An Integrated Management Strategy to Reduce Time and Cost Overruns on Large Projects

by Sitwala JS Simushi

Dissertation presented for the Degree of Doctor of Philosophy in the Faculty of Engineering, at Stellenbosch University

Supervisor: Prof Jan Wium

December 2017

Declaration

By submitting this dissertation electronically, I declare that the entirety of the work contained therein is my own, original work, that I am the sole author thereof (save to the extent explicitly otherwise stated), that reproduction and publication thereof by Stellenbosch University will not infringe any third-party rights and that I have not previously in its entirety or in part submitted it for obtaining any qualification.

S Simushi

December 2017

Abstract

The completion of projects beyond their budgets and scheduled times is one of the biggest problems faced by many infrastructure projects today. Large infrastructure projects are the most affected by these overruns. Some projects have cost overruns of the order of 200 – 400% more than their planned estimates or contract values. Previous research has focused on identifying the most significant causes of time and cost overruns on projects in general and addressed solutions to the individual problems. Few scholars have carried out research in the management of large projects and how the implementation of a project management strategy could be used to reduce time and cost overruns and improve the delivery of these projects. In this research, the aim was to study how the actions of a project team in a large construction project affect the delivery of projects and to develop a project management strategy for the project owner to use on these types of projects.

The research focused on understanding the management of large infrastructure projects and how its dynamics affect performance of a project team. It then investigated how the performance of a project team is related to competence and preparation for the project. The research finally provided a project management strategy that could be used in the delivery of large construction projects in South Africa. The work was researched from the buyer's or client's point of view.

The methodology consisted of a thorough literature study, case studies and a questionnaire survey. Together, these components served to validate the findings and to support the proposal.

The solution consists of the management of the external, organization and project environments. This is to improve the collective project competence of the team for formulation and execution of large projects. The proposal includes the need for a high-level project organisation, a risk review board, early collaboration of stakeholders, and an increase in labour-based activities.

The research adds knowledge to the area of management of large projects and at the same time, integrates various concepts that were previously studied separately to provide a fresh look at the subject of management of projects. The research was focused in the Sub-Saharan region and South Africa in particular. It is hoped that the lessons and strategy formulated will be used in other developing countries.

Key words: large projects, management of large projects, project management strategy, project performance, project management competence, preparation for projects,

early contractor/supplier involvement, procurement, infrastructure, time and cost overruns, Sub-Saharan region, developing countries, South Africa.

Opsomming

Die afhandeling van projekte waarvan die begrotings oorskry word en die voltooiingsdatums nie nagekom word nie, is vandag van die grootste probleme waarmee infrastruktuurprojekte te kampe het. Dit is veral groot infrastruktuurprojekte wat die meeste deur hierdie oorskrydings geraak word. In sekere gevalle is projekoorskrydings tussen 200 en 400% meer as die beplande ramings of kontrakwaardes. Vorige navorsing beklemtoon die belangrikste oorsake vir tyd- en koste-oorskrydings ten opsigte van projekte in die algemeen en bied oplossings vir individuele probleme aan. Min navorsers het tot dusver die fokus op die bestuur van groot projekte laat val en gekyk hoe die implementering van ’n projekbestuurstrategie gebruik kan word om tyd- en koste-oorskrydings te verminder en groot projekte se afleweringstye te verbeter. Die oogmerk met hierdie navorsing is om die bestuur van groot infrastruktuurprojekte te ondersoek en ’n projekbestuurstrategie te ontwikkel wat gebruik kan word om verkryging vir groot konstruksieprojekte te vergemaklik.

Die navorsing fokus daarop om insig in die bestuur van groot infrastruktuurprojekte te bekom en te bepaal hoe ’n projekspan se dinamiek sy prestasie beïnvloed. Daar word vervolgens ondersoek ingestel na die mate wat ’n projekspan se prestasie met bekwaamheid en voorbereiding vir die projek verband hou. Ten slotte verskaf die navorsing ’n geldige besluitnemingsraamwerk waarvolgens ’n projekbestuurstrategie vir die lewering van groot konstruksieprojektegeformuleer kan word. Die werk word vanuit ’n aankoper en ’n kliënt se oogpunt nagevors.

Die metodologie behels ’n deeglike literatuurstudie, gevallestudies en ’n vraelysopname. Saam valideer en ondersteun hierdie komponente die studiebevindings en die aanbevelings.

Die oplossing bestaan uit die bestuur van die eksterne, die organisasie en die projek omgewings. Die doel daarvan is om die gesamentlike vaardighede van die projekspan te verbeter vir die formulering en uitvoering van groot projekte. Die spesifieke voorstel sluit in die nodigheid van ‘n hoë vlak projekorganisasie, ‘n raad om die risiko’s te beoordeel, vroeë samewerking van alle belanghebbendes, en ‘n toename in arbeids gebasseerde aktiwiteite.

Die navorsing verbreed nie alleen die kennisveldoor die bestuur van grootkontrakte nie, maar integreer ook verskeie konsepte wat voorheen afsonderlik bestudeer is,terwyl dit terselfdertyd ’n vars perspektief op die onderwerp projekbestuur bied. Die klem val spesifiek op die sub-Sahara-streek en Suid-Afrika. Die lesse en die strategie wat aangedui word, word as moontlike voorbeeld vir ander ontwikkelende lande voorgehou.

Sleutelwoorde: groot projekte, bestuur van groot projekte, projekbestuurstrategie, projekprestasie, projekbestuurbekwaamheid, projekvoorbereiding, vroeë kontrakteur-/verskafferbetrokkenheid, verkryging, infrastruktuur, tyd- en koste-oorskrydings, sub-Sahara-streek, ontwikkelende lande, Suid-Afrika.

Acknowledgements

I extend my gratitude and appreciation to the following people and organizations:

The Lord for helping me to carry out the study to the end with many a miracle along the way.

My supervisor, Professor Jan Wium for his relentless mentoring, guidance and patience throughout this research project.

Ms Phindile Khanyile for the assistance and organization of contacts for the power plant case study.

Case study contacts and questionnaire respondents for taking their time to attend the long interviews and answer questions in spite of their busy schedules.

Copperbelt University for the funding and opportunity to carry out the study.

My wife, Vestina for the support and patience in the long period of the study.

Department of Construction Engineering and Management, friends and colleagues for the encouragement and material support rendered throughout the study.

Dedications

To the project manager

Table of Contents

List of Figures

List of Tables

List of Abbreviations

ACC	Air Cooling Condensers
AIPM	Australian Institute of Project Managers
APM	Association for Project Managers
APMBOK	Association for Project Managers Body of Knowledge
ASAQS	Association of South African Quantity Surveyors
BAA	British Airways Authority
B. Arch.	Bachelor of Architecture
BEE	Black Economic Empowerment
B. Eng.	Bachelor of Engineering
BIM	Building Information Modelling
BS	British Standard
B. Sc.	Bachelor of Science
B. Tech.	Bachelor of Technology
C&I	Control and Instrumentation
CBE	Council of the Built Environment
CCTV	Closed-Circuit Television
CEO	Chief Executive Officer
CESA	Consulting Engineers South Africa
CIDB	Construction Industry Development Board
CMP	Construction Management Programme
CPD	Continuous Professional Development
DOE	Department of Education
EGAP	Everything Will Go According to Plan
EIA	Environmental Impact Assessment
EIAROD	Environmental Impact Assessment Record of Decision
EOI	Expressions of Interest

ESPRC	Engineering Physical Sciences Research Council
FGD	Flue Gas De-Sulphurisation
FIFA	Fédération Internationale de Football Association
ICB	International Competence Baseline
IMI	Innovative Manufacturing Initiative
IPMA	International Project Management Association
IPD	Integrated Project Delivery
IPPs	Independent Power Producers
ISO	International Standards Organisation
JBCC	Joint Building Contracts Committee
LCD	Liquid Crystal Display
MISTE	Member of Institution of Structural Engineers
PIO	Project Implementation Organisation
PMBOK	Project Management Body of Knowledge
PMI	Project Management Institute
PRMA	Project Risk Management Agency
PRMr	Project Risk Management Report
RIBA	Royal Institute of British Architects
SADC	Southern African Development Community
SAIA	South African Institute of Architects
SAICE	South African Institute of Civil Engineers
SIPDM	Standard for Infrastructure Procurement and Delivery Management
SOE	State Owned Enterprise
VIP	Very Important Person
UDZ	Urban Development Zone
UK	United Kingdom

Glossary of Terms

Checkbox	On-line questionnaire survey platform used by scholars at Stellenbosch University
Large project	A complex project costing more than R250m
Moratorium	A temporary suspension of issuing of new contracts
Overrun	A situation where an actual event takes longer or costs more than planned
Root cause	An initiating cause leading to a condition of overruns
Sub-critical plant	A power plant operating between 500-600MW
Super-critical plant	A power plant operating at more than 600MW, typically 800MW
Virtual Designs	Designs that are not based on the actual site or location

Chapter 1 Introduction

1.1 Background

Large projects are noted for the contribution they make to the development of a region or country. These projects, however, often have a poor record of performance particularly from the public viewpoint. A recurrent problem that often affects them is that of time and cost overruns (Morris & Hough, 1987; Faridi & El-Sayeh, 2006; Jergeas & Ruwanpura, 2010). What makes matters worse are the colossal sums of money involved which in the public view could have gone to other more 'needy' causes. Project management professionals, too, are concerned with the extent of overruns on *large projects* (Flyvbjerg, Bruzelius & Rothengatter, 2003; Whittaker, 1999). Yet there is relatively little research that has been done on the management specifically, of *large projects* (Merrow, 2011). This may be because it is generally understood that all projects have similar characteristics and go through the same project life-cycle and therefore, a general approach to the management of projects could be sufficient.

In South Africa, the focus has been on identifying *factors* that constrain successful implementation of projects and on investigation of causes of delay on projects generally, for instance, Mbachu and Nkado (2007). There has been little published on the *management* of *large projects* and how project size affects time and cost overruns.

Time and cost overruns are noted to be a persistent problem on projects in spite of the apparent progress in the project management profession and use of new techniques and tools (Pinto, 2010). It is not uncommon for projects to have cost overruns of up to 100 percent their original estimates (Jergeas & Ruwanpura, 2010). In the USA, a study done in 1985 found that more than half of the projects cost, on average, 189 percent their original estimates (Whittaker, 1999). The Channel Tunnel was 80 percent overrun in construction costs, 140 percent overrun in financing costs and 50 percent underrun on demand (Flyvbjerg, 2011). Flyvbjerg (2011) further noted in the latter surveys of major projects, that nine out of ten projects, cost overruns of 50 – 100 percent were common and overruns of 100 percent were not uncommon. On the demand side, estimates were typically wrong by 20 – 70 percent compared with actual developments.

Time and cost overruns seem to stem from the actions and inactions of project team members (AlSehaimi, Koskela & Tzortzopoulos, 2013). Whilst time and cost overruns are seen as the 'problem,' they are merely distress signals of prevailing conditions in the project management environment. Singling out factors or determining the most significant may provide some answers, but will not tell the whole picture. Management of *large projects* involves several factors with their numerous interrelationships based on the interplay of several hidden factors in the macro and micro project environments. A detailed investigation

of the work of the project team and how they interact with the *large projects* environment is key to understanding what leads to time and cost overruns in these projects and to the formulation of a strategy to improve their management

1.2 Management of Large Infrastructure Projects

Large projects by their nature demand more on the project resources than smaller projects. They are demanding due to their size, complexity, schedule, urgency or demand on existing resources and know-how (Morris & Hough, 1987). It is also due to the various factors and interactions amongst the project players who are both individuals and institutions. The other reason is that the long-range reach of the projects spanning longer periods of time than the traditional project makes *large projects* inherently very risky undertakings. They also pose difficulties in decision making, planning and management since they are typically multi-action processes with conflicting interests (Flyvbjerg, 2011). These projects typically involve several stakeholders who today include project planners, users, the media community, environmentalists and other pressure groups such as unions. Other factors include much use of non-standard technology and designs, over-commitment to a particular concept at an early stage, large sums of money involved and project scope or ambition which typically changes over time due to the long project horizons (Ibid, 2011). Davidson and Huot (1989) mention that these projects are characterised by political planning and as such, they suffer from change of political policies over their duration which is often long. Their long-range duration also makes them susceptible to fluctuations in interest rates, inflation, material prices and scope changes.

This, therefore, suggests that *large projects* merit to be treated differently from other projects. Some of these projects are so large and complex that they require exceptional levels of leadership and management (Morris & Hough, 1987). It is prudent that proper strategies are adopted and implemented in the planning and management of *large projects* to avoid wasting enormous amounts of resources. This is especially so for developing countries which have less experience with technology and have fewer resources.

1.3 Time and Cost Overruns, a Challenge to Management of Large Projects

Though project management today is increasingly seen as the standard way of running a business not only in construction and defence but also in other industries such as information and services, the history of management of projects has been a poor one. Many projects have failed to meet the time, cost and quality benchmarks set at their inception (Pinto, 2010).

Many reports have been given of projects failing to meet the planned objectives and expectations in the construction industry which include the Latham 1994 report and the Egan 1998 report in United Kingdom (Al-Khalil & Al-Ghafly, 1999; Al-Momani, 2000; Baldry, 1998;

Dahl, Lorentzen, Oglen & Osmundsen, 2017; Faridi & El-Sayeh, 2006; Flyvbjerg et al, 2003; Flyvbjerg, 2011; Klakegg & Lichtenberg, 2016; Love, Smith, Simpson & Olantunji, 2014; Merrow, 2011; Morris S., 1990; Morris & Hough, 1987; Odeh & Battaineh, 2000; Schwalbe, 2007; Simbasivan & Soon, 2007; Steyn, 2009; Toor & Ogunlana, 2008; Whittaker, 1999). These projects have consistently overrun their planned time and cost schedules. *Large projects* appear to be the most affected (Myddelton, 2007).

Projects in South Africa have equally been affected with major projects being completed late and costing more than originally planned (Baloyi & Bekker, 2011). The persistence and recurrence of the problem is indicative that it has not been solved in totality.

1.4 Research in the Management of Large Construction Infrastructure Projects

Many studies have been carried out to investigate the causes of poor performance on projects and specifically what causes time and cost overruns on projects. The studies have been done in both developed countries and developing countries (Toor & Ogunlana, 2008). Long, Ogunlana, Quang and Lam (2004) specifically mention research carried out in the USA and UK in developed countries and Turkey, Nigeria, Saudi Arabia, Thailand, Malaysia and Jordan in developing countries. The focus of most of the studies has been on identification of significant factors and causes of delay on construction projects in general. Fewer studies have investigated causes of time and cost overruns on *large projects* with most of these in the transport sector of the industry (Steyn, 2009). Furthermore, there is no evidence of research carried out to investigate how the working of the project team in its preparation and use of project management principles could potentially lead to overruns on projects. Equally, the predominant research method used on most studies has been that of the questionnaire survey with case studies in a few instances (AlSehaimi et al, 2013).

In South Africa, there has not been decisive research in the management of *large projects* to investigate the puzzle of time and cost overruns (Steyn, 2009). The focus has mostly been on investigating the factors that constrain successful implementation of *large projects*. What is yet to be determined is what lies behind the factors of overruns and how these various factors relate to one another. An understanding of the root cause of project failure in *large projects* is needed. There is no evidence of research that has investigated the root cause of overruns and implementation of a project strategy.

Anderson and Merna (2003) suggested that causes of failure originated from the front end during project strategy formulation in the business mode. Merrow, (2011) was of a similar view, namely that there is inadequate engagement with the project from the boardroom where plans are formulated. Tatum (1984) observed that there is no rationalised way of deciding the organisation structure to use on *large projects*. AlSehaimi et al, 2013, in summarising the

causes of overruns from literature, observed that they were indicative of poor planning during design as well as during execution. Flyvbjerg (2011) recommended that high level research into theories of success and failure of major projects be conducted with strong links to leading research in other areas such as economics, governance, planning, decision making and environment.

It is intended in the current research to close the identified knowledge gap by developing an integrated project management strategy for use on large construction projects.

1.5 Research Questions

The research question to be answered through this thesis is, why and how do large construction projects incur time and cost overruns? The sub-questions are: (1) Is the involvement of the client in the planning and implementation of *large projects* a parameter for consideration? (2) What is the role of training and experience of the project members in the implementation of *large projects*? (3) Are the principles of project management consistently implemented in large infrastructure projects? (4) What is the role of the above points (1, 2, 3) when deciding the project organisational design, time and cost schedules? And, (5) What would be the client's strategy for improving the delivery of *large projects*?

1.6 Research Aim and Objectives

The aim of the research was to study how the actions of a project team in a large construction project in South Africa affect the delivery of projects and to develop a project management strategy for the project owner to use on these types of projects. The objectives of the study were: (1) To study the nature and management of *large projects*. (2) To investigate the root cause of time and cost overruns on large construction projects in South Africa. (3) To investigate how the project team plans and executes projects in South Africa. And, (4) To formulate a project management strategy to be used on *large projects* to improve the delivery of projects and reduce overruns.

1.7 Thesis Statement

The thesis statement is formulated as follows:

By preparing for projects and implementing appropriate project management strategies on large construction projects, and, consistently implementing project management principles, the client can improve the delivery of projects and reduce time and cost overruns.

1.8 The Conceptual Framework

Conceptual framework, literature review and theoretical framework

Conceptual frameworks are important in research as they explain what is going on in the research (Robson, 2011). They provide the mental conceptualisation of abstract ideas or theory plan in the research (Brynard, Hanekom & Brynard, 2014). They help the author to explain the concepts they are investigating (Babbie, 2014). Rocco and Plakhotnik (2009) said that the goal of a conceptual framework is to categorise and describe concepts important to the study and provide a guide on the relationships amongst the concepts.

Conceptual frameworks, however, are associated with difficulties of understanding how they work, how they relate to literature review and where in research they come in. Leshem and Trafford (2007) noted the importance of conceptual frameworks in doctorate studies but they found that most candidates and some supervisors did not fully understand how they work or where in the work they could be located. Rocco and Plakhotnik (2009) also noted that the terms conceptual framework, literature review and theoretical framework are used interchangeably by scholars to explain each other and as steps in the research process. They also said that the terms serve similar functions in an empirical research study. Thus, making it difficult to see the difference amongst the terms. To explain the differences, they said literature review is an exploration of literature around the identified topic to support if a topic is researchable. It involves a review of closely related studies and the establishment of the importance of the current study in relation to the previous studies. Theoretical framework was said to involve the presentation of a specific theory and what has been written about that theory by others. It involves the development of the study through critique of concepts, terms, definitions and ideas on the particular theory. Conceptual framework was said to be used to ground the topic in the relevant knowledge bases important in the problem statement and research questions. It is said, the author demonstrates in the conceptual framework, the importance of the study by defining the main ideas and the relationships amongst them, but his purpose is not to investigate a singular theory.

In this research, the conceptual framework was placed within the literature review in the introductory chapters to guide the reader in the conceptualisation of the research problem, the topics of interest or concepts and ideas and, the direction the empirical research might go. Whilst the whole literature review could be viewed as the theoretical/conceptual framework, the conceptual framework was differentiated to provide a map of concepts and their relationships in the research giving an idea of the theory that may emerge after empirical verification. The term theoretical framework was not used as the research was not

investigating a specific theory such as optimism bias or misrepresentation, but all theoretical and empirical work related to time and cost overruns in large infrastructure projects.

The question of where the conceptual framework should be placed is an important one. Leshem and Trafford (2007) said traditionally, the location depended on the research method adopted. In inductive studies, it could be placed after fieldwork. In deductive, it could be placed before the research design chapter. In research with variable methods or staged research, the location varies depending on the type of research. Rocco and Plakhotnik (2009) said that the theoretical or conceptual framework could follow after the problem statement as most readers would want to know the purpose of the study early.

The conceptual framework in this study

Management of *large projects* is not done in a stable environment but in a dynamic state. The scenario is that of ever changing landscapes and characteristics. These characteristics and states include people, the project team, tools and techniques and the political and economic environments. At the centre of all these dynamics is the project team whose work is to marshal all the resources to ensure that the project's objectives are met. It entails understanding and managing the constraints within the project organisation, sister organisations of the project team or project coalitions as Winch (1989) called them and, managing the macro environment.

Figure 1.1 shows the author's conceptualisation of project management performance and the various factors that affect it. Project management competence of the project team is shown to be at the heart of successful management of the project (Crawford, 2005).

The figure shows that project management competence is a factor of how the project team conceives and formulates strategies, forecasts and plans on the management of the project at hand. Equally, it is a factor of how they respond to the different external influences that come upon the project. The competences are both inference and performance based (Crawford, 2005; Morris et al, 2006), being qualities of project managers (Ceran & Dorman, 1995; Wirth, 1992; Muller & Turner, 2010; Petersen, 1981) and training of project managers (Thomas & Mengel, 2008).

Whilst project competence starts with competence of individuals, it does not end there (Morris et al, 2006; Margerison, 2001). The competence of organisations and that of the project team is of significance as well. The framing of plans and strategies in the firms and the client organisation equally establishes a background of the efficiency and effectiveness of the project team. The preparation of the project team for the work sets the prerequisite of the efficiency of the team and how they will respond to the internal and external requirements. All the actions that the team takes in the management of the project will be from the preparation

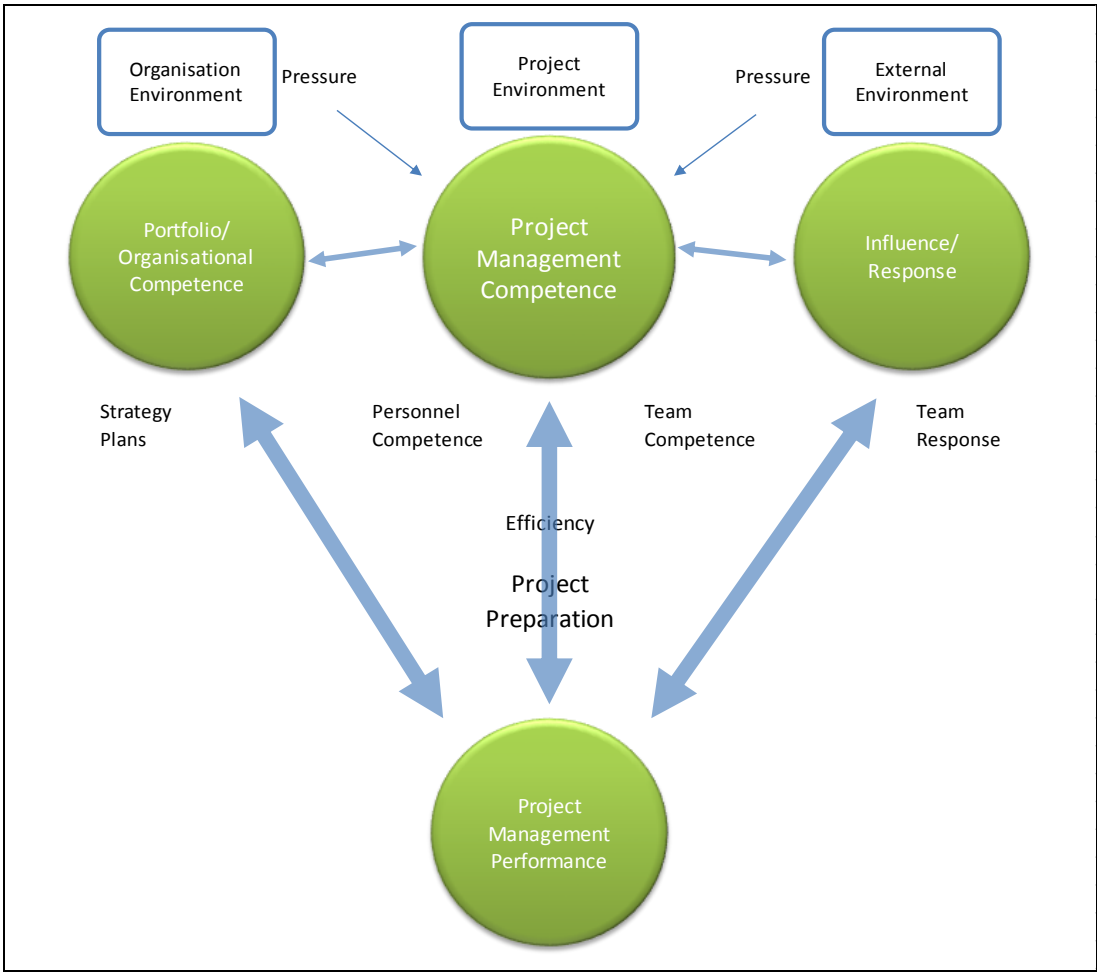


Figure 1.1 Project Management Conceptual Framework

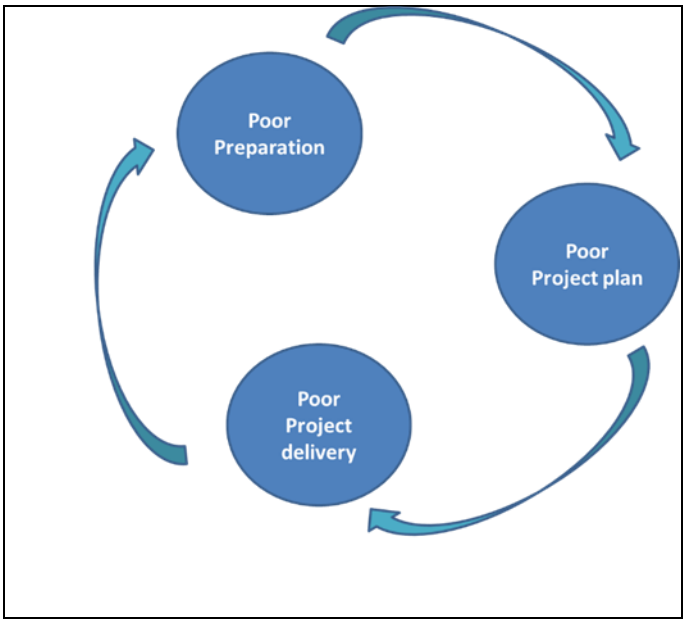


Figure 1.2 The concept of project preparation and how it affects project delivery

Source: Author

of the individuals, the project team and partner organisations. The preparation or lack of it becomes visible during the construction stage of the project. Poor preparation for the project affects the project management competence which leads to a poor project plan and ultimately poor execution. The poor project delivery again affects the preparation for the next project as shown in Figure 1.2.

This study examines how the dynamics of *large projects* contribute to the occurrence of time and cost overruns. It contributes to the knowledge of management of large infrastructure projects.

1.9 Possible Rival Explanations

Two possible rival explanations are examined in the research. The first is that, poor performance on large projects leading to time and cost overruns is because these are public projects since public enterprises are often bureaucratic, politically constrained, have multiple and conflicting goals and have highly underdeveloped accounting and management information systems (Jamali 2004). The other rival explanation is that the poor performance is because large projects are managed the same way small projects are managed since projects are viewed to be the same. Shenhar & Dvir (1996) said that many scholars took it for granted that all projects are the same. Packendorff (1995) equally reported that there is a general assumption that projects are the same.

1.10 Brief Chapter Overviews

Chapter 1

This chapter introduces the study and gives the aims and objectives of the research. Also included is an outline of the literature review on the management of *large projects* and the problems of time and cost overruns

Chapter 2

This chapter constitutes the focussed literature review on the management of *large projects* and causes of poor project performance on these projects. It presents the research that has been carried out on the research problem and the knowledge gaps identified.

Chapter 3

In this chapter, the method used to collect primary data is explained as well as the reasons for the adopted research approach. The aim of the chapter is to formulate a process to aid in the verification of the research argument.

Chapter 4-10

The results of the research are presented in chapters 4 to 10 beginning with the case study results and then the questionnaire results.

Chapter 11

This chapter presents a synthesis of the case studies and questionnaire results.

Chapter 12

The chapter presents the proposed integrated management model for *large projects* as a solution to the identified research problem.

Chapter 13

Chapter 13 is the closing chapter of the research. The chapter provides the conclusion on the aims of the study, the contribution to knowledge of literature on the management of *large projects* and suggestions for further research.

Chapter 2 Literature Review

2.1 Introduction

This chapter presents the literature review background to the problem of time and cost overruns and the management of *large projects*. The review begins by discussing the apparent contradiction between the growth of the project management profession and the challenge of poor project performance. Various attempts that have been made to improve the delivery of projects are discussed. This is followed by a review of literature by scholars on the causes of time and cost overruns. It then identifies some of the knowledge gaps which merited research in the current study.

2.2 The Review of Literature

This literature review was conducted by the author between 2011 and 2016. The search of literature was made primarily from articles that discussed large projects and the concept of time and cost overruns using Stellenbosch University databases: Web of Science, Science Direct as well as the library sources for e-theses at the university and other universities in South Africa.

The most common scholarly journals included International Journal of Project Management and Journal of Construction Engineering and Management. Most of the data came from the International Journal of Project Management, Journal of Construction Engineering and Management, Journal of Construction Management and Economics and Journal of Engineering, Construction and Architectural Management.

For easier search of data, using the Web of Science, the most cited works were followed up. The most significant articles were identified based on the citation index and these provided the network of papers that discussed time and cost overruns. The selection criteria for the articles included the most cited works, the most influential works and those that closely discussed the phenomenon of time and cost overruns and the management of large projects. The review started with the work of Arditi, Akan and Gurdamar (1985) who began discussions on time and cost overruns on projects in general, the influential works of Morris and Hough (1987), Flyvbjerg et al ,2003, (see Siemiatycki, 2016) to later works by other scholars up to 2016.

The search also included books and other scholarly works to gain insights into the concepts of project management, success, estimating, competence and time and cost overruns.

Rowley and Slack, (2004) recommended a disclosure of the tools and search methods used to get literature. In this research, several tools were used to locate information which

included library catalogues, keyword searches using search engines such as Web of Science, Science Direct and Google Scholar. Web of Science and Science Direct were used to get the professional literature on large projects and time and cost overruns. Other tools like Google Scholar and Mendeley were used as well to get certain articles cited but not readily available in the professional affiliated web sites.

2.3 The Need for Project Management

Project management today is increasingly seen as a way of running business, not only in construction and defence, but also in other industries such as technology and services (Gary and Larson, 2008). Söderlund (2004) said this has led to the explosive development of professional organisations such as the International Project Management Association (IPMA) in Europe and the Project Management Institute (PMI) in USA. Shepherd and Atkinson (2011) said that many organisations now recognise project management as key to their business operations. Ramazani and Jergeas (2015) also said that projects play a critical role in the modern enterprise as shown in increasing numbers of industries and project-based systems that are either complementing or replacing traditional functional and divisional structures with project teams.

The resulting increased role of project management in executing projects has led to a twin increase in the demand for the project management profession in all industries and education in project management (Thomas & Mengel, 2008; Pant & Baroudi, 2008). Crawford, (2000) reports that PMI in USA is no longer dominated by construction, engineering, defence and aerospace, but includes larger numbers from telecommunications and other professions.

Pinto (2010) said this increased growth may be partly one of the reasons leading to project failures as many organisations enter into projects without fully understanding how they should be managed and the techniques required to ensure a project delivers according to expectations. The author is of the view that in the desire to meet the demand for project management professionals, there is a possibility that training institutions have not had adequate time to consider the materials and other requisites needed to prepare the trainees for management of projects. Thus, there is a possibility that the owners and consequently consultants and contractors are not adequately prepared when they begin to carry out projects.

2.4 Project Management Challenge

Whilst the project management profession has been growing in demand and popularity all over the globe, projects still fail. Morris and Hough (1987) said that the history of project management has been poor. Many projects have failed to meet the time, cost and quality

benchmarks set at their inception (Pinto, 2010). Later scholars have equally noted the lack of improvement in project performance in spite of tremendous strides in project management knowledge (Love, Smith, Regan and Olatunji, 2014; Klakegg & Lichtenberg, 2016).

The construction industry has been affected by management and other problems for years. Kagioglou, Cooper, Aouad and Sexton, (2000) observed that the UK construction was plagued with several problems which had not disappeared for decades. Briscoe, Dainty, Millett and Neale (2004) reported that many aspects of the UK construction industry's performance have been heavily criticised in recent years and that the industry has suffered from cost overruns, programme delays and poor productivity for a long time. In agreement with this, several UK government reports have been written to try to find solutions to the numerous construction problems. These have included the 1994 Latham report "Constructing the Team" and the 1998 Egan report, "Rethinking Construction."

The Latham (1994) report showed that the fragmented nature of the industry was the major contributor to the poor communication amongst all the parties on a construction project and that this tended to promote adversarial relations amongst the project participants particularly between the contractors and their suppliers (Briscoe et al, 2004). The report also criticised the industry's heavy reliance on lowest competitive tendering and recommended that clients should base their choice of contractors on value for money principles using proper weighting of selection criteria for skill, experience and previous performance. Holt, Olomolaiye and Harris (1995) mentioned that the report recommended the Department of Environment (DOE) to come up with a rationalised document prescribing the detailed selection procedure to be used by the public sector. This included establishing a list of pre-approved contractors for the public sector and introducing a "star" system for contractor performance. The report also recommended that open tendering was not to be used.

The Egan (1998) report affirmed the Latham recommendations (Kagioglou et al, 2000). It further identified 5 key drivers of change for the industry; (1) Committed leadership, (2) Focus on the customer, (3) Integrated processes and teams. (4) Quality driven agenda, and (5) Commitment to people. Product development, project implementation, partnering the supply chain and production components were identified in the integrated process.

Both reports recommended the construction industry to learn from the manufacturing industry. Several movements were born from the reports which include the Innovative Manufacturing Initiative (IMI), the Engineering and Physical Sciences Research Council (EPSRC) funded research resulting in the formulation of the EPSRC Generic Design and Construction Process Protocol and the BAA Plc Process Standard formulated by British Aerospace Authority to guide in the management of the procurement process.

Anderson and Merna (2003) listed several process models made in attempts to improve the management of projects. The earliest of these is that discussed by Morris in 1994 which Anderson and Merna (2003) call the Morris Practice Model. These authors mention that the model lists eight principle items to be managed in a project. The project management concept discussed brings to view the open systems approach to management of projects to ensure that the project was managed in a holistic manner.

In 1995, the British Airports Authority Project Process (BAA Project Process) was developed by BAA Plc to try to improve the management of their projects. The model is similar to the RIBA Plan of work in that it is activity driven. It is divided into phases of the key sub-processes (Shealth, Woolley, Cooper, Hinks & Aouad, 1996): (1) Development Management, (2) Evaluation and Approval, (3) Design Management, (4) Cost Management, (5) Procurement Management, (6) Health and Safety, (7) Implementation and Control, and (8) Commission and Handover.

This process model incorporates the “stage gate” approach where there is a review of a phase before proceeding to the next (Ibid, 1996). This helps to ensure that all the work required to be done in a particular phase is done. It also provides a framework for planning and management of projects effectively so that all required inputs in the process are planned and incorporated. The BAA process however was developed from BAA’s perspective to guide the organisation in the management of projects from conception to commissioning and handover. The model groups the activities into eight activities for effective management as required in the BAA process of design and construction. The model provides a useful reference point to organisations such as Sasol in South Africa who deal with development and design of products and eventually carry out the manufacturing process. Some of the concepts in the BAA process such as the “stage gate” approach were incorporated later in the EPSRC Process Protocol of 2000.

In 1996, the British Standards Institute formulated *BS 6079:1996* to provide guidance on the planning and execution of projects as well as the application of project management techniques. This standard only offers guidance on how the project should be planned and managed. It shows the stages to be followed to ensure that the project is successfully implemented. The Standard helps people to see the various stages required to be achieved in a project and the techniques to be used to achieve success.

The *BS 6079* was followed be *BS ISO 10006* in 1997. This standard tried to incorporate the issues of quality and risk management in the planning and management of projects. Anderson and Merna (2003) comment that the standard differentiates between the quality of management processes and the quality of the project product. Like *BS 6079*, this standard

does not define the project management processes, but is concerned with ensuring that there is quality in the process of management of projects. This standard is useful in that it provides the quality assurance process required in managing projects successfully.

In 1999, the International Project Management Association, UK (IPMA) produced the ICB (International Competence Baseline) which describes 28 core elements which competent project managers and their staff should know and have experience in (Ibid, 2003). The Association produced this to aid in the certification of their members and only those with competence in the core areas were certified to work and be called project managers.

The Association for Project Management has produced standards and other guides such as the APM BOK which they have revised regularly, to provide guidance in the definition of the broad range of knowledge of project management. The standards and guides describe the relevant knowledge areas required of a project manager to successfully manage a project. Equally, the Project Management Institute has produced the PMBOK with the revised 5th edition covering twelve project management knowledge areas: (1) Project life cycle and organisation, (2) Project management process for a project, (3) Project integration management, (4) Project scope management, (5) Project time management, (6) Project cost management, (7) Project quality management, (8) Project human resource management, (9) Project communications management, (10) Project risk management, (11) Project procurement management and (12) Project stakeholder management.

The year 2000, also saw the development of the EPSRC Process Protocol from a study of about two years shown in Figure 2.1.

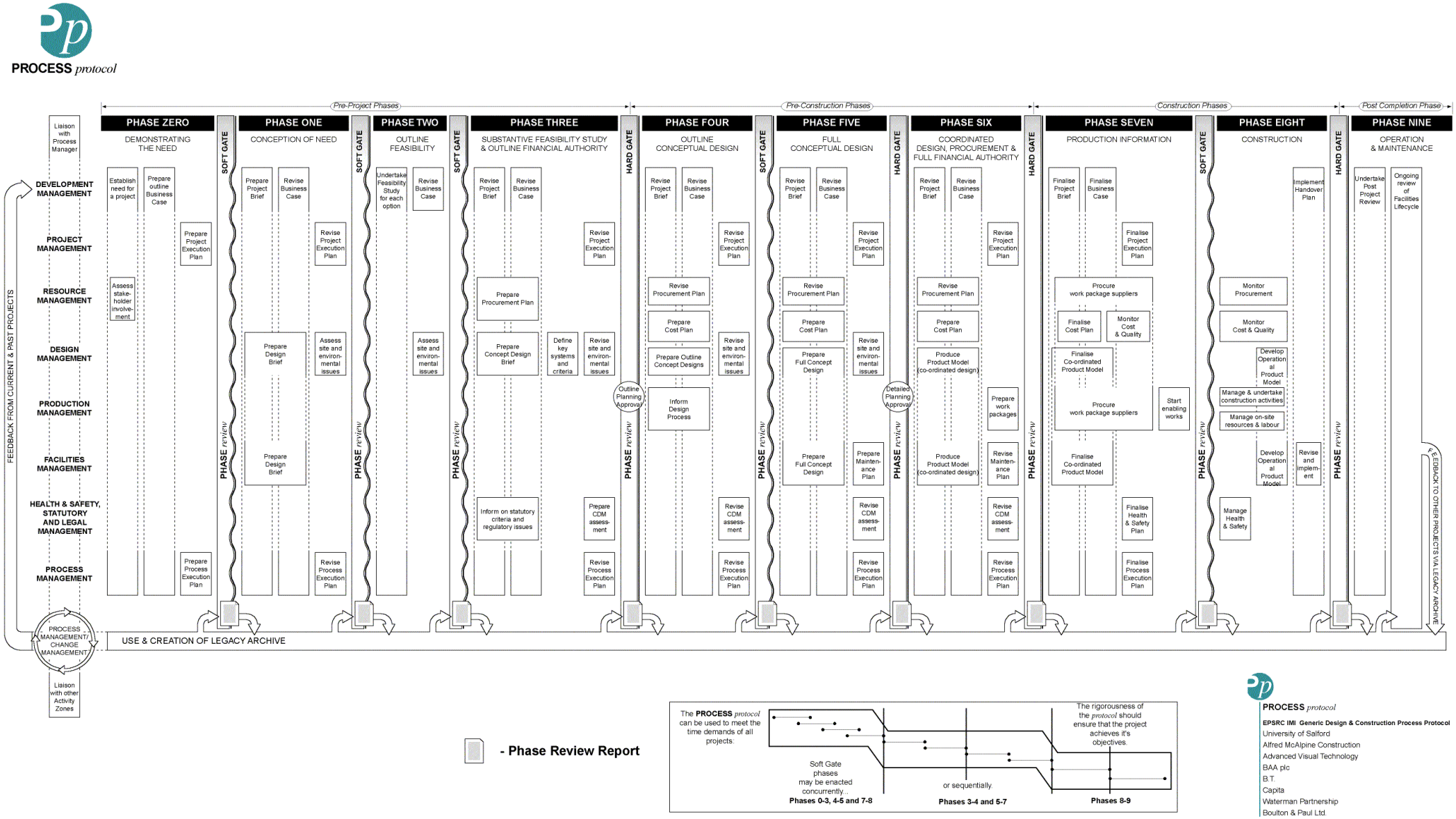


Figure 2.1: The Process Protocol map.

Source: Kagioglou, M., Cooper, R., Aouad, G., Re-Engineering the UK Construction Industry: The Process Protocol.

Unlike the APMBOK and the BS 6079 and ISO 10006 which were produced for general guidance of project management knowledge areas, the Generic Design and Construction Process Protocol was produced specifically to seek to incorporate some practices from the manufacturing industry in the construction project management process. The protocol covers the whole project life-cycle from the pre-project stage to the post-completion stage. The process is divided into four distinct phases as shown in Figure 2.1: pre-project phase, pre-construction phase, construction phase and post-construction phase.

The four phases are further sub-divided into sub-phases, generating a total of nine phases. The protocol was developed in response to calls for improvement in the delivery of construction projects. Using the manufacturing industry as a model, the protocol shows the various activities and action required in the design and construction of projects. The “stage gate” approach from the manufacturing industry has been adopted in the protocol as shown in Fig 2.2.

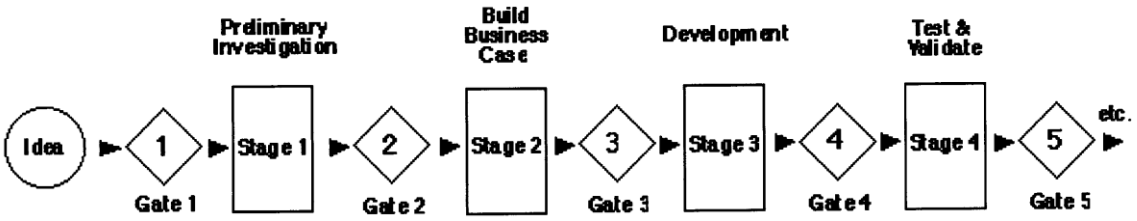


Figure 2.2: The "stage-gate” approach

Source: Kagioglou, Cooper, Aouad & Sexton, (2000).

The aim of providing the “stage gate” approach was to ensure that there is a review at each gate before proceeding to the next stage (Kagioglou et al, 2000). Each gate of the protocol represents a decision-making point where all deliverables are reviewed which in turn form the inputs for the next phase. The author is of the view that the gates could potentially be points of delay for the project as the participants review before proceeding to the next phase.

In the protocol, project participants are identified by their primary responsibilities in “activity zones” and not by their professional or expert status. For instance, Project Board, Design and Construction and not, Client, Engineer and Contractor. It was hoped that this would lead to improvement in communication and a move away from the traditional divisive class distinctions.

The model attempts to show the integrated process of project management in construction drawing on the manufacturing approach to management using a series of gates for approval of the sub-phase before proceeding to the next. What we could learn from this process protocol is that the project management process could be modelled after the manufacturing

industry with gates for review and decision making before proceeding to next phase. The protocol has also emphasised the pre-project phase which is normally glossed over. It has also tried to improve on project participant integration by identifying the participants based on activities rather than profession. This is true since the distinctions in the professions in construction are mostly for teaching and specialisation purposes. This realisation may help break the barriers between the professions such as the engineer and the contractor.

The various processes and models have sought to provide a better way of managing projects. The principle aim has been that of developing an improved model to manage projects successfully. From these models, we learn that the delivery of projects could be improved by: (1) developing standard guidelines for every project, (2) modelling the project management process in comparison with other industries such as the manufacturing, (3) developing projects, (4) isolating process areas with project management problems to improve or correct the defect in the project and, (5) using the “stage gate” approach for phase-review points before proceeding to the next.

All the above models have not differentiated between the different project types. None of them have differentiated between large and small projects but have considered the project management process generally. The PMBOK and the APM BOK do not identify or discuss large and small projects. The guidelines are for all projects. Literature shows that *large projects* have performed worse than small projects consistently (Morris and Hough, 1987; Whittaker, 1999; Merrow, 2011).

2.5 Project Management and Time and Cost overruns

Many reports have been written of projects failing to meet the planned objectives and expectations (Morris and Hough, 1987; Steyn, 2009; Schwalbe, 2007; Flyvbjerg, 2011; Merrow, 2011; Love et al, 2014, Ahiaga-Dagbui, Smith, Love & Ackermann, 2015). These projects have consistently overrun their planned time and cost schedules.

Faridi and El-Sayeh (2006) noted that the issue of time and cost overruns was considered as one of the most recurring problems in the construction industry. Jergeas and Ruwanpura (2010) equally noted the recurrence of this problem in the management of construction projects stating further, that stakeholders such as the government, investors and senior managers were especially concerned considering the huge investments that went into mega-projects. Steyn (2009) quoting Flyvbjerg et al (2003) reported that project cost overruns had neither increased nor decreased over time as shown in Figure 2.3.

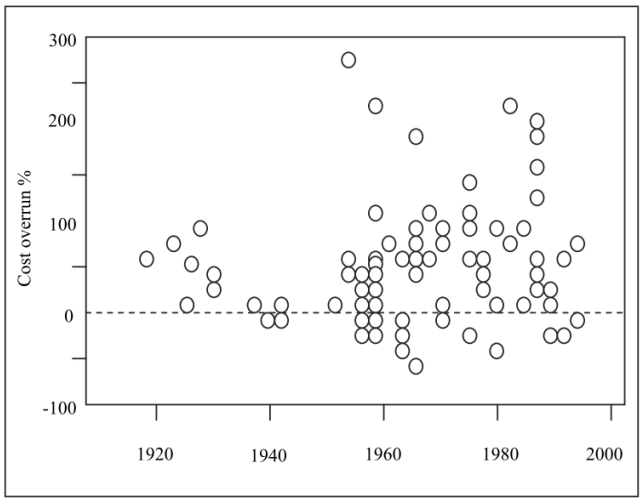


Figure 2.3 Time and cost overruns over the years

Source: Steyn, (2009)

The time and cost overruns do not only affect diverse industries, but also affect both public and private projects. They also affect small and *large projects*, but *large projects* are reportedly the worst affected (Morris and Hough, 1987; Whittaker, 1999; Merrow, 2011). It is reported that nine out of ten *large projects* have cost overruns (Flyvbjerg et al, 2011).

2.6 Causes of Time and Cost Overruns

An overrun is a situation where a planned event actually takes longer or costs more than it was planned. Assaf and Al-Hejji (2006) referred to a delay in construction as the time overrun either beyond the completion date specified in the contract or beyond the date the parties agreed upon for delivery of a project. Kaliba, Muya and Mumba (2008) used the terms schedule delay and cost escalation to refer to time and cost overruns respectively. Time-overrun or schedule delay is defined by Kaliba et al (2008) as a situation where a construction project does not come to completion within the planned period. They defined cost escalation as the increase in the amount of money required to construct a project over and above the original budgeted amount.

Various reasons have been cited in literature as the causes for time and cost overruns. These are mostly based on the actions and inactions of the project members whether the project was large or not. As to which factors are the most significant, it is difficult to determine as each scholar had their own way of presenting their data. Ramanathan, Narayenan and Idrus (2012) after reviewing factors of overruns, found that it was difficult to generalise the root cause of overruns as each study had a unique approach and unique rankings of the causes. They also found, for instance, that some that were found to be most influential in 1995 were

no longer in 2010. However, they noted that the factors appeared to be country, location and project specific.

Love, Ahiaga-Dagbui and Irani (2016) presented two predominant schools of thought of overrun causation that has been discussed by scholars over the years: Evolution theorists and psycho strategists. Evolution theorists are those of the view that overruns are due to scope definition change from what was originally planned at inception. In essence, they are of the view that the plan at the beginning was accurate and that overruns ensued because of deviation from the planned scope and estimate. Eizakshiri, Chan and Emsely (2011) criticised this view as being flawed because it does not question the accuracy of the schedule and cost plan initiated at the beginning.

The psycho strategists, on the other hand, are of the view that overruns are due to deception, optimism bias and planning fallacy when estimating the project plan at the beginning. In other words, the overruns which occur later in the project cycle are due to inaccurate estimates and attitudes of misrepresenting the estimate to get project acceptance. Love et al (2014) criticised the optimism bias and misrepresentation view as an over simplification of a complex problem and that it had potential to lead to adversarial relationships amongst the project team members and mistrust of the project team by the public.

Two further schools of thought are that of project “pathogens” and “cost growth” (Ahagia-Dagbui and Smith, 2014). The first theory is that there are many intermediate events and actions called “pathogens”’ which, unaccounted for at project estimate build-up, remain latent but drive up the costs later. The other theory is that cost growth is a natural phenomenon because projects evolve due to changes in scope, design and leadership which affect the initial aims, scope, skills and competence of the project team later.

Ahiaga-Dagbui et al (2015) criticised the research approach in previous studies saying that it was inadequate and not able to deal with the complexity of the problem of time and cost overruns because it was simplistic, superficial and replicative and even stagnant. They said most scholars identified single points in the network of causal links without considering the whole project system to see how the various variables interacted with each other. They said even though variables may appear to be single standing, they are interrelated in a complexity of ways which requires in-depth understanding of how the whole system works.

Love, Ahiaga-Dagbui and Irani, (2016), also criticised previous research that it tended to explain causes of overruns to be independent as opposed to interdependent causes. They contended that this approach of singular, cause-identification has led to inappropriate risk assessments and failure to identify the interdependence between cause variables. They recommended moving away from simply developing lists or ranks of independent factors to

one where the causal relationships amongst the network of factors are identified. Earlier, Love et al, (2014) had contended that the problem of time and cost overruns would continue unless research methods which enabled the actuality of the “why” and “how” projects incurred time and cost overruns were carried out. They recommended the review of the project delivery strategy or overhaul to shift towards the use of relational project delivery methods such as Integrated Project Delivery (IPD) or other alliances and technological innovations such as Building Information Modelling (BIM) at the project early stages to enhance communication and information management in the design and construction process. Ackerman and Alexander (2016), after considering that human factors had not been accounted for in previous research, proposed that causal mapping should be used by researchers and practitioners to explain project behaviour that leads to time and cost overruns. They recommended two ways of causal mapping: the idiographic which is concerned with understanding a situation and, homothetic which aims to reveal themes/patterns that can be statistically generalised.

Klakegg and Lichtenberg (2016) on the other hand were of the view that the estimating process should be improved to enhance the accuracy of estimates. They recommended a process they call “successive cost estimating” which relies on the principle of accurate and realistic estimating using a series of steps. They proposed the use of triple cost estimating for the significant items. The process is to use experts in estimating and project management to forecast the future uncertainties of the project and predict the likely costs using statistics. They said this method had proved successful in reducing cost overruns in Scandinavian projects. The view of Klakegg and Lichtenberg (2016) is essentially an extension of the psycho strategists of improving the estimating technique to increase the accuracy of estimates. Equally, Awojobi and Jenkins (2016) considered improvements that could be done to the Reference Class Forecasting (RCF) technique to improve the accuracy of estimates.

The author, after reviewing existing literature on time and cost overruns in Africa, Asia and the Middle East in 2013 using Web of Science and Science Direct electronic databases, found that time and cost overruns in the Middle East were viewed to be mostly caused by the client through design changes, late payments to the contractor and delays in decision making. The contractor was seen to contribute through inadequate planning and scheduling, poor supervision and site management and poor productivity. It was also found that the region experienced problems in acquiring professional and artisan skills for projects. (See in the work of Al Momani, 2000; Khoushki, Al-Rashid & Kartam, 2004; Merzher & Tawil, 1998) The reasons given for the overruns suggest that there could be poor preparation during project formulation in the client’s organisation and planning difficulties during tendering and planning before construction commencement in the contractor’s organisation.

In the case of Asia, incompetence in the procurement system as a whole appeared to be

the problem. The clients were said to be inexperienced in project management, inadequately prepared for projects and had unclear objectives which resulted in many design changes. The consultants were unprepared for the task of design and document preparation which resulted in numerous scope changes because of constructability problems and supervision difficulties. They were seen to have poor management of the site, poor estimates and financial problems which may have been caused by poor preparation for the task (See in the work of Abdul-Rahman et al, 2010; Doloi et al, 2012; Long et al, 2004; Morris, 1990; Ramanathan et al, 2012). Again, like in the Middle East, these problems seem to stem from poor pre-project planning sometimes called front-end loading as well as contract tendering and planning by the contractor.

In Africa, the causes were similar to the other two regions. The major cause was said to be the client's late payments to the contractor followed by the contractor's financial problems. The client was blamed for frequent design changes, incomplete designs; inadequate procurement systems and bureaucracies in the organisations especially for public projects. The contractor was blamed for inefficient management systems of labour, materials and the contract. (See Mansfield, Ugwu & Doran, 1994; Ogunlana and Olomolaiye, 1989; Frimpong, Oluwoye & Crawford, 2003; Aibinu and Jagboro 2002; and Baloyi and Bekker, 2011). Most scholars were investigating the overruns during construction. Hatush, Saleh and Shiki (2005), investigated factors during design. They found that they were mostly caused by bottlenecks in the preparation process such as delays in opening letters of credit thus affecting advance payments, instability and bad central administration, continuous change in requirements and long and complicated chain of procedures in the decision-making process.

In essence, the overruns were seen to be a result of the actions of the project team members in the project organisation. This is the evolution theory as suggested by Love et al (2016). The project team did not follow the project execution plan. Thus, what they do in the management and governance of the project is what is seen to be leading to time and cost overruns as depicted in Figure 2.4 developed by the author.

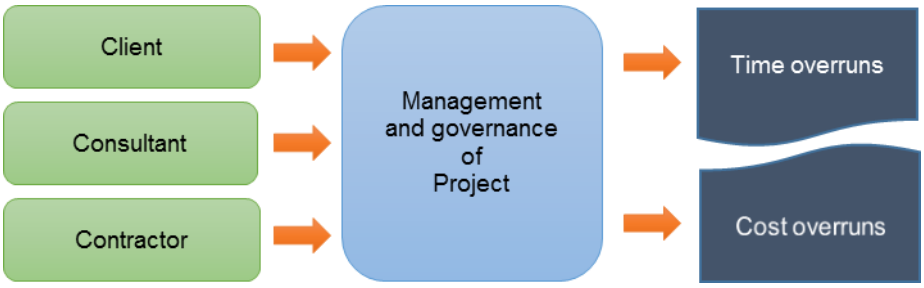


Figure 2.4: Working of team members in the project organisation leads to overruns

It also suggests that there could be some inefficiency in the project organisation or perhaps an environment that promotes the occurrence of time and cost overruns rather than inhibits them from occurring as Love, Edwards, Irani and Walker, (2009) found. Unfortunately, most of the scholars did not investigate the reasons behind these immediate factors leading to overruns (AlSehaimi et al, 2013) and how they relate to one another (Steyn, 2009).

However, comparing overruns from general projects and those of *large projects* seem to show a pattern. Overruns from general projects seem to be caused by the internal project management factors whilst those from *large projects* appear to be caused mostly by external factors (Morris, 1989) some of which are set in motion imperceptibly even before the project starts. From the work of Morris and Hough (1987), overruns were caused by inflation, quantity increase, engineering changes, under-estimating, government induced changes, e.g. environmental requirements, increased safety requirements, interest charges and changes (Figure 2.5). In essence there are economic factors, government/societal factors and participant induced factors.

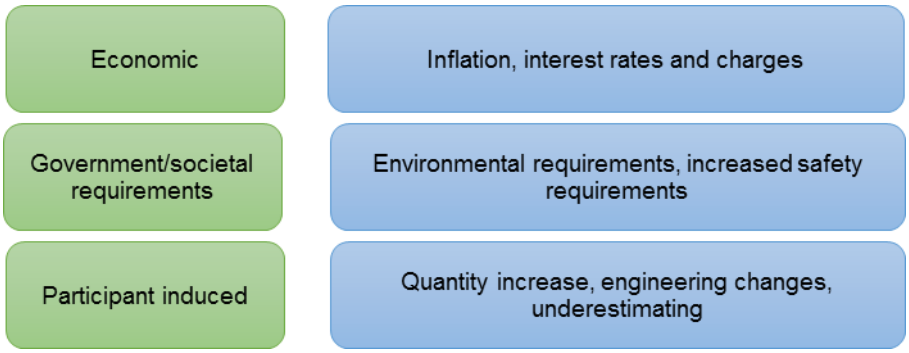


Figure 2.5: Causes of overruns from the work of Morris and Hough, (1987).

What is not routinely discussed is the response of the managing participants to these economic, governmental and participant induced causes. It is possible that these factors merely induce or trigger the fall towards overruns and the response of the participants then determines which direction they would fall to actualise into overruns. Flyvbjerg et al, (2003) somehow indicated lack of accountability and intended misrepresentation of the participants as the causes.

Flyvbjerg et al (2003) after reviewing *large projects* in the transport sector found that the main reason for overruns was that the initial estimates were not realistic. They found that in the main, the costs of projects were under-estimated. The exchange rates, quantity and price changes and geological risks were under-estimated or ignored, expropriation costs, safety and environmental demands were ignored or under-valued. They also found that most *large projects* involve much technological innovation with high risk which often translates into cost increase and these were often not adequately accounted for in the initial estimates.

One aspect they found common on *large projects* is the inaccurate demand forecasts. These forecasts were typically wrong by 20-70% compared to the actual development. It was also found that the extent and magnitude of actual environmental impacts were often different from forecast impacts and there was no post-project auditing. Further the regional, national or international developments usually claimed by promoters were found typically never to materialise and that, the forecast project viability differed from the actual. Forecast viability was often found too optimistic.

They argued that there was a likelihood of optimism bias and misrepresentation during project preparation, risk negligence and a possible lack of accountability when making decisions because promoters would not themselves carry the risk burden, contractors and others stood to gain and would possibly have self-serving interests in under-estimating costs and over-estimating demand forecasts due to this rent-seeking behaviour. Thus, presenting a theory that overruns are caused by optimism bias and misrepresentation by project owners and planners during preparation.

Eizakshiri et al (2011) were of the view that the intentions and motives of project participants potentially affected the project time. Merrow (2011) found that most corporations embarking on projects had outsourced many of their key competencies. Apart from misrepresentation and optimism bias in presentation of estimates, there is a possible theory that decisions are just poorly made due to lack of critical project management skills at the decision-making level in the project organisations.

However, Esty (2004) was of the view that managers of *large projects* had more incentives to make careful and value enhancing decisions because they had more time as these projects take from 1-5 years to structure as well as the fact that there is much at stake: their personal wealth and reputations. This realisation then should restrain them from making poor decisions. He also observed that apart from incentives having a play on the decision-making process, manifestations of conflict in the decision-making process such as distress, agency conflicts, asymmetric information could also affect the decision making.

Combining the work of Morris and Hough (1987) and Flyvbjerg et al, (2003) could provide some clues to what may be going on in the project organisation. For instance, the response of the project management team to economic factors could lead to cost overruns. The same is true with the governmental/society requirements. There is a possibility that certain factors induce certain behaviours in the project team which could potentially lead to time and cost overruns as shown in the author's conceptualisation in Figure 2.6.

Merrow (2011) from a large-scale research on major projects traced the many failures of *large projects* back to the sponsors and their financiers. These are the individuals and

institutions that plan the management of their organisations and the design of the project management structure. From the research, the root cause was seen emanating from the poor management of the front-end. Anderson and Merna (2003) observed that poor performance when re-examined often were due to poor project management especially at strategy formulation in the initial stages rather than poor performance down-stream. Merrow (2011) identified the root cause of overruns as: (1) there is much outsourcing of key

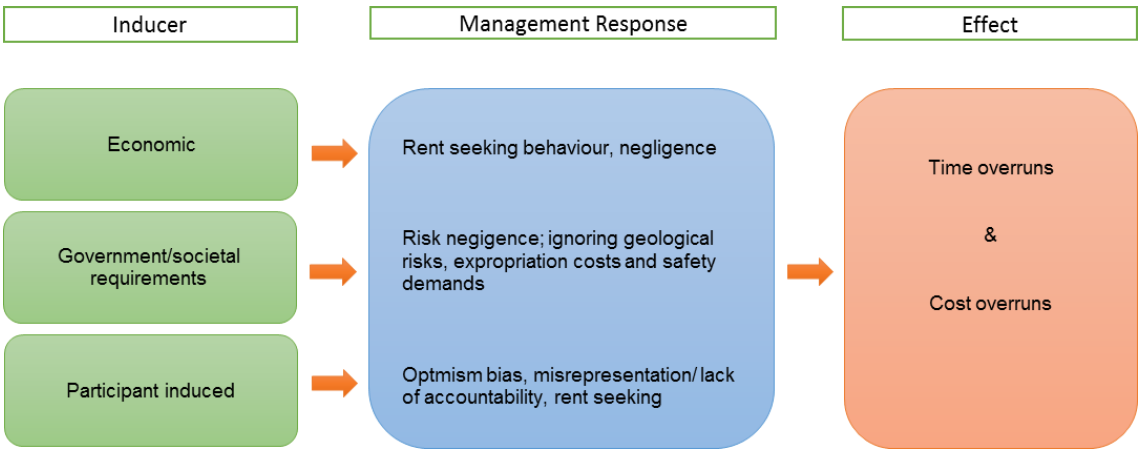


Figure 2.6 Inducers of time and cost overruns

competencies from corporations to private entities; (2) poorly informed decision making; (3) there is a woeful lack of accountability for results in decision making and management and; (4) there is a pathological focus on short-term health of the corporation and its shareholders. These may provide some clues as to what may be causing the managers to respond to the inducers in this way. For instance, outsourcing and poorly informed decision making could be contributing to the risk negligence, ignoring geological risks, expropriation cots and safety.

Viewing the above causes, not only are overruns caused by actions of project members, but also resulting from the activities of the past. Thus, there are present dynamics such as rent-seeking behaviour and risk negligence as well as past dynamics such as outsourcing of key competencies affecting the management of the current project. Merrow (2011) in essence was saying problems of project failure potentially start earlier before the projects are conceived and prepared. Firstly, the organisations have embarked on outsourcing of their key competencies to other entities. This reduces the organisation's control over the services it outsources (Elmuti, 2003). This could potentially leave the organisations without the various skills and professionals to handle projects both at planning and execution level leaving them to be supervisors and overseers of projects they do not fully understand (Groenveld, 2006; Ofori et al, 1996). Another problem, possibly resulting from the previous, is that decision making is often poorly informed. According to Merrow (2011), critical questions are seldom asked at the project conception stage in the board room.

The Rand Model of factors of overruns also gives an idea of what could be going on in the project management environment (Morris, 1989). According to this model, cost estimating errors, faulty execution of the project, changes in the project and changes in the project macro-environment are seen as the principal causes of overruns (see Figure 2.7). Project definition and complexity determine how the costing will be done; technology selection, phasing, project definition and procurement affect the execution of the project; scope changes caused by external/environmental factors or technical problems cause changes in the project. All these ultimately lead to time and cost overruns.

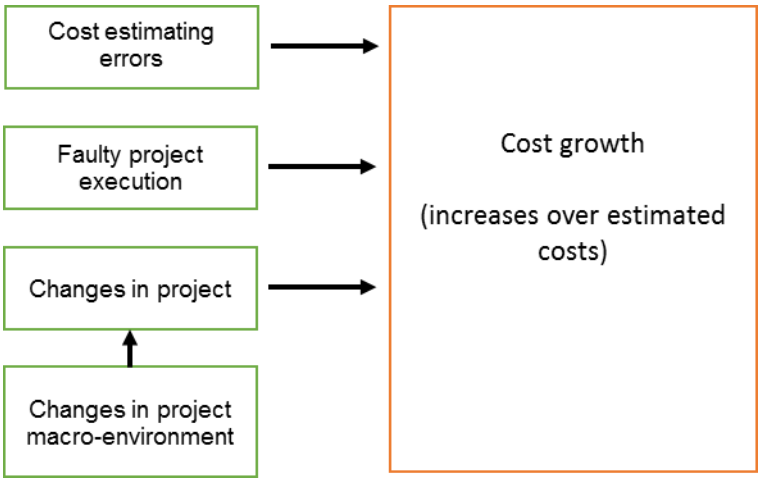


Figure 2.7: The Rand Model of factors causing cost over-runs

Source: Morris, (1989).

2.7 Root Cause of Overruns and the Inter-Relatedness of Factors

As explained previously, on the problem of time and cost overruns, most scholars sought to identify the major or critical factors causing delays, but never went further to understand what may have been behind those factors, for instance, by probing deeper (AlSehaimi et al, 2013), try to understand the mitigating factors (Olawale and Sung, 2010) and the interrelatedness of the various factors (Steyn, 2009).The problem is that none of the key factors are responsible on their own and are all inter-dependent (Clarke, 1999).

Interestingly, Arditi, Akan and Gurdamar (1985), one of the earliest studies on the problem of delays, not only investigated the factors, but also went further to understand the reasons behind the factors using interviews though they did not investigate the interrelationships amongst the factors.

Equally Chan and Kumaraswamy (1997) identified five most significant causes of time and cost overruns shown in Figure 2.8. They said the reasons behind these factors were deficiencies in the management capacity of the clients, consultants and contractors.

Groenveld (2006) pointed to the cyclical nature of the work flows in the South African construction industry as the reason behind poor capacity of the work in the industry. An increase in investment leads to shortage of materials and high input costs. The low work flows lead to retrenchments, resignations and the consequential loss of expertise and manufacturing capacity. Equally, Ofori et al (1996) discussed the negative impacts of work fluctuations on professionals and the contracting sector, which ultimately affects the planning and execution of projects. Knowledge and experience is lost and learning or relearning is required for each project, which affects the maturity of the industry.

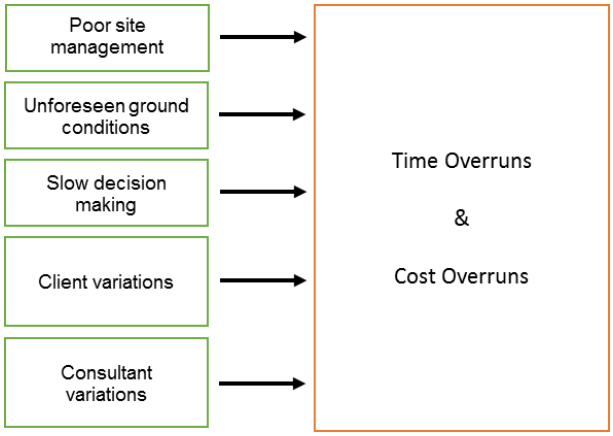


Figure 2.8 Causes of time and cost overruns

Adapted from the work of Chan & Kumaraswamy, (1997).

Morris (1989) said the reasons behind time and cost overruns in *large projects* were external factors or strategic factors such as inflation, customer change orders, geological uncertainty and community action. These issues were beyond the project team level and often started before the project was conceived.

The review from previous scholars suggests that the factors behind the time and cost overruns could potentially start in the external and the organisation environment.

2.8 Managing Large Projects

2.8.1 The definition of a large project

From literature, generating a definition of *large projects* is not straight forward (Jaafari, 2004). This may be because the term *large projects* could be considered relative depending on the type of project, financial value of the project and the type of project owner or participant (Lin and Liu, 2011). Thus, a project may be considered large by one organisation or individual depending on their experience or knowledge. Projects involving unknown or newer technology would be considered complex and difficult and therefore, large. And likewise, an organisation

familiar with that technology would not consider such a project complex and large. This fact was equally noted by Morris and Hough (1987) in their study of the anatomy of *large projects*. They noted that some projects may be considered major though they may not be large monetary-wise but because they are complex and difficult to carry out.

Lin and Liu (2011) in their study of the dynamics of small and *large projects* considered a project as small if it did not cost the company extraordinary amounts of financial assets or if its failure did not fatally affect the company. On the other hand, when a project's failure led to disastrous financial consequences on the company, it was considered to be a large project.

Some scholars find it easier to describe the characteristics of *large projects* than define them. Those who have attempted to define *large projects* do so with reference to the financial value assigned to the project. Some use the term major projects and others use mega projects. In this research, the terms major, mega and large shall mean the same and the term large shall be used.

Esty (2004) defined *large projects* as those projects costing US$ 500 million or more. Tai and Anumba (2009) considered *large projects* as those that were worth more than £3.3 million (about US$5.5million at 2012 values). Murray (2010) defined mega-projects as very *large projects* costing more than US$1 billion. Merrow (2011) defined a mega project as any project with a total capital cost of more than US$1 billion as of January, 2003 or US$1.7bn in 2010 values. Flyvbjerg (2011) defined major projects as projects costing US$100 million or more. A major programme was defined as a suite of projects costing US$1 billion or more.

Nguyeni et al (2004b) researching large projects in developing countries, defined *large projects* as those costing more than US$1 million. Again, this shows the relative nature of the definition of *large projects*. In developed countries, *large projects* are those costing more than US$100 million. In developing countries, *large projects* are those costing more than US$1 million.

Perhaps the earliest comprehensive definition of *large projects* is that given by Morris and Hough (1987) who defined major projects as those which are particularly demanding either because of their size, complexity, schedule urgency or demand on existing resources or know-how.

Whittaker (1999) considered the time dimension as well to the definition of *large projects*. *Large projects* were defined as those projects with a duration of twelve months or more.

Capka (2004) gave a broader view of *large projects* by discussing the characteristics. These were that they are highly complex, require exceptional skills and experience, involve difficult decision-making processes due to the large numbers of stakeholders, have large environmental and human impacts and are of long duration. The projects are fraught with risks

and uncertainty and have increased potential for scope creep because of the multiple stakeholders.

The PMBOK does not define or identify *large projects* as a class of projects on their own, though under Procurement Management, it gets close to identifying *large projects* by recognising that complex projects could involve managing multiple contracts or subcontracts simultaneously or in sequence. This may be because the PMBOK was written from the premise of providing general guidelines on the management of projects. The PMBOK covers knowledge areas for general projects comprehensively.

There are various knowledge areas in the PMBOK that are of particular relevance to *large projects*. These are: (1) Project life-cycle and environment management, (2) Project scope management and organisation structure, (3) Project integration management, (4) Project communications and human resource management, (5) Project time and cost management, (6) Risk management and, (7) Procurement management.

The review above shows that there is no universal definition of *large projects*. Most scholars defined *large projects* from the financial point of view as those costing more than $100m. The major characteristics of these projects are that they are highly complex, require exceptional skills and experience and have high environmental and human impacts which make them very risky undertakings.

In this research carried out in South Africa, a large project is defined as *a project that is complex in terms of project delivery, involves several stakeholders and supply chain partners with a large scale of funding of more than US$30 million.*

2.8.2 Large projects are different

In literature, there is no united view of the difference between *large projects* and small projects and consequently between the management of *large projects* and that of small projects. Some regard projects to be the same whilst others say that projects are not the same depending on size and other factors. Pinto and Covin (1989) said that academics commonly held the view that projects are similar whilst practitioners were of the view that each project is unique with different characteristics. From their research, they concluded that there are both similarities and differences amongst the project types as well as amongst the phases even of the same project.

Shenhar and Dvir (1996) after literature review found that project management texts, handbooks and PMI take it for granted that all projects are similar. “A project is a project is a project.” They contended, however, that this was inconsistent with the fact that projects often have extensive differences within their systems and subsystems.

Packendorff (1995) also found that there is a general assumption that projects are the same in literature. He says this is because the processing of planning, controlling and leading are assumed to be the same yet the differences in the projects should make them to be treated differently. He identified some projects as unique and others as repetitive which from the organisational theory point of view, will have implications on desired competence of managers, choice of the planning methods and the policy composition of the team they should have. The other project typologies he got from the research of others include, well defined easily planned projects against ambiguous unpredictable projects similar to low tech/super-high-tech projects of Shenhar and Dvir (1996). Other categories are based on specialisations and fields such as civil engineering projects, transport projects, mechanical projects and building projects.

Engwall (2003) also criticised the universal view of projects. He says this view is responsible for projects being viewed as a universal phenomenon so that though several project classifications have been suggested, there has been little theoretical impact. From his research findings, he agreed with Shenhar and Dvir (1996) that there are wide variations in projects and that projects have less common characteristics than was thought previously.

Shenhar (2001) said that there are differences in projects. He pointed to the impacts projects have on the environment and the use of technology. Some projects have extensive impacts on the environment whilst others have little impact. Some projects use familiar technologies and others deal in non-existent technologies.

Shenhar and Dvir (1996) from their case study research found that the more complex a project became, the more decision-intense it became, the more also it depended on highly educated and experienced people in specific narrow fields. For less technological projects such as assembly projects, it was found that small, functional and simple processes and tools sufficed to manage the project, but that higher technology projects required a project office to handle subcontracting and other integration efforts in a more formal way. The high-end technology projects required to build umbrella organisations to handle coordination, legal and external connections. In terms of communication at high-tech level, more intense and frequent communication is required.

The distinction of the management of *large projects* compared to smaller projects has also been largely ignored in research as evidenced by the few scholars that have investigated the study of management of *large projects* (Morris and Hough, 1987; Merrow, 2011). This may have come from the lack of distinction between the different projects types by main stream project management professions and institutions such as PMI, APM and scholars as discussed before (Morris, 1997; Packendorff, 1995; Shenhar, 2001, Morris et al 2006). Yet there is a case that a project is a multi-faceted phenomenon contingent on the nature of the

task and the environmental characteristics, which is not consistent with a blanket view of a project applicable to all situations and circumstances (Packendorff, 1995).

Morris et al (2006) said that the lack of distinction in the management approach was due to the mechanistic approach promoted by the PMBOK guide and PMI standards, which give a universal guide with the steps required to manage projects without consideration for complexity in projects, imagination and creativity. They contended that for defined work packages and simplistic solutions, the guides are appropriate but that projects that are more complex require understanding of the various interrelated factors, complex decisions and considerable judgement and experience.

A review of the characteristics of *large projects*, indicates that they are not simplistic, but are complex undertakings. Endsley (1995) said that *large projects* are complex and dynamic. Capka (2004) considered *large projects* to be a different breed not only because of their large size, complexity and costliness, but also because there is ever an intense pressure to minimise or eliminate completely, the project's adverse effects on the quality of life, commerce and the environment both during and after construction. The challenges are said to be more compounded when the projects are carried out in densely populated areas. Thus, the project risks which include politics, media, sensitive communities and, construction methods and techniques are high. Capka (2004) concluded that to successfully manage these projects, it is not only the anticipation of the complexity of the task at hand that is required, but also the realisation that large project management is more than just managing a lot of construction. It also involves the management of complex public dynamics.

The review of literature shows that there is a general assumption in mainstream literature that all projects are the same whether small or large. The main reason behind this is that it is reasoned that the process of management is the same for all projects. Some scholars, however, have argued that there are differences in projects and that *large projects* are different not only due to the size, complexity and cost but also involve management of complex public dynamics such as environment, politics, media and community risks which require exceptional and experienced skills to manage. The review suggests that a realisation of a project type at inception would potentially help the project participants in preparing for the management of complex dynamics in *large projects*.

2.9 Time and Cost Overruns: Influence of Project Management Competence

Reviewing the various causes of time and cost overruns, it is clear that this is a complex problem. It is also indicative that project management performance is not dependent on a few factors, but several with numerous inter-relationships (Steyn, 2009). At the heart is project management competence (Crawford, 2005). This is confirmed by previous research that the

major cause of delay is poor management practice (AlSehaimi et al, 2013). In many studies, it was found that the actual performance on projects was often lower than expected (Ramazani and Jergeas, 2015).

The relationship of project management competence and time and cost overruns has not been explored by many scholars. This may be because many concentrated on identifying the most significant factors of delays without necessarily investigating what was behind them.

It is generally understood that competence of project management personnel has a major impact on the performance of projects and consequently the business (Crawford, 2005). The concern for project management competence has resulted into increased interest in project management training. This is seen in the exponential growth in the membership of professional bodies such as PMI and IPMA (Bredillet et al, 2015). As a result, various project management standards and guides were developed to improve on knowledge and practice.

In project management, project management competence is seen to lead to better project performance which ultimately leads to improved organisational performance (Crawford, 2005) as illustrated in Figure 2.9. There are various factors that constitute competence which include personal characteristics, knowledge and ability to carry out the task. Crawford (2005) conceived an integrated model as shown in Figure 2.10. The model suggests that performance

Figure 2.9 Project management competence and performance relationship

Source: Crawford. (2005).

is dependent on four characteristics: knowledge, skills, personality characteristics and ability to perform on the job. These are personal attributes which enable a person to carry out his work. Boyatzis (1982) said to do a job, a person draws from his inner resources so as to respond to the job requirements or request.

From research carried out by others such as Morris et al (2006), Hartman and Dorée (2015) even Crawford (2005), there are other factors that affect performance in the project apart from the individual's competence such as the organisation a person is working in, the economy of the country, the client, actions of third parties or unforeseen circumstances and other factors that impinge on the organisation, the project and the individual. These could be moderation factors or, as Olawale and Sung (2010) observed, inhibitors in the performance of individuals.

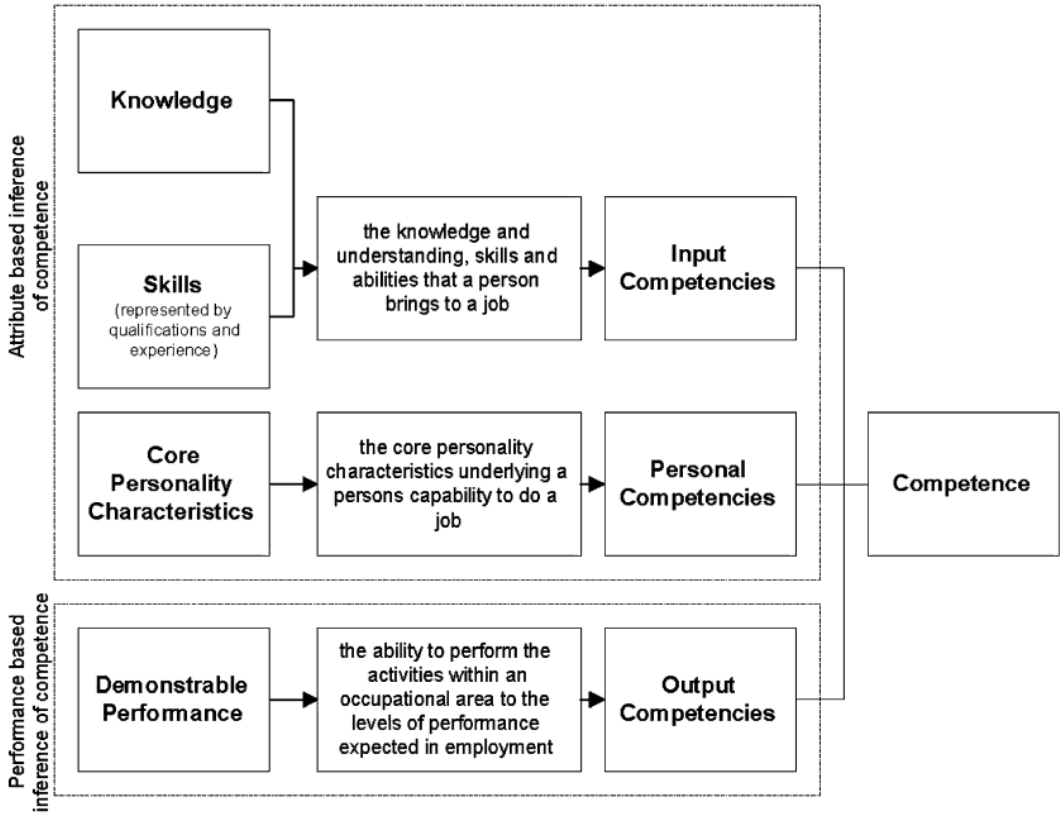


Figure 2.10 Integrated model of competence

Source: Crawford, (2005)

Margerison, (2001) suggested that there has been over-emphasis on individual competence and that this is misplaced as individual competences, though important, they need to be seen in the context of a team and what it requires to do. This therefore means that what affects effective performance is the collective competence of the individuals in the project environment, the competence of individual organisations in the project teams as well as competence of institutions in the external environment.

Would it be that these factors affect the management of projects leading to time and cost overruns? Does project management competence, the collective competence and pressures from without affect the actions of a project team in managing large projects? How do these dynamics lead to time and cost overruns? It is hoped the research will provide some answers to these questions.

2.10 Project Management Performance: Effect of Training and Qualifications

Scholars have appreciated the need for training in project management and the existence of bodies of knowledge such as PMBOK (Shepherd and Atkinson, 2011; Cywinski, 2009, 2004; Cicmil et al, 2006). These are essential for grounding the project manager with requisite knowledge to manage projects.

Several scholars, however, have argued that project management training has not fully equipped project management personnel to effectively manage projects. This is noted from the content and coverage of the training and the method of teaching conducted. (Ramazani and Jergeas, 2015). Thomas and Mengel (2008) argued that PMBOK and other standards focus mostly on linear, rational analytic approaches which conditioned students to think, feel and perform as instructed leaving them ill-prepared to deal with unexpected situations on site and failure to adapt to uncertainties or innovate new techniques and strategies.

Hartman and Dorée (2015) likened the learning approach to the sender/receiver method where the individual acquires abstract and general knowledge through books and experts hoping that this will result in a change in the mental model of the learner which will make him competent to carry out project management.

Shepherd and Atkinson (2011) appreciated the existence of bodies of knowledge but criticized that they did not address project complexity, but discussed projects as having clearly defined goals, well established lifecycle and largely linear in sequence which they found not to be suitable for complex projects. Morris et al (2006) also argued that the project management guides concentrated more on the series of steps required to be taken and less on the issues that needed to be managed. They also found them to be more execution oriented and hardly covered any material on project strategy and definition and management of external factors or human behaviours.

Other areas of concern to scholars were that the training concentrated on certain aspects leaving out other equally important areas. Morris et al (2006) found that the training only covered the execution phase leaving out the preparatory, strategy and project shaping phase. Pant and Baroudi (2008) and, Bourne and Walker (2004) found that the training concentrated on the hard concepts at the expense of the soft concepts.

This orientation is at variance with research on success factors of project management which emphasise more on the need for mixture of skills for project management personnel. Katz (1974) found that an administrator, who can be at any level in the organisation, needs a mixture of technical skills, human skills and conceptual skills to be effective. Pant and Baroudi (2008) found that not only technical competence is required to manage a project effectively but also the human management skills especially in today's complex projects and prevalent specialisation. Working through others is required to accomplish project success. Equally, Loo (2002) found that an even split of human and technical skills were required to successfully manage. El-Sabaa (2001), however found that human skills of project managers were the most influential on project management practice. Turner and Müller (2003) said that the traditional project management competence areas are merely hygiene factors, essential but

do not lead to superior project performance. They proposed managing communication and risk as more critical.

Buganza, Kalchschmidt, Bartezzaghi and Amabile (2013) mention other factors that could affect the performance of the trained personnel which have nothing to do with training. These include organisational factors, the characteristics of an individual and management's commitment which may be supportive or inhibit behavioural changes. The poor results or performance could also be due to the ineffectiveness of the training, possibly due to having poorly designed the course.

Wirth (1992) predicted future trends such as projects becoming global, industry fragmentation and multi-project management which would require managers to deal more with external factors and diverse skills of people. This requires moving away from the traditional technical issues to more relational issues. Morris (2013) called this the "Third Wave" in project management history where there is a move to managing the project's external environment, including stakeholders, consideration of the influence of the project on the parent organisation and the external environment proactively and not reactively only.

The review shows that knowledge through prior training is essential to project management competence. However, the training has been criticised in its approach and orientation. Most scholars have argued that the training has tended to concentrate on technical and hard concepts leaving out human management skills. This is seen by many to be at variance with research results which show that a mixture of both technical and human management skills is essential to successful delivery of projects. This suggests that the unbalanced approach to project management training could potentially affect the delivery of projects.

2.11 Preparing for the Project: A Potential Factor in Project Competence

Many factors have been identified as the causes of time and cost overruns. These include delayed payments from the client, incomplete designs and poor project planning and supervision by the contractors as described earlier in section 2.5. One area that has not received attention by researchers and practitioners is the preparation of project participants for the project (Ribeiro and Ferreira, 2010). The preparation is at two levels. Preparation for the job or position in the organisation and preparation for the project work.

From the Concise Oxford English Dictionary (2008), to prepare is to make ready for use or consideration. It is also to make or get ready to do or deal with something. Preparation is defined as the action or process of preparing or being prepared, something done to get ready for an event or undertaking, a specially made up substance, especially a medicine or food.

For this research, preparing for the project is defined as *the process or action that is undertaken to make ready the participants to plan and execute the project*.

Preparing for a position at work or career is mostly understood to be done through training and education through professional institutions such as PMI and the university or college degrees. The training and application of knowledge thereafter gives the trainee the necessary skills and competence to carry out the tasks in project management. This training however, has been criticised by some scholars that it does not prepare the participants for the actuality of project management due to its approach and orientation.

Edum-Fotwe & McCaffer (2000) said that the training leaned heavily on the technical skills leaving out other areas. Equally, Cywinski (2009) found that the technical training was narrow which made it difficult for trainees to manage the reality of projects which are strewn with a broad array of human relations issues. Pant and Baroudi (2008) said that a mixture of both technical and people skills was required as project management involved a juggling of several issues at the same time. Winter, Smith, Morris and Cicmil (2006), Papke-Shields, Beise and Quan (2010), Ramazani and Jergeas (2015) also found that the preparation of project management personnel for projects through training in the classroom did not meet the actuality of projects particularly the relationship issues with today's complex projects which involve multi-relationships, multi-organisations, people and many unknowns.

Cicmil et al (2006) criticised project management research and training that it portrayed project management personnel as competent, purposive, decisive and rational when the actuality of projects showed that the project environment is messy with a lot of social issues to be solved. Equally, Miller and Lessard (2008) found that showing project management to be comprised of discrete elements did not reflect the actuality of projects which have overlapping phases from inception to completion.

Preparing for a position at work or career is also through the Influence of the ideas and theories held in the industry and training domains as well as national and regional cultures and beliefs. These have an influence on the preparation and execution of projects by the trained project management personnel. Some theories and beliefs even work at variance with project management principles.

Lee and McCalman (2008) contrasted the cultural orientation of the Japanese and the western United States of America. They found that the Japanese belief systems in their social life and at work encouraged trust and collaborative behaviour which is important in project management. The American belief system, however, encouraged competitive behaviour, expectation of compensation for work to be carried out and use of contracts to enforce

compliance which were at variance with the trust and team building required in project management.

Phua and Rowlinson (2003) found that not only was motivation and commitment of team members strongly linked to national and organisational cultures, but that also other factors affected collaborative efforts and team building. These include professional orientation as well as sub-cultures found in organisations

In terms of preparing for the project or project shaping, the early stages of the project, also called the front end (Smith & Winter, 2010; Merrow, 2011) are found to be critical and crucial to the outcome of the project (Söderlund, 2002; Gareis, 1989; Morris et al, 2006, Merrow, 2011). Management of the early phases of the project affect the success of the entire project (Söderlund, 2002). Gareis (1989) found that both pre-project and post-project phases affect the execution phase. Smith and Winter (2010) from their research noted that projects must be soundly based to be successful and that "projects that fail have the seeds of their failure implanted from the onset." Likewise, Gareis (1989) said energy, impulses and objectives invested at the beginning are factors that affect project performance.

Morris et al (2006) wondered why the PMI and other standards seem to imply that project management is limited to the execution phase. If the case is that efficiency and effectiveness of delivery of a project is established at the front end, then it is important that project managers are part of the planning and management of this phase to set up the success frameworks of the project.

Another area of concern is that of knowledge management. Abdul-Rahman, Yahya, Berawi and Wah (2008) found that project learning could help parties to mitigate project delays, yet surprisingly, project knowledge is not properly managed nor prioritised by top management. Ribeiro and Ferreira (2010) found that there is a lot of loss of experience on previous projects, especially the tacit knowledge because many organisations do not have systems of capturing and storing information. The inadequate work flows in the industry also have a potential to affect the adequacy of the preparation, planning and execution of projects as knowledge and experience is lost due to technical and professional turnovers (Ofori et al, 1996; Groenveld, 2006).

Results of the literature review show that many scholars agree that training is essential for preparing participants for project management. However, they criticise the approach of training that it does not prepare participants for the actuality of projects. It has been found to be technical oriented leaving out other equally essential areas such as human relations management. Other scholars brought out that beliefs and cultural orientations also affect

preparation and management of projects. The implication for this research is that these areas may be potential factors requiring attention in the preparation and management of projects.

2.12 Risk Management, Estimating and Decision-Making

The importance of risk management, estimating and decision-making in projects is acknowledged (Charrette, 1996; Busby & Payne, 1999; Flyvbjerg, et al 2003; Flyvbjerg, 2011). Several studies have been done with many scholars devoting attention to a specific area rather than a combination to see how these could potentially relate to each other and lead to time and cost overruns.

Walker (1997) found that power games within project teams affected decision-making. Those with more power prevailed over those with less power. For instance, the consultant and contractor would avoid going against the client's decision in order not to jeopardise future relations. Lui et al (2003) found that expertise and knowledge power could be used by specialists to influence decisions.

Flyvbjerg (2011) found that certain circumstances influenced the behaviour of project participants. He found that the outcome of the decision the participants required influenced their behaviour in estimating and risk management of the projects. There was optimism bias and misrepresentation in estimates where managers ignored or under-estimated project costs because they wanted the project to be accepted. Jennings (2012) found that adversarial politics, organised interests, pursuit of ideological agendas and, other group-think behaviours affected decision-making.

Charrette (1996) discussed the behaviour associated with risk stigma. Project participants ignore risks or consider them to be lower because admitting project riskiness is associated with not fully comprehending the problem or being pessimistic. This results in lower estimates and risk management difficulties due to the mind-set.

In optimism bias it was found that managers ignored or underestimated the risks which affected their estimation of costs and decisions regarding proceeding with the project in spite of evidence to the contrary, thus falling victim to what is called "the planning fallacy" where it is difficult to adjust to other plans and figures and hope that "everything will go according to plan" (EGAP) (Flyvbjerg et al, 2003). Jennings (2012) discusses optimism bias and overconfidence when planning as well. These all affect the estimate and the plan for risk management.

Busby and Payne (1999) found that human decisions are affected by illusion of control, love of decomposition of tasks and the outside view. The first is where participants take future events to be more predictable than they really are so that in planning they over-estimate how

much they can influence them. For the second, when estimating, the project is decomposed to the lowest costs and these costs added up to determine the total cost without considering that previous tasks have influence on subsequent ones as well as the effect of errors one task upon the next task. Lastly, use of past similar outcomes and applying them to the current tasks assuming that the occurrence of events including unexpected events from the past will be the same on the current task. This potentially leads to under and overestimating the project tasks.

Tatum (1984) found that managers in *large projects* used experience and not rational processes to make decisions on organisational structures to use. Furthermore, he found that political and random choice processes also influenced the decision-making. Hartman (2008) said decision-making is not easy in *large projects* because the large project environment is volatile and complex with several forces and factors affecting. This makes it highly uncertain and susceptible to numerous changes, yet decision-making is assumed to be based on the Newtonian model which requires complete information and perfect rationality which rarely happens in practice. Leaders depend more on using human values to make decisions.

Coming to risk management, it is generally assumed as important, but it is not formalised in the project management system in many cases (Tah & Carr, 2000). This is surprising since the most common unexpected risks are the factors behind overruns. Loots (2013) found the most common unexpected risks as (1) latent conditions such as ground conditions, (2) delays due to inadequate design and scope changes, (3) shortage of skilled personnel and increased cost of resources, (4) site access issues, (5) delays with the approval process. Further, as the size of the project increases, so does the complexity and consequently its riskiness due to the increased number of players and unforeseen delays. On *large projects*, public dynamics play into the management and execution of the project (Capka, 2004). The project manager has to deal with tough politics, commercial, regulatory and governance environments (Loots, 2013). These issues, therefore require risk management to be at the fore front of management.

However, Tah and Carr (2000) said it is done on an adhoc basis and appears to be dependent on the skills, experience and risk orientation of the individual participants. Chapman and Ward (2003) said that for risk management to be effective, there must be a culture of reporting in the organisation which may not be the case where the process is not formalised. Charette (1996) says few managers see the need to make risk management a separate, formal or even the main activity especially for large and complex projects. This severely hinders the success of *large projects*. It is worsened also with the traditional bid-build procurement method that is commonly adopted in projects which leaves out other participants in the formative stages. Whilst it is acknowledged that risk should be allocated to the party that can best handle it (Flyvbjerg et al, 2003), the contractor who manages construction risk comes later in the process when the project strategy and approach has been concluded.

Baloi and Price (2003) said that risk management is beneficial if implemented in a systematic manner from the planning stage and throughout the project. It also needs to be understood that there is a risk dependence chain (Tah & Car, 2000). Certain risks are related to other risks which are related to other risks. Some risks lead to others which trigger others still. Risks are dynamic throughout the project's lifecycle. Therefore, planning once and everything goes according to plan is not ideal for risk management especially, the uncertain large project environment.

Tah and Car (2000) said that communication of construction management risks is poor, incomplete and inconsistent throughout the supply chain in the project lifecycle. There is also a problem of not having a unified system of risk management amongst the team members as each uses different techniques and methods for risk identification, analysis and management. The implication of this is that risk management may not be effective.

Considering the high risks and uncertainties involved in *large projects,* Loots, (2013) and Charrette, (1996) recommend that decision making should proceed cautiously, investigating the potential risks of the actions and decisions taken. Equally, the sharing of knowledge and information on risks from various parties may be paramount as each party understands their risks and how they will impact on their work but rarely understand the impacts of their actions on the other participants.

The review shows that there are certain factors that influence the behaviour of project participants in decision making which include power games, optimism bias, misrepresentation and cultural orientations of the participants. This then affects the estimating and risk management that is carried out. Furthermore, some scholars have noted that risk management, though acknowledged to be important, is not formalised in the management of projects. The review suggests that there is a possible link between the behaviour of project participants and the occurrence of time and cost overruns.

2.13 Conclusions

Time and cost overruns have been a persistent problem in infrastructure projects over the years. Various attempts have been made to solve this problem and to improve the delivery of projects which include the United Kingdom reports of Latham in 1994 and Egan in 1998. In the reports, the problem in the industry was seen to be rooted in industry fragmentation, poor communication and adversarial tendencies by project participants. They recommended improvement in the procurement processes which included partnering and less use of competitive tendering. Academic and industry professionals recommended other improvements that included streamlining the procurement process using gate/review points in the project life cycle.

Various factors have been cited by scholars as the causes of time and cost overruns which include numerous change orders from the client, delayed payments to the contractor, incomplete designs, slow decision making, poor planning and scheduling by the contractor, poor site and supervision management, poor productivity and contractor's financial difficulties. The overruns were seen to be the results of actors failing to meet the time, quality and cost plan conceived at planning or tender stage or simply the actions and inactions of the project participants.

Not many attempted to investigate the reasons behind the factors leading to overruns or to link them to other management theories to get a deeper understanding of project participants' behaviour in projects and how that could lead to overruns. This may have been due to the aim of most of the researchers and the research methods used. Most wanted to find out the significant or most significant factors that cause overruns of projects in general. The predominant research method used has been the questionnaire or opinion survey where a list of causes is drawn from previous studies and given to respondents to rank or confirm that these were the problems faced in their projects, or that these were the major causes of over-runs of projects in general. In some cases, the researcher sought to find whether there was consensus amongst the different project management players on the causes of over-runs.

Recent scholars have disputed the often-cited causes of overruns saying they are not the root cause of overruns. They noted that opinions and not actual project data is used, the opinion survey used by most was not well suited to get a deeper understanding of the causes of overruns and that previous studies placed primacy on what the contractor could do to eradicate delays and took it for granted that the planned programme was accurate. A prominent finding in recent studies is that overruns are caused by optimism bias and misrepresentation by the project participants.

Other scholars have contended that large projects are essential to society and have experienced more time and cost overruns compared to smaller projects, but have not received much scholarly attention. They are poorly understood, often inadequately managed and suffer more from time and cost overruns. From literature, the reason could be that scholarly books, articles, textbooks and professional institutions have not differentiated *large projects* from small projects. All projects are considered to be the same. Some scholars have, however, contended that *large projects* are complex, require higher technologies, skills, experience and have large potential to affect the community's quality of life, commercial businesses and the environment during and after construction. *Large projects* involve management of complex dynamics, which require higher competencies.

The importance of project management competence has been discussed in literature and its link to business performance is well understood. However, the relationship between project management competence and time and cost overruns in *large projects* has not been explored. Competence has been modelled to be dependent on a person's knowledge, skills, personal characteristics and ability to perform on the job. Some scholars have argued that effective performance goes beyond an individual's competence and includes contextual considerations such as organisation, economy, the team, actions of third parties and unforeseen circumstances. This suggests that the collective competence of individuals in the project environment, in the organisation environment and external environment affects the management of the project and could potentially lead to time and cost overruns.

Training and qualifications are closely related to competence. The view of most scholars and the industry is that knowledge of project management standards and procedures received through training is the key to effective project performance. Some scholars, however have argued that project management training has not fully equipped project management personnel to effectively manage projects. The standards have been criticised to be linear and rational analytic approaches. These have conditioned students to think and perform as they have been instructed leaving them ill-prepared to deal with uncertain and difficult situations in a project. The training is criticised for concentrating on technical skills leaving out equally important human aspects such as communication.

Preparing for projects, of which training is a part, has received little attention as well. Preparation is at two levels: preparation for the career position in the organisation and preparation for a specific project. Preparation for a career, which was discussed before, has been criticised for its approach and technical orientation which leads to insufficiently prepared project management personnel to manage the actuality of projects filled with much social issues to resolve. The rational deterministic approach has been criticised as well. It orients project participants to fail to adapt to change and look outside for solutions instead of at themselves. Other areas that are seen to affect preparation and eventual execution of project work are ideas and theories held in industry, training domains as well as professional institutions, national and regional cultures and beliefs.

In terms of preparing for project work or a contract, there are two areas of concern: the involvement of the project participant at the front end and the management of knowledge in project organisations. The early phases of a project are important as these affect the success of the entire project. Previous research says that projects that fail have seeds of failure implanted from the onset, yet in project management literature and standards, the project manager is hardly involved in the front-end. He is limited to the execution phase. In spite of

his knowledge and experience in project management, he is not involved in shaping the project in the early stages.

Whilst it is agreed that knowledge management is essential to project performance, scholars say that it is not properly managed and this affects preparation for future projects. There is much experience lost on previous projects due to problems of capturing, storage and re-use of previous project information. It is also compounded by the cyclical work flows in the industry which result in employee turnover with consequential loss of technical and professional expertise.

This suggests that preparation for a project involves not only career training but also the ideas, theories and cultures in professional institutions and countries, shaping of the front-end and knowledge management.

In decision-making, particularly, estimating and risk management, various factors that affect decisions have been presented by scholars. There are political games and power plays in organisations which influence the way decisions are made. There is a stigma associated with admitting the riskiness of a project as it could be seen as an admission of failure to manage the problem, leading to a behaviour of considering risks to be lower in spite of contrary evidence. This potentially leads to failure to prepare and manage risks due to the mind-set. Furthermore, humans are affected by illusion of control and love decomposition of tasks which makes them think they can manage a three-day task in one day and fail to consider the effects of interdependence of tasks due to decomposition.

Scholars have noted that risk management is acknowledged to be important but it is not formalised in the project management system. It is often done on an adhoc basis and is dependent on the skills and risk orientation of the individual participant. Few managers see the need for risk management and it is worsened by the procurement approach commonly taken which does not promote a unified system of risk management among project participants.

From the review of literature, it is seen that most studies investigating time and cost overruns were on general projects, with few investigating overruns on *large projects*. Most studies used the questionnaire survey method. Furthermore, there was not much attempt made to find the interrelationships amongst the various causes or linking them to other management theories to get a deeper understanding of behaviour in projects and how that could affect overruns.

The aim of the research, therefore, using a combined case study and questionnaire survey method, explained further in the next chapter, was to study how the actions of a project team

in a large project affect the delivery of projects and to develop a project management strategy for the project owner to use on these types of projects.

Chapter 3 Research Methodology

3.1 Introduction

In this chapter is described the research approach adopted for this study of the management of large construction infrastructure projects. The rationale for choosing the research approach, the research propositions, and the unit of analysis, selection of cases and participants and ethical issues are discussed. Also included is the explanation of the methods of collecting data and its subsequent analysis. The chapter is concluded with the limitations of the study.

3.2 Research Design

Yin (2014) explains that there are three conditions which help in determining which method to use in a particular study. These are (1) the type of research questions posed, (2) the extent of control a researcher has over actual behavioural elements, and (3) the degree of focus on contemporary as opposed to entirely historical events. On the type of research questions posed, he explains that, research normally answers questions of, “what?” “who?” “where?” “why?” “how?” “how many?” and “how much?” Experiment, history and case study research strategies or approaches address research questions of “how?” and “why?” Surveys and archival analysis, address questions of “who?” “what?” “where?” “how many?” and “how much?” On behavioural events, only the experimental method requires control of behavioural events. Lastly, experiment, survey and case study focus on contemporary events. History focusses on historical and archival analysis on both historical and contemporary events.

The research question for the current study was, “Why and how do large construction infrastructure projects incur time and cost overruns?” The case study method was therefore the most appropriate method of research for the study. However, to improve reliability of results, triangulation of data, of methodology and of results was used (Robson, 2011, Love, Holt & Li, 2002). A mixed method of case studies and questionnaire survey was adopted in the research. Love et al (2002) explained that a mixed method approach was more adapted to construction management research as it dealt with both natural sciences (the positivist view) as well as the social sciences (the interpretist view). A singular method would make one leave out other aspects that the different approach would have brought in. Therefore, in order to get a complete picture of a given phenomenon, a blend of methods should be used. They explained the ways of triangulating that could be used as (1) by time source where the results are from different time intervals, (2) by source nature where results are from different sources such as documentary and interviews, (3) by collaboration of investigators where the results are from more than one investigator, (4) by methodology where different research approaches

are used, (5) by interdisciplinary involving more than one professional discipline, and (5) by validation of input of results

In this research, the case study method was chosen as the primary method of research and the questionnaire survey as the secondary method. The case study method was chosen to get in-depth understanding of the actuality of projects. The questionnaire survey chosen to see how generalisable the case study results are in South Africa as well as investigate how large projects are managed and to get the perceptions of the professionals on the problem of time and cost overruns on large projects in South Africa.

3.3 The Case Study Method

The case study method was chosen as it deals with the “why?” and “how?” questions. The method is also more appropriate for contemporary events and the researcher has no control over the actual behaviour of the elements. Another reason is that the case study research method enables one to carry out an in-depth investigation of the phenomena which makes it suitable for investigating the factors that lead to time and cost overruns.

Strengths of the case study method

The case study method has various advantages over other methods. Darke, Shanks & Broadbent (1998) say that case study research allows investigation into contemporary events in their natural setting and enables a focus on understanding the dynamics in the single setting. Hofstee (1998) also explains that case study research is useful when detailed knowledge is required of any particular case for whatever reasons. Equally, Fellows and Liu (2008) explain that case study research encourages in-depth investigation of particular instances within the subject and also provides insights and ideas as well as helps to describe phenomena.

These attributes are particularly useful in this study where the underlying reasons for the time and cost overruns in projects are being investigated. A holistic approach appears to be useful as it enables the study of the multitude of factors and how they interact in their context. The detailed knowledge to be gained will also help in providing insights and ideas on determining the project management strategy for *large projects*.

Weaknesses of the case study method

Fellows and Liu, (2008) mention two major limitations of the case study research strategy. These are; observer biases and the problem of controlling extraneous variables. In the case of the observer biases, it is pointed out that the researcher’s biases can potentially affect the interpretations in the analysis. The other problem is that the researcher may be affected in his observations of the phenomena based on his or her experience or inclination which effectively

affects the reliability and validity of the results. Yin, (2014) advises that using multiple sources of information helps to reduce the observer biases. Documentary analysis, questionnaires, intensive interviews and observation are the multiple sources that were used to gather data in this research.

Extraneous variables are factors or events not strictly being studied which may affect the research. In experimental research, to remove this problem, the study is normally carried out in a controlled environment so that the researcher can manipulate the isolated variables and see the effect. In case study research, the phenomenon being studied is investigated in its natural setting. This then makes it difficult to rule out alternative explanations from what has been observed. Yin, (2014) mentions two concerns with extraneous variables. The first relates to the causal relationship of x factor leading to y when there could be another third factor. The second is that of inferring from observation that a particular event is due to some earlier occurrence. He proposes two ways of dealing with this problem. One approach is that the researcher should design the research to deal with rival explanations, for instance having case studies which replicate the theory and others which disprove the rival explanations. The other method is to take steps in the analytic phase to deal with the alternative explanations.

Another weakness of the case study research approach is that it is not highly regarded by some scholars and is often taken to be for exploratory research (Yin, 2014). Hofstee, (1998) cautions that the researcher needs to be careful with the method as there is a potential of losing focus with the method and the difficulty of generalizability of results as well as subjectivity. He recommends using this method with others to avoid biased results. He also recommends reading several articles that have used the case study approach to get guidance on how others used the method. Yin, (2014) explains that taking steps in preparing for the case study research as well as drafting a research protocol, which should be adhered to would improve the validity and reliability of the research method.

In recognition of the potential problems as identified by other scholars, articles were considered in project management and other disciplines that have used or discussed the case study approach as well as the formulation of the research protocol, shown in the Appendix A, to minimize the weaknesses observed.

3.3.1 Research instruments

The main instrument for the case study research was the interview. It was supplemented with documentary evidence and observation. Robson (2011) explains that the case study method is essentially a multi-method research strategy enabling a researcher to use various data collection methods which include interviews, documentary evidence and observation. These techniques are discussed in the next paragraphs.

Interview guide and research protocol

An interview guide was developed to use in the field when carrying out the interviews (see Appendix B). A research protocol was also prepared for each case study (Yin, 2014, Creswell, 2014). The protocol contained the interview guide, the procedures and general rules to be followed in the field. It basically had four sections: (1) case study research overview, (2) field procedures, (3) case study questions (4) case study reports and analysis plan.

The case study questions were in two sections, (1) personal data and (2) project specific data. The project specific data included variables of project structure, involvement of the client and other project participants in the planning and execution of the project, qualification and experience of project members, experience during planning and execution of the project, use of project management principles, preparation for the projects, selection of sites, decision making, time and cost overruns and reasons for the overruns. Similar to the approach taken by Hartman and Dorée (2015), in the interviews, the respondents were allowed to reflect and reconstruct the activities of the project and what may have led to time and cost overruns and the effect or involvement of various personnel.

Validity and reliability of research

Creswell, (2014) explains that validity and reliability for a qualitative research is different to that of a quantitative research. Validity for a qualitative research means the researcher checks for accuracy of the findings by employing certain procedures. Reliability refers to the researcher's consistency in his investigation across the different projects or cases. The strategies used to validate research results in this study were: using multiple sources of data also called triangulation (Fellows & Liu, 2008; Love, Holt & Li, 2004, Yin, 2014), checking results with respondents, using rich descriptions to convey what actually happened in the research, presenting contradicting evidence, and spending more time in the field. The strategies to improve reliability included setting up a research protocol, and checking transcripts for errors.

Interviews

The major data collection method used in the case study research was that of interviews with respondents. The method used is similar to that adopted by Giezen (2012) who was investigating ways of reducing mega project complexity. He used two types of interviews; the narrative and the reflexive. In the former, the respondent was allowed to recall as much as he could on the past events without any interruptions. It was considered that this method would help the respondent to recall the defining moments of the project management process. In the

latter, the respondents were asked questions on particular issues. It was hoped this method would provide insights into the perceptions of the actors.

Interviews have advantages and disadvantages, as explained by Robson (2011), compared to other techniques. The first advantage is that they enable a researcher to quickly find out things or what is going on by directly asking the ones involved in the activity or process. They are, therefore, a short-cut to answers to research questions unlike methods such as observation which may take longer before the answers are found. This is useful especially for investigative research. In the current research, the actors in the management of *large projects* are in the best position to explain what they think leads to time and cost overruns in the projects. The second advantage is that interviews offer a researcher the opportunity to modify the line of enquiry as well as probe further and investigate underlying motives and actions. The third advantage is that face-to-face interviews enable the researcher to get non-verbal messages from respondents which may not be apparent in a method such as the questionnaire survey.

The disadvantages relate to the length of time it takes to carry out the interview and the skills of the researcher. The first disadvantage is that interviews could be time consuming thus leading to respondent fatigue which could affect the focus of the researcher as well as the answers given by the respondent. Both the respondent and the researcher may eventually want to complete the process which could affect the clarity of the information being obtained or given out. The respondent fatigue may also affect the respondent's behaviour in subsequent research. The second disadvantage is that interviews require skill and experience to carry out, especially the ability to probe and follow up leads. Sometimes non-verbal cues could be different or conflict with verbal ones and this requires skill for one to get the right message being conveyed. The third disadvantage is the lack of standardisation of the method which could result in difficulties of reliability and biases. Maintaining high levels of professionalism, using both structured and unstructured interviews and thorough preparation and planning are recommended to deal with these disadvantages (Robson, 2011). Other disadvantages mentioned by Fellows and Liu (2008) are that interviews are labour intensive and that the results of the research could be influenced by the way the questions are asked or probed.

To deal with the disadvantages, a pilot interview with two experienced construction professionals was carried out to see whether there is clarity in the matters being discussed and the length of time it would require. A research protocol was also prepared to be used to provide the template and standard to guide the research process.

Documentary evidence

The documents included the materials and reports compiled by the various organisations, particularly the client. Examples of these are the project charter, client's brief, consultant's brief, tender documents, final accounts, periodic reports, minutes of meetings and project handover/commissioning reports. Documentary evidence was used because they give an in-depth insight into the activities during the life of a project, especially that the originators and managers of the project compile them. The other advantages according to Robson, (2011) are that the documents enable unobtrusive evaluation, the data are in a permanent form which enables re-analysis and the data lends itself to possibilities of longitudinal research where a series of documents are available. The disadvantages are that the documents may be limited, they may not meet the needs of the current research as they were written for other purposes and, they may give a biased view as well as overlook issues not recognised or those which the owners choose not to highlight. The multi-source approach helps to minimise this weakness.

Observation

In this method, the researcher observes the activities as they happen to understand the phenomenon. The advantages of this method are that it enables collection of data in a more direct, free from poor memory and the likelihood of the respondent presenting themselves in more favourable light (Robson, 2011). In this way, it helps to get data in a real-life situation compared to other techniques such as interviews and questionnaires. Robson (2011) further says that observation also enables one to get data from what people say and do as opposed to only what people say as there is often a mismatch between what people say and what they do.

There are various disadvantages of this method. It is not easy or trouble free. The observer is perceived to affect the situation. The method is time consuming and there is ever a danger for observer bias in recording events based on personal experience. There is a danger of people being affected in their response by the presence of the observer, the 'Hawthorne effect,' (Fellows & Liu, 2008). Ensuring the observed are unaware of being observed and, the researcher participating in the research as a participant observer are methods used to counter reactivity. To avoid the problem of time, a structured approach was used which entailed identifying activities, individuals and organisations to be observed.

3.3.2 The unit of analysis

The unit of analysis is considered essential in case study research. It helps to clearly delineate what is to be evaluated in the research. Yin (2014) mentions two essential characteristics which should be clearly identified. These are; defining the case and bounding

the case. The first refers to the need to identify a phenomenon for study which is not vague. The second refers to the need to identify the boundary of the case which could be geographic, particular time period or some other context.

The unit of analysis or the case identified in this research was “the workings of project members in formulating and implementing a project.” The aim was to see how the actions of the project team affect the delivery of projects. In terms of bounding the case, the context of workings of project members was in a large infrastructure project in a developing country. This entails understanding the dynamics of a developing country and understanding the characteristics of a large project. The embedded unit of analysis was time and cost overruns.

3.4 The Questionnaire Survey

The questionnaire survey method was chosen to aid in determining what method of management is used in managing large and small projects in South Africa as well as to generalise the results from the case studies. This also required a numeric verification of the number of professionals who manage projects in this particular way. The survey was to complement as well as to compare with the results from the case study. It was carried out after the case studies. Lastly, the method was chosen because it is useful in determining the opinions, beliefs and attitudes of the professionals in the management of projects (Yin, 2014).

In the research, the aim of the questionnaire survey was to find out the beliefs and attitudes of professionals with regard to the management of large and small projects. This requires reaching out to many professionals in various institutions and locations in the vast country of South Africa. Since many cannot be reached, a convenient method is to get a sample of the population. The survey method is well placed to generate this type of information as the basic purpose and rationale of the questionnaire survey is to generalise from a sample of a population so that inferences can be made on any characteristic or behaviour of a population (Creswell, 2014). The other advantages of the survey method are that due to anonymity, they encourage frankness and they can be used to collect generalizable information from anyone (Robson, 2011, Hofstee, 2011).

The disadvantages of questionnaire surveys include the possibility that data may be affected by the characteristics of the respondents e.g. memory and knowledge; the possibility that respondents would not report their beliefs, attitudes; questionnaire surveys typically have low response rates and that respondents would possibly not regard the survey as serious (Ibid, 2011).

3.5 Study Design

The research question was "*Why and how do large construction infrastructure projects incur time and cost overruns?"*

To discuss the question, the following sub-questions were considered: (1) How is the client's involvement in planning and implementation of *large projects*? (2) How does the training and experience of project members affect the implementation of *large projects*? (3) How are the principles of project management implemented in large construction infrastructure projects? (4) How does the involvement of the client, training and experience of project members and consistent use project management principles affect decisions for project organisational design, time and cost schedules? (5) What would be the strategy for improving the delivery of large infrastructure projects?

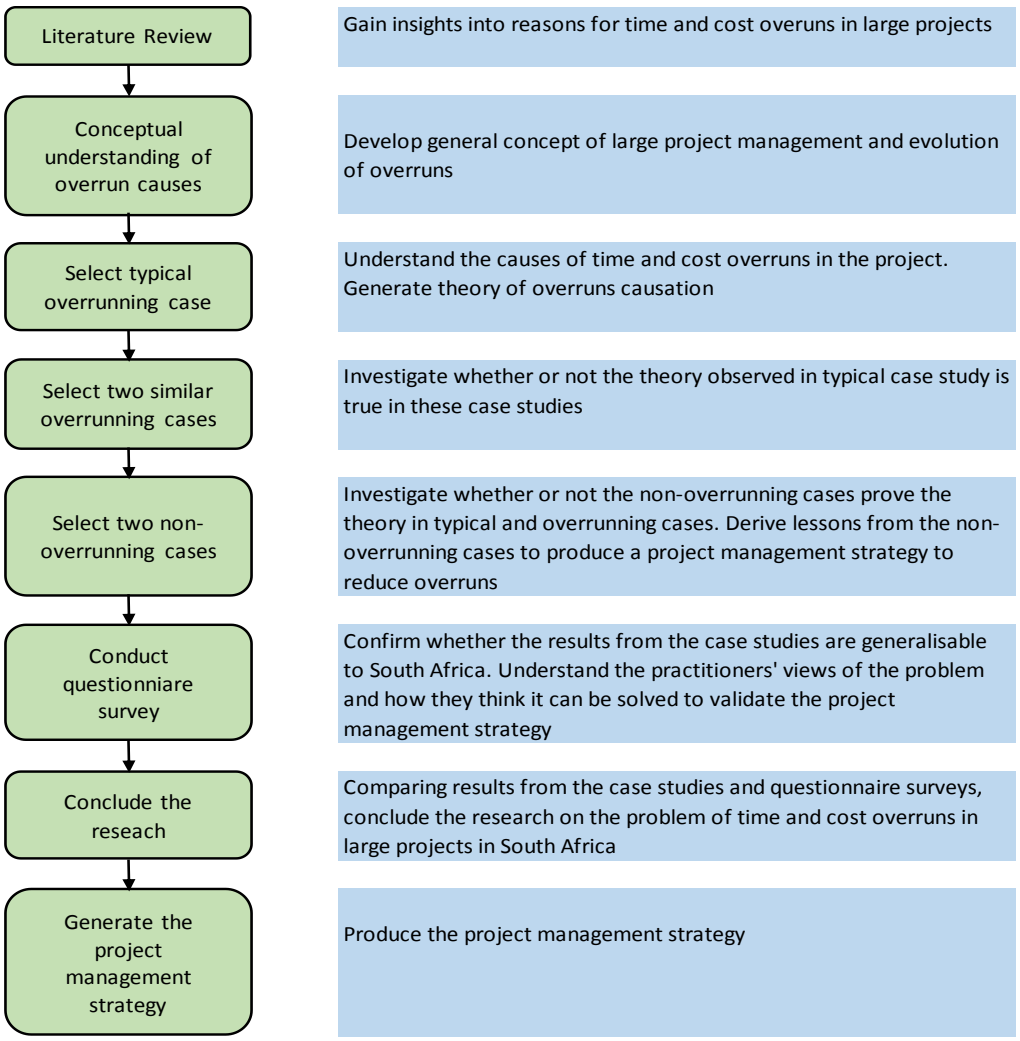


Figure 3.1 Research procedure

3.5.1 Research procedure

A sequential research approach was adopted (Creswell, 2014). Firstly, a literature review was carried out using Stellenbosch University electronic data bases: Web of Science and Science Direct, to gain insights on the management of large projects and the problem of time and cost overruns. (See Figure 3.1). A conceptual understanding of the causes of time and cost overruns and poor management of large projects was formulated followed by identification of a typical overrunning project for study to understand why and how the overruns were caused. Two similar overrunning projects were identified to confirm or not the observations in the typical overrunning project. This was then followed by a study of two non-overrunning projects to confirm the observations in the overrunning projects and to provide a basis for lessons of how a large project was successfully managed. These successful projects would form the background from which the proposed solution was formulated.

A questionnaire survey was then carried out to confirm whether the results could be generalised to the whole of South Africa as well as to validate the formulated strategy. This was then followed by conclusions and final formulation of the project management strategy.

3.5.2 Selection of people and organisations

Research methodologists recommend a series of necessary steps in the formulation of the research design and plan which includes identification of a population and sample which is representative (Fowler, 2009). The population is the group of people or entity that we wish to study or draw conclusions from (Babbie, 2011). Since it is difficult to study or observe everyone in the population, sampling provides a means of collecting data from the population. Further, sampling saves time, simplifies the research, cuts down costs and is a useful way of determining the specific properties of a population (Brynard, Hanekom and Brynard, 2014).

Case study method

Case studies do not use representative sampling commonly used in questionnaire surveys (Darke et al, 1998; Flyvbjerg, 2006; Yin 2014). This is because a very large sample of cases would be required which is impossible to achieve for empirical verification. The other reason is that these types of studies are less concerned with generalisation, but focus on understanding social phenomena in their natural setting or context (Darke et al, 1998).

Non-probability sampling is used in case studies, specifically, purposive sampling and snow ball sampling. As explained by Robson (2011), in purposive sampling, the sample is built up in the research using judgement as to the typicality or interest based on the theory being investigated. Creswell (2013) also explains that this method relies on determining a sample of people or organisations that can best inform the researcher about the problem at hand. In

snow ball sampling, the researcher identifies individuals from the population of interest and these in turn, help to identify other respondents.

Purposive sampling was, therefore, adopted for this research. This involved identification of projects and individuals from whom the data would be gathered. Like Walker (1997) noted, a decision had to be made on whether one key player or several team members were to be interviewed. He chose the construction team as they were considered the most reliable source of knowledge about the projects being studied since they were seen as the ones who dealt with construction delays or cessation of work due to re-design. Even in this research, the construction team is the one that has to deal with time and cost overruns and any mitigation measures required. However, in the current research, it was considered equally important to understand the planning and decisions made before the commencement of construction. This knowledge, the construction team would not have as they get involved in the project life-cycle much later after the design has been finalised. It is also noted by some scholars that the problem of overruns starts in the front-end of the project (Merrow, 2011).

This, therefore, meant that the views and experiences of the client and consultant team were of importance to the research. Respondents were identified based on the function they had in the management and execution of the project. The typical case was of the client, consultant and contractor.

Single or multiple case study research could be carried out (Yin, 2014, Darke et al, 1998). In a single case study, one case is identified and studied in-depth. The situations in which a single case study is used include where the case study represents a critical test of theory or best represents the study of the theory or where the situation provides a unique instance for study and may not be repeated (Yin, 2014). Multiple case studies are used to investigate whether a single case situation is generalizable to others. It is used in three ways. (1) Predict similar results called literal replication, (2) predict contrary results but for predictable reasons also called theoretical replication, and (3) cross case comparison (Ibid, 2014, Darke et al, 1998).

Multiple case study was adopted in this research. Creswell, (2013) recommends that not more than four or five case studies should be included in a single study. Such a number gives the researcher ample opportunity to identify themes of cases as well as enable him to carry out theme analysis across the cases. Harding (2013) recommends strategies to use in selecting the cases: (1) select extreme or deviant cases, when it is thought this could give the best understanding of the field as a whole, (2) selecting typical cases to understand the field from the centre or average, (3) selecting maximum variation of cases in the sample to understand the range of differences in in the population.

In this study, a total of five cases were identified. Firstly, a typical case was identified. To see whether the results from the study would be similar for other projects or not, literal and theoretical replication studies were identified (Yin, 2014). The studies were as follows: (1) Case Study One (public project: stadium) – typical large project with time and cost overruns, (2) Case Study Two (public project: power plant) – literal replication study, (3) Case Study Three (private: transport project) – literal replication study, (4) Case Study Four (public project: dam) - better performed project, theoretical replication study (5) Case Study Five (private: commercial building project) – better performed project, theoretical replication study. The two good cases were studied together with the poor cases not only to verify the observations from the overrunning cases but also to aid in finding the solution to the observed problem. The two good cases gave the concept for the solution that was eventually proposed.

Questionnaire survey

For the questionnaire survey, multistage or clustering was used to identify the population sample. This method is said to be useful where the names of the people to be considered are not known (Creswell, 2014). This involved identifying, based on the unit of analysis, the organisations and individuals to send the questionnaires to. It required identifying the groups or clusters and then sampling within them. This improves the reliability of the research results (Brynard et al, 2014). The individuals and organisations at the heart of managing projects were identified as the client, consultants and contractors. The client is represented by the consultant; therefore, consultants and contractors were considered adequate for the research. It was therefore, decided that the questionnaires be sent to this group.

In the South African construction industry, the various sub-groups include architects, civil and structural engineers, quantity surveyors, project managers and contractors. These are affiliated to different bodies such as South African Institute of Civil Engineers (SAICE), South African Institute of Architects (SAIA), Association of South African Quantity Surveyors (ASAQS), Consulting Engineers South Africa (CESA) and Construction Industry Development Board (CIDB). CESA was chosen for the consultants and CIDB for the contractors. It was also decided to collect data from the Construction Management Programme (CMP) 2014 participants at Stellenbosch University. The CMP is an intensive four-week middle management course offered annually at Stellenbosch University.

CESA was chosen, being an organisation that was representative of all consulting engineers and allied professions involved in the built, human and natural environments who are affiliated to it unlike the other bodies which were found to be devoted to a singular field. It was also found to readily enable access to information such as membership and contact details of members which most other associations did not provide. The membership was also

categorised to indicate the type of work or level of projects the members were involved in. Lastly, most of the firms involved in *large projects* were found to belong to this organisation. The organisations in the *large projects* category were identified.

CIDB for the contractors was chosen as it provided a comprehensive listing of all contractors, required by law in South Africa, to carry out public sector works. The contractors in Grade 9 who carry out work of R130m and above were identified.

CMP participants were chosen because they comprise a diverse group of professionals in the construction industry from client organisations, consultants and contractors. These are professionals in the middle and senior management positions in their respective organisations with several years of experience in the management of projects.

Determining the right sample size is never given a definite answer by scholars (Fowler, 1984). Brynard et al (2014) emphasises that the sample must be representative of the population. They provide a table that could be used as a guide in determining the size. Using the guide, the sample sizes in Table 3.1 were adopted. Since the population sizes were small questionnaires were sent to all people in the groups.

Table 3.1 Population and samples of the questionnaire survey respondents

Group	Population	% Sample Required	Suggested Sample	Actual
CESA	46	64%	29	46
CIDB	98	45%	44	98
CMP	40	64%	26	40

The survey instrument

The platform that was used to collect data was the Stellenbosch University web-based software, Checkbox. Participants were invited to the survey by email. By clicking a link, they could answer the questions. They were given an option to save and later return to continue with the survey. They also had an option of opting out of the survey. The software method was used because of its merits of easier reach to respondents, quicker possibility of response and low cost (Robson, 2011). The method also renders itself easier for use of software for analysis of results. The potential disadvantages of the method include the possibility of low response rates with lengthy questionnaires, possibility of misunderstanding the questions and the researcher's lack of control on the order the questions are answered or not answered at all (Ibid, 2011).

The questionnaire contained 45 questions, both open ended and closed questions. In the closed questions, the respondents were asked to rank or tick the answers that represented their response to the question (see Appendix C). This was useful to compare their responses with previous literature review. Open ended questions enabled the respondents to indicate, in their own words, the best response to the questions. This was thought more appropriate to enable them to describe or list their responses without being influenced by the expected answers.

3.6 Research Analysis

3.6.1 Case study

Various approaches could be used for qualitative data analysis. Harding (2013) recommends four methods. (1) Thematic analysis which involves identifying themes coming out of the data. This could be done by examining commonality for instance, common experience, and common opinion. (2) Comparative analysis which involves comparing or contrasting data from different respondents until no more issues or themes arise anymore. (3) Content analysis where the researchers work through each transcript systematically to see how certain factors arise which are recorded by codes. (4) Discourse analysis which focusses on patterns of speech and the way the language is used to convey meaning.

Yin, (2014) proposes (1) relying on theoretical propositions which form the basis of the units of analysis and (2) generating case descriptions of the areas of analysis to be considered, (3) pattern matching, (4) explanation building and (5) time series analysis.

Using a thematic analysis, theoretical propositions, generating descriptions, pattern matching and explanation building, the analysis of the case study results was carried out.

3.6.2 Questionnaire survey

The following steps were followed to analyse the results: (1) Report on the response from the respondents to the survey; (2) Determination of response bias using wave analysis (Creswell, 2014). Wave analysis involves investigating the responses that came in later with the earlier ones to determine whether there was a significant change in the responses; (3) Descriptive analysis of results using tables and figures using various statistical measures such as means and standard deviations. Since the questionnaire survey was complimenting the main research method, it was thought prudent not get into extensive and detailed statistical analysis. The results were then presented using tables and figures from which interpretation of the results was generated. (4) Report on the conclusions from the survey and implications of the research and comparison with the case study research.

3.7 Approach to Triangulation of Results in the Research

As explained under section 3.2 Research Design, triangulation was embedded in the method of research that was adopted: (1) Different sources of results were used which are documentary analysis, interviews and questionnaires. (2) Two different research approaches were used, namely case studies and questionnaire survey. (3) Input results from one method compared to the other which was done using rich descriptions from case study results and descriptive statistics from the questionnaire survey results.

Within the case studies, the strategy was to embed triangulation of results from one case study to the next. A typical overrunning project was identified and the results from this study were validated using the other two overrunning case studies. This is called literal replication, as discussed earlier (Yin, 2014). The results from the overrunning project helped in understanding how the actions of the project team led to time and cost overruns giving insight to what could be theorised to be the reasons leading to time and cost overruns. The next overrunning case study was attempted to see whether what was observed in the typical case was true or not and whether the theory could be accepted or not. The last replication case was done to confirm further the results observed in the first and second study as at the mouth of two or three witnesses a matter is established (Deuteronomy 19:15; Mathew 18:16 Hodder & Stoughton New International Version).

Furthermore, theoretical replication studies and the strategy of investigating rival explanations were carried out. This involved identifying non-overrunning case studies to understand whether these would confirm the opposite of the results in the overrunning projects as well as to confirm the theory proposed under the typical overrunning projects. It also involved disproving other identified possible rival explanations for the phenomenon under study.

The questionnaire survey was done after the case studies to confirm the nature of the problem in South Africa as well as to confirm the results from the case studies to the whole of South Africa. The questionnaire survey was also used to eliminate the often cited short-coming of case study research of lack of generalisability of results (Hofstee, 1998).

The triangulation of case study results to the questionnaire survey was discussed as the questionnaire results were presented following the adopted sequential presentation of results.

3.8 Limitations

Time and financial constraints were the major limitation to the research. The research may have benefited from total immersion in projects from inception up to completion and handover to enable total observation of all the activities of the participants and the consequences of

these. This would require a longitudinal study of projects over the years of the project duration but due to time limitations this was not possible. Due to the same reasons, not all *large projects* were investigated, but projects were purposively selected to enable an in-depth investigation of the phenomenon of overruns on the projects. The study was also confined to construction infrastructure projects in South Africa. It is believed that the results of the research are applicable to SADC countries and other developing countries.

3.9 Ethics

Ethical considerations are important in research for two reasons: (1) To ensure the participants are protected from potential harm and other negative consequences of the research (Robson, 2011). (2) To ensure that that the researcher carries out an honest research that is not fraudulent in any way (Harding, 2013). The second reason also incorporates the first requirement in that it seeks to regulate the behaviour of the researcher not only in his conduct but also in how he relates with the participants. He is required to uphold high moral research ethics.

Fellows and Lui (2008) discuss a researcher's ethical conduct on the basis of respect for persons, beneficence and justice. Respect for persons requires that participants are not forced to be involved in the research and that those with diminished autonomy such as children are afforded adequate protection and assistance when they take part. Beneficence refers to protecting people's decisions and all endeavours to protect them from harm that may ensure from the research. Justice concerns fairness to all persons without isolating the rights of any one participant. This also refers to fairness in selecting of participants to the study.

In summary, ethical considerations encompass the researcher's conduct when he is carrying out the research and when he is disseminating the results (Lundin, 2011). That is, his conduct during literature review, data collection, use and disposal as well as the handling of data, analysis and reporting of results (Fellows & Lui, 2008). The work of the researcher is to ensure, in the three areas of research mentioned above, the research participants are protected and that he conducts himself morally following acceptable and recognised ethical considerations.

To guide in ethics, ethical codes and guidelines are often adopted by institutions that carry out research (Lundin, 2011). In conformity with such requirements, Stellenbosch University, where the author carried out the current study, set up research ethical guidelines which all scholars and researchers are to strictly adhere to (see Appendix F). The research is only approved and allowed to proceed once the university research ethics committee is satisfied that the measures to uphold ethical conduct are satisfactory. The requirements in the code include explicit explanation of the measures the researcher will take to ensure participants are

informed of the research purpose, information to be gathered and how the researcher will ensure the participants' privacy will be protected, the risks to data protection and how the safety thereof will be adopted.

The potential ethical problems in this study were the disclosure of the names of projects, organisations and individuals concerned and project facts, particularly from case studies. The potential problem was that the disclosure of the project facts was likely to affect the way people would view the individuals and organisations and how these individuals managed the projects concerned. The specific measures taken were to ensure anonymity of individuals and organisations concerned. This was done by not disclosing names of individuals and organisations, but where it would help clarify a particular issue, positions were disclosed. Another measure was that permission was sought from the respondents to disclose project names and facts without identifying the organisations and individuals concerned. This was granted. In some cases, non-disclosure documents were signed where organisations did not want data disclosure without their consent.

In line with the requirements of the university, ethical approval from the University Ethics Committee was also obtained. All reasonable attempts were made to protect information that was collected and this was used only for this research. The data will be kept in the repository of the departmental head at the university and only used with approval or consent of the organisations concerned.

3.10 Conclusions

The research approach that was selected for this study is the mixed method approach with the case study as the primary method and the questionnaire survey as the secondary method using the multi-source strategy for data collection. The techniques used were interviews, documentary analysis, observation, and questionnaires. The first three techniques were used to obtain information on the selected case studies. The questionnaire surveys were used to gain insight into the management of large and small projects generally.

Chapter 4 Research Results

4.1 Introduction

The objectives of the study were: (1) To study the nature and management of *large projects*. (2) To investigate the root cause and effects of time and cost overruns on large construction projects in South Africa. (3) To investigate how the project team plans and executes projects in South Africa. (4) To formulate a project management strategy to be used on *large projects* to improve the delivery of projects and reduce overruns.

The primary method of research that was used is the case study approach using interviews, document analysis and observation where possible as discussed in Chapter Three. Five case studies were carried out. Table 4.1 gives the list and characteristics of the studies investigated. The results of each case study are presented in a chapter beginning with Chapter 4, Case Study I, Chapter 5, Case Study II, Chapter 6, Case Study III, Chapter, and 7, Case Study IV and Chapter 8, Case Study V. This is then followed by a case study comparison, Chapter 9.

Table 4.1 Cases studies investigated

Case Study	Project Description	Project type	Research
Case Study I	Stadium construction	Public	Typical overunning project study
Case Study II	Power plant construction	Public	Literal replication study
Case Study III	High speed rail construction	Public/private	Literal replication study
Case Study IV	Dam construction	Public	Theoretical replication study
Case Study V	Commerical building construction	Private	Theoretical replication study

The second part of the research involved questionnaire surveys to construction personnel in South Africa to understand how *large projects* are managed in the country and specifically, whether there is any difference in management of *large projects* and smaller projects. Results from the questionnaire survey are presented in Chapter 10. This is followed by a synthesis of case study and questionnaire results in Chapter 11. The proposed strategy is presented in Chapter 12. Chapter 13 presents the conclusions for the study.

4.2 Case Study 1 Project Description

This is a case study of a project team in a public project which had time and cost overruns. The project is a stadium that was built to be used in the 2010 FIFA World Cup. After the award to host the 2010 World Cup to South Africa in 2005, it was decided a stadium would be built in the city to host the semi-finals. Selection of the site was a difficult task from the early stages with many residents and environmental pressure groups against the chosen site. Due to lack of experience in this type of work by the client and local consultants, foreign consultants were contracted to work with the locals. Competitive tendering was used on the project to select

contractors. Due to the large size of the project, both consultants and contractors formed joint ventures. The project incurred cost overruns, but was completed in time.

Using idiographic causal mapping (Ackerman & Alexander, 2016), the case study will show why and how the project incurred time and cost overruns. It will show how the lack of project experience by the project participants made them ill-prepared for the project and how that affected their implementation of the project. The case study will also show the effect of pressure on the project team's decision making.

4.3 Respondents

Six respondents were interviewed. These were the client's representative, project manager procurement (overall), project manager (site supervision), quantity surveyor, electronics consultant and contractor's project manager (Table 4.2). The others such as architects and structural civil engineers were not available at this particular time.

Table 4.2 Case Study I respondents

	Project Position	Organisation	Organisation Position	Experience
1	Project Manager (Site supervision)	Consultant Project Manager	Project Management Executive	23 years
2	Part of lead Quantity Surveyor	Lead Quantity Surveyor	Manager practice Lead	8 years
3	Client Representative	Client	Technical Director	35 years
4	Project Manager (Procurement)	Consultant Project Manager	Managing Director	34 years
5	Electronics Consultant	Consultant Electronics	Regional Engineer	about 7 years
6	Project Manager (Construction)	Contractor	Managing Director	16 years

4.4 Contract Data

Table 4.3 Case Study I contract details

Client's estimate	R1,2bn
Consultant's estimate	R2,857bn
Tender sum/contract	R2,998bn
Final contract	R4,110bn
Cost increase	37%
Planned completion date	11-Jun-10
Actual completion date	08-Jun-10

Table 4.4 Case Study I cost break down

Description	Tender Sum	Final Account
Preliminaries	R 487 270 887,00	R 567 977 013,00
Measured Works	R 2 142 729 113,00	R 3 037 799 669,68
Total	R 2 630 000 000,00	R 3 605 776 682,68
Add 14% VAT	R 368 200 000,00	R 504 808 735,58
Total	R 2 998 200 000,00	R 4 110 585 418,26

The contract data shows an increase in the cost from the initial estimate (Table 4.3). The project, however, was completed before the planned completion date and in time for the World Cup.

A contract breakdown analysis of the tender sum shows that preliminaries were 22% of the contract, measured works, 22% and provisional sums 56% of the contract (Table 4.4). More than half the work was in provisional sums showing that most of the work was not completely designed at tender stage.

4.5 Time and Cost Overruns and the Management of the Project

From the interviews and documentary analysis, the reasons for time and cost overruns and how the project team managed the project were reconstructed (See Figure 4.1).

There were six ways that led to time and cost overruns. These are shown in Table 4.5. (1) Location problems, (2) Pressure from the local community and media against the project, (3) The client's insufficient budget, (4) The project participant's under-estimation of the project's complexity, (5) procurement requirements, (6) FIFA/City requirements. Most of the root cause of overruns originated from the external environment followed by project environment and then organisation environment (See Table 4.6 & 4.7).

Table 4.5 Root cause of time and cost overruns on stadium project

Factor	Reasons
1 Location problems	
Resistance from public golf and local community	Community fears of impact of project:
	Area will be flooded by spectators
	Value of the properties would be downgraded
Resistance from golf fraternity	Historic significance of location
EIA rejection of chosen location	Found the alternative location more suitable
Different ground conditions of EIA location	Design had concentrated on original location
	New location sub soil conditions different from the first location
2 Pressure from local community and media against the project	Public fears of project impact:
	Mar tourist attractions in the area
	Mar location's historical siginifcance
	Project would be costly when there are other needy causes
	The project cost would bankrupt the city
	Effect of Afrophobia pressure from Western countries on South Africa's ability to host World Cup
	Threat of court action
3 Client's insufficient budget	Lack of experience of similar projects
	Under-estimating project complexity
	Subtle pressure from public perception that project costly
4 Under-estimating project complexity	Lack of experience of similar projects
5 Procurement requirements	Longer process of statutory requirements:
	Anti-corruption practices
	Competitive tendering
6 FIFA/City requirements	New requirements

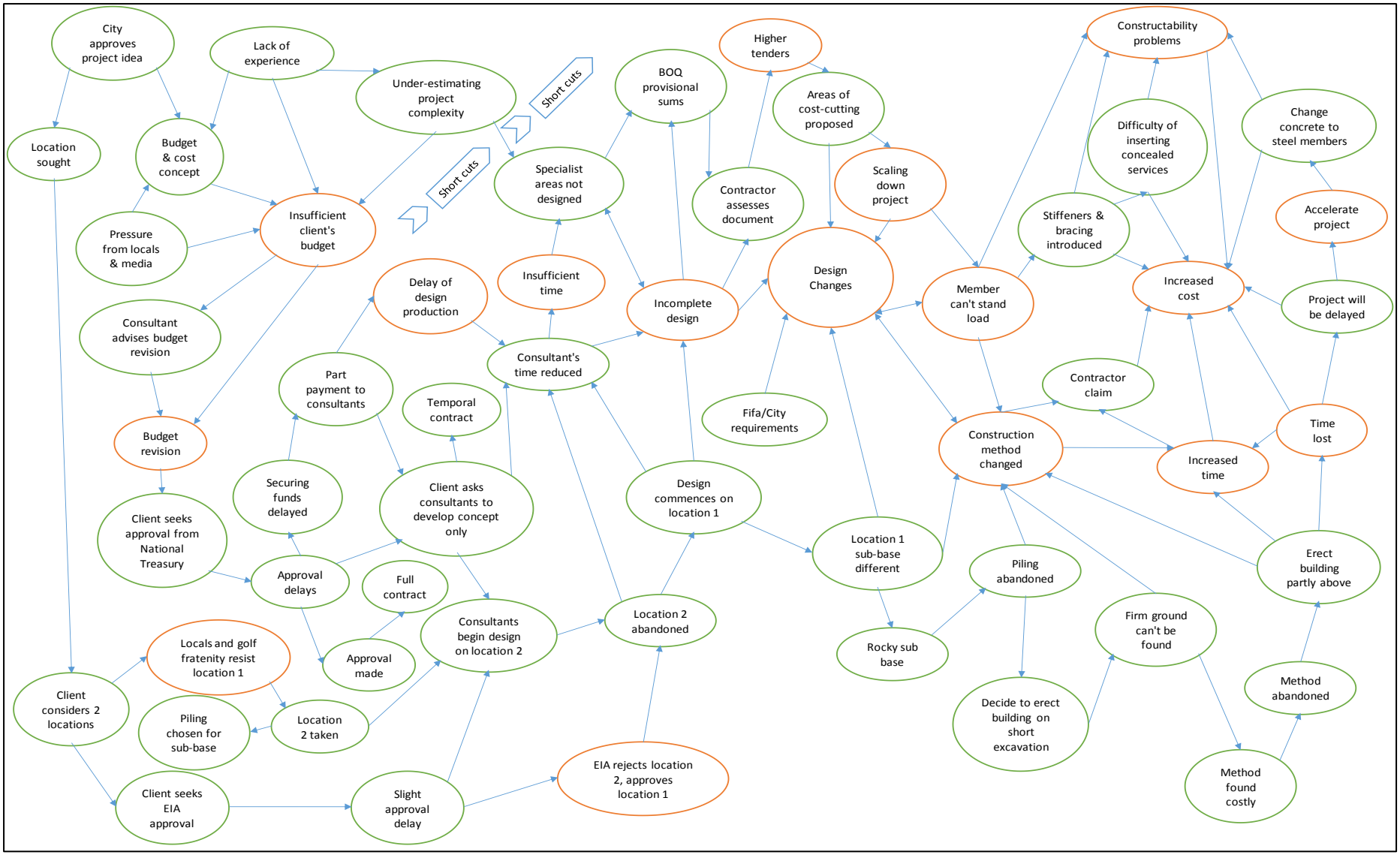


Figure 4.1 Stadium project overall time and cost overruns

Table 4.6 Root cause and the environment they originate from

	Description	Environment
1	Location problems	External
2	Pressure from locals and media against the project	External
3	Client's insufficient budget	Project
4	Project participants' under-estimation of project complexity	Project
5	Procurement requirements	Organisation
6	FIFA/City requirement	External

Table 4.7 Comparison of factors per environment

	Environment	Percentage
3	External	50%
2	Project	33%
1	Organisation	17%
6	Total	100%

4.5.1 Location problems

The problem of location brought about many effects on the project, which ultimately resulted into time and cost overruns. There were four principle reasons for the location problems. The first was that there was resistance of the local community, environmental pressure groups, construction professionals and the media was against the project. The local community and the various pressure groups feared that the general location of the project would disrupt the tourism potential of the area, degrade the value of the location and bankrupt the municipality. The second was that the client was considering two locations in the area with location 1 as their preferred, but the golf community resisted this location because of its historical significance. There was a 100-year-old golf course on this location. The client therefore moved to location 2 and began conceptual designs on it. The third was that when the EIA report came out, location 2 was rejected and location 1 chosen instead. The client therefore moved to location 1 again and began conceptual designs based on this location. The fourth was that the ground conditions on location 1 were different from those of location 2 on which the design had at first been based on. This led to design changes, construction method changes, project delays and the need to accelerate the project with its consequential increased costs in order to complete the project before the World Cup.

Equally, due to the delay in approval of the client's revised budget, there were funding constraints in paying the consultants which affected their design work (see Figure 4.1). A combination of location problems and delayed budget approval led to reduced time to design the project thus resulting into incomplete designs.

Discussion and implications

Going through the effects of the location factor helps in understanding why the consultants did not complete the concept design and how that led to design changes, constructability problems and eventually time and cost overruns. It also helps us understand how the project team managed the project. This is in line with Söderlund (2004) who proposed that contextual investigation would help understand and build better theories on project management. The results confirm previous research that incomplete designs and design changes often said to be factors of time and cost overruns are not the root cause (Love, Edwards, Irani and Walker, 2009). The results also show that: (1) An interplay of factors led to time and cost overruns (Steyn, 2009). In this case, the problem of location was a combination of resistance of the local and golf fraternity as well as the EIA decision which led to the delay of design production and consequential incomplete designs because the time for document preparation was insufficient (Loots, 2013). (2) The external factors affected the management of the project. (3) The shortage of time affected the behaviour of the project team. They resorted to short-cuts in the delivery of the project documents. In this case, they left un-designed the specialist areas and used more provisional sums to produce tender documents. This confirms the work of Mitropoulos, Abdelhamid and Howell (2005) from their research on conditions that lead to accidents that pressure makes workers susceptible to use any means or make do to complete tasks leading to poor working conditions and quality. Atkinson (1998) also found that incomplete investigations by consultants, incomplete documentation and higher risks and tender figures were likely consequences of financial, time, cultural and social and global pressures.

4.5.2 Pressure from the public against the project

Pressure from the public and media affected the project, its budget and concept development. Due to this pressure, the behaviour of the team was affected in two ways (1) the client was inclined to have a lower budget due to sustained criticism that the project would be very expensive, (2) the consultants considered the various objections from the local community and professionals which tended to make the project to cost more. Thus, pressure from the public made the consultants to be less cost-conscious, but made the client to be more cost conscious. The result was an iconic building but with a lower budget which was a mismatch. The resistance from the public and media only finally ended when the contractor set up an information centre promoting the benefits of the project to the public and the country as well as giving them an opportunity to voice their concerns.

Discussion and implications

There were two effects of the resistance against the project. (1) The pressure on the designers/client put them on the defensive to substantiate and defend the location and the type of design on this location. (2) It instilled fear in the public of the suitability of the project, the location and the design. With this fear, the public in turn exerted pressure on the client, as well as the design and construction team on the unfeasibility of the project. These two had a combined effect of taking away the project team's effort from that of devising a project solution to that of defending the project. The result was that the client had several court interdicts, the project start was delayed and they then had to quickly appoint a contractor before the project could be stopped. A review of the professional team on the project clearly shows that there was no professional dealing with the communication with the public. It only comprised technical design professionals. The results suggest that for this type of project, high level communication to the public should be considered and needs to be a key position in the project team. It also suggests that in the project team, there was concentration of technical and design professionals leaving out communication and public relations competencies and this led to failure of the project team to prepare for the management of the public.

4.5.3 Insufficient budget

As explained above, the factors of time and cost overruns and their effects are often interlinked. The lower budget was in a large measure influenced by the pressure from the public. There were two other factors as well. (1) The project team lacked the design and construction experience of stadia as the country had not had such projects for several years. Thus, they had lost the professionals and the competence (Ofori et al, 1996). (2) The project complexity and cost were under-estimated due to the lack of experience. When appointed to design, the consultants quickly understood the budget was insufficient. The budget was revised and approval was then sought from the National Treasury. Approval, however delayed. This resulted in reduced consultants' design time and consequently, incomplete designs.

Discussion and implications

The results show that the client under-estimated the budget due to lack of experience and pressure from the public. Flyvbjerg (2011) found that *large projects* are under-estimated due to optimism bias and misrepresentation. These appear not to have been the primary motivation on this project. The results also show that the pressure had two different effects on the consultants and the client. The client became more cost conscious whilst the consultants became less cost-conscious. Furthermore, the results show that the insufficient budget affected how the project team managed and responded to the challenges of the project. (1) When the budget approval delayed, the client asked consultants to carry out partial concept

designs. (2) Due to reduced time, the project team resorted to short-cuts in the management of the project which concurs with the work of Love et al (2009) who found that under certain latent conditions such as lack of time, people resort to certain practices to solve problems such as recycling design details from another project. (3) The incomplete design led to higher tenders as contractors perceived the project to be riskier. (4) The project participants were all decided not to delay the project in any way and they relaxed the project management principles such as deciding on a course of action after investigating alternative options. The phase/gate approaches to project management were not their immediate concern.

4.5.4 Under-estimating the complexity of the project

The project participants under-estimated the complexity of the project. Respondents said this was mostly due to lack of specific project experience. They had not built stadia in the country for several years and, as Ofori et al (1996) and Groenveld (2006) said for circumstances such as this one, the stadium construction expertise had been lost due to relocations and retirement. The result of lack of experience was a lower client's budget and failure to design specialist areas before tender. This resulted into budget revisions, delay in design production, incomplete designs and, time and cost overruns.

The stadium was designed to have raking pylons each with its unique elevated point, glass topped roof and fabric curtain walls. The construction of the roof and the raking pylons were especially challenging. Most of the respondents said construction implications were not fully appreciated at tender award.

A further complication was the revision to the drawings. The diameter of the stadium and the size of the raking pylons was reduced to keep the project within the revised budget. However, the stiffness of the pylons was now reduced. They therefore had to introduce down-stand beams, bracing and other additional members, which offset the savings, intended. The quantity surveyor said the additional costs were actually more than the savings they had intended.

Discussion and implications

From the results, under-estimating project complexity was due to lack of experience in similar projects by the client and the project team. The effects of under-estimating the project's complexity were an insufficient project budget, budget revision and approval from National Treasury, insufficient consultants' time to design, incomplete designs and tender documents, higher tenders and constructability problems. These all led to time and cost overruns on the project. The results still show interplay of factors and their effects. Under-estimating project complexity resulted into an insufficient budget as well as the need to revise the budget whose delay affected the consultants' preparation for design production. An insufficient budget and

under-estimating the project's complexity are both due to lack of experience. The project team decided to revise the design to be within the budget, but because they under-estimated the complexity of the project, they did not evaluate the resultant complications until construction.

4.5.5 Procurement requirements

Being a public entity, the municipality was required to conform to the various statutory requirements which include the anti-corruption practices, competitive tendering and engagement with the public to get support before carrying out the project. These led to a longer duration of the project before commencement and more cost. The procurement requirements were compounded by threats from the local affluent community of court action to stop the project. This made the client to quickly appoint the contractor before the project could be stopped.

Discussion and implications

The procurement requirements were necessary, but they tended to lengthen the procurement process. Competitive tendering meant more time to prepare documents, call for participation and then tender evaluation. The competitive tendering method also meant a loss on the contractor's contribution to constructability issues. The threat of court action from the local community made the client appoint the contractor even before the designs were complete in order to avoid the work from being stopped.

4.5.6 FIFA/City requirements and other factors

There were not many design change requirements from the City and FIFA. Most of the design changes were due to the changed ground conditions because of location problems and insufficient budget discussed before. The installation of VIP areas with special finishes and entrance and exit ways separate from the public were later incorporated in the design. Installation of more LCD screens and CCTV cameras were also included, which increased the cost of the project. It took a while for funding approvals to be made for the extras. There was also a change to the initial concept of a multi-purpose stadium, which would have dismountable sections such as seating when not in use to one more directed towards soccer with fixed seating.

The timing of the project also contributed to the increase in the costs. There was a change of local government as well as keen construction prices at this time. The project was approved when one political party was in charge of the local authority. After elections, another political party took over the running of the municipality and they started the whole process of project approval again. This led to reduction in project time as the completion date was immoveable.

There were keen prices of construction and materials locally as well as internationally at this time. There were also several projects being carried out at the same time resulting into increased competition for materials, labour and equipment. These led to higher tenders for the World Cup projects.

Discussion and implications

The requirements of the client led to design changes on the project, but these were not significant. Most of the design changes were due to location related problems and the insufficient budget. The results do show, however, that the client's change orders affected the project's design and construction and had a potential to delay the project and increase costs. The timing of the project also affected the cost levels of the project. There were several projects being carried out around the country and the prices of resources locally and internationally were higher at this time. This led to higher costs of resources and contractor's tenders. This suggests that the timing of the project may be important in the expected pricing levels of the projects and that regulating the numbers of *large projects* could be useful in "cooling off" the contractors' pricing and cost of materials.

4.6 Conclusions and Implications for Management of Large Projects

The factors that led to time and cost overruns on this project were: (1) location problems, (2) pressure from the public and media, (3) client's insufficient budget, (4) participant's under-estimation of the project's complexity, (5) lengthy procurement requirements and, (6) FIFA/City requirements.

The results showed that the dominating factor behind the client's insufficient budget and participants' project complexity under-estimation was the lack of project specific experience. Furthermore, the insufficient budget was also due to the pressure from the public's perception that the project would be costly and bankrupt the city, lack of project specific experience as well as the client's under-estimation of the complexity of the project. The different ground conditions were due to local community location resistance as well as EIA request to change the location.

There were various effects of the overrun factors on the management of the project. (1) The project team moved from one location to another due to local community resistance and EIA location change request which resulted into different ground conditions and reduction of consultants' design production time. (2) Lower project budget, iconic design and quick contractor appointment due to public pressure. (3) Budget revision, National Treasury approval, reduction in consultants' design production time due to insufficient budget. (4) Insufficient budget, budget revision and National Treasury approval, reduction in consultants'

design production time, provisional sums and not designing specialist areas, higher tenders due to under-estimating project complexity. (5) Longer procurement process due to procurement requirements and; (6) Design changes, change in construction methods, acceleration and increased costs due to client induced changes.

The most common effect found in most factors is the reduction in the consultants' time to produce designs which led to incomplete designs, design changes, higher tenders, need to reduce project scope to be within the budget and constructability problems. The results show that the factors often cited as causes were found to be effects of the real causes in this research confirming the results from other scholars (Flyvbjerg et al, 2003; Jennings, 2012). The results showed that design changes and incomplete designs were as a result of location problems and insufficient budget which were themselves due to lack of project specific experience of the project team and pressure from the public.

The results also show that there were many inter-relationships amongst the originating causes as well as amongst the secondary effects. This suggests that the factors behind time and cost overruns occur before incomplete designs or design changes. It may also mean that, the recommendation often made by scholars for the client or consultants to complete the designs and avoid design changes would not address the real problem. The solution may lie in improving the project team's relevant experience and the management of the public to minimise resistance to projects.

It was also found that most of the root cause of overruns came from the external environment as also observed by Morris (1989). These were then followed by project factors and then organisational factors. This is in line with the nature of *large projects*. Most of the project management issues have much to do with external factors (Capka, 2004; Morris & Hough, 1987). This suggests that the management of the external environment is important to the management of *large projects* and that if not well managed, time and cost overruns are a possibility on the project.

From the research, it was also found that the behaviour of the participants was often altered by the various pressures which include lack of time, inadequate budget and public pressure. Tatum (1984) found that decision making on projects was based on intuition rather than a rational basis. In this research, it was found that the pressure affected the way the decisions were made and consequently, the strategy and management of the project. Due to lack of time and with the knowledge of a project of national interest and the pressure of Afro phobia, the project participants used short-cuts and did not follow through the project management processes such as value engineering and seeking alternative solutions before deciding. Again, due to public pressure the client became cost conscious whilst the

consultants became less cost conscious as they explored the solutions to the project. This suggests that decisions in large project management are more influenced by external pressure than internal rationalisation.

The results confirm that the involvement of the client is a parameter of consideration as their lack of experience and preparation affected the project in the definition of the project as well as the budget. The results also confirm that the training and experience of the project participants has an important role in the management of *large projects* as it affects the project competence and eventually performance (Crawford, 2005). They also showed the relationship between experience and preparation. Lack of experience leads to poor preparation for the project. The experience and the size of the project was also related to the form of organisation used on the project. Consultants formed joint ventures to increase their project competence and financial capability.

The research also showed that there were certain conditions that favoured the occurrence of time and cost overruns. These were the lack of project type experience, pressure from the public, insufficient client budget, location problems, incomplete designs, insufficient time to prepare for the project, use of short–cuts, inconsistent use of project management principles and under-estimating the project's complexity. This compares with the research of the accident causation modelists who found that there were certain hazardous circumstances that led to accidents (Mitropoulos et al, 2005).

It could therefore be theorised that the lack of experience of the project participants made them ill-prepared for the project and this affected how they managed the project. The pressure from the public and project approval delays, which made them not to use project management principles consistently resulting into time and cost overruns, compounded it.

Chapter 5 Case Study II

5.1 Introduction

This chapter presents a literal replication study to see whether the results in the first study are applicable to this case. The project executing team is in a state-owned enterprise (SOE). The results will show that the factors are similar to the first case study. Firstly, the problems originate from the external environment to the organisational and then the project environment. They will also show that the lack of preparation and experience of participants in the project team affected the management (competence) of the project team and their response to the constraints brought by the external, organisational and project environments.

5.2 Project Description

The project is a power plant that was conceived as part of the strategy to meet the increasing demand for electrical power in South Africa. The power was to be generated from a coal-fired plant using some advanced technology of ensuring minimal disturbance to the environment using flue gas de-sulphurisation (FGD) and water conservation. The project comprised 6 units of 800MW each. It was planned that the first unit would be operational by December 2014 and thereafter a unit each year up to 2018. The planned cost of the project was estimated to have been R118bn (September 2014).

The project consists of boilers, turbines and air-cooling units together with their attendant civil works. The SOE broke down the project into various packages and contracted these to several contractors. The main mechanical works, boilers and turbines, were contracted to two contractors to design and construct complete with the attendant civil works.

The project has experienced cost and time overruns and the completion dates and estimates have been changed several times (it was ongoing at the time of the research).

5.3 Respondents

A total of 16 respondents were interviewed. These included the project director, construction managers and contract managers on the client's side and project and construction managers on the contractor's side. Only one respondent indicated that they used to read journals. Most read magazines such as Engineering News, internet and information from their professional institutions. This represents 6% who read journals. Most of the respondents are experienced with the years of experience ranging from 5 to 22 years. This indicates that most professionals were not abreast with the latest or current research in management of projects.

Table 5.1 shows the list of respondents.

Table 5.1 Power plant project respondents

	Project Position	Organisation	Qualifications	Experience
1	Senior Contracts Manager	Client	BSc Chem	20 years
2	Contracts Manager - Civils	Client	B Tech Civil	10 years
3	Contracts Manager - Flue Gas	Client	B Tech Mechanical	10 years
4	Contracts Manager - Boilers	Client	B Tech Electrical	11 years
5	Construction Manager - Civils	Client	B Mech, MSc Project	20 years
6	Civil Design	Partner organisation	B Tech Civil	8 years
7	Contracts Manager - Mechanical	Client	B Tech Mechanical	5 years
8	Project Execution Manager	Partner organisation	BSc Construction Management	22 years
9	Construction Manager - Civils	Client	B Tech/BSc Supply	
10	Contracts Manager - Balance of Plant	Client	Manager practice Lead	6 years
11	Site Manager	Contractor	B Mech, MSc MBA	10 years
12	Contracts Manager - Instrumentation	Client	B Tech Electrical	13 years
13	Construction Manager - Turbines	Partner organisation	BSc Project Management	14 years
14	Project Director	Client	B Eng Mechanical	21 years
15	Commissioning Manager	Contractor	B Mechanical, MSc	18 years
16	Planner	Contractor	B Mechanical	12 years

5.4 Contract Data

Figure 5.1 shows contract data that was obtained on the project from public sources as well as from the interviews. The results show the project has incurred both time and cost overruns. The project value was earlier estimated to be R80.6bn, was later revised to R80bn, R118bn and then R172bn. The completion date equally was adjusted from December 2014 to December 2018.

	Progress, September 2014		
	Contract value	R3.6bn	
	Procurement	90%	
	Designs	95%	
	Construction	48%	
	Boilers package		
	Contract value	R18,5bn	
	Planned start	January 2010	
	Actual Start	July 2012	
	Planned completion	March 2016	
	Revised completion	September 2017	
	Planned contingency	R1.3bn	
	Revised contingency	R2.8bn	
	Turbines package		
	Contract value		
	Planned start	January 2008	
	Actual start	August 2011	
	Progress, September 2014		
	Planned erection period per unit	25 months per unit	
	Actual September, 2014	24.3 months late, unit 1	
	Unit 1 construction progress	72%	
	Unit 2-6	Not started yet	

Figure 5.1 Power plant project contract data

Reviewing the packages shows that overall, there was a delay of about a year to start work. The Flue Gas package was planned to start in March 2010, but was actually commenced in August 2011. The results are similar with the other packages. The contract value for the package was R2.7bn. By September 2014, the contract value was R3.6bn yet only 48% of the construction work had been carried out. Indicating that the contract value would possibly rise to R7.2bn at contract completion. The Turbines package gives some insight into the planning and actual implementation of the contracts. The project comprised 6 units with each unit to be completed in 25 months with about two months between the units. By September 2014, Unit 1 was 72% complete but 24.3 months late. Units 2-6 had not been started at all.

5.5 Time and Cost Overruns and the Management of the Project

The results show that the reasons for the overruns and the approach to the management of the project were similar to the stadium project case study. The reasons for overruns on this case study were: (1) Insufficient budget; (2) Delayed project start; (3) Ground conditions; (4) Pressure from public/media; (5) Under-estimation of project complexity; (6) Procurement strategy; (7) Lack of experience; (8) Lack of preparation and, (9) Productivity problems. These are shown in Figure 5.2 and Tables 5.2, 5.3 and 5.4.

Table 5.2 Root cause and the environment they originate from

	Description	Environment
1	Insufficient budget	Organisation
2	Delayed project start	External
3	Ground conditions	External
4	Pressure from public and media	External
5	Under-estimating project complexity	Project
6	Procurement strategy	Organisation
7	Lack of experience	Project
8	Lack of preparation	Organisation
9	Productivity problems	Project

Table 5.3 comparison of factors per environment

	Environment	Percentage
3	External	33%
3	Project	33%
3	Organisation	33%
9	Total	100%

5.5.1 Insufficient budget

The client organisation, due to the delay in approval of the new build project, was put in a “crisis mode” as time for design and construction of the new power plants was reduced. To ensure a steady supply of power and for future supply, they decided to embark on two large 6 x 800MW units super critical power plants. Their finances, however, could not allow

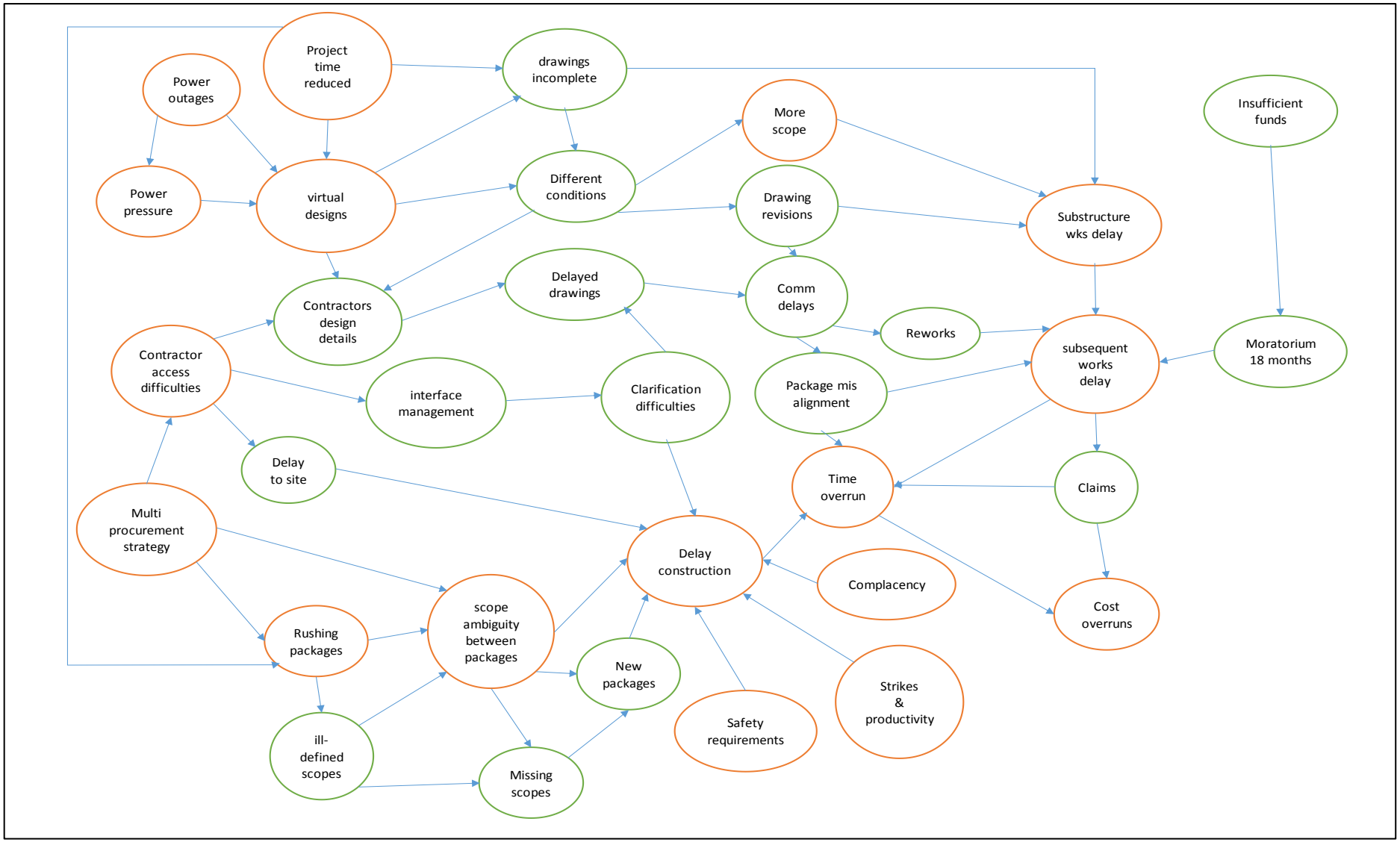


Figure 5.2 Power plant project overall time and cost overruns

progressive simultaneous power plant projects. The project was put on finance moratoriums, where additional funding and contracts were suspended, twice lasting a total of 18 months. This resulted in the project stalling with required subsequent packages not to be awarded leading to delay to all the packages. It eventually put the project out of course from the planned targets.

The major reasons for the insufficient budget was the pressure to solve the looming power crisis and the pressure from the public and media on the perceived inability of the organisation to solve the power crisis. Another reason stems from the decision to build the two super-critical plants. The client did not consider the complexity of building two large plants simultaneously. They based their assumptions on the previous project experience in that they had built several plants in a period of about five years. However, the power plant construction industry had been dormant for about 50 years with the possibility that the skills and manufacturing base was non-existent.

Table 5.4 Power project root cause of time and cost overruns

Factor	**Reasons**
Insufficient budget	Pressure to solve looming power crisis
	Embarking on building two large super critical plants at same time
	Two funding moratoriums
Delayed project start	Delayed project approval
Ground conditions	Started project without site identification
	Chosen site was hilly and required cut & fill and piling
Pressure from public and media	Public anxiety of power shortage
	Pressure from media of power utility's capacity to complete projects
	Pressure on power utility and project executing team to complete projects
Under-estimation of project complexity	Lack of experience of similar projects in immediate past
	Under-estimating project complexity
	Optimistic estimating based on past experience
Procurement strategy	Strategy was chosen on past practice basis
	Lack of experience of similar projects in immediate past
Lack of experience	Lack of similar projects in the country
	Loss of skilled man power due to lack of projects
Lack of preparation	Delayed project start, lack of time
	Lack of experience of similar projects in immediate past
	Optimistic estimating based on past experience
Productivity problems	Inexperienced workforce
	Outsourcing of work
	Shifting organisation culture
	Cultural dynamics
	Package interface problems

Discussion and implications

As in the case of stadium project, the results show the effect of pressure on the project team's management of the project. Due to the pressure of looming power deficits and pressure from the public and media on the ability of the organisation to carry out the projects, the client decided to embark on two super-critical plants at the same time. According to the respondents,

the standard plants are 500-600MW units. 800MW units are higher end technology units not commonly carried out in the world. Equally, the client decided to use newer Flue Gas Desulphurisation (FGD) and air cooling technology. The organisation's finances were thus stretched and resulted in moratoriums which affected the progress of the power plant project. Equally, the pressure made the client and project team to disregard or be optimistic of their ability to carry out the project.

5.5.2 Delayed start to the project

The client organisation foresaw early in 1999 the future power deficits, but the approval was delayed until 2005 because the view of government at this time was that independent power producers (IPPs) should contribute 30% and not the power utility alone. Unfortunately, the IPPs response was poor and no contracts were signed. By this time, the power reserve margins were getting in the negative and under this pressure, the power utility decided to revive old power plants but were not sufficient. By this time, the organisation was in a "crisis mode." They decided to resubmit the project proposal to build a total of 6 units at two power plants. However, due to intense public pressure and the dwindling reserves, they decided to build a total of 12 large capacity units at the two plants with 6 at each plant.

The threat of dwindling reserves and public pressure may be the reason that led to the approval of the project. The approval was given with the understanding that construction would be complete within 6 years. The organisation therefore had less time to prepare for the project. They had to decide whether to go through the project life cycle of obtaining the site, design, bid and build or use virtual designs, bid and build. The first route would last 18 months and the latter 9 months. Due to lack of time, they decided to use virtual designs. The lack of time also led them to rush the contracts resulting in ill-defined and missing scopes in packages.

Discussion and implications

The delayed approval of the project had various effects on the project. (1) Time for the organisation to carry out extensive feasibility studies was reduced, (2) The procurement strategy was rushed, (3) The client used of virtual designs and other short-cuts to start construction in the earliest possible way. Again, as seen in the stadium project, the pressure from the public and the threat of dwindling reserves influenced their decisions and strategies of project execution. They used short cuts, which are prone to errors as noted Love et al (2009). This shows that the reason behind incomplete or ill-defined packages and use of virtual designs was lack of time due to delayed project start. The other reason behind was lack of project specific experience of the project staff. They had not built power plants for over 50 years. A consequence of such a situation, from the research by Groenveld (2006) and Ofori et al (1996) was that they had lost experienced staff due to relocations and retirement. This

affected their planning and preparation for the project. This concurs with Merrow (2011) who found that many failures of *large projects* could be traced back to the sponsors and their financiers.

The results, as observed in the stadium project, suggest that management of *large projects* involves more than the management of the project environment. It also involves the management of the parent organisation as well as the external environment. It also involves management of public dynamics (Capka, 2004). The results also suggest that the problem of time and cost overruns began in the external environment (macro-project environment) – lack of power plant construction projects and government policy on power supply. These resulted into lack of experience and lack of time in the organisation environment, which eventually led to construction delays in the project environment. The implication for research and management of *large projects* is that the potential solution to reducing time and cost overruns may not reside in effecting improved techniques in the project environment, but perfecting the whole process from the macro environment to the organisational and project environments.

5.5.3 Ground conditions

Various factors were associated with the site and the chosen location. From the respondents, one of the most important consideration was the proximity of the coal reserves. From the final scoping report (Ninham Shand & Eskom, 2009), the location of the plant was also related to the efficient conveyor distance of not more than 30 km from the reserves. The chosen site was a wetlands area surrounded with a farming community. The actual location was shifted on recommendations from the EIA report. This area, unfortunately, was sloping. Cut and fill was therefore required and approximately 13 million m^3 of soil had to be moved. Unit 1 was located on a hill and this had to be levelled. Respondents indicate that, in some areas they had 40 metres of fill.

The complication in the process was that the actual site had not been selected when the approval was granted in 2005. Due to lack of time, pressure of imminent power deficits and pressure from the public and media, bidding documents were prepared using virtual designs subject to re-measurement on site. However, the conditions on site were very different. The ground was uneven and this required cut and fill and piling works in the fill area. As a result, the site preparatory works took longer than anticipated leading to delays in the sub-structural works and the subsequent works.

Discussion and implications

A review of the activities that led to the actual site provides some insight into how the project ended up with the difficult ground conditions. The first was that the site had not been identified and consequently the feasibility studies carried out did not include the site. Secondly,

the location problem was closely associated with the delayed approval of the project which affected the time for preparation and eventual execution of the project. Thirdly, there was sustained pressure from the public on the firm's ability to provide power and forestall the imminent power crisis. Fourthly, the organisation was under extreme pressure due to dwindling power reserves which, by 2004 it had become clear that in a few years the reserve margins would get into the negative territory (Eberhard, Kolker & Leigland, 2014) whilst the net capacity of the power utility was on the decrease and the demand on the increase (Department of Energy, 2015). The results of the difficult ground conditions, was the lengthening of the preparatory and sub-structural works leading to project delays and cost overruns on all the packages.

The results show that the root cause of the problem of ground conditions was the lack of preparation by the client. This was mostly due to the delayed project approval which reduced the project team's time to prepare for the project. When the approval was granted, the threat of power deficit had already set in. With the pressure from the public, the organisation prepared project documentation on the basis of virtual designs and partial geotechnical information. This confirms the observation in the stadium project case study of the effect of pressure from the public and insufficient time on the management of the project. They used short cuts in document preparation and partial geotechnical information.

5.5.4 Pressure from the public/media and depleting power reserves

There was sustained pressure from the public and media regarding the project and when it would be completed. This project was part of the power utility's capital projects aimed at increasing the country's power supply which was dwindling (Ninham Shand & Eskom, 2009). The project approval, however, took long and part of the public were in favour of IPPs. Therefore, the onset of delays attracted a lot of attention from the public. This resulted in mounting criticism of the management of the project. Due to the delay of project approval and the looming power deficits, the power utility took one year to plan for the two power plants mentioned before instead of the normal 4 years (Mantshantsha, 2016). Furthermore, according to the Project Director, to cut on time, the power utility opted to use virtual designs. Consequently, they did not prepare concept designs based on the site. However, the site conditions were different from their virtual design assumptions resulting into longer site preparatory works and delays to subsequent construction works.

Discussion and implications

The results confirm the effect of pressure on a project team and its management of the project as observed in the earlier case study. Due to public pressure and the fear of dwindling reserves, the power utility decided to use a shorter procurement route and virtual designs and

proceeded with the project. The consequence was that there was little time for geotechnical studies and when the contractor moved on site, the work was more than anticipated which led to delays and a longer construction process which they were trying to avoid in the first place. Also, the choice of constructing super-critical units (800MW) as opposed to sub-critical units (500-600MW) was due to the need to solve the increasing problem of dwindling power reserves. This, however, was at variance with the skills in the organisation and the manufacturing ability of the country at this time to skill and supply the equipment. Furthermore, the power utility, being a state-owned enterprise (SOE), adopted a competitive multi-procurement approach with conditions of employment of locals in labour and sub-contracting. A combination of these several factors led to a more complicated design and procurement process which required the organisation to be more involved in the project and yet they lacked the skills and management capacity having not built power plants for about 50 years. The result of all these factors was a longer construction process and cost overruns.

The results show that the project team was highly influenced by public pressure, dwindling power reserves as well as the delayed start to the project due to past decisions in the higher organisation corporate ladder and the government. It shows that due to pressure, the client used a shorter procurement route, virtual designs and started the project with little time for geotechnical studies. He also chose to construct two larger power plants concurrently, which were more complicated than the capacity of the industry and the client's experience could match. This suggests that the performance of the project team was affected by public pressure and past decisions made before and during project formation. It shows the need for a long-term approach to project management as observed by Merrow, (2011).

5.5.5 Under-estimating the project complexity

Most of the respondents explained that the complexity of the project was under-estimated by both the client and the contractors. For the client, the main reason for under-estimating was that they had constructed several power plants in a similar space of time in the past and were confident that they could carry out two *large projects* at the same time. The decision was also partly due to pressure of power deficits as explained under section 5.5.4. This somehow reinforced their optimism that they would complete the projects in time. Another reason for the optimism was that they would use global and experienced contractors.

The contractors, too, under-estimated the volume of work and got more than they could manage. Using fleet contracts arrangement, the contractors had projects at both the two plants. They were optimistic that the work would easily be carried out in South Africa. They assumed that, (1) they would easily get resources, (2) the quality of work would be as they

had experienced elsewhere in the world and, (3) that they would manage the manufacturing and construction process and carry out the work the same way they had done elsewhere.

However, when the work was started, it turned out differently. It was taking longer than they had anticipated and the project suffered various interface and construction management challenges. Firstly, the preparatory works took longer than they had planned and most were not done when the subsequent works were required. The roads, the water and waste water reticulation systems were not in place as the packages had not been allocated or were taking longer. In a number of cases, they had to re-route and re-plan which led to more costs and construction delays. The ground conditions also were different from what they had anticipated. There were also numerous problems and access delays on site. Actual productivity was lower than anticipated which prompted the client to get more involved in the project.

Discussion and implications

The results show that both the client and the contractor under-estimated the complexity of the project and this affected the assumptions they had about the project and the methods of delivery they adopted. For the client, due to the successful power plant construction in the past, they were confident that they would carry out two large power projects concurrently in a period of five years. They also looked to the global contractors to be experienced and able to manage the two projects in the planned period. The global contractors equally were optimistic that they would manage the two projects as they had done elsewhere in the world.

Their optimism made them to under-estimate the complexity of the project and this led to poor preparation and execution of the project. They were affected by what Busby and Payne (1999) calls illusion of control where participants feel that they are able to control and contain the situation. When the work was carried out, they encountered several logistical problems. The preparatory works and subsequent works were out of sequence and taking longer than they had anticipated.

The results suggest that the project team was inadequately prepared because of under-estimating the complexity of the project due to optimism in their capacity to carry out the work based on their previous experience and performance of similar works in other places in the world.

The results confirm previous research by Flyvbjerg (2011) that under-estimation is due to optimism bias. However, strategic misrepresentation was not found in this case study. But that lack of time, optimism and lack of experience led to under-estimating the complexity of the project.

5.5.6 Procurement strategy

Most respondents found the procurement strategy adopted by the client as an important factor that led to time and cost overruns. There were four aspects to the strategy. (1) The power utility appointed contractors on the basis of open competitive tendering being an SOE. They also used fleet contracts on the two power plant projects with the case study project starting a year later. The contractors who were appointed at the first project for a particular package automatically became contractors for that package at the case study project. This meant that the design for the first project one was adopted at the case study project with some local modifications. (2) The organisation used multi-procurement with all contracts managed by the client. The project was broken down into various packages reaching about 65 at the time of the case study. These included the preparatory works such as roads, water reticulation, water treatment plant, sub-grade civils, grade civils, mechanical and electrical installations. (3) The project design and construction was outsourced and the work of the client was to manage the interface of the contracts. The main contracts were boilers and turbines and these contractors designed both the mechanical/electrical works and civil works. (4) Alignment of the work/packages to the contractors and the project timeline (Figure 5.3).

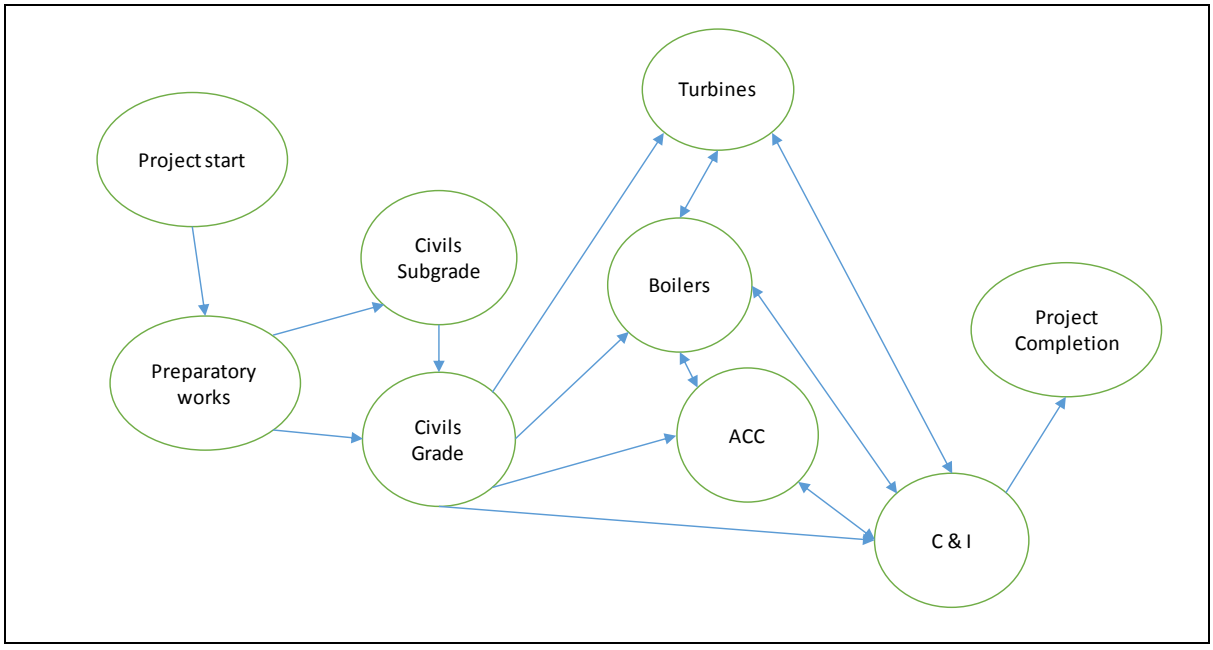


Figure 5.3 Relationship of multi procurement strategy to project completion

The results of the strategy were that, (1) the actual full scope of the project was unknown at concept stage until the outsourced component had been designed and that data given to the next package to design and then pass it on to the next. (2) The contracts had dependencies of one upon another with packages dependent on feeder contracts for information to design and then execute (3) The contractors needed access to sites as well as data from the feeder

contract to design their part. Unfortunately, the feeder contracts starting with preparatory works were delayed which resulted into a whole chain of delays on the project package spectrum. (4) There were several contractors on site at once resulting into access delays and interface management problems which often led to clashes, claims and doubling of contractors' tasks, time and cost overruns. As a result, no one was able to fulfil what they had promised because of other contractor's delays and their own delays. This made it difficult for any contractor to attempt to accelerate their works. (5) The alignment of contracts was based on specialisms and not the power block, mismatching with the organisational objective of supplying power per block. With the built-in dependencies on the feeding and proceeding contracts, it meant that a delay on one package not only affected the proceeding packages in the block but also the packages in all the other blocks since it cut across the blocks (Figure 5.4). The reason behind the adoption of this alignment was that, this was the "organisation's way." They had used this strategy in previous contracts. A Construction Manager said, it worked then because organisations were not multi-disciplinary unlike this time. One organisation would not only supply turbines, but also boilers and air-cooling systems. It was therefore possible to give a complete power block to one organisation and a second block to another. This would have also been in line with the required connection to the grid which was per unit. These decisions were made in the higher organisational levels, the board room.

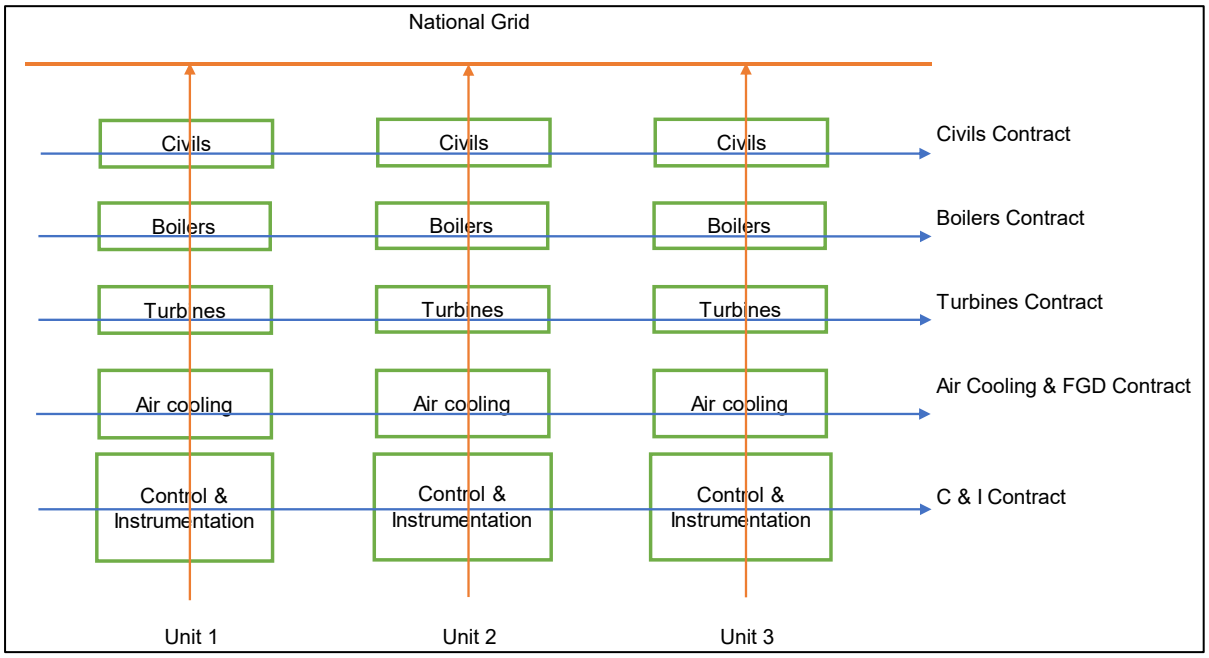


Figure 5.4 A contrast of package alignment against organisational objective

Discussion and implications

The results show that the choice of the procurement approach led to many complications in the management of the project and was a leading factor to time and cost overruns. The set

up put more responsibility on the client to manage and coordinate the various organisational and task interfaces yet he lacked specific project experience in the management of this type of project and did not have the staffing levels to manage the interfaces. All the delays were the responsibility of the client. This made him to be more involved in the project and thus increased his risk.

The contracts had dependencies of one with the other in terms of work continuation as well as data for design of the subsequent contract. Unfortunately, the feeder contracts delayed and that affected all the subsequent contracts which made it difficult for any contractor to accelerate their works. It was also difficult to know the full project scope until the components had been designed and data given to the next package. Furthermore, the large numbers of contractors on site resulted into access delays, doubling up of contractors' tasks, time, and cost overruns.

The results also show that alignment of packages, based on specialisms and not power blocks, contributed to the overall project failure to meet the organisational objective of supplying power per power block unit. When one package was delayed, it affected all the power block units as the contract was across the units (see Figure 5.4).

The results suggest that the procurement method adopted affected the preparation and management of the project. Furthermore, that the decisions that were made at the higher levels in the organisation and the decisions made before the start of the project affected the preparation and management of the project. This suggests that management of the project should not start at project execution, but earlier in the board room. It also shows that decisions are not influenced by pressure only but also by past practices.

5.5.7 Lack of experience

Most of the respondents were of the view that the client lacked experience to carry out a project of this nature due to the lack of power plant construction projects for a long period of time. It meant that they had lost the skilled resources and quantities to execute the project. Even the construction and manufacturing capacity in the country was lacking as well due to the dormant industry. This keenly affected the international contractors as they had to revive a dormant industry in skills and manufacturing capabilities, which risks they never considered. The effects of the lack of experience were that the budget was insufficient, the complexity of the project was under-estimated, they were inadequately prepared for the project and they had numerous problems due to the procurement method that was adopted. The results suggest that experience is an important factor that should be considered in the management of *large projects*.

5.5.8 Lack of preparation

Most of the respondents were of the view that the client had not been prepared when they embarked on the project. This was seen from the numerous problems on site, the incomplete designs, running out of funds in the midst of the project twice, the full scope of the project was not known at project start due to outsourcing and lack of experience in the type of work. This made them fail to anticipate delays and problems of the project. Outsourcing made them to be removed from the axis of action.

The results of inadequate preparation were, (1) preparatory works took longer than anticipated leading to delay in subsequent works, (2) the conceptual design was incomplete and when conditions were different on site, it resulted in time and cost overruns, (3) they had access and interface management difficulties on site which all delayed the packages substantially. For the Control and Instrumentation package, the execution was overrun 5 times. The package, which was planned to be completed in 2016, was now planned to be completed in 2022 (as at September 2014). This showed that the competence of the project team was affected. It was noted, however, during the collection of information that, after appointment, the Project Director instituted a thorough strategy of recruiting members to the executing team from within the country and outside. They later involved an experienced organisation to complement the lack of skills in project construction management. They also developed comprehensive project management work procedures similar to the procedures in Case Study IV and Case Study V, the better-performed projects. These measures improved the management of the project, but the project continued to experience time and cost overruns. The reason may be that when the procedures came in later, the seeds of overruns had already been established. The project start had already been delayed when the procedures were instituted which reduced time to prepare documents and carry out thorough feasibility studies. In addition, the lack of experience in power plants by the executing team and lack of understanding of local conditions by the contractors affected the competence of the project team.

There were several factors behind inadequate preparation. (1) The delay in project approval reduced the client's and executing team's preparation. (2) Pressure from dwindling power reserves made the organisation quickly get to procure the project before the design documents and site had been established. (3) The client lacked the experience in power plant construction due to the dormancy in the industry as described before. A combination of these factors and the procurement strategy affected their preparation and consequently resulted into time and cost overruns.

The contractors were said to have been prepared, but they overlooked the local conditions of productivity and the working culture differences with the local people.

Discussion and implications

The results show that the client was inadequately prepared for the project when it was embarked on. This is seen from incomplete designs and funding problems which resulted in suspension of award of contracts after award of the main contracts; turbines and boilers. The major reasons for lack of preparation were lack of specific project experience, delay in project start due to late project approval, commencing the project before complete investigations because of pressure of waning power reserves and criticism from the public. The results also show that the executing team had instituted well-prepared project management procedures similar to those prepared by the better performed case study projects. These improved the management of the project, but the project continued to experience time and cost overruns. This suggests that the project management procedures were not sufficient to prevent the occurrence of overruns. It also implies that a project management strategy should consider the pre-execution phase as well as the execution phase to manage time and cost overruns effectively.

5.5.9 Productivity

Most respondents said poor productivity was a contributor to time and cost overruns. This was in both the executing team and the contractor's organisations. In most instances, the planned activities were found to be completed late, or taking longer than they had planned. Apart from the other factors mentioned before, poor productivity was identified to be at the heart of the problem. This was both at individual worker level and organisational level (Table 5.5).

The results show that several factors affected productivity on the project. (1) Inexperienced workforce. The reasons were that most were working for the first time, supervisors were not used to managing large numbers of people and the workers and unions had rights. These resulted in workers failing to understand and appreciate working conditions. They would strike and stop work for any reason. Their assumed rights and the backing of the unions also reinforced their desire to strike or stop work for any reason. (2) There were poor skills amongst the workers because of their unwillingness to learn on the job and lack of patience. These resulted in failure of the workers attaining higher skills levels such as high-tech welding. After working for a month, they would want to take over the position from the supervisor and when they do not succeed, they would leave for other contracts. (3) Reduced worker productivity. This was due to a combination of factors: lack of supervision and self-discipline; worker

Table 5.5 Factors leading to poor productivity on the power plant project

Factor	Reasons behind	Effects
Inexperienced workforce	Most working for the first time	Failure to understand and appreciate working conditions, strike/stop work for any reason
	Supervisors not used to managing large numbers	Overwhelmed with volume of work and resources required
	Rights and unions	Desire to strike/stop work for any reason
Poor skills level	Not willing to learn hands-on over time	Poor skills and lack of high level skills such as high tech-welding
	Lack of patience on the job	Desire to take over as supervisor after working for a month
		Leave for other contracts
		Failure to learn other skills that go with the job such as decision making
Reduced worker productivity	Lack of supervision, lack of self discipline	Failure to keep to lunch times
		Large numbers of people at plant cafeteria
	Worker attitude that work can be done any time	Not completing tasks on time or speedily thinking if not done today, they can be done tomorrow
	Government policies and promises of jobs to locals	Attitude that they have right to be employed and will be employed for a long time
	Eskom providing amenities and other requirements to workers	Attitude to demand for more and strike if not given
	Rights and unions	Strike/stop work for any grievance
Cultural dynamics	Contractors	
	Germans: Impersonal, direct, militant approach to supervision	Incompatible with South African personal friendly, family life and democratic approach to work & led to clashes, strikes
	Executive team	
	US Americans: militant, not concerned with personal issues in employees lives	Incompatible with South African supervisors: democratic and interactive and concerned about personal life which led to clashes and slowed work as workers disappeared from work and came back when they wanted
Lack of specialised organisations in power plants	Dormant power plant industry	Contractors had to revive the industry using older people specialised in maintenance of equipment, lack of company culture, affecting supervision and management
Most work was outsourced	Company policy of using various contractors for services	Laxity of control by executing team as project control was in contractors hands leaving executing team to know less about the work, "police without guns"
Shifting organisation culture	Contractors had numerous staff changes especially supervisors	Affected approach to work, contract agreements leading to loss of knowledge and unending learning curves

attitude that work can be done any time, today or the day after, it did not matter; effect of government policies and promises of work to the local community; assumption of worker rights and influence of unions. The effects of these were: failure to keep to lunch times; failure to complete tasks on time and speedily; assumption of the right to be employed, demand for more and strike if not granted. (4) Cultural dynamics in the work place for both the executing team and the contractors. In the executing team, the client had partnered with a construction management organisation from the United States of America which was experienced in power construction. The aim was to improve the competence of the executing team. The Americans were employed in the executing team to be construction managers assisted by the South Africans. However, the incompatibility of the cultural orientation affected the performance at work. The Americans had a militant and non-personal approach to work and this was at variance with the democratic, friendly and personal approach of the South Africans.

Equally, for the contractors, the two leading contracts; boilers and turbines were supervised by construction managers from Germany. Since the project was taken to be high

profile, construction managers from parent organisations in Germany, were appointed to supervise the projects. The Germans were the supervisors and the South Africans the tradesmen. The Germans were reported to be impersonal, direct and militant in their approach to supervision, which often unsettled the tradesmen whose approach was democratic, personal, friendly and concerned about family life. The effects of all these were that the workers would disappear or be not willing to work because of feeling they were not consulted or talked to properly or their family and personal life not considered. (5) Lack of specialised organisations in power plant construction due to a dormant industry. The contractors had a task of reviving a dormant industry with lack of skills and expertise, which affected supervision and execution of work by trades. (6) Most work was outsourced due to the client's policy of using various contractors. This however resulted in laxity of control by the executing team. (7) Shifting organisation culture due to numerous staff changes in the contractors' organisations. This affected the approach to work, contract agreements and loss of organisational and package knowledge leading to unending learning curves.

Discussion and implications

The results show that there were several factors that affected productivity in the project. These include workforce inexperience, poor skills, worker attitude and lack of supervision, difference in cultural orientation between the supervisors and the workers, dormant industry, outsourcing and shifting organisation culture. These factors were triggered in the three environments: external, organisation and project. This suggests that the project management performance is not only affected by workers' skills and competence as shown in the integrated competence model by Crawford (2005). It is also affected by other factors in the project environment, the client's organisation as well as the macro project environment, which include the actions and policies of the governments, unions and other players in the economy. This concurs with Margerison (2001) who found that individual competence should be seen in the context of the project team.

5.6 Conclusions

The factors that led to time and cost overruns on this project were: (1) Insufficient budget, (2) Delayed project start, (3) ground conditions (4) pressure from public/media, (5) under-estimation of project complexity, (6) procurement strategy, (7) lack of experience, (8) lack of preparation, (9) productivity problems.

The results show that the insufficient budget was due to pressure on the client of the looming power deficits and the delayed start to the project. These made them embark on two large supercritical plant projects concurrently. It was also due to the client's lack of specific

project experience as well as under-estimating the complexity of the project because of optimism bias and lack of experience.

The delayed start of the project was due to government's reluctance to approve the power utility's plan to build new power plants. Their policy at this time, driven by public sentiment, was to have independent power producers (IPPs) contribute to the supply. The government finally approved the project plan after the IPPs contracts failed to materialise. By this time, however, there was reduced time for the power utility to plan and construct the projects before the onset of load shedding due to dwindling power reserves. With combined pressure of dwindling reserves and the public criticism, the power utility opted to use a shorter procurement route with the consequential ill-defined packages, access problems and poor project preparation.

The problem of ground conditions was also due to the delayed project approval, which affected the time for preparation and execution of the project. There was also pressure and criticism from the public as well as dwindling power reserves. The project team therefore, used shortcuts to recoup the lost time and this consequently affected the geotechnical studies and the preparatory works on the site. These were not done adequately, leading to time overruns on the initial project works affecting all the subsequent works.

Public pressure played a significant role in the management of this project. The results show that public pressure influenced the decision-making process in the project as was seen in the stadium project. Due to public pressure and criticism, the utility and the project team rushed the procurement process. They decided to build two *large projects* concurrently, which was at variance with the skills of the client and industry. This resulted into a complicated design and procurement process. They also decided to use virtual designs and started the project with little time for geotechnical studies.

The results show that both the client and the contractors under-estimated the project's complexity. This was due to their optimism based on their past performance. It was also influenced by public pressure, dwindling power reserves and, lack of specific project experience. The project team was therefore inadequately prepared to execute the project.

The problem of lack of specific project experience was the springboard of most of the factors seen in this project. It affected the project team's preparation for the project, procurement strategy adopted, under-estimating the project's complexity and the formulation of the budget for the project.

Several factors affected productivity on the project. These include inexperienced workforce, poor worker skills, lack of supervision, cultural dynamics in the workplace, dormant industry, outsourcing and constant change of contractor's management staff.

As in the stadium project, the most common effect found in most factors was the lack of time because of the delayed start of the project and pressure and criticism from the public. This affected the actions of the client and the rest of the project team. The project team used virtual designs, inadequate geotechnical studies and a complicated procurement process, which led to access difficulties and time and cost overruns. Clearly, the actions the project team took affected the delivery of the project. These actions were often reactions to the external factors in the macro and micro project environments. Several decisions made in the macro environment by the government and unions and, decisions in the parent organisation, all had an effect on the response the project team took in managing the project.

The results also show again many inter-relationships amongst the root cause as well as amongst the secondary effects confirming that the time and cost overruns problem is multi-faceted as observed in the stadium project. It was also found that most causes on this project were from the external environment as observed in the stadium project. The major driver of the overruns was the lack of project specific experience, delayed start of the project, pressure from the public and waning power reserves as well as poor productivity.

The results from this research, therefore, affirm that the lack of project specific experience of the project participants, delayed project approval, pressure from the public affected their preparation for the project and use of project management principles, which led to time and cost overruns. The results from this case study, therefore, confirm the theory proposed in the stadium case study (case study I) that the lack of project specific experience of the project participants, public pressure and project approval delays made them ill-prepared for the project and this affected how they managed the project.

Chapter 6 Case study III

6.1 Introduction

This chapter presents a case study of a project team in a large public-private high-speed passenger rail project that was affected by time and cost overruns. The project was chosen firstly, because it incurred time and cost overruns, though it was well-managed. Secondly, because, whilst it was a PPP project managed by private hands, it incurred time and cost overruns. Thirdly, to investigate the rival explanation that time and cost overruns are incurred on projects because they are public projects. The case study will show that a privately managed project is still susceptible to time and cost overruns indicating that there could be other reasons. The case study will also show that time and cost overruns are due to ill-preparation by the project team at inception and that, improved management of the project during execution could not prevent the project from incurring time and cost overruns. Furthermore, the case study will show that teamwork is essential for effective execution of the project and that, the breakdown in teamwork leads to reliance on contracts for performance enforcement which results into claims and time and cost overruns eventually.

6.2 Project Description

This was a high-speed passenger rail transport project in South Africa. The aim of the project was to stimulate investment and social economic development in the area as well as to reduce the travel time and cost in the congested area of the province. It was also aimed at promoting public transport and improving its image to the public. The project consisted of designing and constructing a rail line of about 80km to service 10 stations, some elevated, some underground and some on grade. To maintain the required gradient and route, several roads had to be redirected resulting into construction of new bridges. A total of 50 road and rail bridges were constructed.

The project incurred cost and time overruns though it was well managed.

6.3 Respondents

A total of four respondents were interviewed who included three from the concessionaire and one from the client (Table 6.1). These were all involved in the project with most from the formation of the project up to the completion and hand-over to the operations and maintenance phase. The limitation in the research was that the numbers of the respondents were significantly less than those of the other case studies. This was because other members who were physically involved in the project were not available at the time of the research. However,

it was endeavoured to ensure that at least a representative from the two parties was interviewed to provide information on how the project was carried out. The years of experience for the technical executive and the client's representative were not obtained at the time of the research, but these were highly experienced and senior civil engineers.

Documentary evidence was also used to supplement the information that was obtained from the interviewees. This was either obtained from the representatives and their organisations or from the freely available information from the media.

Table 6.1 High speed rail project respondents

Project Position	Organisation Position	Qualifications	Experience
CEO Turn Key Contractor	Director	BSc Civil	36 yrears
CEO Turn Key Contractor	Contract	BSc Civil	40 years
Technical Executive	Technical Executive	BSc Civil	
Client Representative	CEO Rail Management	BSc Civil	

With regards to journals, none of the respondents said they read research journals. They mostly read technical magazines and other media from their head office or professional affiliation.

Project Details	
Phase I	
Airport line	
Planned duration	48 months
Realigned duration due to start delays	45 months
Original start date	June 2005
Revisions	January 2006, June 2006
Actual start	28 September 2006
Contract completion date	27 June 2010
Actual completion date	8 June 2010
World Cup start date	11 June 2010
Phase II	
Planned duration	54 months
Actual start	28 September 2006
Contract completion date	27 June 2011
Actual completion	June 2012
Phase III	
Actual completion	June 2013
Project costs	
Guesstimate by province	R7bn
Concession offer	R14bn
Contract after negotiations	R25bn
Provisional final project costs	R25.7bn
pending outstanding legal settlements	

Figure 6.1 High speed passenger rail project details

6.4 Contract Data

The project was planned to start in June 2005, but due to prolonged negotiations, it was actually started in September 2006. The original duration was 48 months, but adjusted to 45 months. From a unitary project, it was later phased into three, due to project start delays and other external and project factors explained under section 6.5.

The project costs changed from the estimated figure to the projected final cost. The details are given in Figure 6.1.

6.5 Time and Cost Overruns and the Management of the Project

The reasons for the overruns are similar to the other two case studies. (1) The project start was delayed. (2) There were land acquisition problems. (3) The influence of the World Cup. (4) Water in the tunnel. (5) The client's insufficient budget. (6) Environmental concerns. (7) Pressure and public resistance to the project. (8) Design changes. These are shown in Table 6.2, 6.3 and 6.4. As shown in tables 6.3 and 6.4, most of the causes originate from the external, project and then organisation environment as was the case in the other two case studies.

Table 6.2 High speed rail project root cause of time and cost overruns

Factor	Reasons
Delay to start the project	The concession negotiations took longer
Land acquisition problems	The land acquisition process took longer due to court cases and negotiations bottlenecks
Influence of the World Cup	The World Cup became a completion date milestone to the project
Water in the tunnel	Water levels in the tunnel were higher than planned as well as that the contractor was asked to redo the section for not following the client's specifications
Client's insufficient budget	The client lacked experience in the construction of rapid passenger railways and there was sustained pressure from the public
Environmental concerns	The project had higher than average environmental requirements
Pressure and public resistance	There was concern from the public on the impact of the project especially displacement of people along the route and that the cost would be too high for the province
Design changes	The geotechnical conditions along a section of the route were different from the anticipated

Table 6.3 Root cause and the environment they come from

	Description	Environment
1	Delay to start the project	Project
2	Land acquisition problems	External
3	Influence of the World Cup	External
4	Water in the tunnel	Project
5	Client's lower budget	Organisation
6	Environmental concerns	External
7	Pressure and public resistance	External
8	Design changes	Project

Table 6.4 Comparison of environment of root cause

	Environment	Percentage
5	External	56%
3	Project	33%
1	Organisation	11%
9	Total	100%

6.5.1 Delay in project start

The negotiations took three and half years to conclude from 2003 to June 2005. The prolonged negotiations reduced the project time for design and construction. This was compounded with the need to complete the project before the 2010 World Cup. With the pressure of the public on the project team, they decided to accelerate the project to ensure that they completed it in time for the World Cup. This led to cost overruns.

Discussion and implications

The possible reasons for the prolonged negotiations include, (1) the client's lower budget, which made the parties to consider the required solution against the client's proposals, and other amendments, (2) the complexity of the project had been under-estimated and this was quickly realised during the negotiations. Various amendments and different assumptions were required which were the product of experience with the input of the concessionaire who was well experienced in high speed passenger rail systems. Whilst the client had carried out much preparatory work for the project, they lacked experience in rapid passenger rail systems and this affected the project assumptions and the solutions proposed for the project. This confirms the results in the first and second case study that experience affects the preparation for project delivery. Passenger railway systems had not been built in the country for a period of close to 50 years before this project and consequently, the necessary experience did not exist. It was noted by the respondents that the province did not have the numbers and the skilled personnel with passenger railway construction experience due to passenger rail construction production inactivity for half a century. In this period, the projects related to railway freight services and maintenance of existing stock.

6.5.2 Land acquisition problems

The client had land acquisition problems and this resulted in delays to give land to the contractor which affected his construction programme. Due to the bottlenecks, the land allocation was not uniformly done which affected their planned execution from one end of the project to the other. There was also the combined influence of the delayed start to the project and the World Cup factor which exerted more pressure on the project team. The response of the team was to have several concurrent work sites along the route to accelerate the speedy delivery of the project. The lack of uniform land acquisition, therefore worked at variance with the planned delivery of the project to be in time for the World Cup.

Discussion and implications

The reasons for the delay in land acquisition were twofold, (1) there were several court cases from the private land owners who were unwilling to give their land, (2) the client had planned to use the Land Expropriation Act, but later discovered that most of the land belonged to public entities. He could not therefore use expropriation but negotiations. However, the negotiations and court processes took long to resolve.

The reasons behind the bottlenecks were the ill-preparation of the province for the land acquisition process. They had not done a project of this nature and scale for a long time. They did not have the experience and the skill and numbers of people to carry out the work. The land acquisition process was lengthy and they were under-resourced to deliver the land in the required time frame. The Concessionaire Technical Executive mentioned that the client had a seven-man team which they considered inadequate for this enormous task with issues from court cases to negotiations. They had under-estimated how long it would take to sort out the land issues possibly due to optimism bias as found by Flyvbjerg, (2011). Equally, they had concentrated on the technical aspects of the project of design and construction than this aspect. It may also have been reflective of the technical orientation of the personnel on the project from both the client and the contractor which concurs with the observation of Edum-Fotwe & McCaffer, (2000) that there is a higher technical orientation in construction project management. This problem was also noted in the stadium project where the public communication role was neglected.

6.5.3 The World Cup factor

The World Cup factor affected the project significantly. This also shows the effect of external factors on the project team's management of the project. With the award of the World Cup to South Africa, there was public pressure and a perception that the project would enhance the World Cup. The Finance Minister promised that the project would be ready and assist the World Cup. Thus, the commencement of the tournament became a milestone for

the project. The negotiations, however, took longer than anticipated and this was worsened with the land acquisition problems and the budget approval delay. They had hoped to start the project in 2003 then 2004, 2005, the beginning of 2006 and eventually the middle of 2006. This would have given the project 48 months to complete. However due to the delay they now had exactly 45 months to the tournament.

The contractor was therefore tasked to devise a plan as it was clear the target completion date would not be achieved. The solution was to change the design to fit in the reduced 45 months which was to end on 27 June. Since the tournament was to commence on 11 June, this would be half way through. Acceleration was therefore required. The contractor investigated which parts of the project would be useful to the World Cup and put these on Phase I and the rest on Phase II and run the projects concurrently. Due to this commitment, Phase I was completed on 8 June, 2010, 3 days before the commencement of the tournament.

Discussion and implications

The results show that the World Cup and the influence of the minister of finance, external factors, significantly affected the planning and execution of the high-speed rail project. The opening of the World Cup became a milestone for the project. Since the completion date was difficult to achieve, the project team decided to split the project into Phase I and Phase II. They also decided to accelerate the project to meet the completion date. The results also show that the project plan and eventual execution of the project was due to a combination of the World Cup factor and the prolonged negotiations (project factor).

6.5.4 Insufficient budget

The client had a lower budget and this was realised during negotiations. This was one of the reasons that led to lengthy negotiations. They needed to agree on a budget that could meet the client's requirements and the concessionaire's expectations and capabilities. Various reasons are given in literature for under-estimation: Optimism bias and misrepresentation (Flyvbjerg, 2011); Flawed decision making due to lack of good judgement to predict event (Busby & Payne, 1999); Organisational pressures and poor record keeping (Ibid, 1999).

On this project, three factors contributed to the lower budget. (1) Lack of experience of the client in high speed passenger rail systems construction, (2) optimistic assumptions on the project, (3) under-estimating the project's complexity as seen in the land acquisition problem and, (4) pressure from the public.

The results of the lower budget were that (1) the project start was delayed due to the negotiations and the need for National Treasury approval of the revised budget which delayed,

(2) the project scope was changed to be within the budget, (3) there were design changes to the project, all leading to time and cost overruns on the project.

Discussion and implications

The results show that lack of specific project experience, optimism bias, under-estimating the complexity of the project and pressure from the public were the major drivers for the lower budget on this project. This was a similar experience on the other two case studies discussed before. The results also show the effects of the lower budget on this project. The project start was delayed, the project scope was changed to meet the lower budget and changes to the design were made to accommodate the reduced scope. This was equally seen on the stadium project.

The lower budget constrained the solutions devised, thus restricting innovation in the design. One area affected by the restricted budget was the construction of the tunnel. The client requested for a single bore tunnel as opposed to a double by-directional tunnel because of lack of funds. A single bore tunnel, however, required the creation and construction of a way leave and signalling system. A further operational consequence was the increase in the train time because of the waiting period at the way leave and a possible failure of achieving the planned ridership.

The results confirm the observation in the other case studies that lack of experience in the project type and pressure from the public lead to under-estimating of project budgets. It also shows how under-estimating affects the project decision making process and the potential to lead to time and cost overruns.

6.5.5 Environmental requirements

Most of the respondents were of the view that the environmental requirements were onerous and mostly higher than average. The client wanted best environmental practices to be instituted after a tour of other projects around the world. These considerations, however, were said to have raised the cost of the project. The client desired a lower cost of the project, yet they also wanted the highest environmental standards which was difficult to achieve. It is similar to the experience at the stadium project where the public wanted all their concerns to be taken care of but desired a project that would cost less. This highlights the problem of conflicting interests in *large projects* (Capka, 2004; Morris & Hough, 1987).

From the interviews, it was also noted that the client paid much attention to environmental risks and their mitigation than the construction risks. The explanation was that, construction risks are the contractor's obligation based on the principle that risks are given to the person best able to handle them. The consequence of this was that an opportunity to plan for the

project risks in totality in the early stages of the project was lost. It was further compounded by the procurement process which allowed the contractor to get involved later in the project when the project approval and budget have been agreed.

Discussion and implications

The results show that the environmental risks were a major client's concern on the project whilst construction risks were left to be managed by the contractor. This removed the opportunity of project risks to be planned and managed in totality by the project team from the beginning. The results also show that there was a conflict of interest in the project with clients and the public desiring a lower cost of the project but desiring their mitigation and environmental concerns to be managed potentially leading to a difficult project and a possibility of time and cost overruns.

6.5.6 Public resistance and pressure

Similar to the other two case studies, pressure from the public was significant on this project as well. Therefore, due to public pressure, the cost of the project was kept lower which however, led to project complications and increased costs, notwithstanding. It shows that the lower cost or estimate often seen as a solution to constrained budgets has unintended consequences of project complications, longer project durations and increased costs.

The public was concerned that the project would be expensive and that its construction would displace many people along the route. This therefore resulted in resistance to the project by the general public, private and public entities that were to be affected by the route to be taken. Land acquisition was therefore a difficult task for the client as some property owners and the public took the matter to court. For public entities along the route, negotiations took longer than the client had planned. These all resulted in construction delays.

The project team later responded by setting up a communication and liaison system to answer the many questions raised by the public on the project. They set up community information centres and a hotline. This helped in reducing the public resistance to the project.

Discussion and implications

The major concern of the public was the displacement of the people along the route and the perception of the high cost of the project on the public purse. Whilst the cost and suppression of environmental effects were considered, the plan and mitigation of public resistance was not equally planned and managed resulting in land acquisition problems and public pressure. The setting up of a liaison and communication system later with the input of the contractor helped in resolving many of the matters that affected the public. This helped inform the public about the project and respond to any queries on the project.

The results suggest that public relations and liaison system in management of *large projects* is not given high priority and is a potential cause of project disruptions and time and cost overruns. It also suggests that the contractor is instrumental in the formulation and implementation of the communication system of public relations as noted in the stadium project and the high-speed passenger rail project and that a consideration of his input in the early stages of the project could potentially improve the management of the projects.

6.5.7 Water in the tunnel

The client had specified pre-grouting in the tunnel to contain the higher underground water levels in this area, but the contractor carried out post-grouting and presented their reasons for preferring post grouting. The client therefore decided to take the matter to arbitration where it was ruled in the contractor's favour. The client, not satisfied, later took the matter to court. The court ruled in the client's favour and the contractor was asked to rectify in accordance with the specification. By the time the final verdict was given, the project was almost completed. Since the rectification was going to take some time, the tunnel section was set aside from the rest of the project for the contractor to work on it. This was the birth of Phase III of the project and it took about two years to complete this section. It was also the birth of a strained relationship between the client and the contractor resulting into claims and counter claims on project costs.

Discussion and implications

The results show that disagreement on the method of construction to use in the tunnel affected the client-contractor relationship in the project. They now resorted to arbitration and eventually went to court. The contractor was asked to redo the section when the project was well-nigh complete which lead to delays in completing the project in totality. From this moment, onwards, the relationship in the project changed from that of teamwork to the use of contracts to enforce project requirements.

6.5.8 Lack of experience

The client had taken time to prepare for the project, but they did not have the experience of building a new passenger railway system as they had not built passenger railways for close to twenty-five years. Their professionals were skilled in freight railways and infrastructure. Consequently, the client was not well informed on passenger railway systems and modern high-speed passenger rail construction, which affected the initial planning for the project.

The contractor, on the other hand was experienced in passenger rail construction. The concession team comprised mechanical/electrical, railway track, coach and civil engineering experts from around the world. This team was influential in devising improved design and

construction management capabilities in the project. However, the contractor came in after the project had been defined and budgets set and approved by National Treasury.

Discussion and implications

The lack of knowledge and experience of running a high-speed train system affected the client's planning for the project. From the interviews, for instance, it was brought out that the client planned for use of longer trains, which consequently required longer stations when shorter trains were possible and that would have made the stations shorter and reduced the overall cost of the project. They would also have more trains leading to improved returns on the cost of the project. Another matter that was brought out was that they had opted to have an automatic protection system without the counterpart operating system which would have made them to get more trains. When these matters were brought out during negotiations, the client said it was late to change the plan at that stage and that for transparency, they would need to give chance to other bidders as well and that would take a lot of time.

Thus, the input of the project from the client ultimately affected the planning and management of the project by the project team. The client's lack of project specific experience affected the evaluation of the problem and the solutions devised or sought from the contractors. The knowledge of what is available on the market to fit with what the client needs is important and it requires a team of professionals who have experience and technical know-how for the project.

6.5.9 Design changes

The design changes were due to the lower project budget, prolonged negotiations which led to scope reductions, as well as the different geotechnical conditions of the soil along the route. The first two were products of lack of project experience and pressure from the public. The problem of geotechnical conditions arose from the fact that the project team was not granted permission/access into all the land to carry out exploratory bore holes because of owners' resistance to the project. The result was the team had to depend on partial investigation to design. There were several objections in one area because they wanted the project stopped and this is where the design had to be changed.

Discussion and implications

The results show that design changes were effects of a lower budget, prolonged negotiations and refusal of landowners to grant access to the contractor for geotechnical investigations. Because of a lower budget, the project team changed the design to fit in the budget available. The project was broken into phases to meet the reduced time and the World Cup requirements. The project team furthermore, used partial geotechnical information

because of resistance from landowners. This led to design changes when the conditions during construction were different. The results confirm what was observed in the other two case studies that design changes are effects of other factors in the external environment.

6.6 Conclusions

The results in this case study show that the problems of time and cost overruns were due to various factors which had multiple inter-relationships. The causes were (1) The project start was delayed. (2) There were land acquisition problems. (3) The influence of the World Cup. (4) Water in the tunnel. (5) The client's insufficient budget. (6) Environmental concerns. (7) Pressure and public resistance to the project. (8) Design changes.

The project start was delayed due to prolonged negotiations which resulted in reduced design and construction time leading to pressure on the project team in the management of the construction process. The project also experienced land acquisition delays because the acquisition process took longer than anticipated. The client had under-estimated the complexity of the land acquisition process. This was because they had not done work of this magnitude for a long time and they lacked the experience, skills and numbers to carry out the work. Equally, in the project organisation, there was more emphasis on technical proficiency neglecting softer issues like land negotiations. This orientation was equally seen in the stadium project in regard to communication with the public.

The World Cup factor significantly affected the planning and executing of the project as it became a completion milestone. It also led to the splitting of the project into Phase I and Phase II. The project was also accelerated to ensure that Phase I which was seen to be beneficial to the World Cup was completed before the commencement of the tournament. The insufficient budget, on its part, was due to lack of specific project experience, optimism bias, under-estimating the complexity of the project and pressure from the public of perception of costliness of the proposed project. The effects of the insufficient budget were delayed start to the project and change in the project scope and design.

The client focussed on environmental risks and left construction risks to the contractor. This removed the opportunity for holistic planning and management of the project's risks in totality. The management of the public and the perception about the project were not adequate. This resulted in land acquisition problems on the project. The cost of the project was also kept lower partly because of pressure from the public. This however resulted in project complication and increased costs as was equally seen on the stadium project.

The water in the tunnel, resulting from the disagreement between the client and the contractor on the method of water exclusion in the tunnel led to a break in teamwork between

the client and the contractor. The effect of the disagreement was a delay to the completion of the project and the onset of Phase III.

Design changes were due to the insufficient client's budget, prolonged negotiations as well as different geotechnical conditions along the route. The lower budget and prolonged negotiations were due to the client's lack of project specific experience and public pressure. Geotechnical problems were due to the inability of the project team to carry out all geotechnical surveys along the route because of resistance from some owners of land.

The results show that the factors were mostly external-environment caused as observed in the other two case studies. In this case study, the problems began with the inadequate relevant experience of the client which itself was due to the lack of high speed passenger rail construction for several years. The lack of capacity and skills led to ill-preparation for the project which resulted in a lower budget, land acquisition problems and under-estimating of the project complexity. The lack of experience in combination with the pressure from the public and optimism bias led to under-estimating the project complexity and the project cost.

The results also showed that there were multiple effects of factors upon others and eventually leading to time and cost overruns. The results also showed that the insufficient lower budget led to delay in project start, reduction and change in project scope which eventually led to design changes and construction complications. Suggesting that whilst a lower budget or scaled down project appears desirable, it can potentially lead to design complications and even more cost increases.

The results also showed that the project management team was affected by external environment factors such as the World Cup factor, public pressure and resistance and environmental requirements; organisation factors such as delay to the project start, insufficient budget and project factors such as water in the tunnel. The project team not only dealt with factors in the project environment, but also effects of external and organisation environment factors.

Similar to the other two case studies, the major contributing factors to the time and cost overruns on this project were lack of specific project experience, delayed start to the project, and, pressure and resistance from the public. The other factors specific to the case study were land acquisition problems, the environmental requirements, the World Cup Factor and design changes due geotechnical conditions.

The results from this case study show a positive relationship with the theory that the lack of project specific experience of the project participants, delayed project approval, pressure from the public affected their preparation for the project and use of project management principles which led to time and cost overruns.

Chapter 7 Case Study IV

7.1 Introduction

This chapter presents a case study of a project team working on a river dam project in the Western Cape, South Africa. The project was selected because it presented a case of a project that was completed within time and budget. This is similar to the study by Giezen (2012) of a deviant case (Harding, 2013). This is a project that did not conform to the normal rule of overrunning *large projects*. The dam project was completed within time and cost. The aim of the case study was to see whether it would confirm the opposite of a typical overrunning project or theoretical replication. The case study will show how project specific experience of the client, the project development manager, consultants and the contractor impacted the project team's preparation and eventual execution of the project. The case study will also show why the rival explanation that successful implementation of a project is on the basis of whether it is a public or private project should be rejected. The successful study provided input to the eventual formulation of the proposed strategy for the management of large projects. The study was included because it demonstrated how a large project could be successfully carried out. It showed how the involvement of a project development organisation could lead to successful project delivery.

7.2 Method of Analysis

The analysis was directed at finding out how prepared the participants were in carrying out the project. The following questions were used: (1) Were the project participants prepared for the project? (2) Did they use project management principles consistently? (3) Were the participants experienced? (4) Was there a lack of time? (5) Was there resistance to the project? (6) Was multiple competitive tendering used? (7) Was the budget insufficient? (8) Was the project completed within time and cost planned at tender?

To understand the above, the analysis was centred on extracting information from interviews and documentary evidence.

7.3 Project Description

The project comprised construction of a 68m high x 929m long wall, concrete faced bottom and an embankment of riverbed mined rock, supplement scheme, 2 pump stations and a 12km pipeline. The project was completed on time and within budget. The budget was R1.5bn and completed March 2009. The project was a management partnership of the user client, the city council and the user client's project implementation manager.

7.4 Respondents

Four respondents were interviewed. These are the project director (contractor), the project manager (consultant), the concrete manager and technical manager (Table 7.1). The number of respondents is less than the other case studies. The major reason for the smaller number of respondents was that several personnel who had participated in the project could not be located at this point in time due to relocation and retirement. Another reason was that some personnel could not find time to be available for the interviews. In spite of this limitation, the author endeavoured to find representatives who could give information for the principal parties to the project.

Table 7.1 Dam project case study respondents

Project Position	Organisation	Qualifications	Experience
Project Manager	Consultant	Civil Engineering	31 years
Project Director	Contractor	Civil Engineering	47 years
Concrete Manager	Contractor	Civil Engineering	50 years
Technical Manager	Contractor	Civil Engineering	22 years

7.5 Preparation for the Project

Amongst the project participants, the client was acknowledged by all respondents to have been adequately prepared and experienced in this type of project. The client was the Department of Water Affairs and Sanitation, a public entity. The client took several years preparing before they commenced construction works on the project. On an earlier similar and larger dam project than the case study project, the client had set up an independent semi-autonomous department to finance and manage the construction of dams and tunnels as projects development managers. Before embarking on the project, an experienced Canadian firm was appointed to assist in building up the capacity of the department in training and management of the project. The project was successfully executed enabling the department to gain the relevant knowledge and experience in dams and tunnels construction project management. The semi-autonomous department managed this project exclusively as the client, sourcing project finance, appointing consultants and contractors and handed over the project to the water affairs department after successful completion.

On the case study project, the project development manager was again appointed to finance and construct the dam. The project development manager and the owner client had previously carried out extensive studies on the possibility of a water project in the area concerned. They had even investigated the possible dam types on the site. It took them about three to four years before commencing whilst looking for funding sources. Most of the respondents acknowledged that the project development manager was a high profile

organisation with very experienced personnel who had been working on dams, tunnels and other civil engineering construction projects over time.

Equally, the consultant was prepared for the project as they had intelligence information of the imminent project. They also had extensive experience in this type of work having been involved in the earlier dam project with the same partners in a similar joint venture. Not only did they have the experience, but had worked as a team for the same client, the project development manager before. When they took up the task of designing, preliminary feasibility studies had been carried out by the project development manager on the identified site. They took up these studies and developed them further.

The designs were complete before construction. The Project Director (contractor) said this was one of the few projects he had worked on where drawings were complete. This made the work of construction easier. There were very little provisional sums on the project. Only the penstocks were on provisional sums. The drawings were said to have been thorough and complete which made preparation for the work easier for the contractor. The final amount was not very different from the tender figure.

The contractor was also said to have been prepared for the work but, due to limited time available before construction and the competitive tendering environment, he was less prepared compared to the other two participants. This is said to have been the reason the tender figure was 20 percent lower than the actual cost. Another factor was the contract requirement of 20-30% local labour content which was difficult to achieve. The contractor was further required by law to conform to the country's social inequality reversal programme called Black Economic Empowerment (BEE). This required them to include black owned enterprises in the project. They identified 18 sub-contractors, but only one or two actually got involved in the project with the rest being only interested in attending meetings and allowances.

The spirited work of the parties in preparation for the project was instrumental in the successful execution of the project. The results concur with the work of Gareis (1989) who found that the pre-project phase and the post-project phase affect the performance phase. The energy and impulses invested in the preparation for the project are important factors that allow the project team to perform successfully (Ibid, 1989). Furthermore, even though this was a public project, it was successfully carried out within time and cost showing that successful implementation was not on the basis of whether it was public or not. The rival explanation that a project will incur time and cost overruns because it is a public project is, therefore, rejected.

7.6 Use of Project Management Principles

The participants are said to have followed the traditional project management principles. The client gave the consultant authority and autonomy on the project. All the communication to the contractor was through the consultant. Short-cuts were not an occurrence on this project. The design concept was complete before tender and was based on the actual site after extensive feasibility studies were carried out. The site had been identified and the necessary permits including project and funding approval had been handled before the construction works were commenced. The project development manager engaged the community early in the project before commencement of construction and came up with a labour database that was to be used in recruiting the local people in the project. The community liaison was continued and improved as the contractor became involved in the project.

The owner client had carried out studies on water improvement in the province and earmarked the site as a possible location for a dam. These studies were later picked up by the project development manager and handed over to the consultant's joint venture that consolidated the project into the actual construction concept based on the site. This reduced the risk of location-induced design changes later on in the project life cycle.

The management of environmental, project and funding approvals before commencement of the project reduced the risk of delay to the start of the construction process or delay of the on-going construction process. There was, therefore, less pressure on the project participants to find short-cuts or other means of accelerating the project. The community engagement helped to diffuse the rising resistance to the project reducing the possible stoppage of the project and hence pressure of reduced project time.

7.7 Qualifications and Experience

As noted before, the project participants were experienced in managing and constructing projects of this nature. All of them were experienced in dam construction. This helped in the formulation of design and project management strategies for the project. The estimation for the project was R1.5bn and the contract was R1bn. The consultants and the contractors, too, had extensive experience in dam design and construction. They had also participated in previous contracts with the same partners. With the experience, they were able to respond to the problems they encountered on the project. One of the problems was that they found pockets of poor ground on the river bed and on one river bank. The response of the team was to re-programme activities so that labour moved to other areas whilst designs were carried out. The result was that the overall timeline of the project was not affected at all.

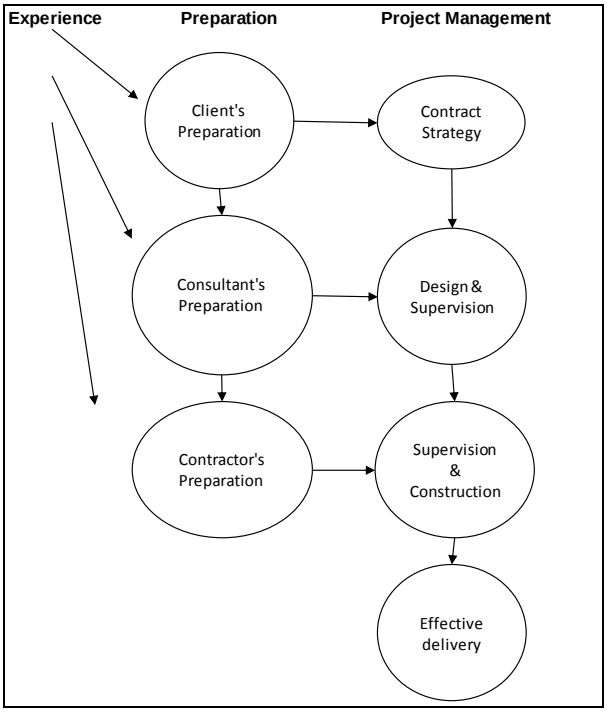


Figure 7.1 Effect of project team's preparation on project management

Having qualified and experienced consultants and contractors was seen by most respondents as key to the successful delivery of the project (Figure 7.1). This started with the competence in the client's organisation which led to good preparation for the project by the client. There is a back and forth relationship between the client's preparation for the project and the competence of the client (Figure 7.2). Their experience which improved their competence made them prepare for the project adequately. Equally, their good preparation for the project impacted on their competence as well as in the follow up activities of the consultant and the contractor. In this case, the competence is historical or based on the accumulated experience gained in the far and near past by the individuals and the organisations. Especially individual knowledge, since organisations are poor at knowledge management (Kuo, 2012).

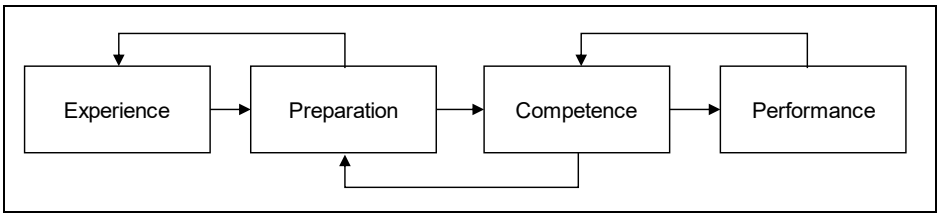


Figure 7.2 Relationship of experience, preparation, competence and performance

7.8 Insufficient Time

Time limitation was not a factor on this project apart from the contractor's limited time during tendering. There was no date set by the client for completion of the contract as in the

case of the stadium project, and the high-speed rail project. The major factor, however, was the need to meet the date of impounding to catch the winter rains and this was achieved successfully. The project start was not delayed and the project permits had all been handled before project commencement on site.

7.9 Community Resistance

There was extensive resistance from the community due mostly to the perceived influence of the project on the community. The respondents said that this was mostly from the affluent community. Their major fears were that the dam would disfigure the valley and that the contractor's labour would lead to erosion of morals in the community. Their views were based on a previous project in the area which resulted in an upswing of moral degeneracy like theft, rapes and pregnancies. The affluent community managed to raise a big movement in the area to discourage the project and many joined in the resistance.

The result of this was that the project team found it difficult to promote the project due to misunderstandings and perception difficulties. In spite of the many benefits the project would bring to the valley such as employment for the youth, suppliers, improved water volume and quality in a water scarce region. This dam would give them clearer water than the poorer quality and mostly muddy water from a nearby dam they had been using. The results give a hint to how organisations and individuals resist projects. Influential community members or a group of community members with partial information get to the community and raise their fears regarding a project that is to be carried out thus influencing their perceptions and judgement. This suggests that to get the community to cooperate in the project, using influential members of the community would help in engaging the community to support the project.

A major breakthrough was achieved when the project team decided to use an influential personage to speak to the community. They engaged the ex-mayor and he helped turn the community to support the project. Eventually, they set up recruitment centres to employ artisans and suppliers of materials.

The employment of the local community, however, had unintended results. The productivity and quality of work was affected because the local labour were used to working on simple building projects which mostly lacked supervision. Much retraining was therefore required and this again affected productivity and tended to increase the costs of the contractor. There was also a mismatch between the labour available, based on the project implementation manager's labour database and what the contractor needed. For example, whilst one was indicated as a concrete mixer operator, they could only operate the basic mixers.

7.10 Design Changes

There were no major design changes on this project. The respondents indicated that this was because extensive feasibility studies had been carried out prior to the commencement of the design. It was also because the client and consultant were experienced and prepared. Another reason was that the site location had been identified and the feasibility concepts were based on the chosen location. However, the ground conditions changed in spite of the trial bore tests they had carried out. They found that the ground conditions between the trial holes were different. Further, they found that the right bank soil was very poor as well as patches of clay here and there which required stabilising and removing respectively.

The team responded by reprogramming the activities so that resources were drawn to other areas whilst investigations of soil conditions and subsequent designs were carried out without disrupting the construction process. The response was also facilitated by the understanding of the client who was experienced in these types of projects and in project management. The client is said to have supported the geotechnical investigation carried out prior to the commencement of construction. The contractor's project manager said that most clients do not understand the importance of geotechnical surveys as a result they are not funded or carried out extensively as required. This, he said, was because most clients and their representatives are from non-technical/non-construction backgrounds.

The results show that identification of the project site, extensive feasibility studies before commencement of design, client and consultant experience and preparation were important factors in avoiding design changes on the project. They also suggest that the response of the project team, which is related to experience, determined how the particular project issues that cropped up were managed. Lastly, the results also show that geotechnical studies were carried out because the client, due to their experience in dam construction and their construction/technical background, appreciated their importance.

7.11 Multiple Contracts and Competitive Tendering

Multi-procurement and competitive tendering was used on this project. The client appointed the consultants as well as the contractors. Consultants: Consultants' joint venture (three consulting firms); dam construction: dam project joint venture (four contractors); pump stations: client construction directorate; mechanical and electrical: one contractor; pumps/ pipelines: one contractor.

The project was carried out within the budget and planned duration and met the dam impounding date.

7.12 Factors Seen to Have Led to Meeting Time and Budget Targets

Several factors were seen to have led to successful delivery of this project. These include experience and adequate preparation of the project team for the project, teamwork, commitment and institution of a management structure to handle the project (Table 7.2).

Table 7.2 Dam Case Study facilitators of successful project delivery

Factors that led to successful project delivery
The client had project specific experienced
The client carried out thorough studies and preparation for the project
The client was understanding and supported the work of consultants and the contractor
The client and project team followed project management traditions and principles
The consultant had autonomy and authority to design and supervise work in spite of client's knowledge and experience
The consultant was qualified and experienced and keen to have project carried out successfully
The consultant was driven by commitment and pride to carry out the work well
The consultant was prepared to carry out the project and had worked with the joint venture partners before
The consultant project manager instituted a system of recruitment of personnel, integration of the design process and the construction process and was present full time on site to drive the project
There was commitment from all team members of the project
There was teamwork in the project and the dedication and experience helped them to manage the challenges faced on site
The project management structure of meetings, anticipation of issues and planning and communication helped in the team response

Preparation for the project

The client, the government water affairs department, was adequately prepared for the project. They took several years before they eventually carried out the project. In the intervening period before embarking on the project, they carried out extensive studies on the possibility of constructing a dam in this region. Furthermore, earlier, when undertaking a previous similar and larger dam project, they had set up a semi-autonomous institution to finance and manage the project on their behalf. The team in the semi-autonomous institution teamed up with experienced professionals from Canada and built up their experience profile during the execution of the project. When the current project under study was carried out later, the institution had extensive experience in both project financing and project management. This institution was the managing client for the project both financing and project management and was adequately prepared for the project. Water, environmental, financing, funding and project approvals were all managed before the project was started. Identification of the actual project site, feasibility studies on the actual site, investigation of possible dam types had been carried out.

The consultants and the contractor were equally prepared for the execution of the project. The designs and drawings were complete before the commencement of construction and the final cost was not very different from the planned cost.

Qualifications and experience

The project participants were experienced in this type of work starting with the user client, the managing client, the consultants and the contractor. They had all worked on the previous similar dam as partners which improved their definition, project strategy formulation and management of the project execution process. The experience improved their competence which also impacted on their preparation and eventual project implementation. The process started from the client's organisation into the consultant's organisation and eventually the contractor and the worker pouring concrete on site.

Project manager and the project management process

Starting with the pre-design process up to construction, the project manager and his team set up processes and procedures of how the work was to be carried out. Previous engagement with other consultants and extensive experience helped in designing and delivering the project design concept as well as the project management process. Furthermore, the project manager established a design office where all consultants would meet to develop the concept, selected the consultants' personnel with his partners and crucially, initiated and implemented a detailed design development strategy to be in line with the construction progression strategy on site to avoid information delays to the contractor. They also set up the required project management structures of calendar of meetings, anticipation of issues, planning and communication of information in the project system to avoid delays.

Commitment and teamwork in the design and construction process

The project manager, the consultants and the contractor, including the client, were all committed to ensure that the project was delivered as efficiently as possible. The reason for the commitment was the pride they had of carrying out the work. This ensured teamwork and dedication to the speedy delivery of the project and handling any problems they encountered on site.

7.13 Conclusions

In this case study, it was found that the client, the project development manager (managing client), the consultants and the contractor were prepared to carry out the project. The drawings and the tender documentation were complete. The feasibility studies had been carried out based on the identified project site. The owner client and the project development manager had extensively carried out the project preparatory works. These include identifying and

locating the project site, investigating the possible dam types and sourcing for funding, carrying out and managing project, funding and environmental approvals for the project. The consultant and the contractor, through market intelligence had information of the imminent project and prepared themselves. Lastly, the project participants had the specific project experience having worked on a similar, but larger project before.

The participants followed the traditional project management principles. Short cuts were not an occurrence on this project. The major factors behind were that the site had been identified before the project was embarked on, the design concept was complete before tender and based on the identified site, the project permits had been thoroughly managed before commencement of construction and the client did not impose a completion date on the project. There was therefore less pressure to use short cuts.

The project participants had project specific experience. They all had worked on a similar and even large dam project before. The project development manager had set up systems and built experience, skills and the numbers of professionals in the management of financing and construction of projects. Equally, the consultants formed a joint venture with organisations and people they had worked with on the previous project. These organisation and individuals had extensive experience in the design and supervision of dams. The same was true with the contractor joint venture. They had worked as partners on the previous project and they shared the experience and knowledge of managing such projects.

Time limitation was not a factor on this project and the client did not set a completion date. The project start was not delayed and the project, funding and environmental approvals had all been managed by the time they started construction. An important date that they had to meet was that of impounding to catch the winter rains which they successfully met.

There was community resistance on this project as is common on *large projects*. The resistance was driven by the community's fear of the impact of the project on the environment and public morals due to the experience they had on a previous project. Led by the affluent community in the area, a big resistance movement was raised. The resistance was managed when they used an influential personage to engage the community and managed to turn the community to support the project.

Multiple procurement and competitive tendering was used on this project. The project structure was that the project development manager sat at the top. Below him were the project manager then consultants and the contractors. The project manager was given the autonomy to manage the project. The development manager employed the project manager, all the consultants and the contractors. The contractors were not numerous on site. They each had a particular site they were working on.

The budget was sufficient. The contract was even lower than the planned expenditure on the project. The project was ultimately completed within the time and cost planned at tender.

The results show that the project participants were prepared to carry out the project. They also show that the factors found to have led to time and cost overruns on the overrunning projects were missing in this project. Furthermore, factors that led to the project's successful implementation were that the client and the project members were prepared and experienced in the project type, had carried out extensive studies before embarking on the project, followed project management principles and there was teamwork in the project.

The results also showed that a public project could be successfully carried out without time and cost overruns rejecting the rival explanation that success in a project is dependent on whether it is public or private. Furthermore, the results showed the influence of the involvement of the project development manager in the formulation and execution of the project beginning with financing, design and construction. Their experience and involvement in the project from the client's organisation environment to the project environment as well as their involvement in other projects in the external environment was important in the successful delivery of the project. This suggests that a successful strategy in the management of large projects in South Africa potentially needs to incorporate the involvement of an organisation with gained experience of several projects in the external environment to help the client in the organisation environment as well as in the project environment to formulate and execute projects.

Chapter 8 Case Study V

8.1 Introduction

This chapter presents a case study of a project team working in a private commercial building project. The project was completed within planned time and cost. Similar to the case study in the previous chapter, the dam project (Case study 4), this study was undertaken to understand the factors that led to its successful delivery and to confirm the theory that preparation and use of project management principles by the client leads to delivery of a project within time and cost. This was the last theoretical replication study. The case study will show why qualifications and experience of the project team were instrumental in successful project preparation, implementation and management of the design and construction process and how that enabled them to devise a project management strategy that promoted a structured approach to the management of the project using project management principles. It will also show how the use of the project implementation manager early in the project led to improved definition and delivery of the project and how a successful construction delivery environment was created leading to completion of the project within time and cost. This study aided in formulating the eventual proposed strategy for management of large projects.

8.2 Project Description

The project was an office block of 32 floors constructed to provide office space for 3000 people. The project started in 2011 and was completed in 2014. It was estimated to cost R1.6bn. The project was three months late, but had cost savings of about R60m.

8.3 Respondents

Nine respondents were interviewed. These included the client's representatives, consultants and the contractor (Table 8.1). The respondents were all involved in the project and are representative of the personnel that was involved in this project. The experience of the respondents ranged from 8 years to 45 years. 44% had experience above 40 years, 22% more than 10 years and 22% less than 10 years. The results show that the project was managed by very experienced people with most of them leaders of the organisations they represented showing the importance they possibly attached to the project or the high-profile nature of the project. Their experience also indicates that their testimony regarding the management of projects could be relied upon.

Table 8.1 Commercial Building Case Study respondents

Project Position	Organisation Position	Qualifications	Experience
Project Engineer - structures, façades	Director	MISTE	12 years
Quantity Surveyor	Associate	B Tech	15 years
Electrical Engineer	Director	B Eng	8 years
Client's Rep - Lead Development Manager	Development Manager	B Arch	40 years
Senior Project Manager	Director	B Sc	40 years
Client Rep - Development Manager	National Development Manager		
Mechanical Engineer	Engineer	B Eng	8 years
Project Manager - Contractor	Managing Director	B Sc	43 years
Project Leader	Contract	Diploma	45 years

With regard to reading of research journals, only one respondent indicated they do, representing 11% of the respondents. Most read magazines and other literature from their affiliated professional institutions. How they keep abreast with research and new developments, the respondents explained that they speak to suppliers on new products, attend seminars and CPD meetings, read documentation from head office, popular magazines such as Engineering News and the Structural Engineer. This suggests that most of the research output in journals is not read by most professionals in the industry.

With regard to experience in similar works, the client organisation and representatives had been involved in similar projects before. Consultant organisations and their representatives had equally been involved in similar projects before. The same was found to be true with the contractor and the representatives. This project, however, was bigger and had more floors than they had worked on before. It had 32 floors compared to the 10-15 floors they worked on before thus making it a more complicated project to them (Morris & Hough, 1987).

8.4 Contract Data

The project had two phases. In the first phase, one client, owned the site and wished to construct offices, a hotel and a gymnasium. The designs were carried out but they could not get the required 50% pre-let contracts the financiers desired. This was from 1999 until 2009 when a banker came along as they wanted to house their group companies in one building. After agreeing on 50/50 sectional title sharing, phase two was launched and the designs were revised. The project was finally constructed and completed below budget and about three months after the planned completion date (Figure 8.1).

Estimate	R800m
Contract Sum	R942m
Final	R880m
Planned start	November 2010
Actual start	November 2010
Planned completion	31 March 2014
Practical completion	May 2014
Final handover	July 2014

Figure 8.1 Commercial Building Case Study contract data

8.5 Preparation for the Project

All the respondents were in agreement that the client was prepared to carry out this project. This is related to the amount of time they took before they actually went into the construction process. They had been working on the project for a period of about 10 years when they were seeking tenants. This enabled them to continue working and developing the concepts before they decided to build. The long period of preparation helped them to have the project thoroughly planned so that, though every project is different, they did not have significant surprises on site. This concurs with Söderlund (2002) quoting Cova and Holstius (1993) that the early phases of project work require much time and strategy.

The other reason was that the clients carry much property developments and have thus specialised personnel to handle the projects. Not only were the clients experienced in property development, they also recruited development managers to manage the construction process which included the appointment of consultants and the contractor. This was similar to the dam project. The owner client appointed a project development manager to finance and manage the project in totality. Though in this case the development managers did not finance the project, but they totally represented the client on the project. Each client had their own preferred development manager and these two managers worked together and formed a unitary client by appointing personnel to be involved on the project with one playing a leading role. All the respondents were in agreement that the development managers knew what they were doing and managed the project well. The results were, a well-defined brief, completed concept and construction designs, an approved site, funding and project permits.

The results suggest that the preparation of a client for the project is a product of the length of time they take before they begin construction, the experience they have and the appointment of competent client representatives who are experienced and carry out this type of work regularly. This was seen in the dam project case study and was mostly absent in the three overrunning projects.

The consultants were also prepared for the project, though they had less time before the start of phase II which somehow affected the detail design process. The work of the consultants was helped with the client's clear brief. They also had extensive experience in multi-storey construction.

The contractor was also prepared to carry out the project. The organisation and individuals had carried out similar high-rise buildings before, though it was their first time to use flush plate façade construction. What also helped was the discussion they had during project interviews at tender submission of how they were going to carry out the works. The contractor also profited from the previous contact he had with Phase I where he provided input to the client on how the work could be carried out.

8.6 Use of Project Management Principles

The participants followed project management principles and similar to the dam project, case study, the project manager was given autonomy and authority to manage the project. All communications to the contractor were done through the project manager. The design concept was complete before the commencement of construction and was based on the identified and approved site. The long preparation for the project had helped in refinement of the design. Equally, the environmental and funding approvals had been managed before the start of construction on site. As a result, the participants were not under pressure of delayed start of the project due to funding bottlenecks or delayed approvals.

They used the JBCC form of contract to manage the project. They also set up a structured method of meeting and resolving issues and coordination required. This included setting up a payment cycle that everyone adhered to.

8.7 Qualifications and Experience

The participants were qualified and experienced in this type of project. The major difference though, was that they had not built up to 32 floors high rise in the country. Most of the respondents pointed out the structured approach to managing the project processes such as communication, meetings, reporting cycles, rules and regulations and approach to variation management to be due to the experience of the project managers and the quantity surveyors, to the efficiency in the payment systems and reports. There was a calendar of meetings and regular reports where all members attended. This helped in improving the competence of the project team. It was also explained that the architects and the project managers were very experienced at coordination meetings and the engineers at ensuring that all important design matters were not overlooked.

The development managers, the client's representatives, due to their experience in the financial systems brought in a system of "management by value" where each consultant was responsible for their budget so that they develop their design within that value and after tender, ensure works are carried out within the bill of quantities amount allocated to their section. This gave them an incentive not to exceed their budgets. Similarly, the development managers agreed with the client a guaranteed amount for the project firstly at design and then tender which if exceeded, the manager would be liable to pay the difference. This created the incentive to work within the budget but also gave the client security. This concurs with Flyvbjerg (2011) who said participants should be made accountable by sharing in the increased cost should the project cost more.

8.8 Insufficient Time

The completion date was fixed by the client because they wanted to benefit from the Urban Development Zone (UDZ) incentive which required the owner occupier to get into their property before April, 2014. They therefore set March 31, 2014 as the closing date and the contractor agreed. The contractor had overlooked the city's rainy and windy weather in which they would not operate cranes or hang out and clean the building. The pressure to meet the external requirements of the tax incentive led the team to have optimistic behaviour and overlook the weather. The pressure from the client which was also pressure from the government incentive policy affected the decision making in the project team. This confirms what was observed in the overrunning case studies.

8.9 Community Resistance

There was community resistance on this project as well. As noted by scholars, *large projects* have extensive impacts on the community and country as a whole (Capka, 2004; Merrow, 2011; Morris & Hough, 1987). This is usually the main reason the public shows concern when such a project is embarked upon without them being consulted or listening to their concerns. This is recognised by the various project management standards such as the PMBOK, which encourages stakeholder management (PMBOK, 2004). The main contention of the community was with the height restrictions in the city to avoid obscuring the city landmark. The resistance was more spirited during Phase I than Phase II. Using consultants and the involvement of the contractor, they managed the resistance. The experience of the project participants and the preparation for the project was instrumental in the resolution of the resistance.

8.10 Design Changes

There were few design changes on the project and these were mostly from the request of the client. He requested to move the building from a 4 star to 5-star green building as well as installation of a gymnasium on the 12th floor. The respondents pointed to the completed design concept, the experience and preparation of the project team as the reasons for the fewer design changes.

8.11 Multiple Contracts and Competitive Tendering

The project team used multi-procurement and competitive tendering on this project as well. The selection of the consultants however was on the basis of negotiation with the personnel and institutions the client had worked with before. The aim was to use organisations with a proven track record of management of a large project. For contractors, they used selective competitive tendering. They first recognised the organisations they deemed capable of carrying out a complex multi-storey project and invited them to bid. The selection process included interviews where the contractor was to present how the work was to be carried out, especially the procurement and management of equipment and approach to construction in the restricted city centre site. The selection method helped them obtain qualified and experienced consultants as well as a very innovative contractor.

8.12 Reasons for Delay of Three Months

There were three main reasons for the project delay. Firstly, due to the UDZ requirement mentioned earlier under section 8.8, the client set a completion date which was difficult to achieve. They agreed to this date, but according to the construction project leader it was difficult to match due to the city's inclement weather of wind and rain. They assumed that they would easily get resources such as skills, labour and materials it being in a city. Thus, they ignored the problem of weather and were hopeful the target would be met. The rainy and windy days, however were more than they had planned for. This affected all the construction activities. It was worsened by the type of building that required use of cranes, and to suspend men on ropes to clean the façade as they proceeded which could not be done.

Secondly, there were some changes to the project arising from the client's requirements. The client requested for the building to be a 5-star green building instead of 4-star. This had multiple implications such as light fittings, fire detection equipment, façade/curtain wall window colours and air-conditioning systems which all led to design changes, delay in construction and increased costs. He also requested for installation of a gymnasium on the 12th floor which led to design changes and longer project duration. The client also insisted that the lifts should be clean when they take over. It meant the contractor was not to use the lifts for transporting

materials and they would have to rely on the hoists and cranes, but with the town's inclement weather, it was a difficult task. It was clear to the contractor that they had not fully understood the complexity of the project.

The third was that the complexity of the project was under-estimated. The building was designed with its various systems interdependent on each other and the participants did not understand this at the beginning because some details were not available that time. It was also due to the lack of experience in large high-rise buildings. It was also compounded by having two clients, each with their own set of requirements.

The banker client was to occupy the top ten floors and the other client the lower ten floors. The owner-occupier, the banker, was required to move in the building earlier, but their offices were to be ready later being on the top floors. They could not build the shell and go up to complete the banker's section. The building needed to be water tight to avoid water ingress. Therefore, they needed to reach the roof and clad the building as well before moving to install the services inside. Secondly, they needed to install the plant room on top floor, basement and mid-way. They could not install the plant room until they had completed the roof and thus they could not service the floors below until the plant was installed. The building was not designed to be built in stages, but as a complete whole.

A combination of a lack of experience in large high-rise buildings, client's requirements and a traditional approach to designs made the process more complicated. The bank could have occupied lower floors. Equally an attempt could have been made to design the building to be built in stages as they progressed. This approach though would be hampered by the restricted site and weather.

The last complication was that each client had their own building and security systems. After practical completion, the client's personnel had to come in and install the systems before the project could be handed over.

8.13 Factors Seen to Have Led to Meeting Time and Budget Targets

The respondents mentioned several factors that led to the project being completed below the contract cost (Table 8.2).

Careful budgeting

The project team had careful budgeting at the beginning due to the experience of the development managers and the consultants. The respondents noted that it was only the façade and the complications of a larger high-rise building where they were doing something new. The experience of the project team was also said to have been instrumental in the preparation for the project. Another factor was the client took long before starting the

construction process. This enabled them to complete the various pre-contract activities such as funding and project permits.

Table 8.2 Factors that led successful delivery of commercial project

Factors that led to successful project delivery
Client experienced in project type
The clients used experienced development managers
Client carried out thorough studies and preparation for the project
The client and project team followed project management traditions and principles
The consultant had autonomy and authority to design and supervise work
Careful budgeting at the beginning
Use of experienced consultants and contractor
The project team was prepared to carry out the work
Structured management of the project
Comptent quantity surveyor and other project members
Teamwork and consolidated effort
Efficient construction process

Use of experienced consultants and contractor

The client used experienced consultants and contractor. These were selected based on record of accomplishment, skills and workload. They only considered those whom they deemed capable of managing a large high-rise project. A development manager explained that another way would have been to break up the project into packages, but that required having a good construction or management contractor. This suggests that they reasoned out the decisions before adopting them.

Preparation for the project

The client and members of the project team were prepared to carry out the project. The client spent about 10 years in preparation as they were investigating the future tenants for the building. In this period, the client appointed consultants who developed design concepts, which provided the basis for decision-making. Furthermore, the client appointed development managers who were instrumental in preparing the project formative processes and the eventual management of the project. The managers then appointed the consultants and the contractor. With their experience, the necessary project permits and statutory requirements were managed.

Project permits

The project team managed to get all the necessary permits before they started construction work. The site had been selected and the necessary approvals done. The environmental impact assessment and the public participation processes had all been completed. This ensured that there was no delay to start the works or interruptions in the

design and construction process. This was related to the length of time it took them before they began construction works on site.

Structured management of the project

Structured management of the project was seen by most respondents to have been critical to the success of the project. The project team had set up a calendar of activities to aid in the management of the project which included, planning meetings, site meetings, technical coordination meetings and, valuation and payment cycles. The team set up a system that required the consultants to think through costs, time and other potential implications of any additions or changes to the project before presenting the requests to the management meeting. This meant that by the time the consultant was presenting the additions needed, he had already carried out the preliminary investigations and coordinated with the contractor on time and cost implications. It was also in line with the cost management system set up that required each consultant to manage their budget. This set up started from the development managers to the consultants, the contractor and the supervisors down to the person placing concrete. Each had a budget and was responsible and self-monitoring to be within their time and cost environment.

The project team also used JBCC, a contract form that is known by practitioners in the country. Everyone understood and knew what their roles and duties were unlike the use of a bespoke form of contract. The factors behind the successful structured project management were that the consultants were experienced and knowledgeable, the project manager was competent and the contractor was experienced and competent as well. Having an inefficient project manager and inexperienced engineers was said to be a harbinger of project problems since the project delivery method assumes the consultant is knowledgeable and prepares competent tender documents. The competence of the project manager, the quantity surveyor and the engineer was seen to be especially critical to the delivery within time and cost. The project manager with the help of the development managers and other consultants set up the system of management described earlier. The quantity surveyor was instrumental in project estimates, budgets and payment system instituted in the project. The engineer's experience was noted to have helped in considering the design solutions and implications not only on their area of specialisation but also design and cost implications on other project areas. This was found to be very useful in ensuring that nothing was overlooked in the planning meetings.

The results suggest that qualifications, training and experience are critical to the success of the project and that there is a close link between project success and use of project management practices confirming results by Papke-Shields et al, (2010), Crawford (2005). It

shows that having a structured method of project management contributes to effective delivery of a project within time and cost.

Teamwork and consolidated effort

Teamwork and consolidated effort was seen by most respondents as important in the successful delivery of the project. The Project Manager said, “Success was not dependent upon one person but on consolidated team effort where all team members understood the end objective.” This view is said to have been achieved through management and communication. The communication within the project team was essential to get people to “buy-in” to the project.

In this complex project with diverse components handled by different expertise, teamwork was essential. The components were all inter-linked, yet managed by different individuals and organisations. The delay or readiness of one system would stress, delay or accelerate the progress of other elements. Individuals, however, are trained in isolation of other professionals. This not only affects the understanding of the integrated nature of the whole project, understanding the role of other parts, but also understanding how their elements affect or are affected by others.

In this project, the members worked as a consolidated team. This was achieved through project management and communication. The result was an assembly of diverse players with the singular objective, willingness and motivation to complete the project. The respondents however explained that this did not happen overnight. It took the project manager to guide the process in the early stages where differences and power plays were common amongst the team members until there was unity in the tribe later (Logan, King & Fischer-Wright, 2008). In contrast, the power project case study, whilst there was a project management structure, there was a lack of consolidated team effort. Most participants did not know what the details of other contracts were. Details of when other contracts would start or end were unknown, but they knew when their contract would begin. Whenever they were delayed possessing the site on the planned date, they claimed from the client. The result was the client received numerous claims from several contractors for delays by other contractors.

Teamwork was also achieved through relationships in previous contracts. Several consultants had worked together in previous assignments in joint ventures or project teams. These relationships made it easier for them to find common ground and easily relate to each other. In this project, when the architect started his work, the moment he knew who the structural engineer was, whom he had worked with before, he approached him to sort out the sizing of the core and columns in a rational way and working out the parking and office grid. They had a lot of informal meetings in this iterative process. Coordination of the design

process occurred at two levels: the informal meetings between one consultant and another and at coordination meetings iteratively until the concept was finalised (Figure 8.2).

Teamwork was also achieved through the use of software called Revit which helped in coordinating the development amongst the consultants (Figure 8.3).

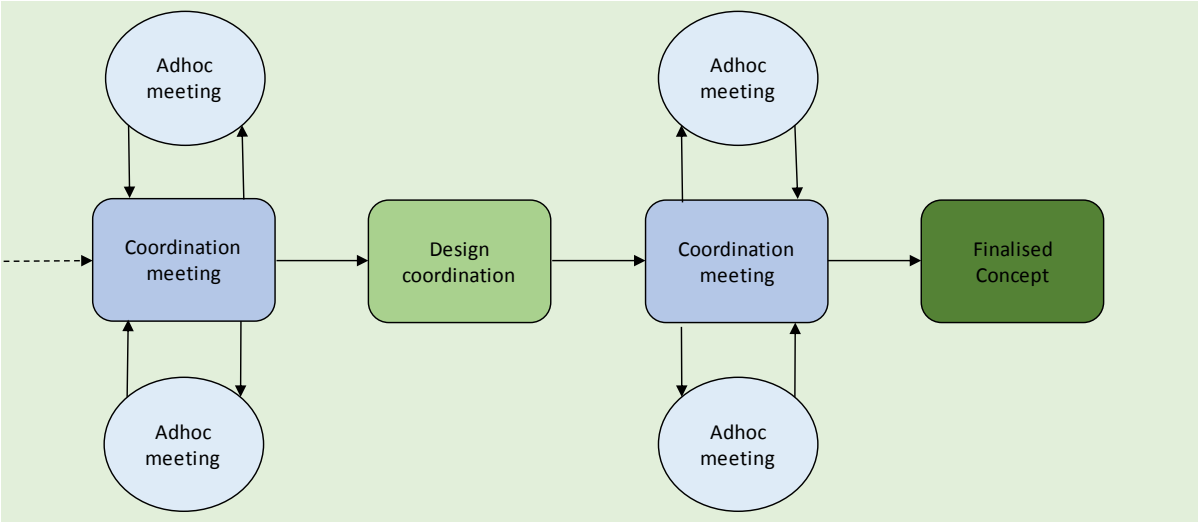


Figure 8.2 Design coordination in the team

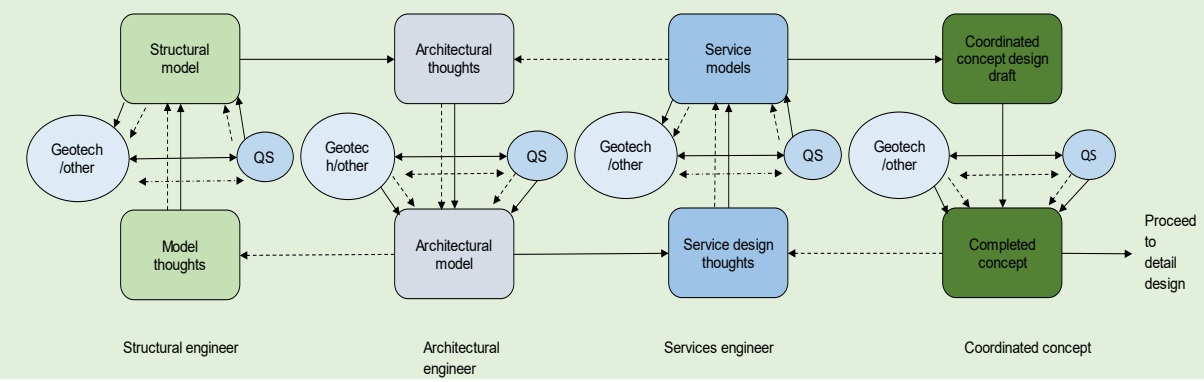


Figure 8.3 Preferred Revit conceptual design evolution

Experience and relationships were seen as instrumental in coordination of meetings and the management of the project. On relationships, the electrical engineer said that working in a multi-disciplinary organisation is the same as working in separate organisations. It is not a matter of “having a desk next or being a telephone call away, but relationships.”

A review of the above suggests that certain circumstances stimulated teamwork and consolidated effort: (1) the project manager was instrumental in coordinating the team, (2) there was determined project management and communication effort by all, (3) previous engagements with individuals or organisations, (4) coordination and adhoc meetings, (5) vast experience and qualifications of the project team. These circumstances were also seen in the dam case study. The consultants had worked together in previous engagements with the same

consultants in joint ventures like at the present. Equally, they had worked for the same client as a team. It was said that they understood and anticipated each other's requirements and those of the client. Their relationship made it easier to formulate the bidding vehicle and the design management strategy.

In contrast, in the overrunning projects however, there was less teamwork. They relied more on contracts to enforce performance. This is especially true of the power plant project case study where both the client and contractors used contracts for work to be done. In some cases, the client got into the contractors' organisation to get them to perform. A process they called "micro-project management." In the high-speed rail project case study, after the breakdown of teamwork, they resorted to use of contracts to enforce performance.

Thus, the less successful projects had these characteristics, (1) participants lacked a defined agreed end goal, (2) there was a lack of appreciation of other elements and how they tie in to the whole project, (3) they used contracts to enforce performance, (4) the client was more involved in the project.

The construction process

The factors that were seen to be influential in the successful delivery of the construction within time and cost were, (1) resolution to complete the project as required and the creative ability to solve challenges they faced, (2) creation of an environment for successful project delivery, (3) experience of the construction team, (4) influence of the development managers.

Using risk management as the anchor for their project delivery, the contractor dealt with each risk by not only identifying the risk and the determination of the cost, but also investigating measures of minimising the risk or eliminating it from occurring. The risks they faced included the "tight" construction programme which was difficult to achieve. The quality of information from the design team which would affect the first risk and the problem of lack of skills to carry out the work to the standard required which included sub-contractors, professional skills, artisans and productivity of the workers.

For the first risk, which also affected the others as well, they resolved that they could achieve the delivery of the project by investigating the various ways this could be achieved. Using scenario planning, they considered best, medium and worst cases and went with the worst case which was that due to bad weather in the city, the programme would be restricted and the number of productive days therefore reduced. Since this work was to be done by artisans, they decided that they should involve them not only in the execution, but in the planning aspect as well so that the resolution is not only by management but that the workers "buy-in" the idea as well. Thus, creating an environment for successful delivery of the project.

Recognising that communication is normally difficult amongst the workers, they decided to use graphics to simply explain processes and what was hoped to be achieved. This work involved a two-stage process. The first was to determine the global programme, then carry out a programme, and risk analysis per trade by considering safety, health and weather. Secondly, prepare a revised programme with the task leaders and engage the workers on how the programme could be achieved to meet the reduced time frame. This was then followed by assignment of responsibility to task leaders of the programme down to the worker who had his daily or hourly programme to meet. The influence of the budgeting and planning of the development managers can clearly be seen in this process. Each person had a budget and programme to manage whose formulation they were involved in and this made them “own” the programme and budget thus ensuring that productivity was managed as well. They decided to use concurrent building processes to shorten the process.

Slow information flow is a known cause of delay on projects (Le-hoai, Lee & Lee, 2008). The contractor had two options, (1) use the contract to claim, should the design information from the consultants be delayed, (2) take a proactive approach and pressurise the system so that drawings and any queries they may have are relayed in a timely manner. They decided that they would take the proactive approach so that information is delivered in time since their interest was to complete the project in time. They therefore employed a document manager who would follow through the processes and remind the project manager and the consultants concerned with the required information in good time as well as give them notice of costs before the end of the day when changes were made to the design.

A last aspect of creating an environment for success was to get the right mix of people on the project starting with the project leader down to the artisans. The contractor decided to appoint people on the basis of previous performance and not on the basis of names or qualifications. They found a project leader who would take up ownership, responsibility and accountability for the project. Someone who would stand and fix the project problems and manage them as his own. With the help of the leader, the lower positions were filled with people they considered competent to carry out the tasks. The project leader considered selection of competent people as the biggest determinant of meeting objectives. This was said to have been a difficult task due to limitation in skills. The project leader therefore decided to find one or two competent individuals from previous experience and used the concept of influence to up-lift the competence levels in the others.

8.14 Conclusions

The results show that qualifications and experience of the project team were instrumental in the successful formulation and management of the design and construction processes. The

experience enabled the project team to devise carefully structured management processes that improved the competence in the management of the project. The experience of the client was equally seen to be important in the formulation of the budgets and permits before the start of the project. The results also showed that there is an apparent correlation between the time it takes the client to prepare for the project and how successful the preparation and hence expedition of the project is. The longer the period of preparation, the better the implementation of the project, within cost and time. When the permits and project and fund approvals are managed prior to the commencement of construction, there is reduced pressure on the project team to make shortcuts and the team is inclined to use project management principles. This proved the proposition that preparation and consistent use of project management principles leads to reduction in time and cost overruns on large projects.

The results also showed that teamwork and consolidated effort were instrumental in delivering the project within time and cost. This is teamwork in both the design and construction processes. The factors that promoted teamwork included previous engagements of the participants, competent project manager and other consultants and efficient communication within the project.

The results also showed that the efficiency of the construction process was anchored in the effective use of risk management in combination with teamwork and communication in the process. Not only were the risks identified, but measures were also implemented on how to mitigate and remove the risks from occurring. Thus, in the management process they included the measures to remove the risks. In this process, they involved the task leaders and the artisans to get them to “buy-in” to the process and the result was effective delivery of the project in time and within cost.

The results suggest that a successful project management strategy needs to consider the management of the experience of project participants, management of the preparation process of the client and the participants, management of the teamwork process and management of the construction risk. The results also suggest that the strategy should lean towards the proactive approach than the reactive approach.

Chapter 9 Case Study Comparison

9.1 Introduction

This chapter presents a comparison of the case studies. The comparison is made with reference to reasons for overruns and management methods adopted by the project teams.

9.2 Comparison Across the Case Studies

Table 9.1 shows the comparisons across the case studies presenting both the reasons for overruns and the methods that were used in managing the projects. The various factors identified as causing overruns and the management methods relating to the topic of overruns are listed in the first column under the categories of external, organisation and project environment. The case study projects are indicated at the top in columns 2 to 6. A tick is indicated or the factor description written in the project's column where a factor affected that project. The measure used is that of overrunning factors. Therefore, a higher figure indicates

Table 9.1 Comparison across the case studies

Factor	Stadium	Power Plant	High Speed Rail	Dam	Commercial Building
1	2	3	4	5	6
External Environment					
Project pressure	World Cup	Power shortage	World Cup	Dam Impounding	Occupier's tax incentive
Delayed start	√	√	√	--	--
Lack of time	√	√	√	--	--
Public pressure against project	√	√	√	√	√
Lack of similar jobs	√	√	√	--	--
EIA approval	√	√	√	√	√
Resistance from locals	√	√	√	√	√
Procurement requirements	√	√	√	√	√
Health and safety	√	√	√	√	√
	8	8	8	5	5
Organisational environment					
Tendering method	Open competitive	Open competitive	Open competitive	Open competitive	Selective competitive
Lack of experience	√	√	√	--	--
Client's lower budget	√	√	√	--	--
Under-estimating complexity	√	√	√	--	√
Procurement requirements	√	√	√	√	√
Lack of preparation	√	√	√	--	--
	5	5	5	1	2
Project Environment					
Lack of preparation	√	√	--	--	--
Ground conditions	√	√	√	√	--
Procurement requirements	√	√	√	√	√
Lack of experience	√	√	√	--	--
Design changes	√	√	√	--	√
Insufficient time	√	√	√	--	--
Constructability problems	√	√	--	--	--
Interface management problems	--	√	--	--	--
Lack of team work	√	√	√	--	--
Enforcement of cooperation	Contracts	Contracts	Contracts	Teamwork	Teamwork
Incomplete design concept	√	√	√	--	--
Time overruns	--	√	√	--	--
Cost overruns	√	√	√	--	--
Under-estimating complexity	√	√	√	--	√
	11	13	10	2	3

that this is an overrunning project and a lower figure indicates that the project performed better.

Under external environment, all the projects had a project pressure, public pressure, and resistance from the community. Equally, they all had to abide by EIA, procurement and health and safety requirements. The better performed projects did not have delayed start, time pressure and lack of similar projects. Under organisation environment, the most prevalent method of tendering used is the open competitive. The projects had similar procurement requirements relating to project approvals and permits before embarking on the project. There is an apparent difference in terms of experience, project budget, estimating project complexity and preparation for the project.

In the project environment, the overrunning projects exhibit similar characteristics and the most affected is the power plant project. It had more project related factors leading to time and cost overruns compared to the other projects.

9.3 Comparison of Overrunning and Non-overrunning Projects

From the researcher's observation and examination of the data, using a qualitative assessment of the factors in both the overrunning and non-overrunning projects, the factors causing overruns were valued and depicted in Figure 9.1. The factors leading to overruns were graded by the researcher qualitatively for each project and tabulated. The higher figure is indicative of the prevalence of that factor in the project. The grades were from 1 to 10.

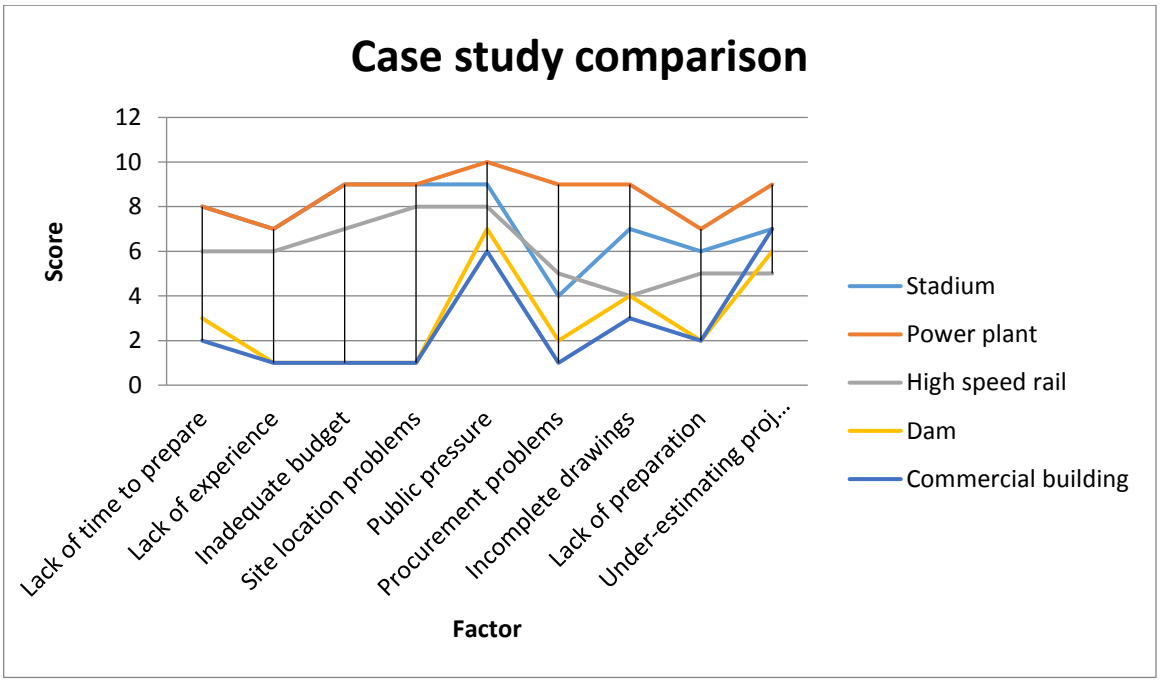


Figure 9.1 A qualitative comparison of overrunning and non-overrunning projects

The comparison shows that overrunning projects had similar characteristics as shown in the banding of the case study projects in Figure 9.1. The overrunning projects occupied the higher values compared to the non-overrunning projects which had lower values.

9.4 Reasons for Overruns

The cross-case comparison shows that the reasons for overruns are similar in the three overrunning projects (Table 9.1, Figure 9.1, 9.2, 9.3, 9.4). Figure 9.2 shows the stadium project was affected by location problems, public pressure, lack of project experience, lower client's budget, lengthy procurement processes and under-estimating the project's

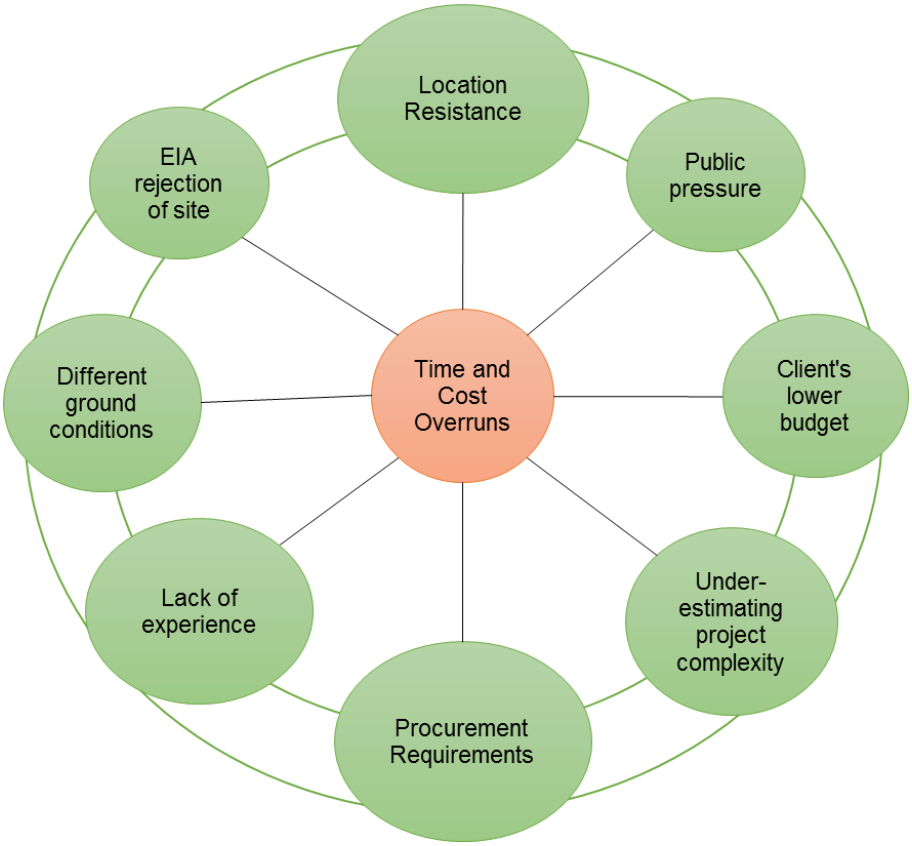


Figure 9.2 Condensed factors causing overruns on stadium project

complexity. From Figure 9.3, the power plant project case study was affected by the same factors with the addition of ground conditions, strikes and productivity, safety requirements and project start delays. Equally, the high-speed rail project, as shown in Figure 9.4, was affected by public pressure, land acquisition problems, environmental concerns, World cup, water in the tunnels and client's lower budget. This confirms what was seen in the replication analysis discussed under each case study (Refer to Chapters 4, 5 and 6). The factors observed in the first case study were also identified in the other two case studies. It was also found that the factors leading to overruns were mostly absent from the better performed projects (Refer to Chapters 7 and 8). The problem of time and cost overruns emanates from

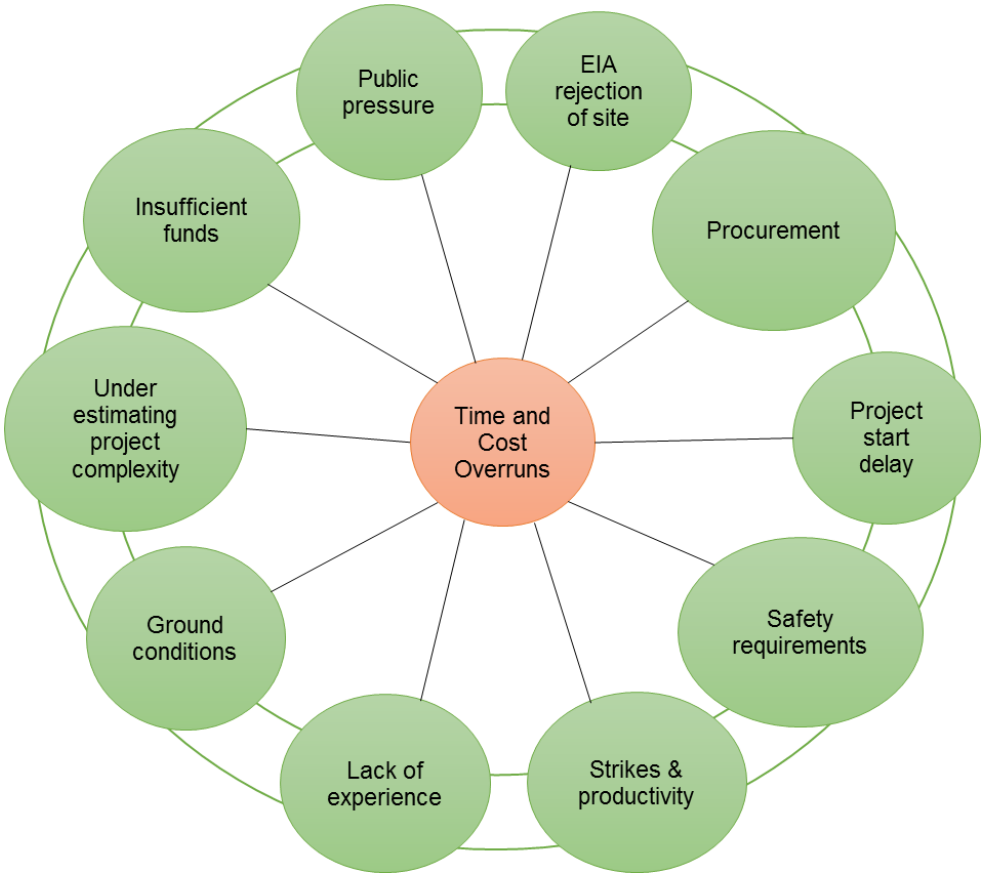


Figure 9.3 Condensed factors causing overruns on the power plant project

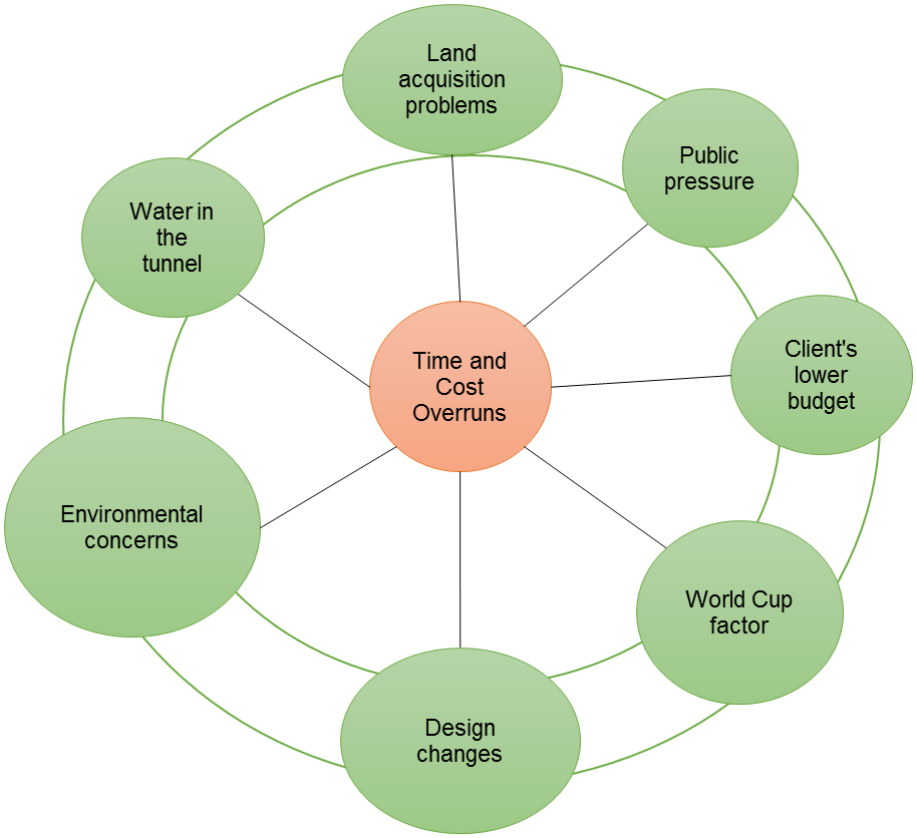


Figure 9.4 Condensed factors causing overruns on the high-speed rail project

the external environment and the response of the project team largely determines how successful the project will be. The response is mostly affected by the experience and competence of the team.

9.5 Management of the Project

Under management methods adopted by the project team, there is an apparent difference in the approach by the teams in overrunning projects compared to those in the better performed projects. The former used contractual agreements for enforcement of performance and the latter predominantly used teamwork and consolidated effort (Table 9.1). Furthermore, on the non-overrunning projects, the project teams used a structured approach to management of the project. They used development and project managers and the permits such as project approvals, funding approvals and environment impact assessment were addressed prior to start of construction on site. The results also reveal that the project team was better prepared and experienced for the specific nature of the project, the design concepts were complete at an early stage, sites had been identified before commencement of construction and clients took longer in preparing for the project in the non-overrunning projects compared to overrunning projects. This supports the view that the project teams in the better performing projects had higher levels of project specific competence compared to the teams in the overrunning projects.

The results also show that the project team's management of the project was influenced predominantly, by factors in the external and organisation environment. They also show that the behaviour of the team was often altered by these external factors leading to their failure to prepare adequately for the project and to use project management principles consistently.

The results showed that the clients determined the project strategy and approach adopted in managing the large projects. From the results, the effect of these strategies on the management of the project were clearly seen. For instance, in the power plant case study, the client adopted a procurement approach of packages with many contractual dependencies leading to inefficiency and incompetence in the management of design data and actual construction. Many feeder contracts were delayed resulting in overruns in design and construction data in all the subsequent contracts. Furthermore, the client in the board room, determined the alignment of the packages based on specialisms and not power blocks resulting in the project's failure to meet the organisational objective of supplying power per block (see section 5.5.6 for details).

The results also showed the effect of the client's experience and preparation for the project. Where the client lacked the project specific experience, project budgets and the complexity of the project were under-estimated and the client and the rest of the project team

were ill-prepared to carry out the project. Where the client was experienced, the projects had better budgets and execution strategy and the project team were better prepared to carry out the works.

Therefore, the results show that the involvement of the client is a parameter of consideration in the effective management of large projects.

The results also confirmed that the training, qualifications and experience of the project participants as a whole had a role in the management of large projects as this affected the competence of the team and their eventual performance. This was clearly seen in both the overrunning and the non-overrunning projects. Firstly, the effect of training as well as experience of the different consultants and contractors, was visible in their lack of large view understanding or impression of the project. Most understood their area of specialisation, for instance, structures or boilers and not other specialisms such as air cooling systems or turbines or fire installation and management systems. This made them have difficulties in evaluating the complexity of the project. Whilst previous study showed that management of projects is affected because there is concentration on technical fields at the expense of soft skills (Cywinski, 2009; Edum-Fotwe & McCaffer, 2000; Pant & Baroudi, 2008, Ramazani & Jergeas, 2015), this research also revealed that management of the project was also affected by the general failure of project participants to appreciate the whole project process because of the training that confines them to their limited fields of specialisation as well as lack of project specific experience. This was also visible between consultants and contractors. Certain issues only came to be appreciated and understood when the contractor began constructing. In several cases, certain consultants raised issues of constructability and how their area would fit in the whole process, but were not fully appreciated. The contractor equally raised some issues even before construction was embarked upon but were only embraced by other consultants later.

Secondly, the effect of training, qualifications and experience was also seen in the advanced and better management exhibited in the non-overrunning projects. The dam project and the commercial building project showed how successfully the projects were managed using experienced and qualified project development managers. These managed the project starting in the client's organisation to the final execution and implementation of the projects. They obtained their experience from managing several large projects on behalf of the client. This made them build up various organisational and individual professional portfolios over time which gained them the necessary experience to manage projects on behalf of the client. They were trained and experienced not only in civil engineering design and construction but also in project finance and community management.

The effect of the trained and experienced project manager and other consultants was also clearly visible in both the overrunning and non-overrunning projects. This enabled them set up effective project management systems that aided in the delivery of the projects which included a calendar of meetings and harmonisation of the detailed design evolution and construction implementation process to avoid lapses in information delivery and management. It was also found that the character, vision and drive of the project manager was instrumental in effective implementation of the project management process which included assigning works and harmonising the different specialisms, who are predisposed to work in isolation due to their training, to work collaboratively with others. Furthermore, it was noted that the experience of the individual consultants was important in terms of their contribution to the united work they presented. For instance, it was noted in the Stadium and Commercial Building case studies, that apart from the project manager, the architect, the structural engineer and the quantity surveyor were very instrumental in chairing the meetings, understanding the design and change ramifications and cost management approach and implications respectively. This was useful in the speedy management and execution of the project and in a large measure, aided in the project management structures that were set up.

Thirdly, it was seen that, where the project teams had worked together on previous engagements, they were more successful at team working than those where they had not worked together before. Where they had worked together before, they easily set up joint ventures and project bids as well as execution strategies, they understood and anticipated the needs of the project as well as those of the partner organisation. This was equally true in the case of the client and the consultants and contractors. It tended to promote team work and consolidated effort. It was, however, noted that competitive tendering tended to lessen the spirit of teamwork in the project. It was highly visible under the power plant project where teams concentrated on their contract to the exclusion of others in their endeavour to meet their contractual objectives. It was also seen that where teamwork was lacking, the participants depended on contracts to enforce performance in the project, which led to claims and counter claims, promoting further tensions and time and cost overruns.

The results also showed how the contractor was instrumental in managing the local and public community as well as the teamwork and consolidated effort in the construction process. It was seen in most of the projects that the community resistance was often put to rest with the coming in of the contractors in the project. It was also seen that where the contractor approached the construction process as a member of the team and adopted a proactive strategy of creating a successful delivery environment with both the consultants and his own workers, the project was successfully delivered. In the commercial building case study, the contractor, rather than adopting a claims strategy, he adopted a strategy of pressurising the

system to provide drawings in time. He also ensured all the workers were involved as important members of the project team by enabling them to get involved not only in the implementation but in the planning of the whole work and the budgets. This was achieved in part by using the graphical communication and also in daily communications with workers to agree work targets which they were party in their formulation, thus ensuring worker “buy in.”

Lastly, the results showed that certain practices at work affected teamwork and work behaviour in the projects. These included outsourcing, influence of training, far-spaced large project activities, cultural dynamics, reduced worker productivity, government incentives and influence of the trade unions.

It was found that outsourcing affected the competence of the organisations and supervisors of project tasks. In the power plant project, due to outsourcing of certain competencies (contracts/packages), the executing team became far removed from the work and had less understanding of the activities thus affecting their role of supervision. Equally, due to outsourcing project tasks such as design and construction of boilers and turbines, the organisation (power utility) became less proficient in the design and management of these activities which affected their planning and preparation for the new projects.

It was also found that the practice of separate training of the construction industry professions tended to foster the spirit of working in isolation from other members of the industry. This often resulted in lack of a balanced understanding of the construction process in totality affecting the wholesale planning and execution of projects.

Large projects were found not to be a common occurrence in South Africa. The construction activities could be 30-50 years apart so that when such a project is embarked upon, most of the skills, both in terms of organisational and individual expertise is lost through relocation to other industries and regions of the world or due to retirement. This affected the planning and delivery of the projects under study.

Added to this, was the impact of the cultural dynamics on the productivity of workers in the workplace. This was clearly exhibited in the power plant project between the expatriate supervising managers and the implementing managers, local South Africans, as well as between the expatriate construction supervisors and the artisans, local South Africans. The approach to work of the supervising managers was impersonal, militant and commanding which was at variance with the democratic and personal approach of the implementing managers. This was equally true with the construction expatriates and the local artisans. The effect of the militant approach on the South Africans was that they would leave work and boycott or refuse to work or involve unions and strike leading to numerous work stoppages.

This was also related to the reduced worker productivity, government incentives, the trade unions and the problem of numerous staff changes. It was found that due to lack of supervision, lack of self-discipline by the workers, the effect of government promises on the workers, the growing power and influence of trade unions and the numerous staff changes in the contractors' organisations, the productivity of workers was affected. The workers could stop work at any time which affected the productivity at work leading to time and cost overruns.

In summary, the results show that certain factors within the macro and micro project environment either promoted or inhibited effective management of the large projects. Thus, the approach of the project team, the external pressure on the project participants, particularly lack of time and resistance by locals and other professionals, the experience and preparation of the client and the project team members, the influence of training, qualifications and experience of the consultants and contractors, outsourcing of competencies, far-spaced large project activities, and work dynamics in the work place all affected how the was the project was managed. However, it was seen that the experience and preparation of the client and the rest of the project team was instrumental in ensuring effective performance and creating a conducive environment for successful project delivery.

9.6 Conclusions

The comparison of case studies shows that the factors causing overruns were similar across the case studies. It also reveals that these factors were mostly absent from the better performed projects. Furthermore, the comparison shows that there was a difference in the approach to management between the overrunning projects and those of the non-overrunning projects. In the overrunning projects, contractual agreements were used to enforce performance whereas in the better-managed projects, teamwork was used. It was also revealed that project teams in non-overrunning projects had project specific experience and used structured management which were mostly absent from the overrunning projects. The project teams were prepared for the execution of the projects and they used project management principles consistently which led to reductions in time and cost overruns. The client and the rest of the project team had project specific experience and were prepared for project delivery compared to the overrunning projects where the teams did not have experience and were ill-prepared to carry out the projects.

Chapter 10 Questionnaire Survey

10.1 Introduction

This chapter presents the results from the questionnaire survey. The purpose of the survey was to understand from the views and opinions of project professionals in South Africa how large and small projects are managed and what the general factors are that cause overruns to complement the case study research.

The questionnaire survey was used sequentially with the case studies in a triangulation of data, of research methods and of results (Robson, 2011; Love et al, 2002). Whilst the case studies were chosen to get in-depth understanding of the actuality of projects, the questionnaire survey was used to gain an understanding of how large projects are managed in South Africa as well as the perceptions of professionals in the construction industry on the time and cost overruns problem and how it could be solved. The results were used to confirm the validity of the case study results and also provided input to the proposed solution to the problem of time and cost overruns on large projects.

The total response counts vary in the tables presented. This is because some respondents opted not to answer certain questions.

10.2 Response to Questionnaires

The responses to questionnaires are presented in Table 10.1.

Table 10.1 Summary of survey responses

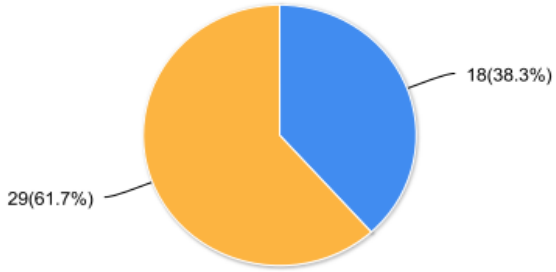
Summary of Responses							
	Responses						
	A	B	C	D	E	F	
Group	Sample Population	Completed	Not completed	Attempted	Not attempted	Total B+C	Response
CIDB Contractors	98	9	6	4	83	15	15%
CESA	46	4	7	3	35	11	24%
CMP	40	11	10	3	19	21	53%
	184	24	23	10	137	47	26%

The lowest response rate was from the CIDB contractors at 15% followed by consultants at 24% and the highest was from CMP at 53%. Although the combined response rate of 26% is acceptable, the number of response rates may also influence the outcome of the survey, the investigation was qualitative rather than quantitative.

10.3 Respondents

Industry sector

Figure 10.1 shows a sectorial representation of respondents from the survey. The majority of the respondents were from the private sector (62%). In terms of category of industry, the respondents were from a diverse background with the majority project managers (28%) followed by engineers (22%). 18% came from owner organisations. The respondents were thus well-represented (Table 10.2).



Total Response Total Count	47	
Answer	**Count**	**Percent**
Public	18	38,3%
Private	29	61,7%

Figure 10.1 Respondents' industry sector representation

Table 10.2 Respondents' construction industry profession category

Total Response count	50	
Answer	**Count**	**Percent**
Owner organisation	9	18,0%
Architect	1	2,0%
Engineer	11	22,0%
Project Manager	14	28,0%
Quantity Surveyor	2	4,0%
Construction Manager	8	16,0%
Contractor/Builder	5	10,0%

Work experience, qualifications and work position in organisation

Most of the respondents had a bachelor's degree (41%) followed by master's and diploma (24%). The minimum qualification was a matric certificate (4%), (Table 10.3). The minimum qualification was a matric certificate (4%). Regarding experience, the majority had experience of more than 20 years (46%) followed by those with 10 to 20 years' experience (35%). Thus, those with more than 10 years' experience constituted 81% of the respondents (Table 10.4). The responses can therefore be relied upon coming from experienced and qualified professionals from most sectors of the construction industry.

Most of the respondents held the position of Programme/Project Manager/Project

Table 10.3 Respondents' highest qualifications

Answer Total Response Count	Count 47	Percent
Matric certificate	2	4,4%
Diploma	11	23,9%
Bachelor's degree	19	41,3%
Master's degree	11	23,9%
Other	3	6,5%

Table 10.4 Respondents' experience in the industry

Total Response Count Answer	46 Count	Percent
Up to 5yrs	3	6,5%
5 to 10yrs	6	13,0%
10 to 20yrs	16	34,8%
More than 20yrs	21	45,7%

Engineer (33%) followed by Managing Director/Director/Associate (27%) then Procurement/Contracts/Commercial Manager (24%). This may be indicative of the importance the organisations attached to the topic at hand and that their responses could be relied upon by virtue of their position in the organisation (Table 10.5).

Table 10.5 Respondents' position in the organisation

Total Response Count Answer	45 Count	Percent
Project/Programme Manager/Project Engineer	15	33,0%
Procurement/Contracts/Commercial Manager	11	24,4%
Director/Managing Director/ Associate	12	26,7%
Company Lawyer/Company Secretary	2	4,4%
Administrative Estimator	1	2,2%
Human Resource Administrator	2	4,4%
Chief Financial Officer	2	4,4%

Organisational information

Most organisations have been in existence for more than 20 years with the majority of respondents spending more than 5 years with the same organisation. This suggests that most organisations are mature especially seeing that the project management personnel have stayed in the same organisation for 10 or more years (Table 10.6, 10.7).

Table 10.6 Organisations' operational life

Total Response Count Answer	47 Count	Percent
Up to 5yrs	1	2,13%
10 to 20yrs	17	36,17%
More than 20yrs	29	61,70%

Table 10.7 Years served with the organisation

Total Response Count Answer	46 Count	 percent
Up to 5yrs	16	34,78%
5 to 10yrs	8	17,39%
10 to 20yrs	16	34,78%
More than 20yrs	6	13,04%

10.4 Definition of a Large Project

The majority of the respondents describe a large project as one financially large (39%) followed by complex (29%), larger size (21%) and then geographically spread (9%). (Table 10.8). Financially, most defined *large projects* as those whose value exceeds R100 million (Figure 10.2). This was followed by R1billion then R2 billion. The lowest was R10 million.

Table 10.8 Description of a large project

Total Response Count Answer	70 Count	 Percent
Financially large	27	38,6%
Large project size	15	21,4%
Geographically spread	6	8,6%
Complex project	20	28,6%
Other	2	2,9%

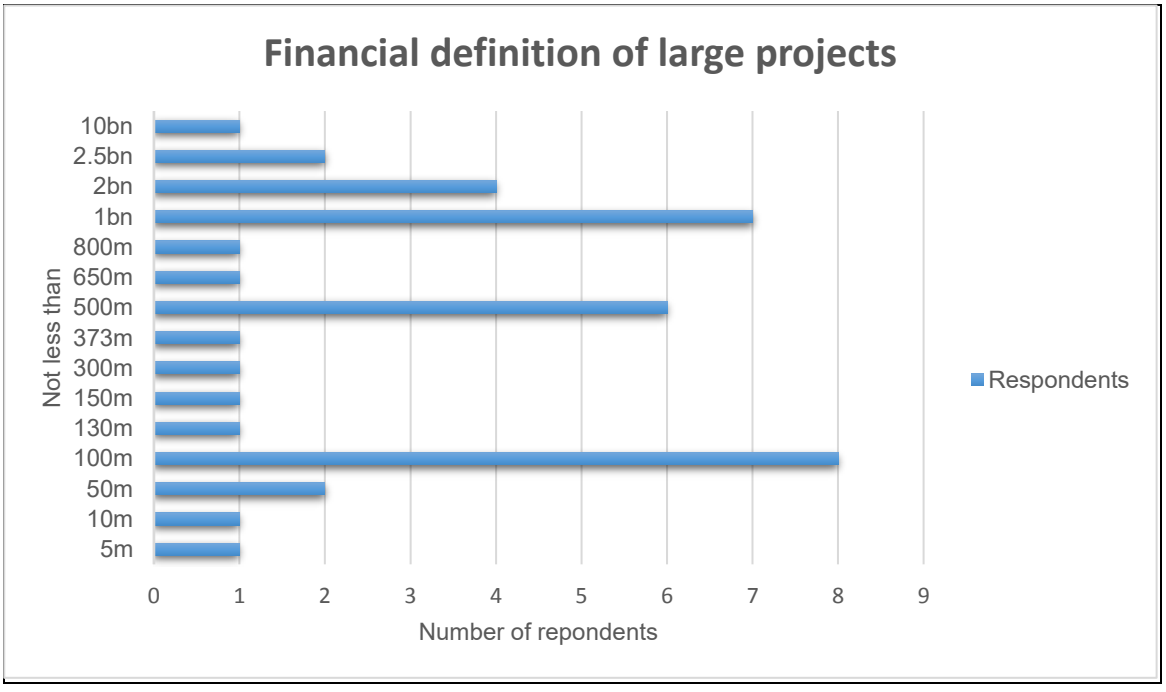


Figure 10.2 Financial definition of a large project

10.5 Performance of Large and Small Projects in South Africa

Success on small and large projects

The respondents viewed *large projects* to be barely successful in South Africa and small projects to be just about successful (Table 10.9). On time and cost overruns, 8 out of 10 *large projects* in South Africa have overruns compared to 6 out of 10 small projects (Table 10.10). This concurs with Flyvbjerg (2011) who found that 9 out of 10 *large projects* have overruns. Public projects, 8 out of 10 have time and cost overruns compared to 5 out of 10 private

Table 10.9 Respondents' view of success of large and small projects

Question	# Responses	Mean	Median	Mode	Standard Deviation
On a scale of 1-5 with 1 being failed and 5 successful projects in South Africa, where would you put the category					
Large Projects	36	3,3	3,5	4	0,9
Small Projects	36	3,9	3,5	4	0,9

projects. The results show that most *large projects* have time and cost overruns compared to small projects. Equally, most public projects have time and cost overruns compared to private projects. The variation in the responses was not significant.

Table 10.10 Numbers of projects with time and cost overruns in South Africa

Question	# Responses	Mean	Median	Mode	Standard Deviation
Out of 10 projects, in your opinion, how many projects of the category would you say have time and cost overruns in South Africa?					
Large Projects	29	7,9	8,0	10	1,8
Small Projects	29	5,9	5,0	5	2,3
Public Projects	28	7,6	8,5	10	2,8
Private Projects	28	5,2	5,0	5	2,5

Perception of a successful project

The completion criteria of time and within budget was considered by the respondents as the basis for their description of a successful project (Lim and Mohamed, 1999). This was followed by the satisfaction criteria of conformance and satisfaction (Table 10.11). The results suggest that, a project is judged successful if it has met the completion criteria of time and cost as well as the satisfaction criteria of quality and approval from the client and other stakeholders.

Table 10.11 Respondents' success criteria

Total Response Count Answer	40 Count	 Percent
Completed on time	29	26,1%
Completed within budget	28	25,2%
Met quality requirements	25	22,5%
Satisfied client	25	22,5%
Other	4	3,6%

10.6 Management of Large Projects in South Africa

Public and private projects

There was no conclusive difference on how the respondents viewed the management of public and private projects (Table 10.12). This question was viewed from two perspectives, the approach to management of the project and the effectiveness or efficiency of the management process by either the private or public client. On the approach, most who felt

Table 10.12 Management of public, private, large and small projects in South Africa

Total Response Count Management of public and private projects	40 Count	 Percent
Similar	18	45,0%
Not similar	22	55,0%
Total Response Count **How large and small projects are managed**	**38** **Count**	 **Percent**
Large projects are managed the same way small projects are managed	14	36,8%
Large projects are not managed the same way small projects are managed	23	60,5%
Other	1	2,6%
Total Response Count **Effect of size on management of a project**	**37** **Count**	 **Percent**
The size of the project affects the way it is managed	29	78,4%
The size of the project does not affect the way it is managed	8	21,6%
Total Response Count **How large and small projects should be managed**	**37** **Count**	 **percent**
Large projects should be managed the same way small projects are managed	16	43,2%
Large projects should not be managed the same way small projects are managed	21	56,8%

the projects were similar were of the view that the legislation processes and project management principles are the same. That all follow a methodology whether private or public and that all projects have experienced similar challenges. Those who viewed the approach to be different saw that the type of client determined the mandates and objectives, procurement strategies, priorities and variables in their execution of the project.

On effectiveness or efficiency of the management process which relates to performance, most were of the view that private projects are better managed compared to public projects.

Public projects experience budget overruns due mainly to designs and scope creep. Private projects do not have delays and cash flow problems. The reasons for better management of private projects were seen from the execution process itself and the end goal of the project. In the process, it was said that they still have competent people managing the projects resulting into better planning and control and, better management and execution of the projects. The end goal of the private entities is to make money and thus, they ruthlessly manage the projects inspecting timelines and budgets daily. Furthermore, private clients were said to be results-driven and that they treat non-completion as non- negotiable.

For public projects, on the other hand, the reasons for poor performance were seen to be rooted in the project initiation and definition, employment of personnel, project execution and political influence. The public projects were seen to be often poorly defined, lack business cases, poor stakeholder management and interaction, which was compounded with an inflexible supply chain process resulting into poorly conceived projects. The public sector was also seen to lack management skills and experience. One of the reasons was that in the public sector, there was a tendency to employ people on the basis of political affiliation rather than experience and known competence. Furthermore, the changes in political leadership at district and provincial level after elections, often lead to changes in project implementation strategies as a result of change of project leaders. This then, leads to poor execution of the project resulting into overruns and sometimes, suspension of projects due to lack of funds.

The results suggest that the process of management of public and private projects may be the same, but the performance is different. Public projects are seen to be poorly managed whilst private projects are better managed. This may suggest that the management approach to these projects should not be the same. In one, there is a tendency towards poor definition of projects, employment of less competent personnel and poor project execution whilst in the other there is employment of competent people and focus on the end goal which drives management to put in measures to ensure the goal is attained. This however, is at variance with the results from the case study of the dam project. Though it was a public project, it was successfully planned and managed. This suggests that successful management of the project may not be because it is private or public, but it does indicate that there could be other factors that affect the performance in the projects.

Size of the project

Nearly all respondents said that the size of the project affects the way it is managed and this was further confirmed by two follow up questions on whether large and small projects are managed and should be managed the same way. The majority of the respondents said *large*

projects are not managed the same way and also that they should not be managed the same way as small projects (Table 10.12).

The reasons given for managing them the same way were that the basic principles of project management are the same irrespective of size or complexity of the project and that projects are the same. The smaller projects may be less complex than the larger projects, but the basic management tools remain the same. Larger projects might require a few more people due to the workload to cope with the documents.

The reasons given for managing them differently were centred on the nature of the projects. These were: the resources required or used, the skills and experience and the complexity of the projects. *Large projects* were said to require more resources and processes than smaller projects. They require more planning and control, more experienced and qualified personnel to design and construct and more time is usually invested to manage time, cost, quality and benefits due to the complexity of the project. Secondly, they involve more multi-disciplinary professions than smaller projects. These projects have many unknowns, uncertainties and risks and, therefore, require more collaboration thus making them more difficult to manage. Thirdly, *large projects* are more complex compared to smaller projects due to the various processes required, the multi-organisation and multi-disciplinary nature making them difficult to manage. Thus, they require high skill sets to manage them, more planning and control, more experienced and qualified personnel to design and construct the projects. Furthermore, they require project management tools to assist the project manager to keep the project on track with the multiple dependencies and interfaces in the project parts.

The results suggest that *large projects* are not managed the same way as smaller projects in South Africa. Therefore, the proposition that *large projects* are managed the same way as small projects is not supported. The results, however, concur with previous research that *large projects* need to be managed differently from smaller projects (Capka, 2004) due to their nature. The results also suggest that experience and high skills are required to manage *large projects* due to their complexity, multi-disciplinary nature and resource requirements. This also confirms the results from the case studies that experience of project participants is cardinal to the effective delivery of these projects.

Involvement of the client in projects

This part was divided into two sections. The first was to find out the respondent's views of the owner's or client's management of *large projects* in terms of success or not. The second was the involvement of the client and the factors that would require the client's more or less involvement in projects.

On the owner's management of projects, half said it was successful and the other half that it was not (Table 10.13). They pointed to the evidence of several projects that are not successfully completed, and several projects as well with time and cost overruns, scope creep and many changes to the initial project plans. Most respondents were of the view that some projects have been well managed and others not. It was dependent on the type of client as well as the project team used. Private clients were said to manage their projects well compared to public clients. This is because the owners were more fully involved in the projects and experienced compared to their counterparts. Having the right team was also seen to be important in effective client management of the project especially that these projects are carried out by consultants or contractors on behalf of the client. Competent teams are able to assist the client in project definition and fill in any gaps and help in its implementation. Some organisations were identified which were said to have competence and capacity to carry out *large projects* successfully.

The reasons for unsuccessful management were that the industry lacks local skills and this affected the owner's management of the project as he was dependent on those skills. Most clients were not well-informed, the quality of planning and control was often inadequate and that owners lacked project management competence especially in the public service such as local government.

Table 10.13 Client's involvement in projects

Total Response Count	**40**	
Owner's management of projects	**Count**	**Percent**
Successful	20	50,0%
Not successful	20	50,0%
Total Response Count	**25**	
Client's involvement in the management of projects	**Count**	**Percent**
The client is sufficiently involved	10	40,0%
The client is not sufficiently involved	14	56,0%
Other	1	4,0%

Most respondents said that the client is not sufficiently involved in the management of *large projects* in South Africa (Table 10.13). The reasons were that information is not given out when required, the client does not attend meetings, there is no full-time dedicated sponsor, the client lacks knowledge about the project and his briefs are often not clear enough thus requiring him to be more involved. Most respondents said that the client should be involved in the project most of the time but especially in circumstances where the project risks were higher and the need for prompt decisions was required. Most further said, there is no time that the client should be less involved in the project, but that he should delegate his responsibility. It

was also indicated that sometimes the client gets too involved when he should use delegated responsibility.

10.7 Time and Cost Overruns

Has the problem been solved?

All the respondents except for one who was not sure said the problem of time and cost overruns has not been solved (Table 10.14). The evidence was said to be visible on most projects. Scope creep, time and cost overruns still affect many *large projects*. Various reasons were given to be behind this state of affairs. These were collapsed into four categories. (1) Problems at project inception, (2) problems at document formulation, (3) problems at tender pricing and, (4) problems at project and construction execution.

Table 10.14 Respondents' view on the problem of time and cost overruns

Total Response Count	**29**	
In your opinion, has the problem of time and cost overruns been solved?	**Count**	**Percent**
No	28	96,6%
Not sure	1	3,4%

At inception, it was said that there were problems of inadequate client and design briefs which often resulted into scope creep, time and cost overruns in the later parts of the project life cycle. At document formulation, there were problems of lack of information, incomplete documentation, inaccurate planning and inaccurate bills of quantities and a lack of competence by professionals assembling documents. Some of the specific issues mentioned were the failure to cater for many unknowns at design stage, big imbalance between the planned work and the actual. At tender pricing, there were problems of low pricing due to lack of professionalism and low-tender pricing tactics hoping to recoup the cost later. There were also problems of lack of information in the documentation and culture of tendering on incomplete information. At project management and construction execution, there were problems of inherited poor quality of planning and information, imbalance of planned against the actual, allowing scope creep in the projects, poor management and lack of use of project management tools. There were also problems of power of unions, labour unrest and economic conditions.

The results suggest a problem of competence of the project system starting with the client, then the consultants and the contractors. This confirms the results from the case studies that preparation and use of project management principles may be at the heart of time and cost overruns in *large projects*.

Major causes of time and cost overruns

Various causes of time and cost overruns were identified by the respondents (see Appendix D). These were collapsed into five categories. (1) Inception, (2) document formulation, (3) tender and pricing, (4) project management and construction and, (5) others.

From the responses, causal maps were developed showing how the overruns evolved from the root cause to time and cost overruns. Whilst in reality, the causes and their effects are inter-related, for purposes of explanation, these are discussed and indicated in isolation from the others for ease of comprehension.

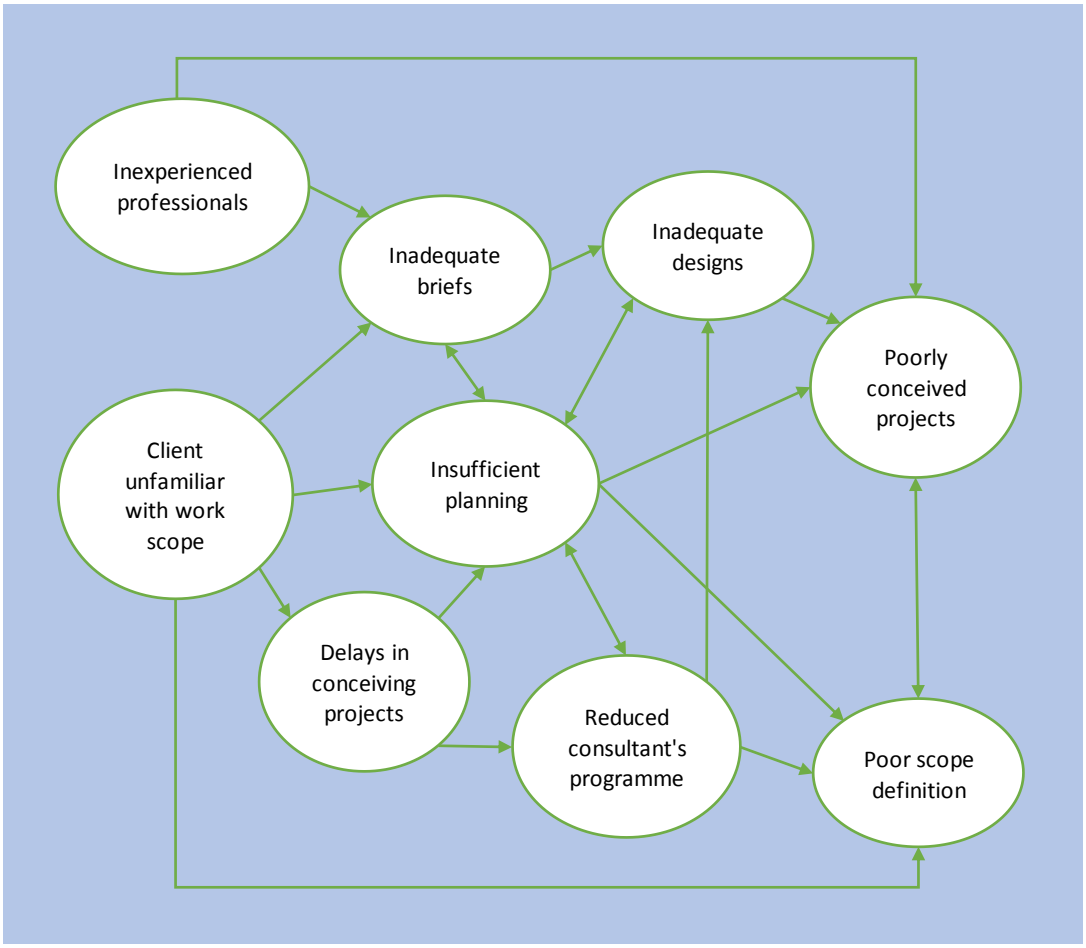


Figure 10.3 Causes of overruns at project inception

At inception, the causes of time and cost overruns were that inadequate briefs at inception and design were made and that the client was mostly unfamiliar with work scope and the necessary requirements to complete a planned project. Most were of the view that there was insufficient planning upfront leading to poorly conceived projects and poor scope definitions which resulted in scope creep later. It was also said that there were delays in conceiving and defining projects resulting in pressure to deliver projects quickly and to spend less time on the early stages. Lastly, it was said that there is inexperience amongst the professionals which

leads to failure to define work scope upfront. The causal map (Figure 10.3) shows that the root cause of overruns was inexperience of professionals and the client's unfamiliarity with work scope.

Under document formulation, the causes were incomplete designs and inaccurate bills of quantities, poor professionalism by professional teams resulting into lack of timely design information, appointment of unsuitable or inexperienced contractors due to lapses in contractor selection, lack of planning, not catering for project unknowns, lack of upfront planning, inadequate briefs at inception and design, lack of time and pressure to complete work, the culture of going to tender on uncompleted designs and inexperience among the professionals which lead to failure to define work upfront and failure to implement projects effectively. All these causes appear to reflect the competence problem in the professional team in preparing for the projects. Some of them are typically effects of the causes at inception for instance incomplete designs due to lack of time resulting from delays in conceiving and defining projects at inception. The causal map (Figure 10.4) shows that the root cause of overruns was inexperience of the professionals and lack of time.

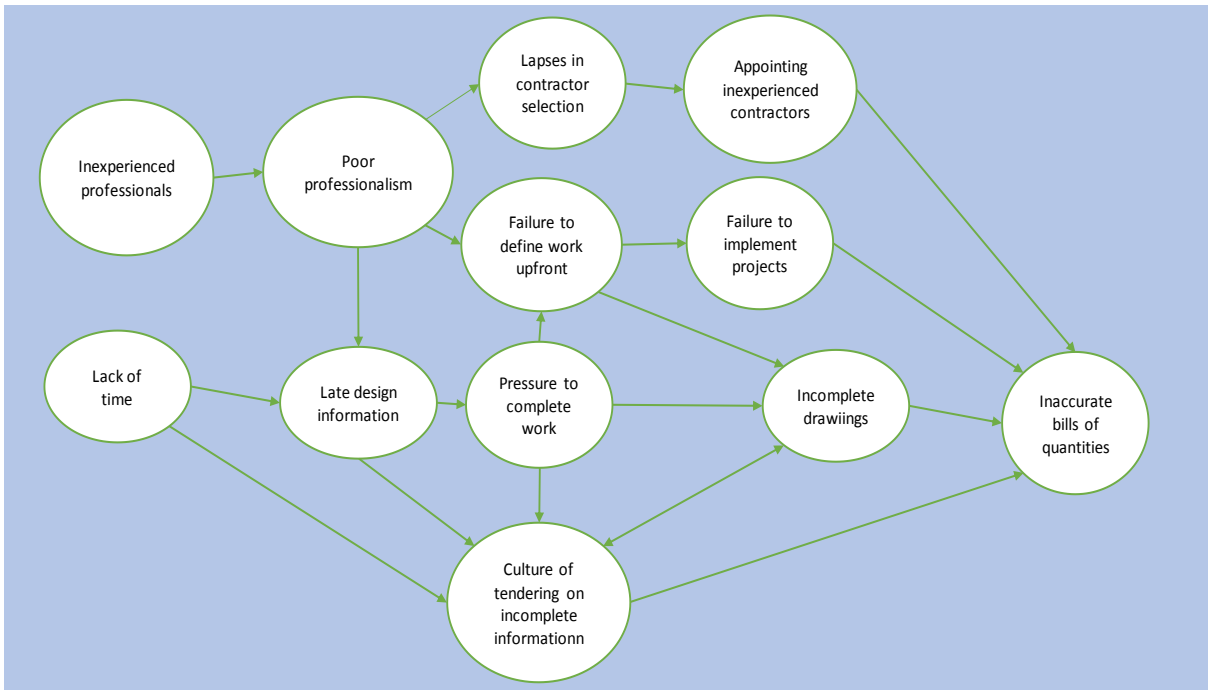


Figure 10.4 Causes of overruns at document formulation stage

Under tender pricing, the causes were that contractors keenly price the tenders hoping to recoup the cost later in claims. They also put in low bids with exclusion clauses to the detriment of the client. Appointment of an experienced and competent consultant was said to be a solution and also that the recommendations should be followed by the client. The last cause was that contractors had a culture of tendering on uncompleted drawings.

From the survey, the major driver for low tenders and bids is the competitive environment (Figure 10.5). This was also the reason for the culture of tendering on incomplete information. Should a contractor fail to tender, others willing to tender would easily be found. The result of these is under-estimated tenders and budgets and contractor's claims leading to time and cost overruns. Under document formulation, other reasons for the culture of tendering on incomplete information was the lack of time, late design information and pressure on the consultants to complete the work.

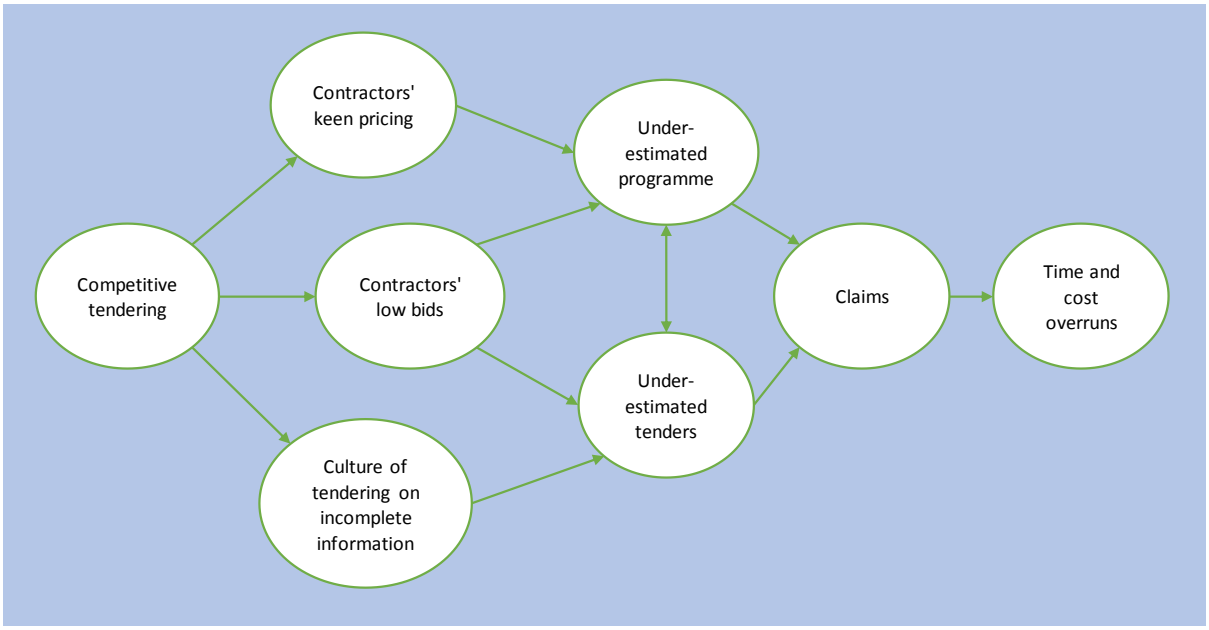


Figure 10.5 Causes of overruns at tender pricing stage

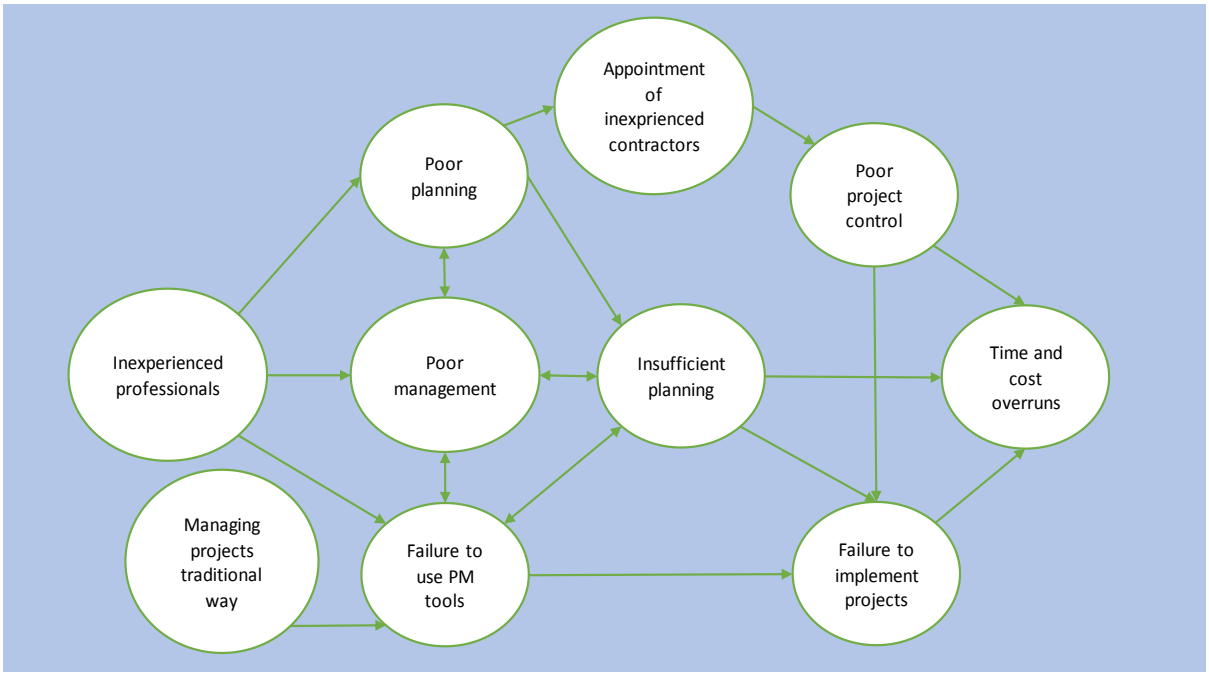


Figure 10.6 Causes of overruns at project management and construction stage

Under project management and construction, poor planning, poor management and insufficient planning, poor project control, appointment of inexperienced contractors, managing projects the traditional way, and failure to use project management tools were said to be causes of time and cost overruns. It was also said that inexperienced professionals failed to implement projects, to manage the process as well as to manage contractors.

The main drivers of overruns under this category, as shown in Figure 10.6, were inexperienced professionals and the practice of managing projects the traditional way. These resulted into poor planning, poor management and failure to use project management tools. These further led to appointment of inexperienced contractors, insufficient planning, poor project control, failure to implement projects and time and cost overruns.

Lastly, other causes were identified which could not be classified under the above categories. These were, corruption, economic conditions, power of trade unions, labour demands and unrest and, having many stakeholders. The respondents were of the view that these also led to time and cost overruns as the projects cost more than they should at tendering stage as well as during construction due to corruption practices driven by poor economic conditions. The power of trade unions and labour unrest were seen to result in increased demands and the culture of work stoppage amongst the workers. The number of stake holders was also seen to have a potential for scope creep due to the many interests which could result in design changes and consequential time and cost overruns.

Most of the causes identified by the respondents are in the organisation and project environment with a few in the external environment. This may be because these are the causes they typically deal with. The results suggest that time and cost overruns are caused by insufficient planning and project definition upfront by the client and the consultant, inadequate document formulation, poor project management and external factors such as labour unrest and economic conditions. At the centre of these causes is the competence of the project team affected by lack of experience. The implication for project management and strategy formulation is that the improvement of competence in the project may lead to reduced time and cost overruns.

The results confirm the earlier results from the case studies that time and cost overruns are caused by lack of preparation by the project team when they embark upon the projects. The lack of preparation is due to lack of experience which affects the project team's competence to manage large projects. Furthermore, they show that the problem starts with the project formulation in the client's organisation called inception in the above discussion of results and then to the project implementation parties: the consultants and the contractor.

Ways of reducing time and cost overruns

Respondents mentioned various ways of reducing time and cost overruns (see Appendix E). These were mostly centred on improvement in the organisation and project environment, which included improvements in planning upfront, early involvement and use of competent personnel, stakeholder management, document preparation, monitoring and control and labour relations.

Most respondents said that there should be better and adequate planning in the early stages of the project by the client and the professional team, to improve on scope definition and project management plans which concurs with the observation of Morris & Hough, (1987). It was also said that planning should be complete before the award of projects to contractors and a change in the delivery method of contracts be considered. Early involvement of consultants and contractors and use of experienced and competent professionals was also said to be important to planning and management of projects.

For improvements in document and tender preparation, the solutions suggested were that construction should only start after well-prepared and complete tender documentation has been finalised. There should be early assembly of a complete experienced and competent design team and, an experienced and competent contractor to be part of the designing team. The contractor would bring in his knowledge of bill of quantities preparation and pricing. They further proposed selection and procurement processes, which include detailed geotechnical investigations, selecting the project team on competence basis and not on lowest bidder and, moving away from the traditional project procurement methods. The results suggest that the client holds the potential solution to improvement of the documentation and tender preparation, which lie in employing a competent project team early in the project's life cycle and ensuring that the construction is embarked upon after the preparations for the project have been finalised.

Under execution and management, most respondents said that there should be better implementation of monitoring and control of projects, better project execution planning, use of experienced project managers, better coordination and management of stakeholders throughout the project life cycle, use of gated and controlled project environment and better labour agreements with unions and workers excluding politicians to avoid work stoppages.

The results suggest that improving the organisation and project environment has potential to improve the management of *large projects* and eventual reduction in time and cost overruns whereas the results from the case studies showed that management of external, organisation and project environments is a potential solution to reducing time and cost overruns on *large projects* in South Africa. This also suggests that, a project management strategy for *large*

projects may need to incorporate more than the management of the project environment. With this information from the questionnaires coupled with the results from the case studies, the project management strategy should incorporate the management, not only of the project environment, but of the organisation and external environment as well. It should involve the management of the micro as well as the macro project environments.

10.8 Use of Project Management Principles

The majority of respondents said that project participants do not use project management principles consistently, though there was a narrow difference between those who affirmed and those who did not (Table 10.15). However, in the follow up question of inadequacies in project participants, the majority said there were project management inadequacies and most were said to be in the client's organisation followed by the consultants, then contractors and sub-

Table 10.15 Use of project management principles in the project

Total Response Count	**25**	
In your opinion, do project participants use project management principles consistently?	**Count**	**Percent**
Yes	12	48,00%
No	13	52,00%
Total Response Count	**25**	
In your opinion are there any project management inadequacies in project participants	**Count**	**Percent**
Yes	20	80,00%
No	3	12,00%
Not sure	2	8,00%
Total response count	**50**	
If the answer to project management inadequacies was "yes," where would you say most inadequacies are?	**Count**	**percent**
Owner organisations	15	30,00%
Consultants	12	24,00%
Contractors	9	18,00%
Sub-contractors	9	18,00%
Suppliers	4	8,00%
Other	1	2,00%

contractors. This concurs with the results from the case studies where project participants, particularly the client lacked specific project experience.

Those who said the principles were used consistently mentioned that there were guidelines and project management standards, which the project managers followed. On the other hand, those who said they were not used consistently mentioned that most project managers did not have the full training, qualification and experience and that, not all client bodies have thorough project management standards. They also said there is incompetence

in the project teams, the bigger picture of the project is not understood by the teams and that the evidence of overrunning projects and incomplete designs before execution were indicative that the principles were not used consistently.

On inadequacies in the project teams, most mentioned that the project teams lacked experienced personnel, particularly in the owner and consultant organisations. In state-owned project teams, it was said that some personnel were appointed to positions before they had acquired sufficient experience. It was also said that the project management profession has not been embraced as a specialised profession.

10.9 Training, Qualifications and Experience of Project Participants

The majority of the respondents were of the view that training, qualification and experience of project participants in South Africa was inadequate (Table 10.16). The results concur those observed above where the respondents were of the view that most participants were inexperienced in the management of *large projects*.

Table 10.16 Adequacy of training and qualifications of project participants

Total Response Count	**33**	
Answer	**Count**	**Percent**
Adequate	15	45,45%
Inadequate	18	54,55%

Those who said the training, qualification and experience were adequate said that the participants were competent and have the necessary qualifications to handle *large projects* and that the qualifications were recognisable globally which concurs with Ofori et al (1996). One third of the respondents said the participants are competent but that there are inefficiencies in the management system.

Those who said the training, qualifications and experience were inadequate pointed to the evidence of projects being behind schedule and the general non-success rate. Most of the respondents said that there were inadequate skills and experience amongst contractors, consultants and owners, particularly, public sector clients whose capability and capacity was said to be poor on average. It was said that many government and SOEs have severe shortages of skilled and experienced personnel. Most experienced personnel have in the past 20 years relocated due to lack of *large projects* in the country. The other reasons given were that there is a lack of professionalism in that project participants fail to resist political interference, employers rush to implement projects before the project concepts are developed fully and that the project participants are not trained to manage *large projects*.

The results suggest that the participants may be qualified, but may not be trained to manage *large projects* and generally lack experience in managing *large projects*.

10.10 Conclusions

From the questionnaire survey, *large projects* are defined from the financial point of view, complexity as well as size. Financially, *large projects* are considered to be those costing more than R100m which is slightly lower than the amount used in this research of R250m.

On the question of success of projects, small projects were seen to be more successful and *large projects* barely successful. 8 out of 10 *large projects* were found to be with time and cost overruns compared to 6 out of 10 small projects. This concurs the results from Flyvbjerg (2011) who found 9 out of 10 large transport projects had cost overruns. Regarding public and private projects, 8 out of 10 public projects have time and cost overruns compared to 5 out of 10 private projects. The criteria that is most used to define success on projects is the completion criteria and then the satisfaction criteria (Lin & Mohamed, 1999).

Most view the management of public projects to be different to the management of private projects in terms of approach and efficiency whilst legislation and procurement processes were similar. Private projects are better managed compared to public projects due to the employment of competent personnel and determination of the owners to reach the end goal.

Similarly, *large projects* are not managed the same way as small projects are managed in South Africa. The result suggests that time and cost overruns on *large projects* may not be due to managing *large projects* the same way small projects are managed, but that *large projects* require high skilled, qualified and experienced personnel to manage them.

There were mixed results on whether the client's management of projects was successful or not with half agreeing and the other half disagreeing. From the comments, most were of the view that success depended on the type of client and employment of a competent team. Private clients managed their projects better than public clients and this was because private clients were fully involved in the projects and were more experienced compared to their counter parts.

The results also showed that the problem of time and cost overruns has not been resolved as projects are still plagued with scope creep and time and cost overruns due to problems at inception, document formulation, tendering and pricing and, project execution. The results confirm that poor preparation and lack of use of project management principles is at the heart of the problem of time and cost overruns in *large projects*.

The causes of overruns were identified as insufficient planning and project formulation upfront by the client and consultant, inadequate document formulation, poor project management and external factors such as labour unrest and unions and economic conditions.

At the heart of all these is the lack of competence of the project team due to lack of experience thus confirming the results from the case studies.

Chapter 11 Synthesis of Case Studies and Questionnaire Survey Results

11.1 Introduction

This chapter presents a summary of the results from the case studies and the questionnaire survey. The chapter starts with a discussion of the results from the case studies followed by one from the questionnaire survey. The final section provides a synthesis of results from the literature, case study and questionnaire survey research.

11.2 Case Study Results

Research strategy

Case study research was used as the principle method of research based on the hypothesis that a representation of factors that lead to time and cost overruns could be developed from an in-depth investigation of project teams working in a large construction infrastructure project. The thesis statement was that *by preparing for projects and implementing appropriate project management strategies on large projects, and, consistently implementing project management principles, the client can improve the delivery of projects and reduce time and cost overruns.*

The strategy that was used to analyse was, firstly to identify a typical overrunning project and compare it with other overrunning projects using replication analysis and, secondly, identify non-overrunning projects and see whether these would confirm the opposite results from the typical and overrunning projects. Five cases were identified for the research. Three were overrunning projects and two, non-overrunning projects.

Results

Time and cost overruns

Results obtained were that several factors led to time and cost overruns and these had multiple inter-relationships. From the typical overrunning project, it was found that the root cause was: (1) Public and local community resistance; (2) EIA location change requests; (3) Pressure from the public and media; (4) Lack of project specific experience;(5) Insufficient budget; (6) Under-estimating project complexity;(7) Lengthy procurement requirements; (8) Client change requests. The combined effects of these factors were found to affect the project team's management of the project leading to time and cost overruns. For instance, due to the first factor, the project team in Case study 1 moved the project from one location to another due to local community resistance and the EIA change request made them to relocate to the

first location the community had resisted. By then, the team had advanced in the design and had to start again, thus reducing their design production time since the project had a fixed completion date. With pressure from the public combined with lack of experience, which made them under-estimate the project's complexity, they could not submit a higher budget. With a lower budget, the change of location twice meant the project was overrun even before construction started.

Similar factors leading to time and cost overruns were found in the other two overrunning projects. Typically, there was lack of project specific experience, insufficient client budgets, pressure from the public against the project, under-estimating project complexity, change requests, procurement method problems and different ground conditions. These factors were found to be largely absent in the non-overrunning projects. Rather in those two case studies, it was found that the project participants had project specific experience, the client had sufficient project budgets, the project team was prepared before the start of the project, the project had less change requests and they did not use short cuts.

The results from the overrunning and non-overrunning projects showed that there were conditions that promoted the prevalence of time and cost overruns and those that did not. Those that promoted were: lack of project specific experience, insufficient client project budget, delayed project approval, starting construction with incomplete design concepts, insufficient time to prepare for the project, use of short cuts, under-estimating project complexity, use of contractual agreements to enforce performance and, a lack of a holistic appreciation of the project and role of other participants. Those that inhibited time and cost overruns were: sufficient client budget, project specific experience, use of a structured approach to project management, having a complete design concept before construction start, teamwork and consolidated effort, proactive contractor and construction process to create a successful delivery environment, appreciation of other members' roles and place in the project.

It was also found that the root cause of time and cost overruns stem from the external environment which are, lack of experience due to lack of similar work, pressure and resistance from the public and change requirements from stakeholders. The effects of these are shortage of time to design and construct, delays to project start, insufficient budgets, incomplete drawings, higher contractor tenders and, constructability problems during execution. The results also showed that there was interplay of factors as observed by Steyn (2009).

The results show that there were high levels of public resistance to these projects which suggest that *large projects* require high levels of communication with the public to avoid disruptions, delays to project start and rushing to start the project before proper project document finalisation. It was, however, shown that there was a concentration of technical

capabilities in the project teams, without sufficient competencies of communications and public relations. This resulted in difficulties of managing these communication risks.

Management of projects and use of project management principles

It was also found across the projects that in the management of *large projects*, the project participants' behaviour was affected by various pressures and was often altered by pressure such as inadequate budget, lack of time and public resistance to the project or perception of costliness of the project. This pressure affected the way decisions were made and consequently affected the project strategy. The pressure often led to participants using short-cuts and not following the project management principles consistently. Furthermore, policies and decisions past and present in the external and organisational environments, as well as the experience and competence of the development managers and other participants, had an influence on how project teams managed the projects.

Client involvement, experience and preparation of project participants

The results confirm that the involvement of the client is a parameter of consideration as their lack of project specific experience and preparation affected the formulation of project procurement strategies and budgets. The results also confirm that the training and *experience of the project participants has an important role in the management of large projects* as it affects the project competence and eventually performance. This concurs with the results from Crawford, (2005). The results further showed the relationship between experience and preparation. Lack of experience leads to poor preparation for the project. The experience and the size of the project were also related to the form of organisation used on the project. Consultants formed joint ventures to increase their project competence and financial capability. Furthermore, the results showed that the principles of project management were not used consistently in the overrunning projects.

11.3 Questionnaire Survey Results

Research Strategy

The questionnaire was the secondary research method. It was chosen to complement the case study method to be able to give a complete understanding of the phenomenon of time and cost overruns in line with the advice of Love et al (2002) that a blend of methods of research is best adapted to construction management research since it dealt with both the natural and the social sciences. It was also chosen to validate the case study results as well as to aid in the formulation and gauging of the practicality of the solution to the problem.

The strategy that was used to collect data was to identify organisations and individuals that were involved in large projects in South Africa. These would be the client, the consultant

and the contractor. Since consultants represent clients, it was considered adequate to collect data from consultants and contractors. Using the affiliate institutions of consultants and contractors, CESA and CIDB, individuals involved in large projects were invited to participate in the research. Furthermore, personnel involved in the Construction Management Programme (CMP 2014) who were senior managers in their organisations in the construction industry were invited. Those who accepted filled in the questionnaires using the university online questionnaire survey platform.

Results

Specific issues investigated

The specific issues arising from the research results were the problem of time and cost overruns in South Africa, the nature and management of large projects in South Africa, the use of project management principles in the industry, client involvement in the management of projects, public and private projects and, training, qualifications and experience of project participants.

Time and cost overruns

On the problem of time and cost overruns in South Africa, 97% of the respondents said that the problem of time and cost overruns had not been solved in the country. They pointed to the apparent scope creep and time and cost overruns which affected many large projects in the country. Various causes of time and cost overruns were mentioned by the respondents. These have been categorised into causes at inception, document formulation, tender pricing, project management and construction and, other factors.

The root cause under inception were identified as inexperienced professionals and clients unfamiliar with projects and work scope. This confirms the results from the case studies which showed that the root cause of time and cost overruns was the lack of project specific experience by the project team. The lack of experience is what affects the way the project team prepare and execute projects.

Under document formulation, the root cause was identified as inexperienced professionals, insufficient time and poor professionalism amongst the project team members. The combined effect of these is the failure to determine work upfront, pressure to complete works, lack of and late design information, lapses in contractor selection and a culture of tendering on incomplete information. Similar reasons were observed under the case studies: lack of specific project experience and pressure of insufficient time on the project team which led to incomplete designs and inaccurate tender documents which resulted into higher tenders.

The root cause under tender pricing was the competitive tendering environment. Contractors submit keen prices hoping that they will recoup the costs later. Similarly, they submit low bids with exclusion clauses for risky areas and sections where information is insufficient. Contractors were also said to have a culture of tendering on incomplete information. The links in the chain of causes can be easily seen starting with lack of time by the design team which inevitably leads to incomplete designs and tender documents. Contractors, in competition, submit keen and low bids on incomplete information but put in exclusion clauses to cover themselves for any changes in the prices, quantities and other unforeseen risks in the documents. When the work is finally carried out, not only are the prices and construction programmes under-estimated but the volume of work is different from what was planned with the complete information now available.

This reinforces what was observed earlier and under the case studies that reduced time to prepare for projects, in combination with the lack of project specific experience, led to ill-preparation for projects by the project team who often resorted to short-cuts and not to thoroughly complete tender documents leading to design changes and eventual time and cost overruns in projects.

The root cause of time and cost overruns under project management and construction were similar to the previous three: inexperience amongst professionals and, additionally, the tendency of managing projects using the traditional design-bid-construction method with its attendant problems of reduced competence in estimating and pricing project costs, constructability and holistic project risk management. The result is poor planning, poor project management and construction leading to time and cost overruns.

Other factors which did not directly relate to the four areas discussed above were; corruption, the power of trade unions, labour demands and unrest and the problem of having multiple stakeholders commonly encountered under large projects. These factors lead to increase in project costs, disruption in work activities and scope creep and design changes due to many users and requirements.

The results show that the root cause of time and cost overruns is the lack of project experience which results into poor professionalism, poor project plans and inadequate project management as well as pressure on project professionals, due to lack of time to design and prepare for projects adequately. These are essentially, external environment factors which affect both the organisation and project environments as was seen under the case studies. The results confirm the case studies results that project participants were ill-prepared when they embarked on projects due to lack of time and that they lacked project specific experience, especially the client and the consultants.

Various solutions were proposed by the respondents. The solutions were mostly centred on improving the organisation and project environment. This included the need for adequate planning in the early stages of the project by the client and the project team, the need for completing tender documents before the start of construction, the need for a change in the delivery method of projects to incorporate early involvement of consultants and contractors and the use of competent and experienced professionals.

Reviewing the causes of time and cost overruns and the suggested solutions from the respondents, the results suggest that the organisation and project environment should be improved which validates the suggested approach to the solutions (see section 4.6 and section 8.14) further confirmed by the deviant case studies (see chapter 7 and 8).

The suggested questionnaire survey solutions, however, centred mostly on what the project team members could do in the project environment whereas, the results from the case studies showed that there were other factors outside the project environment that needed attention. These include the low and unregulated numbers of large projects in the country which result in poor organisational and individual project management experience, the lack of project specific experience in the client's organisation both in private and public departments as well as the public and local community resistance to projects.

Nature and management of large projects in South Africa

On the nature of large projects in South Africa, a large project is described based on its financial size, its complexity and its physical size. Most defined large projects as those costing more than R100m. In terms of performance of large projects in comparison to other categories, large projects are viewed to be barely successful compared to small projects which they viewed as successful. In terms of time and cost overruns, 8 out of 10 large projects have overruns compared to 6 out of 10 small projects. For public projects, 8 out of 10 have time and cost overruns compared to 5 out of 10 private projects. This shows that most large projects and most public projects have time and cost overruns.

The completion and satisfaction criteria was the basis for the respondents' description of how successful a project was. They judged a project to be successful if it met the completion criteria of time and cost as well as the satisfaction criteria of quality and approval from the client and other stakeholders.

On the size of the project, most respondents were of the view that size affects the way a project is managed. They further said that large projects in South Africa are not managed the same way small projects are managed. It came out that the principles of management are the same irrespective of the size, but what differentiated the projects was that large projects require more resources and higher skills due to their complexity compared to small projects.

They require more planning to design and execute, involved multi-organisations and were more multi-disciplinary compared to small projects. They thus required more experienced and qualified personnel to design and construct and more management tools to assist in project formulation and execution to keep them on track due to multiple dependencies and interfaces in the project parts.

This concurs with the results from the case studies which showed that experience of project participants is cardinal to effective preparation and execution of large projects. The results, however, disproved the rival explanation that time and cost overruns could be due to project teams managing large projects the same way small projects are managed.

Use of project management principles

There was a mixed response on whether project management principles are used consistently in the South African construction industry. 48% were of the view that project management principles are used consistently whereas 52% disagreed. Those who said the principles are followed pointed to the availability of guidelines and project management standards which participants followed. Those who said they were not followed said that most managers did not have the full project management training, qualifications and experience and that not all client bodies had thorough project management standards. They further said there was incompetence in the project teams and the lack of understanding of the bigger picture of projects by teams. They pointed to the occurrence of time and cost overruns as evidence that principles were not being followed.

On a follow-up question which was on inadequacies in project teams, 80% said that project teams had project management inadequacies. The majority said that most inadequacies were in the clients' and consultant's organisations. Most said that project teams, particularly the owners and consultant organisations, lacked experience. In state owned project teams, the view was that some personnel were appointed to positions before they had acquired sufficient experience.

Client's involvement

Two issues were considered under client's involvement: their view on whether the owner's management of projects was successful or not and whether they felt the client was sufficiently involved in projects or not. Respondents' views were not conclusive on whether the owner's management of projects was successful or not. Most, though said that the client is not sufficiently involved in projects. They pointed to delays in information flow, client's failure to attend meetings, lack of dedicated project sponsors, the client's lack of project knowledge and unclear briefs. There was also concern of lack of skills in the industry which affected the owner's management of projects. It was said further that most clients were not well-informed

and lacked project management competence. This affected the quality of planning and control in the project especially in the public service such as local government.

Private and public projects

The respondents were asked on their views on whether public and private projects were similar or not. Similarities were viewed from two perspectives: approach to management and effectiveness of management.

On approach to management, the majority were of the view that public and private projects were similar in terms of the legislation process and project management principles. They all follow the same project life cycle and project management principles. The major difference was said to be in the type of client and how they manage the projects. On effectiveness or performance, most were of the view that private projects are better performed than public projects. They pointed to the visible budget overruns due to design changes and scope creep in public projects compared to lack of delays and cash flow problems of private projects. The reasons for better execution of private projects were said to be rooted in the employment of competent personnel as well as the drive the owners have to achieve end goals. Public enterprises were said to lack management skills and experience and suffered from a tendency to employ unqualified employees. Private enterprises, on the other hand, employed competent personnel with management skills and were mostly driven with the desire to accomplish project end goals of completing within time and cost.

The results concur with the commercial building project case study, a private project which was better performed but are at variance with the dam project which was a public project but better performed as well as the high-speed train project, a private managed project but incurred time and cost overruns. This suggests that there are more reasons to what affects the competence and performance of large projects apart from whether it is public or private managed.

Training, qualifications and experience of project participants

The respondents were asked on their view of the adequacy of the training and experience of project participants. 55% were of the view that it was inadequate and 45% said that it was adequate. Those of the view that the training and experience was adequate said that the South African qualifications were recognised globally which concurred with Ofori et al (1996). They, however, said that there were inefficiencies in the management system. Those of the view that it was inadequate pointed to the evidence of general no-success rate and projects being behind schedule. Most said that there were inadequate skills and experience amongst contractors, consultants and owners especially the public-sector clients whose capability they rated as poor on average. The reasons given were that government and state-owned

enterprises had severe shortages of skilled and experienced personnel, most personnel had in the past 20 years (as at 2014) relocated due to lack of large projects in the country. It was further said that there was lack of professionalism as participants failed to resist political interference, employers rushed to implement projects before project concepts were fully developed and that participants were not trained to manage large projects.

These results confirm what was observed in the case studies. The major factors brought out are that there are inefficiencies in the system. These come about mostly due to lack of enough large projects to encourage individual and organisational project participants' experience which was observed in the case studies. The effect of the behaviour of the participants was also brought out. Employers often rush projects before concepts are fully developed and that participants are not trained to manage large projects. This potentially points to some inefficiency in the training of project professionals which may merit further research. From the case studies, the complexity of the projects was often under-estimated in both the overrunning and non-overrunning projects. Overall, the questionnaire survey results have confirmed the results from the case studies.

11.4 Time and Cost Overruns Model

The results showed that the root cause of time and cost overruns start in the external environment. There are certain circumstances that promote the origin and existence of time and cost overruns in the external environment. The presence of these are a harbinger of time and cost overruns in the project. These are insufficient numbers of large projects, pressure from the public or other national pressure such as dwindling power reserves, delayed funding and project approvals, past decisions or policies of government, parent organisation (client) or other external entities such as training institutions and local authorities. These have immediate impact in the project in that they set seeds of time and cost overruns, but they further affect the decisions and behaviour in the organisation environment which, in turn affect the project environment and the individuals involved in the project, leading to time and cost overruns.

Figure 11.1 is a simplified illustration of how time and cost overruns develop in the large project environment. It shows that time and cost overruns have their origin in the macro project environment going into the micro project environment. They start in the external environment spurred on by circumstances that create an environment conducive for time and cost overruns. From research results, these were found to be lack of large projects, past government and parent organisation decisions and policies, project approval and funding delays and pressure from the public due to national importance of large projects. These affect the organisation and project environments above. They result in lack of experience of organisations and individuals

both in the organisation and project environments leading to time and cost overruns at the three levels: organisation, project and individual indicated by the arrows to the right.

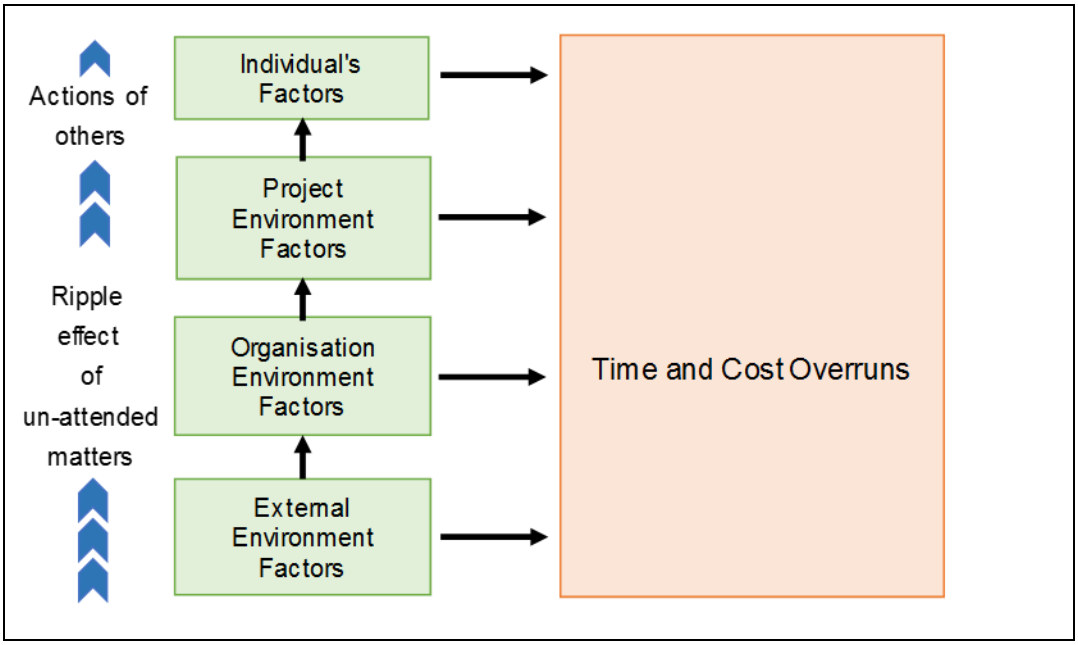


Figure 11.1 Overruns development model on large infrastructure projects

Similarly, pressure from the public in combination with other factors result in under-estimating budgets and project complexity by both the organisation and project environments, delays to project starting which further up the project environment results into reduced project time, pressure to complete the project, use of short cuts, incomplete design and eventually, time and cost overruns. Thus, starting with the lower level external factors, these affect the ones above. At each level, circumstances for overruns are sown and lead to time and cost overruns. These are indicated by arrows to the right from each environment. The arrows on the left, from the external to the individual, show the influence of the circumstances and factors from the lower level to those above. There is a ripple effect beginning from the lower levels to the ones above. The model shows that overruns start in the external environment, affect the organisation and project environments above and at each level, they lead to time and cost overruns.

Circumstances affect the behaviour of project members at each level and the level above, which creates a conducive environment for overruns. For instance, due to project approval and funding delays emanating from the external environment, the project start was delayed which created a conducive environment for the onset of time and cost overruns as a large project of national interest, often with a fixed completion date cannot be delayed. The project at this stage was already late even before it was started. Furthermore, the delay made the client in the organisation environment to rush the procurement process using virtual designs,

shorter procurement route and start the project before detailed geotechnical surveys and concept designs. This affected the behaviour of the consultants and the contractor to further use short-cuts in the project environment.

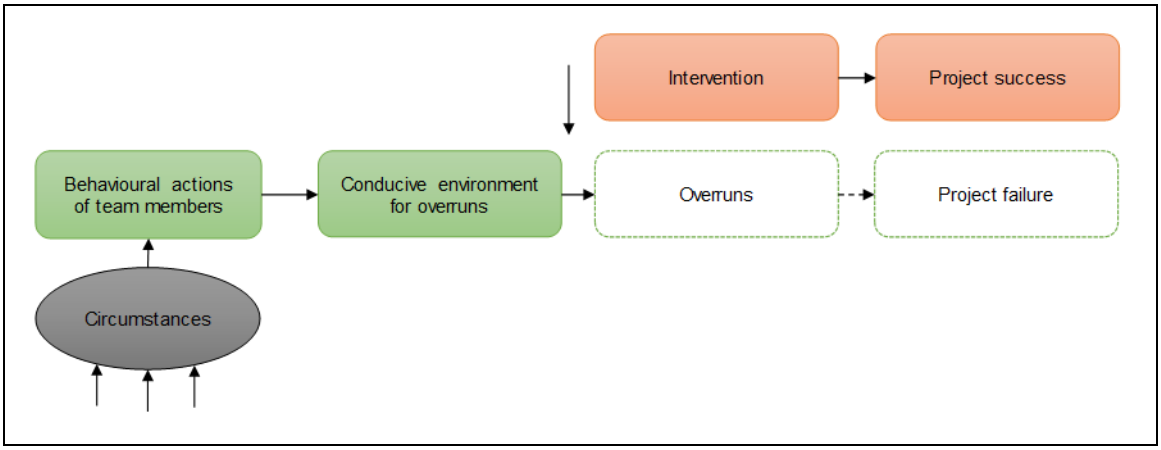


Figure 11.2 Effect of circumstances on project delivery

Figure 11.2 shows how circumstances in the different large project environment affect the behaviour of project participants. As explained earlier, certain circumstances affect the behaviour of project participants which leads to the creation of a conducive environment to time and cost overruns. The diagram shows that unless there is an intervention using a project management strategy, the project will experience time and cost overruns which will result into project failure. In Chapter 12, the project management strategy for a client managing large projects is proposed.

11.5 Summary

In summary, the explanation of management and development of time and cost overruns is shown in Figure 11.3. From literature, it was seen that the project environment factors and the actions of team members affect the management of the projects and lead to time and cost overruns. The project manager is seen as the executor of the task handed down from the business case.

From the results of this research, the initiating factors are resident in the external environment and then translate to the organisation environment and then to the project. The external and organisation factors affect the project teams' upfront decision-making and these, together with project environment's factors, lead to time and cost overruns. This is summarised in Figure 11.4.

The results show that the time and cost overruns phenomenon is complex and involves various factors in more than one environment and cannot be reduced to a singular solution as

often done in previous studies in what some scholars call reductionist tendency (Busby & Payne, 1999; Fellows & Liu, 2012).

Management of these factors in the three environments therefore, is important in reducing time and cost overruns. To improve the management of large projects, there is need to

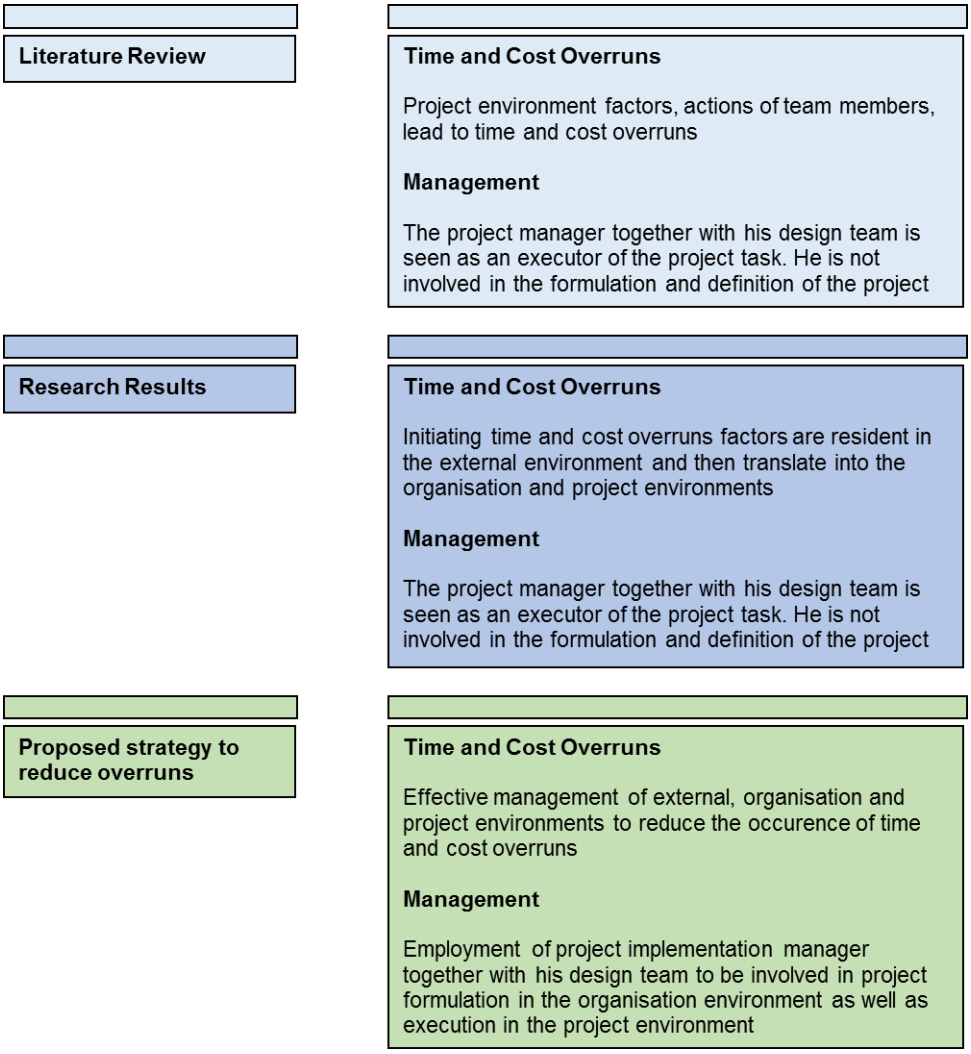


Figure 11.3 Time and cost overruns model from literature review to final results

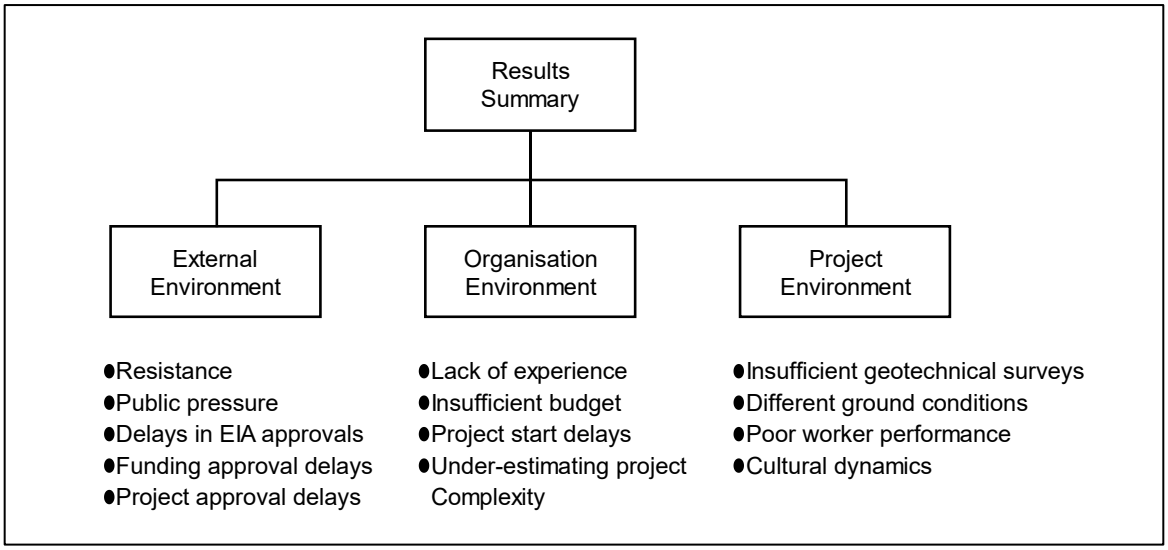


Figure 11.4 Final summary of identified problem

manage the external environment to overcome project resistance, public pressure and project permits and approvals. There is need to manage the organisation environment to improve participant experience, budgeting and project conception. Finally, there is need to manage the project environment to improve the project team competence that will lead to better delivery of the project. Thus, an integrated project management strategy is required to manage all the three large project environments that affect how the team plans and executes the project. This is discussed further in the proposed integrated project management strategy in Chapter 12.

Chapter 12 **Proposed Project Management Strategy**

12.1 Introduction

The results show that time and cost overruns on large infrastructure projects are often due to poor preparation by the client and consultant as a result of lack of project specific experience. The problem was observed to originate from the external environment leading to the organisation environment and then into the project environment. The detailed results are presented in Chapter 11.

Chapter 12 introduces the proposed project management strategy that could be used to manage time and cost overruns on *large projects*. It is believed the use of the strategy by the client when carrying out *large projects* will lead to reduction in time and cost overruns and eventual improvement in the management of these projects.

12.2 Proposed Project Management Strategy

As presented in Chapter 11, the typical issues that promote the occurrence of overruns or the pathogens (Love et al, 2009), from the *external environment* are, resistance from the local community, public pressure against the project, delays in environmental impact approvals and, project and funding approvals and other permits (Figure 11.4). The issues from the *organisation environment* are insufficient client's budget, project start delays, under-estimating project complexity, lack of experience, lack of preparation. Lastly, from the *project environment*, the issues are insufficient geotechnical surveys and different ground conditions, poor worker performance and safety requirements.

These issues may vary from project to project, but emanate from the three environments: *external environment, organisation environment and project environment*. This suggests that, the improved management of these environments would lead to reducing time and cost overruns. This was observed in the better-performed case studies in this research.

The *proposed strategy* is, therefore, aimed at improving the management of the macro and micro project environments. This proposed strategy is illustrated in Figure 12.1 and is elaborated upon further in Figures 12.2 to 12.6 to show how the different components fit into the integrated process:

<u>Macro project environment</u>

Figure 12.2 – Large project screening and approval process
Figure 12.3 – Traditional project participant involvement
Figure 12.4 – Improved participant involvement

Micro-project environment

Figure 12.5 – Large project procurement process

Figure 12.6 – Concept formulation process

The proposal in summary is:

- Establishment of a Project Implementation Organisation (PIO)
- Establishment of a Project Risk Management Agency (PRMA)
- Increased project management role in client's organisation
- Revision of the concept formulation and development process

Each of these, will be elaborated upon in the subsequent sections. Thereafter, a practical implementation of the solution will be presented in section 12.3.

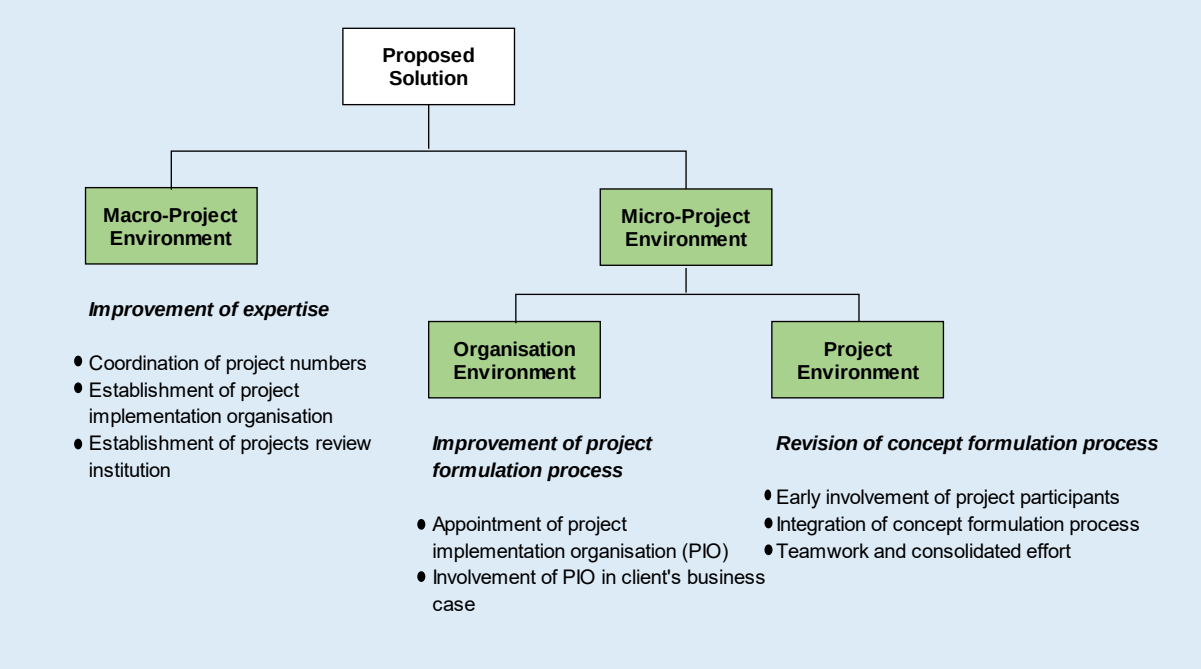


Figure 12.1 Proposed project management strategy

12.2.1 Macro-project environment management

The macro project environment constitutes various players and influences which impact on the project directly or indirectly. These include the suppliers of materials and labour, professional bodies, unions, environmental pressure groups, governmental bodies, training institutions and other economic, financial and legal institutions in the external environment. Morris and Geraldi (2011) included the client organisation in this external environment and called it the institutional level management. They exclusively emphasised the institutional environment because other areas in the external environment such as government bodies and training institutions were considered beyond the influence of the project management team and, therefore, difficult to control. On the other hand, the client body and other project

organisations are considered part of the micro-project environment in this research, as they are amenable to project management influence. The macro-project environment, however, may require a different type of intervention as it is mostly beyond the control of a single project manager or project implementation organisation.

12.2.1.1 The problem

The major problem of large project management as observed in literature, case studies and questionnaire survey, is the lack of project specific experience due to lack of sufficient repetition projects (see Sections 11.2 & 11.3). After graduate professionals obtain their qualifications, they need to work under a mentor to obtain the required experience. This, however, requires them to work in a reputable organisation, which in turn needs to have projects. Large project experience is important, but it is dependent on the availability of *large projects*. In South Africa, large projects are spaced far apart and not a common occurrence which affects infrastructure growth (Groenveld, 2006, Ofori et al, 1996). If infrastructure is growing or the need for infrastructure growth is there, it creates opportunities for reputable firms to undertake projects and thus to build on the experience of the work force.

Where there are few *large projects* and spaced far apart in time, such as in the case of stadia, power plants and high-speed railways, this results in lack of project specific experience for organisations and professionals in the industry. For instance, in the stadium case study, the client's representatives were highly experienced with over 30 years, but in municipal engineering and not stadia construction.

12.2.1.2 The solution

To address the lack of project specific experience at macro-project environment level, the proposal entails improving expertise in three ways: (1) coordination of numbers of projects, (2) establishment of a project implementation organisation to manage projects and, (3) establishment of a projects review institution to promote project risk management.

Coordination of projects

Coordination of projects is aimed at the policy level. A two-fold step is proposed: (1) Coordinating the number of *large projects* in the country to avoid the cyclic nature of high and low volumes of work often experienced in infrastructure development (Groenveld, 2006; Ofori et al, 1966). (2) Encouraging more labour intensive methods of project delivery to increase the numbers of people exposed to project experience.

The proposed policy is expected to lead to improvement in the experience of various personnel. The coordination could be done by the central and local government in conjunction with the Construction Industry Development Board (CIDB), Council of the Built Environment

(CBE) and other project management bodies. Further research may be required to investigate the actualisation of the policy.

Project implementation organisation

To improve the management and execution of projects, the *setting up* of an institution to manage the execution of *large projects* on behalf of the client both at macro and micro project level is recommended. The project implementation organisation when set up, works in the macro project environment as well as in the micro-project environment. Section 12.2.2.2 elaborates further the role of the implementation organisation under the micro-project environment and how it is *appointed*.

The aim of the project implementation organisation at macro project level is to prepare and execute all large projects on behalf of the client who may be a public or a private entity. The project implementation organisation and individual professionals working there build their organisational and individual professional experience as they manage the various projects nationally or over a large geographical area and over time, as was the case in the more successful case studies. The implementation organisation and individuals had capability in this role from the experience they gained from managing several projects on behalf of the client over time.

However, there is need to investigate further whether this entity would be set up for all national projects or based on specialisms such as building projects and civil engineering projects or per province.

Projects review institution

It was seen from the results that large projects need more project management competencies and have much impact on the environment compared to smaller projects. It was also seen that there was no unified approach to the management of project risks.

The proposal entails setting up a semi-autonomous institution to foster project management proficiency based on risk management competency called Project Risk Management Agency (PRMA). It could follow a legislative process similar to that for environmental impact assessment. The main aim of the agency would be to encourage formulation and auditing of risk management plans for *large projects*. The advantage of such a board is that it would encourage the client and the consultants to plan for project risks at large and not just environmental risks.

The semi-autonomous institution is recommended to be an authority to house both the environmental and infrastructure project risk management personnel to review and approve *large projects*. The process of approval and verification of preparedness to embark on projects

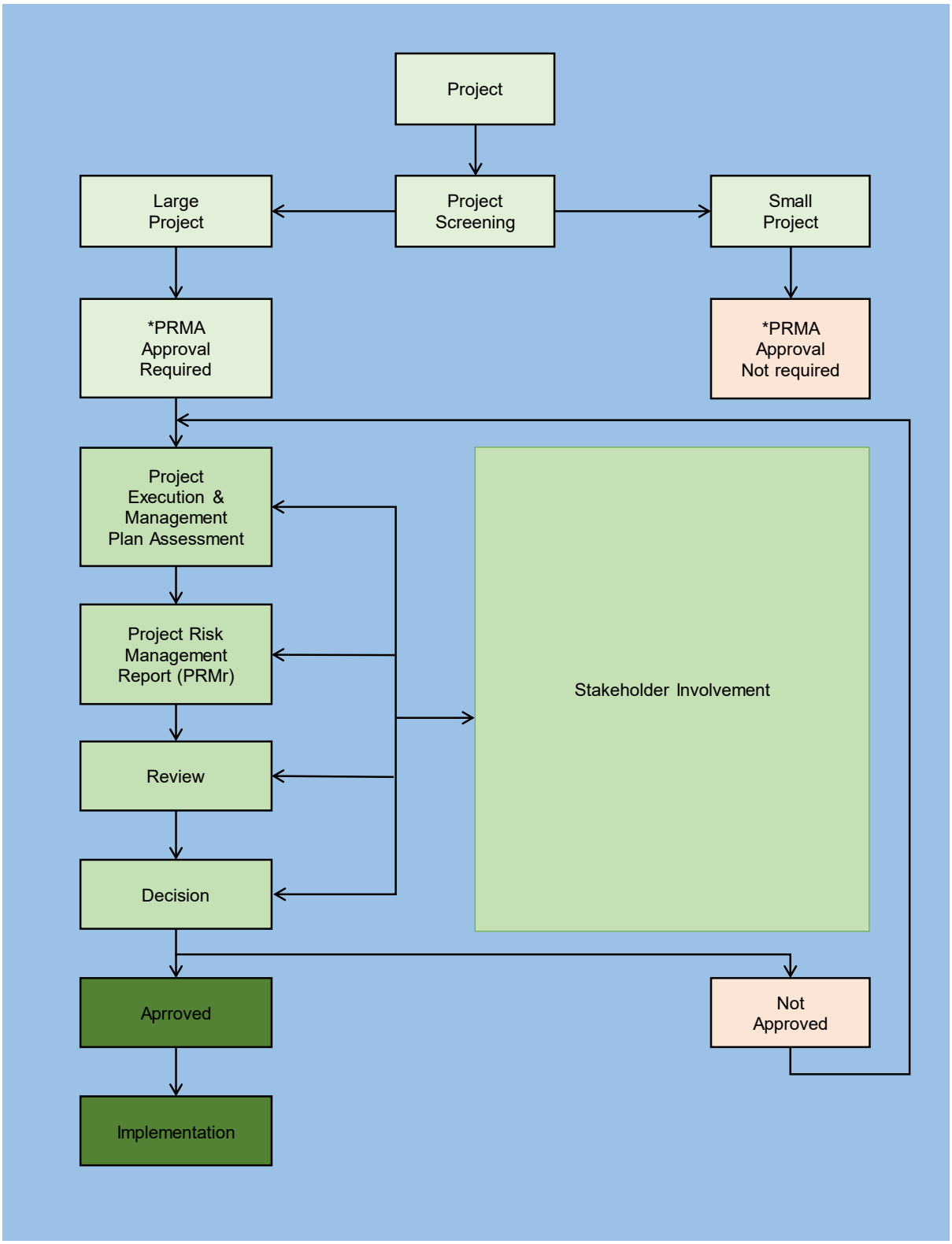


Figure 12.2 Large project approval and implementation process

Adapted from EIA generic process, Aucamp, P.T. (2009).

PRMA stands for Project Risk Management Agency

is to follow a process outlined in Figure 12.2 starting with project screening, review, decision and approval for project implementation. The first step is to determine whether approval is required under this authority by considering the size of the project. Where approval is required, together with stakeholders, an assessment of the execution and management plan comprising the risk factors for the project at large would be carried out. A Project Risk Management report (PRMr) submitted to the authority by the project owner then follows this. The authority then reviews the document. Where the plan is approved, the project is certified for implementation.

The authority would provide infrastructure clients with a single entity for review and approval of both environmental and project risk management plans. Furthermore, the single authority would give prospective clients a less complex environmental management compliance process by dealing with one entity compared to the processes entailed by the Environmental Management Act 1998 of different competent authorities depending on the nature of the activity.

12.2.2 Micro-project environment

The micro-project environment comprises both the project and organisation environments. This is similar to the technical and strategic levels discussed by Morris and Geraldi (2011). As discussed under the macro project environment, the micro-project environment is within the influence of the project implementation manager. This environment includes the client's organisation, project design and construction consultants and the individuals involved in the project such as contractor's construction workers.

12.2.2.1 The problem

Lack of project specific experience

The project participants, especially the client, lacked project specific experience in the case studies. This affected their preparation and competence for execution of projects. This was confirmed in the questionnaire survey where inadequacies were found in the members of the project teams especially that of the client and the consultant.

Reduced project team competence

The major problem identified from the results was that in the micro-project environment there was reduced competence in the project team evidenced by insufficient budgets, under-estimating project complexity and insufficient geotechnical surveys. This was due to the delivery approach adopted, which divided the design and the construction processes in problem solving and the practice of late involvement of design and construction teams in project formulation. The results of this approach, as shown in Figure 12.3, is that the client and consultants conceived design solutions without the involvement of the contractor and the

construction solutions were conceived by the construction team without the involvement of the design team.

Furthermore, the project management experience and knowledge during project formulation was absent as project participants were appointed after the business case, and after the initial concept had been defined. The contractor was appointed much later after the design concept had been defined. This position was confirmed in the questionnaire surveys that the contractor is appointed much later in the delivery process and this affects the formulation of solutions such as estimates and construction programmes. This situation created problems in the project decision making process due to lack of requisite skills and knowledge at project initiation stage because the project manager's and consultant's and, contractor's experience and knowledge, was not available at project conception and at design stage respectively.

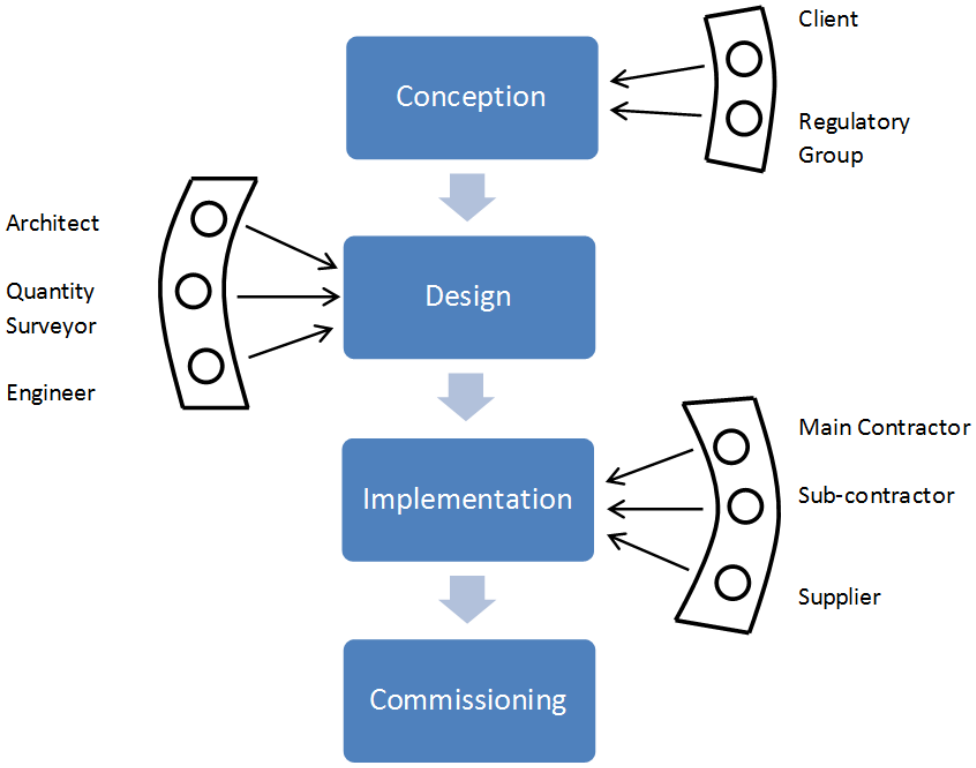


Figure 12.3 Traditional participant involvement in a project life cycle

Teamwork and collaboration

There was also a lack of teamwork and collaboration amongst project participants. This is between the design team and the construction team as well as within the sub-systems themselves. The results indicate this may have been due to reliance on contracts for performance enforcement as well as the influence of procurement approaches adopted.

The results also showed a lack of a unified process to risk management with the client concentrating on environmental risks leaving out construction risks to the contractor. Furthermore, there was no unified review of the project as a whole, of the various processes and subsystems within the organisation and the project environments. The factors behind the lack of a unified process, as revealed from the case studies and the questionnaire survey were:

- The training and culture of professional affiliation of project participants where candidates for each profession are trained and work in isolation from other professionals in devising design and construction solutions,
- Procurement systems embarked on at the direction of the top management and,
- The decisions made in the past or in the external environment.

12.2.2.2 The solution

The proposed solution is aimed at improving the project and concept formulation process in the micro-project environment. The solution comprises two parts. Firstly, the recommendation entails creating an improved project formulation process in the *organisation environment*. Secondly, it involves the revision of the concept formulation process in the *project environment.*

Organisation environment: improvement of project formulation process

Appointment of the project implementation organisation

Further to the setting up of the project implementation organisation at macro project level, as explained under Section 12.2.1.2, this section explains this organisation's role at micro-project level and how it is appointed.

The *project implementation organisation* is proposed to be *appointed* immediately as the need for a project is established to facilitate the management of key factors in the client's organisation environment as well as oversee the development of the project from design up to construction. This will help in providing the missing project management experience and knowledge required in the formulation of the project definition and addressing of important questions in the boardroom which Merrow (2011) found pitifully missing. It will also help in moving away from the reactionary and restricted execution role of the project management function discussed by Morris et al (2006) to that of the formulator of the project strategy as well.

This organisation manages the project on behalf of the client and it is they that interact with the various project participants. The *project implementation organisation* then, becomes the client and manager of the project on behalf of the user client and guarantees the

completion sums and completion dates to the client and delivers the completed project to the client. The advantage is that this organisation will have the project management experience which, from the results, has been seen to be essential to the preparation and execution of *large projects*.

From the case studies, the results have shown that the use of such an organisation was instrumental in the successful delivery of projects mostly because the implementation organisation had the experience and was focussed to ensure that the project was delivered on time and within cost. Another factor is that the implementation organisation will have an undertaking with the client and guarantee delivery within time and cost to the client which if not achieved, they will contribute to the extra cost or risk losing future work with the client.

Involvement of the project implementation organisation in the client's business case

It is proposed that the project implementation organisation be involved in the management of the organisation environment to guide in the formulation and definition of the project strategy as well as the concept formulation process discussed later. This will provide for the lack of experience and project management competence that was seen to be absent in the project formulation process.

From the results, it was shown that in the project initiation processes where project approval and funding approval are managed, the project consultants are excluded. This is where project approval and funding approval are managed. Even though consultants may help write the project charter, project approval and funding approval are done external to the project management boundaries. The obvious disadvantage of this approach is that the team in the project boundary has much experience in planning and delivering projects yet their input in the business case is not available. This affects the planning and execution for the project as was seen in the case studies. Furthermore, it was seen that the client lacked project specific experience and this affected their planning and shaping of the project strategy.

Project environment: revision of the concept formulation process

Early involvement of project participants

The early appointment of project participants is considered important to deal with the problem of poor decision-making due to lack of requisite skills and knowledge in the project formative stages. The early involvement of contractors and other consultants will be useful in preparing for the project in terms of budgets, project scopes and schedules and thus help eliminate the conducive environment for time and cost overruns observed in the case studies.

Integration of the concept formulation process

The project management strategy is that both design and construction professionals be involved at design and construction stage as shown in Figure 12.4. This will lead to improved project supply chain management as well as project delivery as all the critical steps, methods of construction and availability of resources will be pre-viewed and essential risk management strategies and mitigation measures be formulated. This forms part of the decision support system required in the formulation of the procurement options which also consider the synergising of the operational sub-systems up-front as observed by Kumaraswamy, Love, Dulaimi and Rahman (2004).

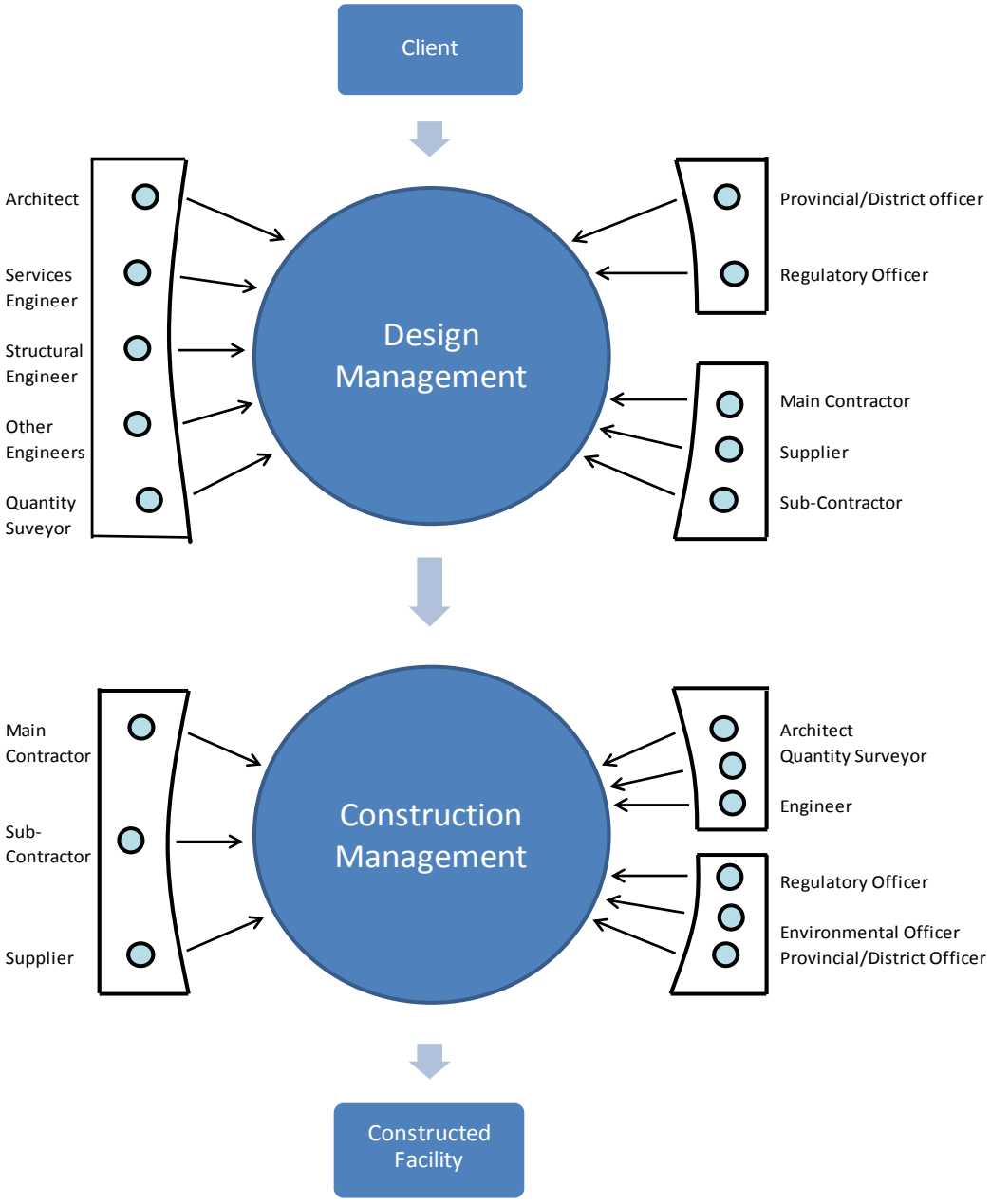


Figure 12.4 Proposed project management participant involvement

Teamwork and consolidated effort

The results showed that there was a lack of teamwork and collaboration amongst project participants in the overrunning projects. They also showed a lack of a unified approach to risk management of the project at large. The client concentrated on the environmental risks and left the construction risks to the contractor who got involved in the project much later after the project concept had been finalised.

The primary reason for lack of teamwork and collaboration was seen to be the divide between design and construction and the orientation to discipline isolation in design and construction solutions.

The solution, therefore, entails having a concept formulation process that will involve all the participants together under initial concept development and detail concept development. The project participants, who are not identified on the basis of their disciplinary names but on the roles that they play, work together to conceive the project character and plan. The implementation of this solution is further described and discussed under Section 12.3. This will ensure that it is not only the environmental risks that are considered in the front-end, but also construction risks (Akintoye & Mcleod, 1997).

The focus of the risk management approach would then be, not only to minimise the impact or transfer to other parties, but also to reduce or eliminate them. A preliminary risk plan is formulated by the *project implementation organisation*, which the bidding team develops further at initial, and detail concept development phases outlined in Figures 12.5 and 12.6.

12.3 Proposed Implementation of the Solution

The major components of the solution were discussed above. To demonstrate how the implementation process could proceed, the procurement process and the concept formulation process are used to describe how the proposal could be carried out.

The procurement implementation process is depicted in figure 12.5 and the concept formulation process is shown in Figure 12.6. The numbers highlighted in orange in Figure 12.5 relate to the steps shown in the complimentary Figure 12.6.

The procurement process starts with the establishment of the need in the client's organisation, then the appointment of the *project implementation organisation* (step 1) who defines the preliminary scope, environmental and risk management plans (see Figure 12.5). The implementation organisation requests from the Project Risk Management Agency (PRMA) approval and then from the National Treasury in the case of public organsations as

recommended in the SIPDM (2015). This will be followed by step 2, requests of interest and proposals from organisations. Step 3 is the submission of initial concepts from joint venture or

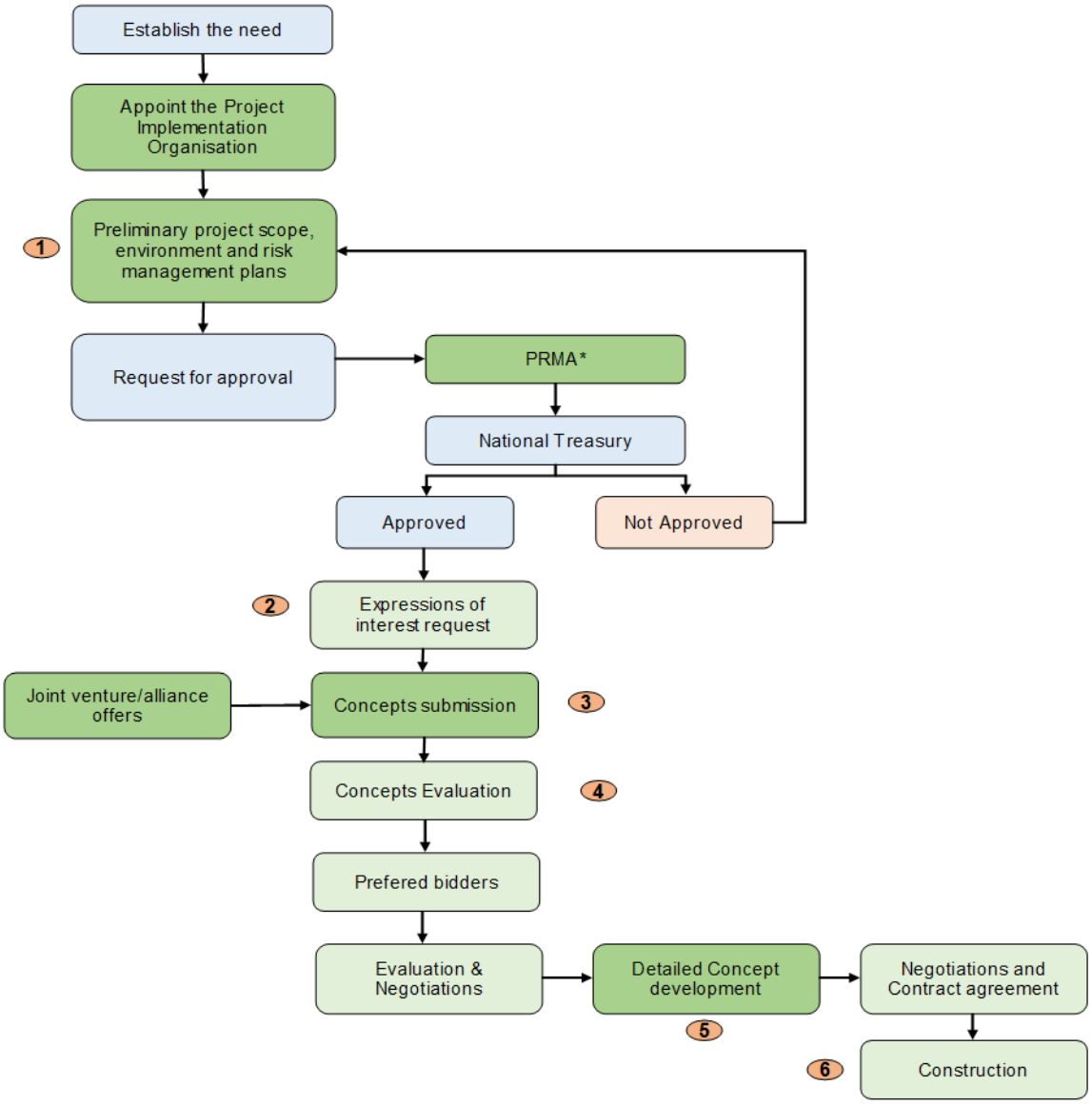


Figure 12.5 Large projects procurement process

*PRMA stands for Project Risk Management Agency

alliance partners further highlighted in Figure 12.6. Step 4 is the evaluation of offers and selection of preferred bidders which may involve some negotiations. This would be followed by step 5, the development of a detailed concept and step 6, construction of the project.

In the concept formulation process, the task of the *project implementation organisation* would initially be to set up the preliminary project scope. The next would be to invite expressions of interest from consortia or joint ventures or organisations in a loose alliance, to formulate an initial project concept. Once the concept is evaluated and accepted, it would be

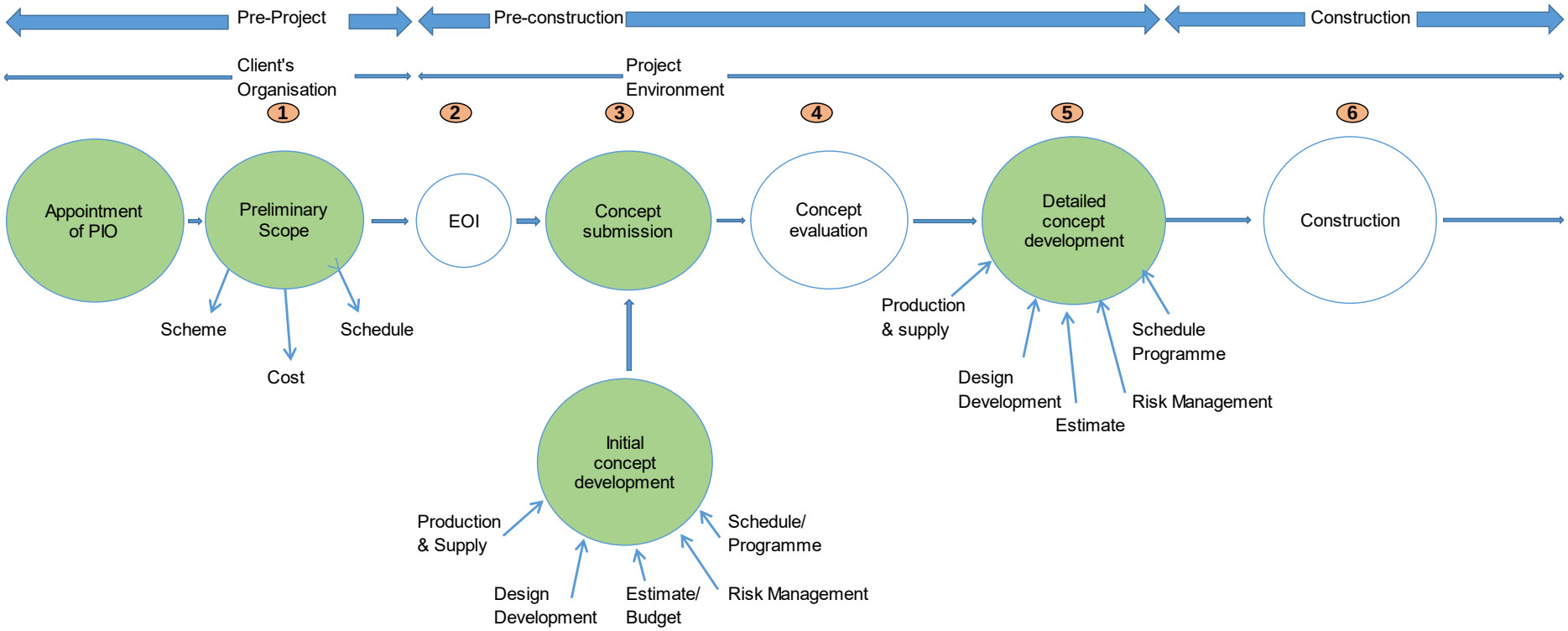


Figure 12.6 Concept formulation process

developed further and then approved for construction. These are shown in Figure 12.6 as steps 1 and 2 respectively. At step 1, the outputs from the process are the scheme concept, the budget and schedule or programme. These would provide the initial information which the bidders will use at step 3.

In Figure 12.6 the deliverables rather than the professional names of the participants are identified to de-emphasize the delivery approach based on professional affiliations. Similar to the design and construct, and public private partnership arrangements, these participants prepare and submit the initial project concept, broadly delineating the project technically and financially at step 3. Step 4, the *project implementation organisation* evaluates the initial concepts and selects the preferred bidders at step 5. The preferred bidders then develop the detailed concept which after negotiations leads to step 6, construction of the project.

The measures proposed are in line with the National Treasury Standard for Infrastructure Procurement and Delivery Management (SIPDM) Section 4, Control Frameworks, which seeks to promote value for money and efficiency in the procurement of infrastructure projects. The principles advocated in the SIPDM include stages and gates for control of procurement flow with emphasis on proceeding only after approval or gate review and use of competitive tendering.

12.4 Validation of Proposed Project Management Strategy

Validation of the research results and the *project management strategy* was done through the method of triangulation using case studies, documentary analysis and questionnaires. In case studies and documentary analysis, firstly, results from the typical overrunning case were confirmed in the literal replication case studies which showed that the factors that led to time and cost overruns and the management approach of the typical case study were similar with the replication studies. Secondly, the non-overrunning case studies, using theoretical replication, showed the absence of those factors seen in the overrunning projects. They also showed the management approach that led to improved performance in these projects. Furthermore, the successful projects were instrumental in the formulation of the final proposal having had components of the suggested solution as part of the project strategies.

The questionnaire was used as a benchmark for confirming the general nature of the results from the case studies. The general factors that lead to overruns were confirmed. The questionnaire also provided insights into the methods that could be used to improve the management of projects and reduction of overruns from the views of the respondents.

Chapter 13 Conclusions and Recommendations

13.1 Management of Large Projects and Occurrence of Time and Cost Overruns

The recurrent problem of time and cost overruns on *large projects* has been noted by many practitioners and scholars over the years and several studies carried out (Dahl et al 2017; Merrow, 2011; Morris & Hough, 1987; Mukuka et al, 2015, Senouci et al 2016). Most have attempted to understand by investigating singular, independent causes or most significant factors that lead to time and cost overruns. However, not many have attempted to understand in depth, the actuality of why and how time and cost overruns develop in large projects (Love et al, 2014), and how a holistic view of the problem would provide understanding of the interaction of the various variables leading to time and cost overruns (Ahiaga-Dagbui et al 2015).

There is therefore an incomplete theory and understanding of the phenomenon of time and cost overruns (Love et al, 2016) as conventional research has not taken account of human factors which could explain project behaviour that leads to time and cost overruns (Ackermann & Alexander, 2016). This has affected the approach to project management strategies and solutions proposed. To fill in the identified knowledge gap, this research was carried out in South Africa using a mixed research method of case studies and a questionnaire survey. This was to gain a holistic understanding of the forces and factors at play in the management of *large projects* in South Africa and how they lead to time and cost overruns.

The main aim of the research was to understand how the actions of a project team affect the delivery of the project and to develop a project management strategy to manage these projects. The specific objectives were to study the nature of large projects, investigate the root cause of time and cost overruns on large construction projects in South Africa, investigate how a project team plans and executes projects and then formulate a project management strategy the client can use to improve the delivery of large projects and reduce time and cost overruns. This was successfully addressed in the research and further areas of study were recommended.

The methodology was to investigate the problem in case studies and then use questionnaires to understand how to generalize the results in South Africa. In the case studies, the approach was to identify a typical overrunning large project by using causal mapping to understand how the project team managed the project, and how time and cost overruns were incurred on the project. This was followed by identification and investigation of other overrunning projects for literal replication to see whether they would confirm the results in the typical case study and then generation of a potential solution to the problem. The next stage

was the investigation of better performed projects, non-overrunning projects for theoretical replication to see whether they would confirm the opposite of what was observed in the overrunning project. Simply, whether they would prove the theory generated from the overrunning projects or not. The results helped in the generation of the final proposed solution.

The final part was the questionnaire survey to understand generally, in South Africa, how large projects are managed and what are considered to be the factors that lead to time and cost overruns and poor performance on large projects in South Africa. The results were also used to understand the accuracy of the proposed solution in comparison with the view of the project professionals.

Outcome of investigation

How actions of the project team affected project delivery

From the study of overrunning projects, it was observed that project teams took certain actions that affected the delivery of the projects. These actions were in response to external factors.

Firstly, the project team spent a considerable amount of their time managing external factors; the government, the local community and media resistance against the project.

Secondly, the government and local community resistance delayed the uptake of the commencement of the project. This delayed the team in the selection and identification of project sites which in turn affected the project teams' adoption of feasibility studies, preparation and completion of design concepts.

Thirdly, the projects had fixed completion dates and in response, the project teams instituted acceleration measures and ignoring of phase/gate reviews and investigation of alternative project solutions before deciding. Due to pressure of lack of time, they adopted short-cuts to project planning and execution.

The results of the investigation showed how the actions of the project team affected the delivery of the project. The results also showed the factors or the reasons that made the project teams take such actions or behave in that particular way. In most cases, decisions made in the past by external entities such as the government and decisions made in the higher levels of the client organisation, had an effect in the way the project was effected and how it was managed by the project team. Thus, the results give an indication or understanding of why and how the project teams managed the project in this particular way. This, therefore, gave insight into understanding the interaction of historical and external factors on project participant behaviour and its influence on project delivery which is important in devising solutions to project delivery improvement. This in a way, answers the concerns of Ahiaga-

Dagbui et al (2015) and Love et al (2016) of the need for project management research to understand the actuality of projects to enable the formulation of solutions to the project management problems.

The results add knowledge to the management of large projects. Already in 1984, Tatum (1984) had found that project teams use intuition rather than rationalisation in decision-making. In this research, it was found that the project team's decision-making was affected by external pressure of lack of time, insufficient budgets and negative pressure from the public, media and local community. The project teams made short-cuts in designing feasibility studies in the procurement process and how they prepared and used project management principles. Often, in the overrunning projects, due to pressure of lack of time and insufficient budget, the project team did not adequately prepare for the project and did not use project management principles. This was also compounded by their lack of project specific experience which affected their ability to carry out the projects. On the other hand, the better performed projects, whilst they had pressure from the community, project start was not delayed, project teams were better prepared and they used project management principles. This was found to be because, the client, the development manager, the project manager and consultants had project specific experience. Furthermore, they instituted a structured management of the project and used teamwork to enforce performance as opposed to reliance on contracts for enforcement used by the overrunning projects teams.

There were, however, two situations with conflicting results. The first was that in comparing results from the overrunning and non-overrunning case studies, it was found that in one overrunning project, the client's project manager had instituted prudent and high level structured project management principles and regulations, but the project still incurred time and cost overruns. The second was that the same contractor had worked in one project which overrun and in the other project which was better executed. From the interviews, it was learnt that the same principles of proactive risk management, teamwork and avoidance of delays the contractor instituted on the better project were also instituted on the overrunning project. Whilst the answer may not be conclusive and may require further research, this was indicative of the interactivity of the causes of overruns and why a holistic understanding of the whole project situation is important as advised by Ackerman and Alexander (2016) and Ahagia-Dagbui et al (2015).

It was found in the first case that by the time productive project management principles were instituted by the project executing team, the seeds of overruns had already been planted due to project start delay, insufficient budgets and lack of project specific experience both in design evolution and project management. This equally applied in the second case. The prudent management of the contractor helped in mitigating the poor results but was not

sufficient to stop them altogether not only because the seeds had been planted but also because the contractor came in later when the design solution and management strategy had already been established by the client and consultant, who in this case lacked the experience of designing and managing a project of this nature.

The results from the research also established that the collective competence of the client, the development manager, the project manager, the consultants and the contractor is at the heart of the success or failure of the project as postulated in the conceptual framework in Chapter 1. This collective competence, which largely impacts the eventual project team's response, strategies and preparation for the project, was found to be influenced by the external environment, the organisation environment and the project environment. It was found to be affected by the qualifications and experience of the client, the client's representative or development manager, the project manager, other consultants and the contractor. This in turn, influenced how the project team responded to the external influences, as discussed earlier, and how they prepared for a project, the strategies and actions they adopted to manage it. It was also found that the behaviour of project participants was often altered by circumstances such as shortage of time, public pressure, delayed start of the project, the national importance of the project and the negative sentiments from media and other bodies. This made them often take short-cuts to ensure the speedy delivery of the project which unfortunately led to incomplete designs, failure to carry out thorough feasibility studies, higher tenders, constructability problems and eventual time and cost overruns.

The nature and management of large projects in South Africa

From the results, the nature of large projects was that these are multi-disciplinary living organisations with several interactive elements in constant motion that require to be managed. Unlike, smaller projects, these require experienced and high-level skills to manage them due to their complexity, multi-disciplinary, multi-organisational and large resource requirements. Large projects, although not viewed as a distinct class on their own, therefore, merit separation and study on their own as earlier observed by Loots (2013). *Large projects* were considered to be those costing more than R100m. Respondents were of the view that 8 out of 10 *large projects* compared to 6 out of 10 small projects have time and cost overruns in South Africa which concurs with 9 out of 10 on large transport projects in Europe (Flyvbjerg, 2011).

From the questionnaire survey, most respondents were of the view that large projects are managed and should be managed differently compared to small projects indicating that time and cost overruns may not be due to large projects being managed the same way smaller projects are managed. Furthermore, the results from the questionnaire survey showed that most respondents were of the view that large public projects are managed poorly compared

to private projects. The case studies however showed that even public projects could be successfully implemented and private projects poorly executed and result in time and cost overruns on the project. This suggests that time and cost overruns on large projects may not be due to whether the project is public or private.

How the project team plans and executes large projects in South Africa

The results showed that the involvement of the client as well as the experience and competence of the consultants contributed significantly to the management of projects. It was found that where the client and the rest of the project team had project specific experience, project teams prepared for projects and used project management principles consistently. Where the experience was lacking, project teams were ill-prepared and did not use project management principles consistently.

It was also found that implementation of risk management practices was not project-wide. The client and consultants concerned themselves with environmental risks and left the construction risks to the contractor which affected the wholesale planning and execution of project risks. Furthermore, incidences of power games in behaviour of team members, optimism bias and overconfidence were found which affected the budget estimates and preparation for the projects.

The results also showed that training, qualifications and experience of the client and the rest of the project team affected the competence of the team and the eventual execution of the project. Furthermore, it was found that most team members lacked a project-wide broad-view understanding of the project due to the industry-wide training practice that limits their understanding to their areas of specialisation. This affected the planning and execution of large projects which are complex with diverse yet inter-linked components managed by different expertise. The delay or readiness of one component in both design and construction potentially leads to stress or delay of the other. This was commonly seen not only amongst consultants, but also between consultants and contractors and amongst different contractors.

Competitive tendering is commonly used by the client in the industry to select both consultants and contractors. Furthermore, the procurement practice commonly used on large projects is that of design-bid-construct. Both these practices affect the employment of teamwork between the competing parties as well as the eventual involvement of participants on the project engagement path in the project lifecycle, eventually affecting the project team in preparing and implementing the projects.

The results also showed that there was a concentration of technical fields in the design and management of large projects leaving out other equally important roles such as communication and public management. The results confirm observations in previous studies

of unbalanced concentration of technical skills in the training of industry participants (Cywinski, 2009, Edum-Fotwe, 2000, Ramazani & Jergeas, 2015). This affected how teams managed public resistance and perception of the project.

The results showed that outsourcing, far-spaced large project activities, work cultural dynamics and external influences such as trade unions and public pressure affected worker productivity as well as how the project teams managed projects in South Africa.

The root cause of time and cost overruns

The root cause of time and cost overruns in large infrastructure projects in South Africa was found to be, (1) lack of project specific experience by the project team due to insufficient numbers of large projects and often far-spaced apart, (2) external and organisation environment decisions in the far and immediate past as well as in the higher organisational levels of the client which affected the project start, project approval and project funding, (3) pressure and resistance from the public as well as from other external environment factors which affected project start and, in combination with the other two factors, led the project team to use short-cuts in their delivery of projects resulting into incomplete designs and consequently, time and cost overruns, and (4) change requirements from the stakeholders often in combination with lack of project specific experience leading to time and cost overruns.

All these factors stem from the external environment. These led to poor preparation by the client and the consultant teams and, inconsistent use of project management principles by the project team. In general, the effects of the external factors were shortage of time to design and construct, project start delays, insufficient budgets, incomplete designs, higher tenders and constructability problems. The results show that the factors such as incomplete designs and design changes often cited as the root cause of overruns in previous research were found to be effects of the root cause in this research, confirming the results from Flyvbjerg (2011).

Rather than singular factors working in isolation, the results showed that there were many inter-relationships amongst the originating causes as well as amongst the effects suggesting that the root cause of time and cost overruns happened before incomplete designs or incomplete tender documents. The implication of this on the management of projects is that, the recommendation often made by scholars on the problem of time and cost overruns for the client or consultants to complete designs or avoid design changes, fails to address the real problem.

From the case study results, it has been established that the problem of time and cost overruns has vertical and horizontal dimensions. Vertical, being from the external environment to the organisation and then the project environment, and, horizontal being in the far and the immediate past to the present. From the questionnaire survey, the overruns were seen to be

mostly caused by factors in the organisation and project environment, or by actions of participants, which is the commonly held view in previous research (AlSehaimi et al, 2013). Therefore, an integrated management of the external, organisation and project environment is important for the client to successfully manage large projects and reduce time and cost overruns.

Proposed strategy

The results from both the case studies and questionnaire survey suggest that an effective management strategy for *large projects* to reduce time and cost overruns needs to incorporate the management of the external, organisation and project environments. The strategy can in summary be described as:

External Environment

- Institution of a policy to regulate numbers of large projects in South Africa
- Establishment of a project implementing organisation (PIO)
- Establishment of a Project Risk Management Agency

Organisation Environment

- Appointment of the PIO
- Increased role of the PIO in client's organisation

Project Environment

- Revision of project procurement process
    - Early participant involvement
    - Integration of project concept formulation
    - Teamwork and consolidated effort

The proposal is aimed at addressing the client's relevant experience, obtaining early collaboration and consideration of project risks and constructability in the formulation and execution of large projects.

13.2 Novelty of the Research

The novelty of this research is that it gives a detailed view of how time and cost overruns develop in a large project and how the interrelatedness of the causes and effects together lead to time and cost overruns. The research provides a fresh insight on an old problem using an intensive research method of case studies and questionnaires to understand how a project team's approach and management could lead to overruns. Most previous studies sought to determine or confirm the most significant causes of delay on projects in general (Love et al 2016). Fewer studies examined this problem in the context of *large construction projects*.

The uniqueness of this research was that, unlike many studies which focussed on identifying the significant and singular factors of delay on construction projects in general using opinion surveys (see the review by AlSehaimi et al, 2013), a mixed research strategy of case studies of actual projects and industry wide questionnaire survey was used in this research. This enabled a detailed and holistic understanding of forces at play in the large project environment and how they interact leading to time and cost overruns. The information provided is useful in advancing the knowledge of the theory of time and cost overruns causation which is important in understanding the root cause of time and cost overruns and of the management of large construction projects. The results provide a strategy for clients to improve the delivery of these projects.

The major contributions of this research to knowledge of management of *large projects* were:

1) Contributed knowledge to the theory of how time and cost overruns are caused in projects. By using a combination of documentary analysis, interviews and questionnaire surveys, the research has conveyed a rich understanding of the root cause of overruns and how the various environments impact on the project team's management of the project. This understanding is useful in formulating and executing project and management strategies with holistic interventions.
2) Contributed to the knowledge of how large projects should be managed by proposing a project management strategy that can be used by a client.

Other contributions of the research were:

1) Actual projects were investigated, both overrunning and better performed projects to reveal the conditions in the macro and micro project environments that facilitate the occurrence of overruns. This provided empirical evidence of how the circumstances in the project environment, which include the actions of the project team, contribute to the occurrence of time and cost overruns in large projects.
2) Traditionally, the approach used in studying project delays and time overruns is opinion or questionnaire surveys. This method has been criticised for its inability to help identify the root cause of the problem (Love et al, 2016, Ramanathan et al 2011). In this research, a combined approach of case study and questionnaire surveys was used which helped in carrying out an in-depth study using the dualistic approach that is important for construction management research

13.3 Implications for Project Management Strategy Formulation

The results from the case studies and questionnaire survey suggest that the management of *large projects* involves not only the management of the project environment but the management of the parent organisation as well as the external environment. The results also suggest that time and cost overruns begin in the external environment then extend into the organisation and project environments. The results imply that the potential solution to reducing overruns in large infrastructure projects may not reside in effecting improved techniques in the project environment but in perfecting the whole process from the macro to the micro project environment. Thus, having a project management strategy that integrates the various processes in the macro and micro project environment which improves effective delivery of large projects.

The results suggest further that the project team's preparation for a project, teamwork and consolidated effort, use of project management principles and management of construction project risks lead to improved execution of the project as seen in the better performed case studies. This is enhanced by the experience of the client, the consultant and contractor. It implies that a successful strategy needs to consider the management of: the experience of project participants, the preparation process for the client and participants, the teamwork process and the construction project risks which require early appointment of project participants. The results also showed the interplay of factors from the external to the organisation and eventually, to the project environment. Furthermore, the drivers of time and cost overruns originate from the external environment into the organisation and then into the project environment.

The proposed strategy thus entails management of the external, organisation and project environments to improve the competence in both the project formulation and execution processes. It incorporates the management of the experience of project participants and organisations, the management of project team preparation, teamwork and the execution process from the macro to the micro-project environment. At the macro project environment, it was seen that insufficient repetition of large projects leads to lack of organisational and individual project experience. The strategy at this level is aimed at policy level to coordinate the volumes of large projects in the country and encouragement of labour intensive methods. The other part is the setting up of a project implementation organisation (PIO) as well as a projects risk management agency (PRMA) to improve project formulation and project risk management competence in the implementation of large projects. At the micro-project management level, the strategy is aimed at managing the lack of experience in the client organisation, late involvement of project experts and lack of teamwork and collaboration in the project team. The strategy at this level is aimed at improving the project formulation process

by appointing a project implementation organisation (PIO) to work in the client's organisation in the business case and at board room level, as well as revision of the concept formulation process by incorporating early involvement of project experts, integration of the project formulation process, teamwork and consolidated effort.

13.4 Limitations of the research

Time and financial constraints were the major limitations in this study. Therefore, only a few projects were investigated in the case studies. The projects were purposively selected and limited to five to enable an in-depth investigation of the phenomenon of time and cost overruns on large projects. To deal with the limitation, the questionnaire survey was used to generalise the case study results to the whole of South Africa. Not all project participants were available for the interviews, but in all cases, it was sought to have representation from the three categories of client, consultant and contractor to have a balanced view of the results.

Furthermore, the research was confined to infrastructure construction projects in South Africa. It is, however, believed that the results are applicable to other countries in SADC and elsewhere in the world.

Finally, the proposed management strategy was not tested in the industry. Ideally, the opinions of the government institutions and professionals should be sought to test the practicality of the PIO and PRMA. It is proposed that this be taken up in further research.

13.5 Suggestions for Further Research

The setting up of a project implementation organisation was recommended to improve the project experience and competence in the macro project environment. It was, however, not possible, due to time constraints, to investigate further whether the implementation organisation should be set up at national or regional/provincial level as well as whether the organisation should be mono or multi-specialism based. Further research work is recommended to determine the best mode of implementation for South Africa.

In the same manner, a projects review institution called Project Risk Management Agency (PRMA) was proposed to house both the environmental impact assessment and project/construction risk assessment and management components. The research however, did not go further to investigate the merits and demerits of having a combined entity of environmental impact assessment and project risks assessment and management or having a separate project risks assessment and management entity altogether. It is therefore recommended that further research work be carried out.

In the micro-project environment, at the request proposal stage, the level of information that would be required from the bidders and the number of parties to be chosen as preferred bidders was not determined. It is recommended that further research be carried out to determine the level of detail and the numbers of preferred bidders required.

Lastly, the review of literature has revealed consistently that the problem of time and cost overruns has been persistent in spite of much research carried out over the years (Klakegg & Lichtenberg, 2016). From the investigation in this research of how many respondents read journals, it was found that less than 6% read journals. Most read magazines such as Construction News, Engineering News and information they get from their organisation through emails and work-related correspondence. It is recommended to investigate further whether there could be a link between the lack of reading of research journals by practising project implementers and the persistence of the problem.

References

Abdul-Rahman, H., Berawi, M.A., Berawi, A. R., Mohamed, O., Othman, M. & Yahya, I. A. 2006. Delay mitigation in the Malaysian construction industry. *Journal of Construction Engineering and Management*. 132(2): 125-133.

Abdul-Rahman, H., Takim, R. & Min, W. S. 2009. Financial-related causes contributing to project delays. *Journal of Retail and Leisure Property* 3(3): 225-238.

Abdul-Rahman, H., Wang, C., Takim, R. & Wong, S. 2010. Project schedule influenced by financial issues: evidence in construction industry. *Scientific Research and Essays*, 6:205-212.

Abdul-Rahman, H., Yahya, I.A., Berawi, M.A.& Wah, L.W. 2008. Conceptual delay mitigation model using a project learning approach in practice. *Construction Management and Economics*, 26: 15-27.

Abubaker, A. E., Greenwood, D. & Osborne, A. 2008. A study of project planning on Libyan construction projects. In *24th Annual ARCOM Conference*, Cardiff, edited by Dainty, A. (London: Association of Researchers in Construction Management), 789-798.

Ackermann, F. & Alexander, J. 2016. Researching complex projects: using causal mapping to take a systems perspective. *International Journal of Project Management*. 34: 891-901.

Ahiaga-Dagbui, D. D., Smith, S. D., Love, P. E. D. & Ackermann, F. 2015. Spotlight on construction cost overrun research: superficial, replicative and stagnated. In *Proceedings of 31st Annual ARCOM Conference,* edited by Raiden, A. & Aboagye-Nimo. (Association of Researchers in Construction Management).

Aibinu, A. A. & Odeyinka, A. 2006. Construction delays and their causative factors in Nigeria. *Journal of Construction Engineering and Management*. 132(7): 667-677.

Aibinu, A. A. & Jagboro, G. O. 2002. The effects of construction delays on project delivery in Nigerian construction industry. *International Journal of Project Management*. 20: 593-599.

Alaghabari, W., Kadir, M. R. A., Salim, A. & Ernawati. 2007. The significant factors causing delay in building construction projects in Malaysia. *Engineering, Construction and Architectural Management*. 14(2): 192-206.

Al-Khalil, M.I. & Al-Ghafly, M.A. 1999. Important causes of delay in public utility projects in Saudi Arabia, *Construction Management and Economics*. 17(5): 647-655.

Al-Kharashi, A. & Skitmore, M. 2009. Causes of delay in Saudi Arabian public sector construction projects. *Construction Management and Economics*. 27(1): 3-23

Al-Momani, A.H. 2000. Construction delay: a quantitative analysis, *International Journal of Project Management*. 18: 51-59.

AlSehaimi, A., Koskela, L. & Tzortzopoulos, P. 2013. The need for alternative research approaches in construction management: the case of delay studies. *Journal of Management in Engineering*. 29: 407-413.

Anderson, D.K. & Merna, T. 2003. Project management strategy - project management represented as a process based set of management domains and the consequences of project management strategy. *International Journal of Project Management.* 21: 387-393.

Arditi, D., Akan, G. T. & Gurdamar, S. 1985. Reasons for delay in public projects in Turkey. *Construction Management and Economics*. 3: 171-181.

Assaf, S. A. & Al-Hejji, S. 2006. Causes of delay in large construction projects. *International Journal of Project Management.* 24: 349-357.

Assaf, S. A. & Al-Khalil, M. 1995. Causes of delay in large building construction projects. *Journal of Management in Engineering*. 11(2): 45-50.

Association of Construction Project Manager membership. [Online], available: http://www.acpm.co.za. [2015, September, 22].

Association of Project Management. 2000. *Association of Project Management Body of Knowledge*. 4th Edition. High Wycombe: APM.

Atkinson, R 1999. Project management: cost, time and quality, two best guesses and a phenomenon, it's time to accept other success criteria. *International Journal of Project Management.*17(6): 337-342.

Auchamp, P.T. 2009. *Environmental Impact Assessment: A Practical Guide for the Discerning Practitioner*. Pretoria: Van Schaik.

Babbie, E. 2014. *The Basics of Social Research*. *6th Edition*. California: Wadsworth.

Baldry, D. 1998. The evaluation of risk management in public sector capital projects. *International Journal of Project Management.* 16(1):35-41.

Baloi, D. & Price, A.D.F. 2003. Modelling global risk factors affecting construction cost performance. *International Journal of Project Management.* 21: 261-269.

Baloyi, L. & Bekker, M. 2011. Causes of construction cost and time overruns: The 2010 FIFA world cup stadia in South Africa, *Acta Structilia.* 18(1): 51-67.

Barry, M-L. & Uys, L. 2011. An investigation into the status of project management in South Africa. *Journal of Industrial Engineering*. 22(1): 29–44.

Bourne, L. & Walker, D.H.T. 2004. Advancing project management learning in organizations. *The Learning Organization.* 11(3): 226-243.

Boyatzis, R. 1982. *The Competent Manager: A Model for Effective Performance*. New York: John Wiley and Sons.

Bredillet, C., Tywoniak, S. & Dwivedula, R. 2015. What is a good project manager? An Aristotelian perspective. *International Journal of Project Management.* 33: 254-266.

Brynard, D.J., Hanekom, S.X. & Brynard, P. A. 2014. *Introduction to Research. 3rd Edition*. Pretoria: Van Schaik.

BS 6079. 1996. *Guide to Project Management.* London: British Standards Institution.

BS ISO 10006. 1997. Quality Management – Guidelines to Quality in Project management. London. British Standards Institution.

Buganza, T., Kalchschmidt, M. Bartezzaghi, E. & Amabile, D. 2013. Measuring the impact of a major management education programme: the PMP case in Finmeccanica. *International Journal of Project Management*. 31: 285-298.

Busby, J.S. & Payne, K. 1999. Issues of organisational behaviour in effort estimation for development projects. *International Journal of Project Management*. 17(5): 293-300.

Capka, J.R. 2004. Mega-projects are a different breed. *Public Roads*: July/August.

Ceran, T. Dorman, A. A. 1995. The complete project manager. *Journal of Architectural Engineering.* 1: 67-72.

Challal, A. & Tkiouat, M. 2012. Identification of causes of deadline slippage in construction projects: state of the art and application. *Journal of Science Service and Management.* 5: 151–159.

Chan, D. W. M. & Kumaraswamy, M. M. 1997. A comparative study of causes of time overruns in Hong Kong construction projects. *International Journal of Project Management*. 15(1): 55-63.

Chapman, C. & Ward, S. 2003. *Project Risk Management: Processes, Techniques and Insights*. Chichester: Wiley.

Charrette, R. N. 1996. Large scale project management is risk management. *IEEE Software*. 13(4): 110-117.

Cicmil, S., Williams, T., Thomas, J. & Hodgson, D. 2006. Rethinking project management: researching the actuality of projects. *International Journal of Project Management*. 24(8): 675-686.

Clarke, A. 1999. A practical use of key success factors to improve the effectiveness of project management. *International Journal of Project Management*. 17(3): 139-145.

Cova, B. & Holstius, K. 1993. How to create competitive advantage in project business. *Journal of Marketing Management*. 9(2): 105-121.

Concise Oxford English Dictionary 2008. Oxford: University Press.

Cooper, D. R. & Schindler, P. S. 2008. *Business Research Methods, 10th Edition*. Singapore: McGraw Hill.

Crawford, L. 2000. *Project management competence for the new millennium* [Online], available: http://www.researchgate.net/publication/237648165_Project_Management_competence_for_the_New_Millenium. [2015, December 02].

Crawford, L. 2005. Senior management perceptions of project competence. *International Journal of Project Management.* 23: 337-342.

Crawford, L., Morris, P., Thomas, J. & Winter, M. 2006. Practitioner development: from trained technicians to reflective practitioners. *International Journal of Project Management.* 24: 722-733.

Creswell, J. R. 2013. *Qualitative Inquiry and Research Design: Choosing Among Five Approaches*. London: Sage

Creswell, J. R. 2014. *Research Design: Qualitative, Quantitative and Mixed Methods Approaches, 4th Edition*. Los Angeles: Sage.

Cywinski, Z. 2004. How to teach sustainable structural engineering. *Structural Engineering International*. 3: 190-191.

Cywinski, Z. 2009. Discussion of “General education for civil engineers: sustainable development,” by William Kelly. *Journal of Professional Issues in Engineering Education and Practice.* 134: 75-83.

Dahl, R. E., Lorentzen, S., Oglend, A. & Osmundsen, P. 2017. Pro-cyclical petroleum investments and cost overruns in Norway. *Energy Policy*. 100: 68-78.

Darke, P., Shanks, G. & Broadbent, M. 1998. Successfully completing case study research: combining rigour, relevance and pragmatism. *Information Systems Journal*. 8: 273-289.

Davidson, F.P. & Huot, J-C 1989. Management trends for major projects. *Project Appraisal*. 4(3): 133-142.

Dawson, C. 2009. *Introduction to Research Methods*. Oxford: How to Books.

Department of Energy. 2015. *State of Renewable Energy in South Africa*. Pretoria: Department of Energy.

Dlakwa, M. M. & Culpin, M. F. 1990. Reasons for overrun in public sector construction projects in Nigeria. *Project Management.* 8: 237–241.

Dvir, D. 2005. Transferring projects to their final users. The effect of planning and preparation for commissioning on project success. *International Journal of Project Management.* 23: 256-265.

Doloi, H., Sawhney, A. & Iyer, K. C. 2012. Structural equation for investigating factors affecting delay in Indian construction projects. *Construction Management and Economics*. 30(10): 869-884.

Doloi, H., Sawhney, A., Iyer, K. C. & Rentala. S. 2012. Analysing factors affecting delays in Indian construction projects. *International Journal of Project Management.* 30(4): 479-489.

Eberhard, A. Kolker, J. & Leigland J. 2014. *South Africa's Renewable Energy IPP Procurement Program: Success Factors and Lessons.* Washington: Public Private Advisory Facility.

Edum-Fotwe, F. T. & McCaffer, R. 2000. Developing project management competency: perspectives from the construction industry. *International Journal of Project Management.* 18: 111-124.

Egan, J. 1998. *Rethinking Construction: Report of the Construction Task Force*. London: HMSO.

Eizakshiri, F., Chan, P. W. & Emsely, M. 2011, Delays, what delays? A critical review of the literature on delays in construction. In *Proceedings 27th Annual ARCOM Conference*, Bristol, edited by Egbu, C. and Lou, E. C. W. (Association of Researchers in Construction Management). 839–848.

Elinwa, A. U. & Joshua, M. 2001. Time overrun factors in Nigeria construction industry. *Journal of Construction Engineering and Management*. 127(5): 419-425.

Elmuti, D, 2003. The perceived impact of outsourcing on organisational performance. *Mid-America Journal of Business*. 18(2): 33-41.

El-Razek, M. E. A., Bassioni, H. A. & Mobarak, A. M. 2008. Causes of delay in building projects in Egypt. *Journal of Construction Engineering and Management.* 134(11): 831-841.

El-Sabaa, S. 2001. The skills and career path of an effective project manager. *International Journal of Project Management.* 19: 1-7.

Endsley, M.R. 1995. Toward a theory of situation awareness in dynamic systems. *Human Factors.* 37(1): 32-64.

Engwall, M. 2003. No project is an island: linking projects to history and context. *Research Policy.* 32(5): 789-808.

Enshassi, A. & Al-Najjar, J. 2009. Delays and cost overruns in the construction projects in the Gaza strip. *Journal of Financial Management of Property and Construction.* 14(2): 126-151.

Esty, B.C. 2004. Why study large projects? An introduction to research on project finance. *European Financial Management.* 10(2): 213-224.

Fallahnejad, M. H. 2013. Delay causes in Iran gas pipeline projects. *International Journal of Project Management.* 31: 136-146.

Fard, K. D. 2012. The pathology of the execution of the budget allocated to development projects out of the national budget – a case study on the budget of the development projects of Tehran Province. *Interdisciplinary Journal of Contemporary Research in Business.* 4(7): 733-741.

Faridi, A.S. & El-Sayeh, S.M. 2006. Significant factors causing delay in the UAE construction industry. *Construction Management and Economics.* 24(11): 1167-1176

Fellows, R. & Lui, A. 2008. *Research Methods for Construction*. Chichester: Blackwell.

Flyvbjerg, B. 2006. Five misunderstandings about case study research: *Qualitative Inquiry*. 12(2): 219-245.

Flyvbjerg, B. 2011. Over budget, over time, over and over again. Managing major projects in Morris, P.W.G. and Pinto, J.K. (eds.), *The Oxford Handbook of Project Management* by Oxford University Press: 321-344.

Flyvbjerg, B; Bruzelius, N. & Rothengatter, W. (2003), *Megaprojects and Risk: An Anatomy of Ambition.* Cambridge: Cambridge University Press.

Flyvbjerg, B., Holm, M. K. S. & Buhl, S. L. 2004. What causes cost overruns in transport infrastructure projects? *Transport Reviews*. 24(1): 3-18.

Fowler, F.J. 2009. *Survey Research Methods*. Los Angeles: Sage Publications.

Frimpong, Y., Oluwoye, J. & Crawford, L. 2003, Causes of delay and cost overruns in construction of groundwater projects in a developing country: Ghana as a case study. *International Journal of Project Management.* 21: 321-326.

Gareis, R. 1989. Management by projects: the management approach for the future. *International Journal of Project Management.* 7(4): 243-249.

Gray, C. F. & Larson, E. W. 2008. *Project Management: The Managerial Process. 4th Edition*. New York: McGraw-Hill.

Gharehbaghi, K. & McManus, K 2003. The construction manager as a leader. *Leadership in Management Engineering.* 3: 56-58.

Giezen, M. 2012. Keeping it simple? A case study into the advantages and disadvantages of reducing complexity in mega project planning. *International Journal of Project Management.* 30: 781-790.

Groenveld, G. D. 2006. The way forward for the South African construction industry: an analysis with project management solutions. Unpublished MBA thesis. Stellenbosch: Stellenbosch University.

Halloum, M. A. & Bajracharya, A. 2012. Cost and time overruns revisited. A study on infrastructure projects in AbuDhabi, UAE in *3rd International Conference on Construction in Developing Countries*. Bangkok. July 4-6.

Harding, J. 2013. *Qualitative Data Analysis from Start to Finish*. London: Sage.

Hartman, F. 2008. Preparing the mind for dynamic management. *International Journal of Project Management.* 26: 258-267.

Hartman, A. & Dorée, A. 2015. Learning between projects: more than sending messages in bottles. *International Journal of Project Management.* 33: 341-351.

Hart, Chris. 2005. Innovation in construction: a sociology of technology approach. *Building Research and Information.* 33(6): 512-522.

Hatush, Z., Saleh, S. & Shiki, A. 2005, Effect of critical delay factors on cost-overrun during the design stage. In *21st Annual ARCOM Conference*, University of London, edited by Khosrowshashi, F. (London: Association of Researchers in Constriction Management). 2: 885-892.

Hennirik, M., Hutter, I., & Bailey, A. *Qualitative Research Methods.* London: Sage.

Hodder & Stoughton. 1984. *Holy Bible. New International Version*. London: British Library.

Hofstee, E. 1998. *Constructing a Good Dissertation*. Sandton: EPE.

Holt, G. D., Olomolaiye. P. O. & Harris, F. C. 1995. A review of contractor selection practice in the UK construction industry. *Building and Environment*. 30(4): 553-561.

Hwang, B-G., Zhao, X. & Ng, S. Y. 2013, Identifying the critical factors affecting schedule performance of public housing projects. *Habitat International.* 38: 214-221.

Introduction to SACPCMP. [online], available: http://www.sacpcmp.org.za. [2015, September, 22].

Jaafari, A. 2004. Modelling large projects in Morris, P.W.G. & Pinto, J.K. (eds) *The Wiley Guide to Managing Projects.* New Jersey: John Wiley and Sons Inc.

Jamali, D. 2004. Success and failure mechanisms of public private partnerships (PPPS) in developing countries: insights from Lebanon. *The International Journal of Public Sector Management.* 17 (5): 414-430.

Jennings, W. 2012. Executive politics, risk and the mega-projects paradox. ESRC Research. Manchester: University of Manchester.

Jergeas, G. F. & Ruwanpura, J. 2010. Why cost and schedule overruns on mega oil sand projects? *Practice Periodical on Structural Design and Construction, ASCE*. 40-43.

Kagioglou, M., Cooper, R. & Aouad, G. Re-engineering the UK construction Industry: the process protocol. [Online], available: http://www.researchgate.net/profile/Mike_Kagioglou/publication/242078115_RE-ENGINEERING_THE_UK_CONSTRUCTION_INDUSTRY_THE_PROCESS_PROTOCOL/links/0deec532888a592f1b000000.pdf. [2015, November 20].

Kagioglou, M., Cooper, R., Aouad, G. &Sexton, M. 2000. Rethinking construction: the generic design and construction process protocol. *Engineering, Construction and Architectural Management*. 7(2): 141-143.

Kaliba, C. Muya, M. & Mumba, K. 2009, Cost escalation and schedule delays in road construction projects in Zambia. *International Journal of Project Management.* 27: 522–531.

Katz, R.L. 1974. Skills of an effective administrator. *Harvard Business Review*. 52(5): 90-102.

Klakegg, O. J. & Lichtenberg, S. 2016. Successive cost estimating – successful budgeting of major projects. *Proceedia – Social and Behavioral Sciences*. 226: 176-183.

Kvale, S. 2007. *Doing Interviews*. London: Sage.

Kazaz, A., Ulubeyli, S. & Tuncbileki, N. A. 2012. Causes of delays in construction projects in Turkey. *Journal of Civil Engineering and Management*. 18(3): 426-435.

Koushki, P. A., Al-Rashid, K. & Kartam, N. 2005. Delays and cost increases in the construction of private residential projects in Kuwait. *Construction Management and Economics*. 23: 285-294.

Krima, N., Aouad, G. & Baldry, D. 2005. An assessment model – the efficiency of consultants when dealing with delays in construction projects in Libya in *21st Annual ARCOM Conference.* London: University of London. 1: 23–32.

Krima, N. A., Wood, G., Aouad, G. F. & Hatush, Z. 2007. Assessing the performance of Libyan supervising engineers. *Construction Economics and Management.* 25(5): 509–518.

Kumaraswamy, M., Love, P. E. D., Dulaimi, M. & Rahman, M. 2004. Integrating procurement and operational innovations for construction industry development. *Engineering, Construction and Architectural Management*. 11(5): 323-334.

Kuo, V. 2012. The role of knowledge management in improving constructability. Unpublished master's thesis. Stellenbosch. Stellenbosch University.

Latham, M. 1994. *Constructing the Team*. London: HMSO.

Lee, J. C. & McCalman, D. 2008. Japanese management approaches: the fit for project management. *International Journal of Project Management.*25(3):584-594.

Le-hoai, L., Lee, Y. D., Lee, J. Y. 2008. Delay and cost overruns in Vietnam large construction projects: a comparison with other selected countries. *KSCE Journal of Civil Engineering*. 12(6): 367-377.

Leshem, S. & Trafford, V. 2007. Overlooking the conceptual framework. *Innovations in Education and Teaching International*. 44(1): 93-105.

Lin, Y. & Lui, S. 2011. Small and large projects: their dynamics and which ones to take. *Kybernetes*. 40(9): 1354-1372.

Long, D. N., Ogunlana, S., O. & Lan, D. T. X. 2004a. A study on project success factors in large construction projects in Vietnam. *Engineering, Construction and Architectural Management.* 11(6): 404–413.

Long, D. N., Ogunlana, S., Quang, T. & Lam, K. C. 2004b. Large construction projects in developing countries: a case study from Vietnam. *International Journal of Project Management.* 22: 553-561.

Loo, R. 2002. Working towards best practices in project management: a Canadian study. *International Journal of Project Management.* 20: 93-98.

Loots, P. 2013. Contractual mechanisms for managing construction costs in LNG and other major energy projects, unpublished paper delivered in 37th National Conference. Adelaide: South Australia. 16-19 October.

Love, P. E. D., Ahiaga-Dagbui, D. D. & Irani, Z. 2016. Cost overruns in transportation infrastructure projects: sowing the seeds for a probabilistic theory of causation. *Transportation Research Part A*. 92: 184-194.

Love, P. E. D., Edwards, D. J., Irani, Z. & Walker, D. H. T. 2009. Project pathogens: the anatomy of omission errors in construction and resource engineering project. *IEEE Transactions on Engineering Management*. 56(3): 425-435.

Love, P. E. D., Holt, G. D. & Li, H. 2002. Triangulation in construction management research. *Engineering, Construction and Architectural Management*. 9 (4): 294-303.

Love, P. E. D., Smith, J., Simpson, I., Regan, M. & Olatunji, O. 2014. Understanding the landscape of overruns in transport infrastructure projects. *Environment and Planning B: Planning and Design.* 41: 1-20.

Lundin, R. A. & Söderholm, A. 1995. A theory of the temporary organisation. *Scandinavian Journal of Management*. 1(4): 437-455.

Mansfield, N., R, Ugwu, O. O. & Doran, T. 1994, Causes of delay and cost overruns in Nigerian construction projects. *International Journal of Project Management.* 12(4): 254-260.

Mantshantsha, S. Eskom costs balloon again. *Financial Mail*. [Online]. Available: http://www.financialmail.co.za/features/2016/06/24/eskom-costs-ballon-again. [2016, September, 17].

Margerison, C. 2001. Team competences. *Team Performance Management: An International Journal*. 7(7/8): 117-122.

Mbachu, J. & Nkado, R. 2007. Factors constraining successful building project implementation in South Africa. *Construction Management and Economics.* 25(1): 39-54.

McCaffer, R. & Harris, F. 2001. *Modern Construction Management. 5th Edition*. Oxford: Blackwell Science.

Mehdi-Riazi, S., Skitmore, S. & Cheung, Y. K. F. 2011. The use of supply chain management to reduce delays: Malaysian public sector construction projects in *Proceedings of the 6th Nordic Conference on Construction Economics and Organisation Society*. Copenhagen: Aalborg University. 2: 95-96.

Merrow, E.W. 2011, *Industrial Megaprojects: Concepts, Strategies and Practices for Success*. Hoboken, New Jersey: John Wiley and Sons.

Merzher, T. & Tawil, W. 1998. Causes of delays in the construction industry in Lebanon. *Engineering, Construction and Architectural Management*. 5(3): 252-260.

Miller, R. & Lessard, D. R. 2000. *The Strategic Management of Large Engineering Projects*. Cambridge: MA MIT Press.

Miller, R. & Lessard, D. R. 2008. Evolving strategy: risk management and the shaping of mega-projects in Priemus, H., Flyvbjerg, B. & Van Wee, B. (eds.) *Decision-Making on Mega-Projects: Cost-Benefit Analysis, Planning and Innovation*. Cheltenham: Edward Elgar.

Mitropoulos, P., Abdelhamid, T. S. & Howell, G. A. 2005. Systems model of accident causation. *Journal of Construction Engineering and Management.* 131(7): 816-825.

Morris, P.W.G. 1989. Initiating major projects: the unperceived role of project management. *International Journal of Project Management.* 7(3): 180-185.

Morris, P.W.G. 2013. The trajectory of project management: why using EPOS is important. *The Engineering Project Organisation Journal*. 13(2): 66-70.

Morris, P.W.G & Geraldi, J. 2011. Managing the institutional context for projects. *Project Management Journal*. 42(6): 20-32.

Morris, P.W.G. & Hough, G.H. 1987.*The Anatomy of Major Projects: A Study of the Reality of Project Management*. Chichester: John Wiley and Sons.

Morris, P.W.G., Crawford, L., Hodgson, D., Shepherd, M.M. & Thomas, J. 2006. Exploring the role of formal bodies of knowledge in defining a profession – the case of project management. *International Journal of Project Management.*24(8): 710-721.

Morris, S. 1990, Cost and time overruns in public sector projects. *Economic and Political Weekly.* 25(47): M154-M168.

Mukuka, M., Aigbavboa, C. & Thwala, W. 2015. Effects of construction project schedule overruns: a case of the Gauteng Province, South Africa. *Procedia Manufacturing.* 3: 1690-1695.

Muller, R. & Turner, R. 2010. Leadership competency profiles of successful project managers. *International Journal of Project Management.* 28: 437-448.

Murray, M. 2010. An investigation into programme management risks. Unpublished doctoral dissertation. Johannesburg: University of Witwatersrand.

Muriithi, N. & Crawford, L. 2003. Approaches to project management in Africa: implications for international development projects. *International Journal of Project Management.* 21(5): 309-319.

Myddelton, D.R. (2007), *They Meant Well.* London: Institute of Economic Affairs.

Napier, N.J., Keil, M. & Tan, F.B. 2009. IT project managers' construction of successful project management practice: a repertory grid investigation. *Information Systems Journal*. 19(3): 255-282.

Nguyeni, L.D., Ogunlana, S. O. & Lan, D.T.X. 2004a. A study on project success factors in large construction projects in Vietnam. *Engineering, Construction and Architectural Management.* 11(6): 404-413.

Nguyeni, L.D., Ogunlana, S.O., Quang, T. & Lam, K.C. 2004b. Large construction projects in developing countries: a case study from Vietnam. *International Journal of Project Management*. 22: 553-561.

Ninham Shand (Pty) Ltd & Eskom Ltd, 2009. *Environmental impact assessment process: proposed coal fired power stations and associated infrastructure in the Waterberg, Limpopo: Final scoping report.* [Online]. Available: http://www.earthlife.org.za/www/wp-content/uploads/2013/09/0903_coal-3_Enviornment_Scoping_FSR-FSR-Mar-09.pdf. [2016, September, 17].

Nkado, R. N. & Mbachu, J. C. 2008. Causes and solutions to client dissatisfaction in the South African building industry: the client's perspectives. *RICS Education Trust.* unpublished research.

Odeh, A.M. & Battaineh, H.T. 2000. Causes of construction delay: traditional contracts. *International Journal of Project Management.* 20: 67-73.

Odusami, K. T., Lyagba, R. R. O. & Omirin, M. M. 2003, The relationship between project leadership, team composition and construction project performance in Nigeria. *International Journal of Project Management.* 21: 519–527.

Ogunlana, S. O. & Olomolaiye, P. O. 1989. A survey of site management practice on some selected sites in Nigeria. *Building and Environment.* 24(2): 191–196.

Okuwoga, A. A. 1998, Cost-time performance of public sector housing projects in Nigeria. *Habitat International.* 22(4): 389–395.

Olawale Y. A. & Sung, M. 2010. Cost and time control of construction projects: inhibiting factors and mitigating measures in practice. *Management and Economics*. 28: 509-525.

Olatungi, A.A. 2010.Influences on Construction Project Delivery Time. Unpublished doctoral dissertation. Port Elizabeth: Nelson Mandela Metropolitan University.

Olima, W. H. A & K'akumu, O. A. 1999. The problems of project implementation: a post-mortem study of Thika Dam project, Kenya. *Habitat International.* 23(4): 467-479.

Oyedele, L. O. & Tham, K. W. 2005. Examining architects' performance in Nigerian private and public sectors building projects. *Engineering, Construction and Architectural Management*. 12(1): 52-68.

Oyedele, L. O. & Tham, K. W. 2007, Client's assessment of architects' performance in building delivery process: evidence from Nigeria. *Building and Environment.* 42: 2090-2099.

Othman, A. A., Torrance, J. V. & Hamid, M. A. 2006. Factors influencing the construction time of civil engineering projects in Malaysia. *Engineering, Construction and Architectural Engineering Management*. 13(5): 481-501.

Packendorff, J. 1995. Inquiry into the temporary organisation: new directions for project management research. *Scandinavian Journal of Management*. 11(4): 319-333.

Pant, I & Baroudi, B. 2008. Project management education: the human skills imperative. *International Journal of Project Management*. 26: 124-128.

Papke-Shields, K.E., Beise, C. & Quan, J. 2010. Do project managers practice what they preach and does it matter to project success? *International Journal of Project Management.* 28: 650-662.

Petersen, N. 1991. What do we know about the effective project manager? *Project Management*. 9(2): 99-104.

Phua, F. T. T. & Rowlinson, S. 2003. Cultural differences as an explanatory variable for adversarial attitudes in construction industry: the case of Hong Kong. *Construction Management and Economics.* 21(7): 777-785.

Pinto, J. K. 2010. *Project Management: Achieving Competitive Advantage*. *2nd Edition*. Upper Saddle River: Pearson.

Pinto, J. K. & Covin J. G. 1989. Critical factors in project implementation: a comparison of construction and R & D projects. *Technovation.* 9: 49-62.

Project Management Talent Gap Report. 2003. Project Management Institute.

Project Management Institute. 2004. *A Guide to the Project Management Body of Knowledge (PMBOK Guide). 3rd Edition*. Pennsylvania: Project Management Institute.

PMSA membership. [Online], available: http://www.pmsa.site-ym.com/?page=origins [2015, September, 22].

PMI. 2008. Annual Report. Project Management Institute.

PMI. 2001. *Project Manager Competence Development Framework Exposure Draft*. [Online], available: http://www.solutionsgpcmg.com/PMCDF_Exposure_draft.pdf. [2015, December, 03].

Ramanathan, C., Narayanan, S. P. & Idrus, A. B. 2012, Construction delays causing risks on time and cost – a critical review. *Australasian Journal of Construction Economics and Building.* 12: 37–57.

Ramazani, j. & Jergeas, G. 2015. Project managers and the journey from good to great. The benefits of investment in project management training and education. *International Journal of Project Management.* 33: 41-53.

Rowley, J. & Slack, F. 2004. Conducting a Literature Review. *Management Research News*. 27(6): 31-39.

Ribeiro, F.L. & Ferreira, V. L. 2010. Using knowledge to improve preparation of construction projects. *Business Process Management Journal*. 16(3): 361-376.

Robson, C. 2011. *Real World Research*. Oxford: Blackwell.

Rocco, T. S. & Plakhotnik, M. S. 2009. Literature reviews, conceptual frameworks and theoretical frameworks: terms, functions and distinctions. *Human Resources Development Review*. 8(1): 120-130.

Schwalbe, K. 2007, *Information Technology Project Management, 5th Edition*. Thomson Course Technology, Boston.

Senouci, A., Ismail, A. & Eldin, N. 2016. Time delay and cost overrun in Qatari public construction projects. *Procedia Engineering.* 164: 368-375.

Shealth, D.M., Woolley, H., Cooper, R., Hinks, J. & Aouad, G. 1996. *A process for change – The development of a generic design and construction process protocol for the UK construction industry*. [Online]. Available: http://www.processprotocol.com/pdf/incit96.pdf [2012, August 12].

Shenhar, A. J. 2001. One size does not fit all projects: exploring classical contingency domains. *Management Science.* 47(3): 394-414.

Shenhar, A. & Dvir, D. 1996. Toward a typological theory of project management. *Research Policy. 25: 607-632*.

Shepherd, M. & Atkinson, R. 2011. Project management bodies of knowledge, conjectures and refutations. *The Electronic Journal of Business Research Methods.* 9(2): 152-158.

Siemiatycki, M. 2016. The making and impacting of a classic text in mega project management: the case of cost overrun research. *International Journal of Project Management*. [Online]. Available: http://dx.doi.org/10.1016/j.ijproman.2016.07.003. [2016, July 07].

Simbasivan, M. & Soon, Y.W. 2007. Causes of delay in Malaysian construction industry. *International Journal of Project Management*. 25: 517-526.

Smith, C. & Winter, M. 2010. The craft of project shaping. *International Journal of Managing Projects in Business*. 3(1): 46-60.

Söderlund, J. 2002. On the development of project management research: schools of thought and critique. *International Project Management Journal.* 8(12): 20-31.

Söderlund, J. 2004. Building theories of project management: past research, questions for the future. *International Journal of Project Management.* 22(3): 183-191.

Steyn, H. 2009, Why are capital projects often late and over-spent? Putting the puzzle together. *Essays Innovate*. No. 3, University of Pretoria.

Sweis, G., Sweis, R., Hammad, A. & Shboul, A. 2008. Delays in construction projects: case of Jordan. *International Journal of Project Management*. 26: 665-674.

Tah, J.H.M. & Carr, V. 2000. Information modelling for a construction project risk management system. *Engineering, Construction and Architecture Management.* 7(2): 107-119.

Tai, S. W. & Anumba, C. J. 2009. A survey on communications in large-scale construction projects in China. *Engineering, Construction and Architectural Management*. 16(2): 136-149.

Tatum, C. B. 1984. Organizing large projects: how managers decide. *Journal of Construction Engineering and Management*. 110(3): 346-358.

The Department of Energy. 2015. *State of renewable energy in South Africa.* Pretoria.

Thomas, J. & Mengel, T. 2008. Preparing project managers to deal with complexity – advanced project management education. *International Journal of Project Management*. 26: 304-315.

Toor, S.U. & Ogunlana, S.O. 2008. Problems causing delays in major construction projects in Thailand. *Construction Management and Economics*. 26(4): 395-408.

Turner, J. & Müller, R. 2003. On the nature of the project as a temporary organization. *International Journal of Project Management*. 21: 1-8.

Vilasini, M., Neitzert, T.R., Rotimi, J.O.B. and Windapo, A.O. 2012. A framework for sub-contractor integration in alliance contracts. *International Journal of Construction Supply Chain Management*. 2(1): 17-33.

Walker, D. H. T. 1997. Choosing an appropriate research methodology. *Construction Management and Economics*. 15: 149-159.

Wearne, C. 2008. Stakeholders in excellence in teaching and learning of project management. *International Journal of Project Management*. 26: 326-328.

Whittaker, B. 1999. What went wrong? Unsuccessful information technology projects, *Information Management and Computer Security.* 7(1): 23–29.

Winch, G 1989. The Construction firm and the construction project: a transaction cost approach in *ARCOM Research Methodology Conference.* Manchester: University of Manchester Institute of Science and Technology.: 331-345.

Winter, M., Smith, C. Morris, P. & Cicmil, S. 2006. Directions for future research in project management: the main findings of a UK government-funded research network. *International Journal of Project Management*. 24(8): 638-649.

Wirth, I. 1992. The project-management education: current issues and future trends. *International Journal of Project Management*. 10(1): 49-54.

Yin, R. 2013. *Case Study Research: Design and Methods*. Los Angeles: Sage.

Yin, R. 2014. *Case Study Research: Design and Methods. 5th Edition*. Los Angeles: Sage.

Zaneldin, E. K. 2006. Construction claims in United Arab Emirates: types, causes, and frequency. *International Journal of Project Management*. 24(5): 453-459.

Appendix A Case Study Protocol

Typical Case Study Protocol – Power Plant

A Overview of the case study

The aim of the case study was to investigate the management of the design and construction process from inception up to project handover. The project is current or ongoing/completed. It was desired to see the factors that may have led to project time and cost overruns and whether these are the same as observed in literature and the other case studies.

This case study was chosen because it is one of the largest projects embarked on in South Africa. The value of the project is about R118bn. The other reasons are that that it has experienced time and cost overruns and is of major significance to the country. The project was also chosen to investigate the theoretical replication logic from the stadium case study.

The research proposition was that by preparing and consistently using project management principles by the client, time and cost overruns on large projects can be reduced. The reverse is that poor preparation and inconsistent use of project management principles by the client leads to poor project delivery and ultimately time and cost overruns.

B Data Collection Procedures

Data is to be collected by the researcher: S Simushi.

Data Collection Plan

- Initial review of preliminary information, July/August, 2014
- Type of evidence expected:
  - Reports, minutes, interviews
- Access procedures:
  - Contact former CMP student :Ms..
  - Travel to project, interview and collect information
  - Get permission to research
- Data collection period
  - August/September 2014 depending on the schedules from power plant personnel and management
    - Planned 18-30 August, 2014
    - Actual 8-19 September, 2014
- Persons interviewed
  - Executing team personnel
  - Contractors personnel
- Prior preparation for fieldwork
  - Review of articles and other documents on project. Specifically, documents written by personnel on the project, reports, minutes, information sheets, on-line web information
- Establishing logistics
  - Writing pads, pens, stapler and paper puncher, files
  - Getting a quiet place to write up observations and other notes:
    - Office/desk at plant project office
    - Accommodation near the site

D Data collection questions

- Concept/initiation of the project
  - When did the project start? Who initiated it? What was the estimate? When was it planned to be carried out?
  - What management structure was used on the project? What effect did it have on the project?
  - What was involved in the client's/consultants' preparation for the project? How prepared was the client/consultant for the project?
  - At what point was the consultant brought in? How was he selected?
  - Which consultants were involved? What was their experience?
- Design development
  - When did detail design commence? Who was responsible? How long did it take? Was duration sufficient? Did duration go as planned? If not, reasons? Consultant done similar work before? Individual experience. Comments on client's brief, clarity? Any problems with client's brief?
  - Any challenges during design development? Qualifications and experience of consultants? Any issues?
  - Did the client have a deliberate project management strategy? What was the consultant's strategy? Project manager's strategy?
  - Was the design completed? Before tender? During tender? During construction?
  - Any design changes? Before tender? During construction? What were the reasons?
- Construction management
  - When did the tendering process begin? How long was it? How was the contractor selected? When did the contractor get involved in the project? When did he move on site?
  - When was work planned to start? What was the actual start date? Any reasons for the difference? What was the contract price/tender sum? Comparison with feasibility figure? Comments?
  - Experience on contractor's supervision of work (by consultant/contractor)? Experience with quality of work and competence of constructors (artisans and contractor organisation). Productivity?
  - Any changes to the work? Reasons?
  - When was the work completed? What was the planned completion date? What was the final project cost?
  - Any cost overruns? What were the reasons?
- Selection of the site
  - How was the site selected? Any problems encountered in this process? How were they resolved? Did the problems affect the project in any way?
- Decision making
  - How was decision making in the client's organisation? How was it in the project manager's organisation? In the project management process? Were there any delays due to decision-making? Examples?

D Guide for the case study report

- International journal of Project Management/Journal of Construction and Architectural Engineering/SABINET
- PhD research committee/supervisor/civil engineering department requirements
- Give a list of documents/data forming part of the report:
  - Audio interviews
  - Written transcripts

    - Documents
- List of persons/organisations interviewed or targeted:
    - Design personnel
    - Contracts personnel
    - Construction personnel
- Chronology of events leading to project start and completion
- Exhibit to be developed: Logic of events leading to time and cost overruns

Appendix B Case Study Guide

1. **Personal data**
    - names and position of the interviewee
    - position in the project
    - information on qualifications and experience
    - information on journals and other literature of interest
2. **Project specific issues**
    - information on organisation structure (project)
        - what form of structure was used: dedicated team, matrix
        - who communicated with community, press and outsiders?
        - how was the project affected by the form of structure used?
    - consultant involvement:
        - start and end dates,
        - bidding duration
        - criteria of appointment of project manager, what was their experience/background
    - experience on design of the works
        - done similar work before? (individual, organisation)
        - clarity of information from concept, communication to and from other consultants
        - challenges in design work, materials, products availability, site factors, project type factors
        - duration of design process. as planned? how was the duration arrived at?
        - any changes to design and reasons
    - experience of project members
        - was experience/qualification any factor in members' execution of the works?
        - were these two factors of any influence on time and cost overruns on the project?
    - involvement of the client on the project
        - who was client's representative, their experience and qualifications, project management experience?
        - how involved was the client in the project? how did this affect the project?
    - project management
        - principles were followed?
            - design
            - construction
        - any guides available for contract formulation, were they followed?
        - was there a deliberate strategy from client's side, consultant's side? contractor's side?
    - preparation for the project
        - in your opinion, how prepared was:
            - the client?
            - the consultant?
            - the contractor?
        - if not, what was not attended to?
        - what things would you consider necessary to prepare for a project such as this one?

- Tendering process
  - how long was the process? did it proceed as planned?
  - how was the contractor selected?
- construction and installation
  - when did the contractor get involved in the project? did this affect the project in any way?
  - experience on supervision of construction work
  - comments on quality of work and competence of constructors (artisans and contractor)
  - any changes to works and reasons
  - start and completion dates? achieved? If not, reasons.
  - construction costs, achieved as planned? If not, reasons.
  - If there were overruns on the project, which elements were the most affected? what would you consider the major source of these overruns?
- selection of the site
  - any problems encountered with site selection?
  - how were these resolved? did these problems affect the project in any way?
- decision making
  - how would you describe decision making process in the client's organisation?
  - how would you describe the project manager's decision making process?
- were there any delays due to decision making? examples?

Appendix C Questionnaire Survey Questions

1. **Indicate the sector of the industry in which you work**
   - ○ Public
   - ○ Private

2. **Please indicate the number of years the organisation has been operational**
   - ○ Up to 5yrs
   - ○ 5 to 10yrs
   - ○ 10 to 20yrs
   - ○ More than 20yrs

3. **Pease indicate your highest qualifications**
   - ○ Matric certificate
   - ○ Diploma
   - ○ Bachelor's degree
   - ○ Master's degree
   - ○ Doctorate
   - ○ Others, please specify:

4. **In which category of the construction professions do you belong?**
   - ☐ Owner organisation
   - ☐ Architect
   - ☐ Engineer
   - ☐ Project Manager
   - ☐ Quantity Surveyor
   - ☐ Construction Manager
   - ☐ Contractor/Builder

5. **Please state your current position in the organisation**

6. **Please, indicate your years of experience in the industry**
   - ○ Up to 5yrs
   - ○ 5 to 10yrs
   - ○ 10 to 20yrs
   - ○ More than 20yrs

7. **Please, indicate the number of years you have worked with your current employer**
   - ○ Up to 5yrs
   - ○ 5 to 10yrs
   - ○ 10 to 20yrs
   - ○ More than 20yrs

8. **How would you describe a large project?**
   - [ ] Financially large
   - [ ] Large project size
   - [ ] Geographically spread
   - [ ] Complex project
   - [ ] Other:

9. **Financially, how would you define large projects (e.g. exceeding ...)**

10. **What is your general view of the owner's management of large projects in South Africa?**
    - ( ) Successful
    - ( ) Not successful

11. **Please explain your answer to the question above**

12. **On a scale of 1 to 5 below where would you put large projects in South Africa?**

Failed Projects		Barely Successful		Successful projects
( )	( )	( )	( )	( )
1	2	3	4	5

13. **On a scale of 1 to 5 below, where would you put small projects?**

Failed Projects		Barely Successful		Successful Projects
( )	( )	( )	( )	( )
1	2	3	4	5

14. **What would you describe as successful projects:**
    - [ ] Completed on time
    - [ ] Completed within budget
    - [ ] Met quality requirements
    - [ ] Satisfied client
    - [ ] Others, please specify:

15. **What is your view of the management of public and private projects?**
    - ( ) Similar
    - ( ) Not similar

16. **Please state any reasons for your answer to the question above**

17. **Please state, from your observation, how large and small projects are managed:**
    - ( ) Large projects are managed the same way small projects are managed
    - ( ) Large projects are not managed the same way small projects are managed
    - ( ) Other:

18. Please state your view on project size and the way it is managed:

- ○ The size of the project affects the way it is managed
- ○ The size of the project does not affect the way it is managed
- ○ Other:

19. Please state, in your view, how large projects should be managed:

- ○ Large projects should be managed the same way small projects are managed
- ○ Large projects should not be managed the same way small projects are managed
- ○ Other:

20. Please state any reasons for your answer above on how projects large/small should be managed

21. Please cite some large projects, which in your view, have been well managed

22. Please cite some large projects, in your view, that have not been managed well

23. What is your opinion of the experience, training and qualifications of project participants for large projects in South Africa?

- ○ Adequate
- ○ Inadequate

24. Please give any reasons for your view in the last question above

25. Out of 10 projects, in your opinion, how many large projects would you say have time and cost overruns in South Africa?

26. Out of 10 projects, in your opinion, how many small projects would you say have time and cost overruns in South Africa?

27. Out of 10 projects, in your opinion, how many public projects would you say have time and cost overruns in South Africa?

28. Out of 10 projects, in your opinion, how many private projects would you say have time and cost overruns in South Africa?

29. In your opinion, has the problem of time and cost overruns been solved?

- Yes
- No
- Not sure

30. Please state any reasons for your answer to the question above

31. What would you consider to be the major causes of time and cost overruns on large projects in South Africa?

32. What would you consider to be some of the effects of time and cost overruns on large projects in South Africa?

33. Please indicate three most significant factors or methods that could be used to help overcome the problem of time and cost overruns in South Africa

34. **From your experience with large projects in South Africa, please indicate your view of the involvement of the client in the management of the project**

- ☐ The client is sufficiently involved
- ☐ The client is not sufficicentl;y involved
- ☐ Other:

35. **Please state any reasons for your answer to the question above**

36. **What factors/situations require of the client to be more involved?**

37. **What factors/situations require of the client to be less involved?**

38. **Please indicate below, by ticking the appropriate box(es), at what stage in the project cycle, the stakeholders are involved in the project**

	Inception	Feasibility	Detailed Design	Construction	Commissioning
Client	☐	☐	☐	☐	☐
Project Manager	☐	☐	☐	☐	☐
Architect	☐	☐	☐	☐	☐
Civil Engineer	☐	☐	☐	☐	☐
Structural Engineer	☐	☐	☐	☐	☐
Services Engineer	☐	☐	☐	☐	☐
Quantity Surveyor	☐	☐	☐	☐	☐
Geo-tech Engineer	☐	☐	☐	☐	☐
Contractor	☐	☐	☐	☐	☐
Specialist Contractor	☐	☐	☐	☐	☐
Supplier	☐	☐	☐	☐	☐
Land Surveyor	☐	☐	☐	☐	☐
Property/Valuation Surveyor	☐	☐	☐	☐	☐

39. **Please indicate below, by ticking the appropriate box(es), at what stage in the project cycle, the stakeholders should be involved in the project**

	Inception	Feasibility	Detailed Design	Construction	Commissioning
Client	☐	☐	☐	☐	☐
Project Manager	☐	☐	☐	☐	☐
Architect	☐	☐	☐	☐	☐
Civil Engineer	☐	☐	☐	☐	☐
Structural Engineer	☐	☐	☐	☐	☐
Services Engineer	☐	☐	☐	☐	☐
Quantity Surveyor	☐	☐	☐	☐	☐

Geo-tech Engineer	☐	☐	☐	☐	☐
Contractor	☐	☐	☐	☐	☐
Specialist Contractor	☐	☐	☐	☐	☐
Supplier	☐	☐	☐	☐	☐
Land Surveyor	☐	☐	☐	☐	☐
Property/Valuation Surveyor	☐	☐	☐	☐	☐

UNIVERSITEIT STELLENBOSCH UNIVERSITY

40. In your opinion, do project participants in large projects in South Africa use project management principles consistently?

- ○ Yes
- ○ No

41. Please explain any reasons for the answer to the question above

42. In your opinion, are there any project management inadequacies in the project participants?

- ○ Yes
- ○ No
- ○ Not sure

43. If the answer to the previous question above on inadequacies was, 'Yes,' where would you say most inadequacies are

- ☐ Owner organisations
- ☐ Consultants
- ☐ Contractors
- ☐ Sub-contractors
- ☐ Suppliers
- ☐ Others, please specify:

44. Please explain any reasons for the answer to the question above

45. Please state below any recommendations for improving the management of large projects in South Africa

Thank you for taking the survey.

Appendix D Causes of Time and Cost Overruns

	What would you consider to be the major causes of time and cost overruns on large projects in South Africa?
	Same
	1. Late information and design changes 2. Labour disruptions
	Client not fully familiar with the scope of work and the necessary requirements to complete a planned project.
	Inaccurate BOQ's
	Poor planning. Poor controls.
	scope changes
	Similar reasons to above plus shrewd contractors bidding low with exclusions that they use to nail the client. An experienced professional can weed out this contractors if they are involved with the adjudication process and their recommendations are implemented correctly
	IR
	Same as above, lack of timeous information from the professional teams, as well as the wrong contractor being appointed on public projects.
	Too many Scope changes
	To many players that need to share in the proceeds. Power of the trade unions.
	Many and complex causes. Most significant come from scope definitions and business plans. Poorly conceived projects with clear business plans lead to scope changes, scope creep and consequently cost overruns. Also delays in conceiving and defining the project, then results in time pressure to deliver quickly, with insufficient time spent on early project stages. The biggest influences on project costs occur at the start of the project. Too little time is spent on early stages.
	Labour demands Planning and control
	As above
	Scope definitions and skills
	Design
	Managed the traditional way
	Incomplete design and errors in quantities
	Corruption
	Insufficient planning Major change in scope
	same as above
	Same as above
	no upfront planning and scope

	What would you consider to be some of the effects of time and cost overruns on large projects in South Africa?
	Project costs more than it should and is completed too late
	The projects are late and over budget
	Impact on people who should benefit from the project. People are negatively affected when service delivery is not on time as planned.
	Unhappy clients who possibly paid the correct amount but was misinformed by the original tender value
	Culture of leniency or acceptability of overruns.
	not applicable
	client not paying the contractor on time inadequate scope definition inadequate or incorrect delivery time frames incompetent contractors e.g. For Kusile and Medupi penalties for late delivery have been applied bankrupting some contractors and contractors using welders that do not follow quality procedures required by the client. Contractors using young inexperienced engineers to work on the project. how difficult is it to turn a turbine using steam? Casual approach by global companies to deliver projects in South Africa
	In the power industry, insufficient power generation capacity for the country's needs.
	so many. late in handing over and being occupied, cost the tax payer so much more than should have.
	More money is being spent and the Tax payer eventually pays for this misuse
	Lowers the growth of the country
	Waste of tax payers money. Electricity shortages Water shortages...to become critical in the near future.
	Poor design quality
	Margin erosion
	Resourcing issues and lengthy periods of plant and people stay on longer on a project
	Managed the trading way
	Extension of time with cost Disputes, Claims and arbitration
	delays to commissioning of the projects
	The major one for me is Labour unrest and the currency value
	Define the scope and get the contractor up front involve and then do proper planning.
	Service delivery gets delayed because fiscal resources are concentrated into one project

Appendix E Ways of Reducing Time and Cost Overruns

	Please indicate three most significant factors or methods that could be used to help overcome the problem of time and cost overruns in South Africa
	Competent Employer staff supervising the project Advance the information timeously (to also avoid changes)
	Proper scope of work definition Proper tender evaluation of at least three tenders received based on technical competence and not necessarily on lowest bidder Proper project execution planning
	Make use of the Contractors knowledge at time of setting up BOQ's for tenders.
	Better planning during early stages. Proper implementation of monitoring and control systems Comprehensive stakeholder engagement throughout project
	Adequate front end loading of projects leaning from our shortfalls Having a good mix of new entrants, mid tier experienced individuals and highly experienced individuals with skills transfer taking place across the board
	Better management of resources.
	1. Better planning by the owner and his professional team 2. selecting the best contractor for the project. 3. Well prepared and complete set of drawing and documentation before the project starts.
	Hold people responsible for their actions. Reign in the power of trade unions.
	Appoint experienced Consultants and qualified contractors The client should employ competent Project managers whether internal or external. Planning should be completed prior to award of projects. Co-ordination stake holders. Labour agreements to be made by Contractors and Clients, without Politicians getting involved.
	Changing the delivery model of the contracts
	Car get involved at design stage and concentrate on executing all projects on design and construct basis
	Move from traditional methods to new method.
	Detailed geotechnical Complete tender documentation Early assembly of complete design team
	procurement sufficient planning to avoid scope changes simplistic designs
	Early procurement of the a contractor to be part of the designing team Have designs completed before starting construction Use proper project management tools to manage the projects
	Stick to the schedule, Ban Labour Unions and have a different strategy of dealing with labour and have experienced project managers
	early involvement, people knowing there field, experience
	Gated Controlled Project Environment WBS Activity Schedule Pricing

	Please state below any recommendations for improving the management of large projects in South Africa
	Proper scope of work definition Proper tender evaluation of at least three tenders received based on technical competence and not necessarily on lowest bidder Proper project execution planning
	A simple but effective solution is to ensure that all project participants are appointed on the basis that they have the competency to carry out the roles assigned to them. It is also important that the entire team is aligned to the project goals and no other organisational or personal agendas compete for the focus and priority.
	Employing not only qualified people but people with the correct experience as well.
	Enhanced public sector capacity and capability. Professional recognition and credibility of Statutory PM body - currently just fulfilling regulatory role and not adding professional value. Improved project governance
	A clear definition of all stakeholder expectations and objectives from the inception of all projects. the other is skills, skills and skills
	Employ experienced people Train less experienced people Clients should consult competent project managers both internally and externally
	Training required
	I stakeholder involvement
	There should be collaboration at inception for all stakeholders (Owner, Consultant and Contractor)
	We need 1 person to lead wrt management. build trust among all stakeholders. involve contractors early in the process.
	Early engagements of contractors and other stakeholders. designs to be completed before the execution stage. people involved in project management should have a crush course on project management
	Get qualified project managers.
	Improve Scope Development Use WBS Cost into Elements not entire project Improve stakeholder engagement

Appendix F Ethics Approval Form Guide

Department of Civil Engineering

Stellenbosch University

Departmental Ethics Screening Committee questionnaire.

This questionnaire shall be completed by each researcher (and or student) who wishes to involve persons/animals in their research.

1. General information:
    a. Name and surname: _____
    b. Application date: _____
    c. Project title: _____
    d. If for degree purposes, which degree:
    _____
    e. Study leader (if applicable): _____

2. Type of people to be surveyed:

- ☐ Adults
- ☐ Children
- ☐ Stellenbosch university students
- ☐ Professionals in industry
- ☐ General population
- ☐ Other?

_____
_

3. Roughly how many involved?

4. Form of survey:

- ☐ Qualitative interview with individual a) face-to-face
  b) telephone interview
- ☐ Qualitative interview with group (focus group)
- ☐ Quantitative survey tool a) hard copy form
  b) electronic online survey

5. How will you ensure the participants are well informed about the purpose of the research and how the research results will be disseminated?
6. How will you record their consent to participate?

(This is difficult with phone interviews but may be necessary to have a record of)

7. Communication issues

- ☐ Are there likely to be any communication issues due to language or education? YES/NO
- ☐ If YES, how will you ensure that the person is fully informed of their rights?

_____

8. Nature of information requested:

- ☐ Any personal information recorded (name, address, id number)? Yes/No.
- ☐ If Yes, what information? _____
- ☐ Any information of a personal nature (personal experiences?) Yes/No
- ☐ If Yes, what information? _____
- ☐ Any information of a particularly sensitive nature (relating to traumatic experiences, potentially triggering memories of traumatic events; relating to unsafe or illegal activities?)
- ☐ If Yes, what information? _____
- ☐ Any information relating to other identifiable people?

_____

- ☐ If Yes, what information and from what people?

_____

9. How will you ensure rights to privacy and confidentiality?

_____

10. How will you keep data safe and available for future auditing?

_____

11. Will the respondents benefit in any way – directly – from participating? i.e. do they stand to gain financially/ are you providing an incentive etc.?

_____

12. How will you ensure fair selection of research participants?

_____

13. Provide details of a risk benefit analysis/disadvantages.

_____

14. How will research in a community be coordinated in order not to place unwarranted burden upon such community?

_____