance Delivery	Implementation of Asset Management Plan	Similar in nature
5	All types of obsolescence	Incidence Responses	Contingency Planning	Similar in nature
6	All types of obsolescence	Risk Management	Risk Management	Similar in nature
7	All types of obsolescence	Asset Rationalisation and Portfolio Optimisation	Performance Assessment and Improvement	Similar in nature
8	All types of obsolescence	Management Review, Audit and Assurance	Management Review	Similar in nature

Table 4.5- Comparison of South African Legislation to International best practice (Created by researcher).

In terms of addressing climate induced obsolescence South Africa has various pieces of legislation that address climate change such as Global warming bill and other sustainability

causes and councils. One such council that aims to reduce carbon emissions in buildings right from construction throughout the life of the building is the Green Building Council of South Africa whose sole aim is to develop market-based green building solutions for the transformation of the South African property industry. Similarly, Australia and the United Kingdom have their own Councils that also champion the same agenda. Collectively they formed what is referred to the World Green Building Council where they share ideas based on their experiences.

On the issue of Economic Obsolescence, South African PPP contracts just like those entered into in Australia and the United Kingdom which have clauses that guarantee, the following:

- Minimum aggregate demand, so that the projects are viable for the concessions should aggregate demand for the infrastructure fall below break-even point.
- Payments are made on the number of patients treated over and above the minimum demand guaranteed.

From Table 4.5 above, it seems that South African legislation with regards to obsolescence is in every way similar to international best practice. It is in light of this that the researcher can assert that any obsolescence that occurs in South African hospitals would not be as a result of flaws legislation as it is at par with international best practice. Unless international best practice is flawed.

4.3.3 Causes of obsolescence in PPP projects

Respondents were asked to rank the causes of obsolescence (list derived from previous literature review) whose results are tabulated in table 4.6 below. Table 4.6 below shows that the lack of political will to support PPPs was the main cause of obsolescence in hospitals.

Item No	Description	Mean Score	Standard Deviation
1	Changes in regulations by governments and municipalities	2,40	0,80
2	Increased competition	3,20	0,75
3	Changes in market conditions	2,20	0,98
4	Improved efficiency of infrastructure	2,00	1,26
5	Greater capacity of new infrastructure	3,00	0,63
6	Physical deterioration (Wear and tear)	2,80	1,33
7	Social forces/ pressure groups	1,80	0,75
8	Climate induced obsolescence	1,60	0,80
9	Injudicious design by professional consultants.	1,60	0,80
10	Poor workmanship by contractors which reduces the life span of buildings.	1,80	0,98
11	Inability to perform the function for which it was designed.	2,60	1,36
12	Lack of political will to support hospital PPPs.	3,80	1,17
13	Variability of output over time. Changes in population demographics over time.	3,40	1,02
14	Live hospital regulations that restrict construction maintenance work.	2,20	1,60
15	Changes in currency exchange rates that result in concessions not affording to service equipment acquired abroad.	2,20	1,60

16	Any other please specify…….....	1,80	0,98

Table 4.6: Causes of obsolescence (created by the researcher)

4.3.4 Challenges caused by obsolescence in hospital PPPs.

Table 4.7 below shows the list of challenges that were caused by PPPs, respondents were asked to rank them according to their prevalence in the projects that they worked on. Table 4.7 shows that loss of production is the leading challenge caused by obsolescence followed by job cuts and brain drain.

1	Description	Mean Score	Standard Deviation
1	Brain Drain- (professionals leaving the hospitals due to obsolete infrastructure)	4,60	1,96
2	Poor service delivery	3,40	1,85
3	Loss of production	5,00	1,90
4	Higher costs of alternative emergency measures needed during breakdowns	2,60	1,85
5	Higher costs of unbudgeted replacement of infrastructure	3,20	2,23
6	Job losses	4,80	1,83
7	Hospitals failing to meet health targets.	4,00	2,00
8	Unhealthy hospital environments that are not well managed, which end up spreading diseases.	3,00	2,19
9	Other (specify)…… …… ……	2,10	2,40

Table 4.7: Challenges caused by obsolescence

4.3.5 Remedies for curbing the prevalence of obsolescence in hospital PPP projects

In Table 4.8 below, respondents were asked to rank the remedies that can be used to curb obsolescence in PPP projects, mainly in hospitals. The respondents overwhelmingly stated

that the best way to curb obsolescence was through making flexibility a design goal, followed by actions in maintenance.

Item	Description	Mean Score	Standard Deviation
1	Making flexibility a design goal	4,00	1,26
2	Actions in construction- such a Total Quality Management	3,80	0,98
3	Actions in operations and maintenance	4,00	0,63
4	Adapting for reuse	3,20	0,98
5	Penalty clauses by private parties for surges in patients demand for health care.	2,60	1,02
6	Applying the penalty clause so as to ensure that concessions stick to the Operational Interface Agreement.	2,80	1,33
7	Construction of more hospitals to reduce aggregate demand for current PPP hospitals.	3,40	1,02
8	Making do with existing hospital PPP facilities.	2,60	1,02
9	Improving eHospital services so that patients can be diagnosed over the internet (ie video calls, logging symptoms on applications) thereby reducing aggregate demand for hospital beds in cases where patients are not serious.	3,20	0,98
10	Other (specify).....	2,80	0,98

Table 4.8 – Remedies for curbing obsolescence

4.4 The Chi – Square Goodness of fit test

The researcher conducted the Chi – Square goodness of fit test on all of the questionnaire variables except for the open-ended questions. According to Hoy (2009), the reason for carrying out the Chi- Square goodness of fit test is for determining the number of cases there would be if the sample data were distributed according to the claim. The following hypotheses were assumed when conducting this test and they are:

- Null Hypothesis (H_0) – The observed number of cases is similar to the expected number of cases. Alternatively, there is no difference between the observed and the expected.
- Alternative Hypothesis (H_1) – there is a significant difference between the observed and expected cases to reject the null hypothesis.

Questionnaire Reference	Description	Result of the Chi - Square Goodness Fit test	Value
8.1	Changes in regulations by governments and municipalities	Not sig	0
8.2	Increased competition	Not sig	0
8.3	Changes in market conditions	Not sig	0
8.4	Improved efficiency of infrastructure	Not sig	0
8.5	Greater capacity of new infrastructure	Not sig	0
8.6	Physical deterioration (Wear and tear)	Not sig	0
8.7	Social forces/ pressure groups	Sig	1
8.8	Climate induced obsolescence	Sig	1
8.9	Injudicious design by professional consultants.	Sig	1
8.10	Poor workmanship by contractors which reduces the life span of buildings.	Sig	1
8.11	Inability to perform the function for which it was designed.	Not sig	0
8.12	Lack of political will to support hospital PPPs.	Not sig	0
8.13	Variability of output over time. Changes in	Not sig	0

	population demographics over time.		
8.14	Live hospital regulations that restrict construction maintenance work.	Sig	1
8.15	Changes in currency exchange rates that result in concessions not affording to service equipment acquired abroad.	Sig	1
9.1	Brain Drain- (professionals leaving the hospitals due to obsolete infrastructure)	Not sig	0
9.2	Poor service delivery	Not sig	0
9.3	Loss of production	Not sig	0
9.4	Higher costs of alternative emergency measures needed during breakdowns	Not sig	0
9.5	Higher costs of unbudgeted replacement of infrastructure	Not sig	0
9.6	Job losses	Not sig	0
9.7	Hospitals failing to meet health targets.	Not sig	0
9.8	Unhealthy hospital environments that are not well managed, which end up spreading diseases.	Not sig	0
10.1	Making flexibility a design goal	Not sig	0
10.2	Actions in construction- such a Total Quality	Not sig	0

	Management		
10.3	Actions in operations and maintenance	Not sig	0
10.4	Adapting for reuse	Not sig	0
10.5	Penalty clauses by private parties for surges in patients demand for health care.	Not sig	0
10.6	Applying the penalty clause so as to ensure that concessions stick to the Operational Interface Agreement.	Not sig	0
10.7	Construction of more hospitals to reduce aggregate demand for current PPP hospitals.	Not sig	0
10.8	Making do with existing hospital PPP facilities.	Not sig	0
10.9	Improving e-hospital services so that patients can be diagnosed over the internet (i.e. video calls, logging symptoms on applications) thereby reducing aggregate demand for hospital beds in cases where patients are not serious.	Not sig	0

Table 4.9 – Chi – Square goodness of fit test

4.5 Chapter Summary

This chapter presented the findings of the research of all the objectives. Starting with the causes of obsolescence, comparison of South African Legislation to international best practice, the challenges caused by obsolescence within the South African context and lastly the ways of mitigating or reducing and even eradicating obsolescence. Discussions, conclusions and recommendations are discussed in chapter five.

CHAPTER FIVE - INTERPRETATION OF FINDINGS, DISCUSSION AND CONCLUSION

5.1 Introduction

This chapter concludes the research report. It presents a summary of the research findings on the subject of 'Obsolescence' in PPP projects with a focus on hospitals. The researcher had intended to assess the causes of obsolescence in hospital PPPs, to compare South African legislation to international best practice with regards to obsolescence, to investigate the current challenges caused by obsolescence and lastly to provide remedies that can be used to curb obsolescence in hospital PPPs.

5.2 Summary of Findings

The respondents that were involved in the study were composed of Project Managers, Contractors, Facilities Managers and clients (government departments). There was a 39% response rate which was considered adequate for the research. The study revealed that 45% of the respondents were females, while this may seem like a high a figure, it shows that the industry still shows that there is still a shortfall in women involvement in the PPP industry. The respondents also had at least 5 years work experience. The research also revealed that the respondents were fairly educated as the least educated respondent had a matric and the highest a postgraduate qualification.

5.2.1 Causes of obsolescence

The first objective sought to assess the causes of obsolescence within the South African PPP hospitals and it revealed the following:

- Lack of political will by the government in supporting or promoting PPPs within the health sector,

- Variability of output over time, caused by changes in population demographics over time.
- Increased competition

Political will has a major influence on the performance of PPPs, this was in line with the findings from Schmiede (2005) as well as Montagu and Harding (2012) and Espirages and Torres (2009). Schmiede (2005) asserted that the policy intent needs to be overt and bipartisan. That is without government bureaucratic commitment to the model. Political will in support of PPPs means that there must be some form of goodwill and common sense, otherwise there will be adversity between the parties to the PPP contract. Akin to Schmiede (2005), Montagu and Harding (2012) painted a clear picture when they asserted that PPP hospitals are political rather than marketplace. Montagu and Harding (2012) and Espirages and Torres (2009) back up their assertion by stating that the risks of PPP hospital success are often more due to uncertainty about long term compliance with payment rather than market demands. The lack of political will means less resources are channelled to the PPP contract hence failure will be inevitable.

Changes in population and technology have an impact on the performance of hospitals. Equipment and buildings tend to deteriorate much quicker when they are constantly used. However, since concessions have maintenance that they would have planned and budged for, they would be required to maintain them in much shorter intervals i.e. more times than the budgeted maintenance. This is a huge financial burden on the parties to the contract as they are now forced to meet these unbudgeted costs. South Africa has been affected by huge migration both from the Apartheid era to post independence (Siddique 2004); this has placed a huge burden on its medical facilities as they have to handle higher than normal patients. Even though PPPs are designed to cater for gradual increases in population, however they

cannot meet surges in population. This is in line with the assertions from the Health Minister Motsoaledi (2018).

5.2.2 Comparison of South African legislation on obsolescence to international best practice

The comparison carried out in Chapter four revealed that South Africa's legislation on obsolescence is at par with international best practice. However, there is lack of implementation of the legislative instruments by government officials to ensure obsolescence does not occur or is kept at an absolute minimum. There are numerous speculative theories on why South Africa does not or fails to implement some of its legislative instruments and they are:

- Lack of qualified personnel in government that can implement or administer contracts properly. This has always been a bone of contention especially on the issue of political appointees heading critical government departments. This is in line with Abuzaineh et al (2018) who asserted that the area of identifying and maintaining clinical standards is a major challenge for many governments world over. Abuzaineh et al (2018) assert that the enforcement of clinical quality and performance standards is an integral component of the integrated PPP model.

  According to Abuzaineh (2018), PPPs are typically managed by governments at the national or subnational level due to their complexity and legal as well as financing requirements. There is a shortage of skilled personnel in government departments who have enough skills to manage PPPs. The problem lays in the fact that the dedicated PPP unit in the Department of Finance in most instances only negotiates with concessions during the formation of the PPP. Departments are then left manage PPPs with employees that do not have the necessary skills.

- Corruption – Government employees taking bribes so that they do not enforce legislation, this is in line with the findings from Robertson et al (2012), who stated that there is little risk for a private partner to be taken to court should they breach certain parts of the PPP contract. Government agents, for political reasons tend to avoid raising public complaints against private partners as this would also expose their own incompetence.

5.2.3 Challenges caused by obsolescence

The study revealed that loss of production is the major challenge of obsolescence. In the hospital PPP obsolescence demoralises employees, creates hazardous working and clinical environments and in the case of dysfunctional equipment patients will have to be referred to other hospitals. All these factors mean that service or health care delivery is reduced to an absolute minimum as obsolescence rears its ugly head. Hospital's ability to meet design service delivery parameters is reduced significantly.

The study also revealed that obsolescence also leads to job losses. As productivity within hospital PPPs reduces, it means that payments to the concessions are also reduced as a certain portion of the repayments is based on the number of patients serviced. Once concessions start making losses and this situation is not addressed, they will obviously respond by cutting costs. Always the first cost cutting measure in any exercise is reduction of the labour force, this has been demonstrated in many organisations and governments as they implement austerity measures.

5.2.4 Remedies that can be used to curb obsolescence

The research established that to solve the occurrence of obsolescence in PPP particularly in the health sector, the powers that be need to:

- Make flexibility a design goal;

- Actions in operations and maintenance;

5.2.4.1 Making flexibility a design goal

This was in-line with findings from Iselin and Lemer (1993), where they concluded that buildings need to be flexible enough to allow for changes in the future. Hospitals are the most susceptible to obsolescence as they have to endure changing demographics and disease patterns. In the 21st century, flexibility in design has even become more important especially in the area of medical equipment where they are forever advancing in response to chronic disease patterns. This has not only challenged parties to PPP contracts to continuously change equipment but also change the layout of the hospitals to accommodate equipment whose sizes and design constantly changes.

5.2.4.2 Actions in operations and maintenance

The study revealed that South Africa has legislation that is more or less similar to international best practice. It is in light of this that the researcher deduced that the problem lay with the implementation of the legislation which is more of the contract management side of hospitals. This was in line with the findings from Bothma and Cloete (2000) as revealed in the literature review. Although Bothma and Cloete (2000) were referring to hospitals procured through the traditional method, they asserted that there is a 'bad culture' of not maintaining hospitals in South Africa. Bothma and Cloete (2000) went further to state that there was a lack of vision especially on government officials regarding the maintenance of hospitals and its long-term effects.

However, PPPs are managed by private concessions who have their own maintenance systems different from Government run hospitals. Lack of maintenance of PPP facilities cannot be as a result of the concession's failure to maintain hospitals as their counterparts in the fully privatised hospitals seem to be providing a high quality of service.

The major cause of lack of maintenance could be the issue of crowding which leads to intense utilisation of PPP facilities. This reason is in line with the findings from the Victoria Auditor General (2003) though referring to medical equipment.

5.3 Chi - Square Goodness of fit test

As explained earlier, the Chi – Square goodness of fit test conducted in chapter 4, sought to determine the difference between the observed data and the expected normal distribution data. Table 4.9 depicts that 6 out of 31 variables clearly indicate that the difference between the observed and expected normal distribution data is significantly different. This means that a circa 81% of the variables depict that there is no significant difference between the observed data and the expected normal distribution data. Therefore, the researcher concludes that the results are a clear representation of the South African situation since they relatively resemble the expected normal distribution.

5.4 Contributions of the study to the Construction Industry and Academia

5.4.1 To the Construction Industry

The research has added to the limited body of knowledge on the subject of obsolescence in PPP projects. The research identified the factors are crucial in order for PPP projects to be free from obsolescence. Construction industry personnel will be more informed when entering or managing hospital PPP projects. The research further recommends that PPPs be trusted into the hands of “construction” professionals akin to the traditional method of procurement. As with most PPPs globally, PPPs in South Africa are mostly led by lawyers who in most instances delay if not stall the process of negotiations. There is therefore a need for the PPP model of procurement to be used more in the construction industry so that professionals can develop in-depth understanding on the subject matter.

5.4.2 To Academia

The research revealed the lack of skilled personnel required to evaluate the performance of PPPs at the most basic level, lack of design flexibility in hospital designs and poor actions in maintenance. While the research recommended that:

1. there is a need for up- skilling existing PPP evaluators with the necessary knowledge to evaluate hospital PPP performance,
2. making design flexibility a goal so that PPP hospitals can respond to changes in populations and subsequently healthcare.

In hindsight there is a need for academia to research further how both the South African government and the private sector can come up with an "Independent-Evaluator" who can evaluate PPP performance in the interest of the public.

5. 5 Conclusion of the study

The research identified that there is a need to allow for design flexibility in hospital PPPs. Flexibility allows the building to respond to changes the changing needs of the occupants, which require the internal layout of buildings to be rearranged throughout the life of the PPP hospital. However, one of the respondents in the open-ended section of the questionnaire also identified adaptable building. Adaptable building is a building whose design and construction takes into consideration how it can be altered to lengthen its lifecycle. The research therefore identified that there is therefore a serious need for design teams to design hospital PPPs in a manner that makes them flexible and adaptable so as to reduce obsolescence. This is to address issues to do with changes in disease patterns, dynamic shifts in demographics and hospital equipment technological changes.

The research further identified that there is need for actions operations and maintenance. Though the researcher acknowledges that PPP contracts have concessions that manage,

service and maintain hospitals. This is done according to the agreed service cycles, however excessive use of hospital facilities and equipment caused by crowding mean that the facilities and equipment are worn down much quicker. The solution to this would be for government to allow for budget adjustments to cater for shorter service cycles through renegotiating the contract. Again, this takes us back to the need for political will to support hospital PPPs.

For government to deal with crowding in the hospitals, they can renegotiate the PPP to ensure that the concession improves on patient turnaround times. This is so that patients are treated much quicker and they spend minimal time at the hospital facilities. The other option though very costly would be to build more hospital PPPs so as to address the issue of crowding.

It should however be noted that shortening the service cycles in the PPPs and improving turnaround times means government would be required to spend more on its repayments to the concessions. It is also important to note that hospitals, if maintained properly, may not be affected by locational obsolescence. The research also revealed that South African PPP contracts have not yet been affected by Economic Obsolescence, reason being none of them have been bailed out as has been witnessed in the United Kingdom and Australia.

Lastly, South African PPP hospitals have not yet been affected by climate change induced obsolescence, however it is worthwhile to prepare for it on all future developments. Climate change is growing global concern that does not discriminate nations. There is therefore a need for parties to PPPs to make them climate proof.

5.6 Limitations of the study

The researcher could not access executed PPP contracts for in-depth analysis. The concessions did state that they could not divulge such information for public or academic research purposes citing commercial secrecy. This presents a challenge especially on

contracts that involve government and also the fact that PPP procurement is in direct competition with the traditional method of procurement.

There is therefore a need for PPP contracts to be placed in the open in the same manner that traditional procurement contracts are subject to public and academic scrutiny. This ensures accountability in procurement of government contracts, as it stands the public will never know for sure if they are receiving Value for Money as required by South African legislation. Access to contracts would have made it easier for the researcher to scrutinise the clauses that deal with contract management.

5.7 Suggestions for Future Study

There is a need for in-depth studies on the subject of obsolescence for individual PPP categories. The researches could be split into the following:

1. Services PPPs
2. Finance/ Facility
3. Combined
4. Co – location

Due to their very nature, facilities procured through the different categories of PPPs experience different types of obsolescence at different times within their lifecycles. Further to this, there is a need for an investigation on the reason(s) why there is lack of political will to support PPPs in South Africa. The lack of political will in support of PPPs is not a new phenomenon that is specific to the South African context. Another area of future study would be the impact of constant changes in technology on hospital equipment, today's world is now that of telehealth, robotic surgery (i.e. cyber knife) and point of care diagnostics. Finally, more research needs to be carried out on how PPP hospitals can be future proofed i.e. future hospitals will need electric car charging stations in their parking spaces.

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APPENDIX 1

INFORMED CONSENT

UNIVERSITY OF THE WITWATERSRAND

SCHOOL OF CONSTRUCTION ECONOMICS AND MANAGEMENT

Master of Science in Building in the field of Project Management in Construction

PROJECT TITLE

The impact of obsolescence on Public-Private Partnership projects

NAME OF RESEARCHER : BRIGHTON MUKUVARI

EMAIL : 787530@students.wits.ac.za

CELLPHONE : 071 988 1109

SUPERVISOR : DR NTHATISI KHATLELI

SUPERVISOR'S EMAIL : nthatisi.khatleli@wits.ac.za

INFORMED CONSENT SECTION- PLEASE TICK THE APPROPRIATE BOX

1. I have read and understood the requirements of the research questionnaire and my participation is voluntary •

2. I have the right to pull out or revoke my participation at any time without the need to explain myself. •

3. The researcher has notified me that all responses (data) will be kept confidential. University staff and academic students will only access coded information which will not show any names of individuals or organisations. •

4. All responses will be scanned and stored in a password locked external hard drives or cupboards. •

5. I have the right to report to the researcher's supervisor Dr Khatleli if I feel the researcher has not done things according to the issues outlined above at any time without fear of victimisation.

Any other issue(s) that the participant feels need to be addressed, please state below.

…….

…….

…….

…….

By signing below, you are have voluntarily agreeing to take part in the research and you state that you were not in any way misrepresented, coerced or placed under duress and are above the legal age of 18 years prior to taking part in the research.

Name of participant Date

…….

…….

APPENDIX 2

INFORMATION SHEET

INFORMATION DOCUMENT

Research title:

The Impact of obsolescence on Public Private Partnership projects.

Greeting:

You are hereby invited to take part in the research. Please make sure you have read and understood the reasons for carrying the research, please feel free to consult your colleagues on issues you may not be comfortable.

Introduction:

The postgraduate research is being carried out with the purpose of investigating the impact of obsolescence on Public Private Partnership projects. The findings and recommendations of the study will assist the South African construction industry with better ways of implementing PPP infrastructure projects. The following are the objectives of the study:

1. To assess the current understanding of obsolescence;
2. To compare the South African legislation with international best practices with regards to obsolescence;
3. To investigate the current challenges caused by obsolescence;
4. To investigate the remedies that can be used to curb obsolescence in Public Private Partnership projects.

Invitation to participate:

We are pleased to invite you to take part in the research, you may decline the offer if you choose.

What is involved in the study?

We require you answer the questionnaire in full. We anticipate that there will be thirty-six participants who have been involved in Public Private Partnership projects within South Africa. The questionnaire is made up of general information, current understanding of obsolescence, comparisons of the South African legislation with international best practices specifically on obsolescence, the current challenges caused by obsolescence as well the remedies that can be used to curb obsolescence in Public Private Partnership projects.

The findings from this study will not in any way identify any names of individuals or organisations. The findings will be shared with you if you are willing.

Risks

You will be required to share demographic details about yourself, your organization and the project for data validation and clarification purposes. Information will remain private and confidential.

Benefits of being in the study.

Your participation in this survey, will improve our frontiers of knowledge on obsolescence in Public Private Partnerships projects particularly hospitals.

Alternative procedures or courses of treatment that might be advantageous to the subject.

Voluntary participation, refusal to participate will not in any way be held against you therefore you will suffer no financial loss. Please be advised that you may discontinue your participation should you choose to do.

Reimbursements

This is a research study conducted solely for academic purposes; therefore, respondents will not be reimbursed in any way.

Confidentiality:

All information or responses from the participants will be kept strictly confidential. All information will be stored in an external hard drive which is protected by password. The hard drive will be formatted a year later. The School of Construction Economics and Management (SCEM) at the University of the Witwatersrand may inspect research responses for quality assurance purposes. The research may be published in the Wits library by the SCEM.

Researcher's contact details- if you require any additional information or have any queries

Name: Brighton Mukuvari
Email:*787530@students.wits.ac.za*
Cell: 0719881109

APPENDIX 3

RESEARCH QUESTIONNAIRE

Dear sir/ madam 29 May 2018

REF: The Impact of Obsolescence on Public- Private Partnership Projects

This survey is part of the Master of Science in Building dissertation which seeks to find out the impact of obsolescence on public-private partnerships projects. The dissertation is in partial fulfilment of the requirements of the MSc (Building) in the field of Project Management in Construction at the University of the Witwatersrand. The research aims to understand the current treatment and appreciation of obsolescence in Public-Private Partnerships with a focus on Hospitals.

We would be grateful for your response. Please note that all the information will be treated as confidential. Your response will assist on the limited body of knowledge particularly in the field of obsolescence in PPPs.

Brighton Mukuvari

Cell: 071 988 1109

Or via email: bmukuvari@yahoo.co.uk or 787530@students.wits.ac.za

Regards

Brighton Mukuvari

RESEARCH QUESTIONNAIRE

The Impact of Obsolescence in Public Private Projects

Section 1: DEMOGRAPHIC INFORMATION

1. Please indicate the construction Industry stakeholder you represent

- General Contractor
- Client
- Professional Consultant

2. Please indicate your position in your organisation.

- Director
- Trainee/Intern
- Senior Staff
- Junior Staff

3. Please indicate the size of the practice you work for

- 1-5 people
- 6-10 people
- 11-20 people
- 21-30 people
- Greater than 30 people

PERSONAL

4. Please indicate the age category you fall in?

- 20-24 years
- 25-34 years
- 35-44 years
- 45-54 years
- 55 or more

5. Please indicate your gender

- Male
- Female

6. Please state how many years you have been involved in the construction industry

- Less than 5 years
- 5-9 years
- 10 to 14 years
- 15-20 years
- More than 20 years

7. What is your highest formal qualification?

- None
- Matric Certificate
- Diploma
- Undergraduate Degree
- Postgraduate

Section 2

Assessing the current understanding of obsolescence

7. Are you well versed with the subject of obsolescence in in infrastructure?

- Yes
- No

8. The following list has been drawn up from previous researches as the main causes of obsolescence. Rate each of them according to the frequency in which they occur on your projects.

Item No	Description	Very Low Frequency	Low Frequency	Average Frequency	High Frequency	Very High Frequency
8.1	Changes in regulations by governments and municipalities					
8.2	Increased competition from private hospitals, which are better					

	maintained and have the latest technology					
8.3	Changes in market conditions					
8.4	Improved efficiency of infrastructure					
8.5	Greater capacity of new infrastructure					
8.6	Physical deterioration (Wear and tear)					
8.7	Social forces/ pressure groups					
8.8	Climate induced obsolescence					
8.9	Injudicious design by professional consultants.					
8.10	Poor workmanship by contractors which reduces the life span of buildings.					
8.11	Inability to perform the function for which it was designed.					
8.12	Lack of political will to support hospital PPPs.					
8.13	Variability of output over time. Changes in population demographics over time.					
8.14	Live hospital regulations that restrict construction maintenance work.					
8.15	Changes in currency exchange rates that result in concessions not affording to service equipment acquired					

	abroad.					
8.16	Any other please specify…… …… ….....					

Section 3

Challenges caused by obsolescence

Item No	Description	Very Low Frequency	Low Frequency	Average Frequency	High Frequency	Very High frequency
9.1	Brain Drain- (professionals leaving the hospitals due to obsolete infrastructure)					
9.2	Poor service delivery					
9.3	Loss of production					
9.4	Higher costs of alternative emergency measures needed during breakdowns					
9.5	Higher costs of unbudgeted replacement of infrastructure					
9.6	Job losses					
9.7	Hospitals failing to meet health targets.					
9.8	Unhealthy hospital environments that are not well managed, which end up spreading diseases.					
9.9	Other (specify)……. …… …… ……					

9. The following have been identified as the challenges caused by obsolescence in infrastructure. Please rank them according to their frequency on your projects.

Section 4
Remedies for curbing obsolescence in Hospital PPP infrastructure projects
10. Please rank the following ways of mitigating the occurrence of or effects of obsolescence

Item No	Description	1	2	3	4	5
10.1	Making flexibility a design goal					
10.2	Actions in construction- such a Total Quality Management					
10.3	Actions in operations and maintenance					
10.4	Adapting for reuse					
10.5	Penalty clauses by private parties for surges in patients demand for health care.					
10.6	Applying the penalty clause so as to ensure that concessions stick to the Operational Interface Agreement.					
10.7	Construction of more hospitals to reduce aggregate demand for current PPP hospitals.					
10.8	Making do with existing hospital PPP facilities.					
10.9	Improving e-hospital services so that patients can be diagnosed over the internet (i.e. video calls, logging symptoms on applications) thereby reducing aggregate demand for hospital beds in cases where patients are not serious.					
10.10	Other (specify)……					

APPENDIX 4

ETHICS CLEARANCE CERTIFICATE

School of Construction Economics & Management

University of the Witwatersrand, Johannesburg -PO Box 20, Wits 2050, South Africa • Tel: +27 (0)11 717 7652/77669 · Fax: +27 (0)11 717 9729 Email:CEM@wits.ac.za

SCHOOL OF CONSTRUCTION ECONOMICS AND MANAGEMENT RESEARCH ETHICS COMMITTEE

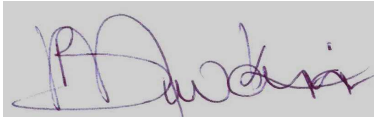
CLEARANCE CERTIFICATE	**PROTOCOL NUMBER CEM/18/05/BM**
PROJECT TITLE	The Impact of Obsolescence on Public- Private Partnership Projects industry.
INVESTIGATOR	**Brighton Mukuvari 787530**
SCHOOL/DEPARTMENT	**SCHOOL OF CONSTRUCTION ECONOMICS AND MANAGEMENT**
DATE CONSIDERED	18 May 2018
DECISION OF THE COMMITTEE	Approved conditionally with respect to the declaration
EXPIRY DATE	19 May 2019
DATE	18 May 2018
ACTING CHAIRPERSON	Mrs T Ramantswana

cc: Supervisor : Dr Nthatisi Khatleli

DECLARATION OF INVESTIGATOR (S)

To be completed in duplicate and **ONE COPY** returned to the Secretary Mrs. M. Sithole at the CEM reception desk.

I/We fully understand the conditions under which I am/we are authorized to carry out the abovementioned research and I/we guarantee to ensure compliance with these conditions. Should any departure to be contemplated from the research procedure as approved I/we undertake to resubmit the protocol to the Committee. **I agree to completion of a yearly progress report.**



Signature **Date** **_04_____/01_____/2019_____**