The Effect of Variation Orders on Project Cost and Schedule Overruns

by
Wouter Smith

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Supervisor: Prof. Jan Wium
Faculty of Engineering"

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Declaration

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Abstract

Cost and schedule overruns are common occurrences in construction projects, regardless of the various studies that have been done on the subjects. These overruns can occur for a wide variety of reasons; most of these reasons however can be attributed to scope change. The General Conditions of Contract for Construction Works use Variation Orders (VO's) to deal with scope changes. Where other studies have focussed only on cost overruns and their causes, or schedule overruns and their causes, this research uses information collected about VO's to determine the role of changes on the project schedule and costs. A database of 137 projects which were completed within the last 10 years has been investigated in order to determine if the number of VO's or timing of VO's have any effect on the project cost and schedule overruns. The Western Cape Department of Transportation and Public Works was the client for all the projects, thus only public transportation projects were studied. The research finds that projects with more VO's have larger cost and schedule overruns than those with less VO's. Additionally it also finds that larger cost and schedule overruns occur when the VO's occur later in the project.

Opsomming

Koste en skedule oorskrydings in konstruksie projekte is algemene verskynsels, ongeag die aantal studies wat oor die onderwerpe gedoen is. Hierdie oorskrydings kan deur 'n wye verskeidenheid van redes veroorsaak word. Die meeste van hierdie redes kan egter toegeskryf word aan wysigings aan die omvang van projekte. Die algemene kontrakvoorwaardes vir konstruksiewerk (GCC) maak gebruik van Wysigingsopdrag (VO) om die veranderinge aan n projek se omvang te bestudeer. Waar ander studies slegs op koste oorskrydings en hul oorsake, of skedule oorskrydings en hul oorsake gefokus het, gebruik hierdie studie die inligting wat ingesamel is oor wysigingsopdrate om die effek van die veranderinge aan die projek skedule en kostes te bepaal. ‘n Databasis van 137 projekte wat binne die laaste 10 jaar volrooi is word bestudeer om te bepaal of die aantal wysigingsopdragte of tydsberekening van die wysigingsopdragte enige impak op die projek koste en skedule oorskrydings het. Die Wes Kaapse Departemetn van Vervoer en Publieke werke was die klient vir al die projekte, dus is word slegs publiek vervoer projekte bestudeer. Die navorsing vind dat projekte met meer wysigingsopdragte ondergaan groter koste en skedule oorskrydings as die met minder. Verder is dit ook bepaal dat groter koste en skedule oorskrydings ervaar word deur projekte waar die wysigingsopdragte later plaasvind.

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List of Abreviations

AC	Actual Cost
BAC	Budget at Completion
CO	Cost Overrun
CPI	Cost Performance Index
CV	Cost Variance
EAC	Estimated Cost at Completion
ETC	Estimate to Complete
EV	Earned Value
EVM	Earned Value Management
FC	Final Cost
FD	Final Duration
GCC	General Conditions of Contract for Construction Works
OD	Original Duration
PMB	Performance Measurement Baseline
PMBOK	Project Management Body of Knowledge
PV	Planned Value
SO	Schedule Overrun
SPI	Schedule Performance Index
SV	Schedule Variance
TA	Tender Amount
TCPI	To Complete Performance Index
VO	Variation Order
WBS	Work Breakdown Structure

1. Introduction

1.1. Background

Cost and schedule overruns are common occurrences in construction projects despite the various studies that have been done on the subjects (Kumaraswamy & Chan, 1998) (Baloi & Price, 2003) (Flyvbjerg, et al., 2004). (Lo, et al., 2006) (Sumbasivan & Soon, 2007). These overruns can occur for a wide variety of reasons; many of these reasons however can be attributed to scope change (Serag, et al., 2010). The General Conditions of Contract for Construction Works (SAICE, 2010) use VO's to deal with scope changes. Where other studies have focussed only on cost overruns and their causes, or schedule overruns and their causes, this study will use information collected about VO's to determine the role of changes on the project schedule and costs. It will also look at timing of VO's and the effect thereof on the project cost and schedule overruns.

1.2. The Research Hypothesis

This research will investigate the following hypothesis:

The number of VO's influence the size of the schedule and cost overruns, thus projects with more VO's will have overruns more often and the overruns will be larger than projects with less VO's.

The timing of VO's also influence the effect of the schedule and cost variations. Thus the more VO's a project has towards the end of the project the greater the effect on cost and schedule.

1.3. Research Scope

Given the hypothesis stated above, it is necessary to define what the scope of this research will be.

For the purpose of this research only projects done by Western Cape Department of Transport and Public Works were considered. This department is the largest client for road construction work within the Western Cape Province. Since the department is a public entity all the projects were procured using the traditional tender procurement system, meaning they were completely designed by a consultant before going out on tender. The project is then awarded to the tenderer with best score. The tender score is calculated as 90% based on project price and 10% on the broad-based black economic empowerment (BB-BEE) score.

Another reason for considering only public projects; is the ease of access to information. Public entities are required by law to provide any information requested about public works projects. It is much harder to get information from private entities, due to them keeping their information secret for competitive advantages.

However there is a restriction with confining the study to a single department; which is that the conclusions will only be applicable to that specific department. In order to overcome this limitation, the results will be compared to other similar studies.

Lastly, only projects which were completed within the last ten years were considered, this will minimise the effect of inflation on the results.

1.4. Research Objectives

Given the research scope and the hypothesis discussed above; it is necessary to define the objectives of this research:

- How common are projects with cost overruns, and how large are these overruns?
- How common are projects with schedule overruns, and how large are these overruns?
- How frequent are VO's? Do all projects have VO's, and what is the average number of VO's per project?
- Does the number of VO's have an effect on the occurrence or size of the cost and schedule overruns?
- Does the type of VO have an effect on the occurrence or size of the cost and schedule overruns?
- Does the timing of VO's have an effect on the occurrence or size of the cost and schedule overruns?

1.5. Research outline

A short description of each chapter and their topics is discussed in this part.

Chapter 2 reviews the literature about project cost and schedule escalation. This chapter also discusses the relevant project management principles relating to cost and schedule management. Lastly the chapter investigates the literature about project scope management.

Chapter 3 discusses the research method used during this research. The two different research methods (quantitative vs. qualitative) will be weighed against each other and the reason for the chosen research method will be discussed.

In chapter 4 the data gathered about cost overruns and schedule overruns is analysed. This chapter explores the effect of the project size and duration on the overruns. The effect of the cost and schedule on each other is also investigated.

In chapter 5, VO's and their effect on cost and schedule overruns is studied. The data collected about the VO's is analysed as is the effect they have on project cost and schedule overrun. Additionally, the type and timing of VO's and their effect on cost and schedule overruns is considered.

Chapter 6 summarises the results of the previous chapters and compare it with those found by other studies.

In Chapter 7 the conclusion and the recommendations of this research are given.

2. Literature Review

2.1. Chapter Introduction

Construction and the development of infrastructure are important for economic growth (Shenhar & Dvir, 2007). However cost and schedule overruns are very common and widespread during these projects, which has led to various studies being done on these topics.

This chapter will discuss the literature related to the thesis statement, beginning with a background of the research done by others on cost and schedule overruns. This will be followed by a discussion of relevant project management principles. A special focus will then be placed on cost, schedule and scope management, where the various reasons for cost and schedule overruns as well as the reasons and effect of scope change will be investigated.

2.2. Literature Background

This section will cover the initial literature review, which was used to define the research hypothesis.

The body of work done by Flyvbjerg is good starting point for research about cost overruns (Flyvbjerg, et al., 2003) (Flyvbjerg, et al., 2003) (Flyvbjerg, et al., 2004).

A survey (Flyvbjerg, et al., 2003) which covered 250 large infrastructure projects in 20 countries was conducted. This survey found that large cost overruns occurred on nearly 90% of the projects. The survey also found that road projects had an average cost escalation of 20%. According to the survey cost overruns were just as common and large 30 years ago as they are today.

In another study (Flyvbjerg, et al., 2004), the authors investigated the reasons for the cost overruns. In this study they focussed on the dependence of cost escalation on;

- The length of the project implementation phase.
- The size of the project.
- The type of project ownership.

Firstly the study found that the project cost overruns are highly dependent on the length of the implementation phase; with longer projects having larger cost escalation than shorter projects. Secondly it found that larger construction projects had larger cost overruns. Lastly it was found that there was little difference between public and private projects when it came to cost escalation. (Flyvbjerg, et al., 2004)

A recent study (Cantarelli, et al., 2012) also considered the effect the size and the duration of a project has on a project's cost overruns in the Netherlands. The findings of the study were the following:

- The problem of cost overruns is most severe for small projects, but that the project size does not significantly influence the size of the cost overrun.
- The length of the construction phase has a weak relationship with cost overruns. Compared to the pre-construction phase, where the projects which spend longer in planning faced the larger cost overruns.

Most of the research done on delays was focussed on the causes of delays (Doloi, et al., 2012) (Sumbasivan & Soon, 2007) (Lo, et al., 2006). These studies focussed on the factors which cause delays. They have divided the causes into various factor categories, such as project-related, client-related, consultant-related, contractor-related, etc. There is also a certain amount of overlap between these factor categories, with some factors able to be placed within more than one category.

These studies also ranked the various delay causing factors by their importance. The top delay causing factor differed from author to author; from delay of material delivery (Doloi, et al., 2012), to poor site management (Sumbasivan & Soon, 2007), to unforeseen ground conditions (Kumaraswamy & Chan, 1998), and to lack of contractor cash flow (Lo, et al., 2006). However the factor which was rated highly by all the authors was the change of or addition to the scope of works.

According to Warhoe & Giammalvo (2010) the one constant during projects is scope change. Warhoe & Giammalvo also listed the categories for the primary causes of changes;

- Design deficiencies.
- Criteria changes.
- Unforeseen conditions.
- Changes directed by the owner.
- Other.

These categories are similar to some of the delay causing factors listed by the authors on the causes of schedule delays (Doloi, et al., 2012) (Lo, et al., 2006) (Kumaraswamy & Chan, 1998).

Another study done on change orders (Alnuaimi, et al., 2010) found that the most important effect of change orders was the delay of the completion date of projects. The second most important effect it was found to be that changes would result in claims and disputes. Thirdly cost overruns were found to be another important effect of scope variations.

This initial research has shown that cost overruns and schedule overruns are common and widespread. Various authors have studied the causes and effects of the overruns; a common factor among the research was scope change. This was confirmed by the research done on the effects of scope change, which mentioned that cost and schedule overruns are among the most important effects of the scope change.

Cost management, schedule management and scope management form part of the project management body of knowledge (PMI, 2008). The remainder of the chapter will focus on certain project management principles, with a special focus on cost, schedule and scope management.

2.3. Project management

Even though people have been involved in projects since the beginning of civilization, the field of Project management has only become a distinct discipline within the last 100 years or so (Flyvbjerg, et al., 2004). Bodies of knowledge and standards are guidelines developed by associations and organizations, which define the competencies required for the proper management of projects (De-Miguel, et al., 2015).

One study confirms that there are a large number of standards published by organizations world-wide (Ahleman, et al., 2009). Another study (Wirth & Tryloff, 1995) discusses and compares the orientation and relevance of six efforts, which were readily available at the time of the study, to document the project management body of knowledge. The aim of that study was to identify common attributes between the efforts to document the project management body of knowledge. The six standards discussed by the study were (Wirth & Tryloff, 1995):

- the North American Project Management Institute's (PMI) A Guide to the Project Management Body of Knowledge (PMBOK).
- the Australian Institute of Project Management's Reference Curriculum for Project Management Courses.
- the Association of Project Manager's Body of Knowledge.
- the Projekmanagement Austria Intitut's (PMA) Project Management Body of Knowledge.
- the Norwegian Association of Project Management's Fundamentals of Project Management.
- the ISO's draft guidelines to quality in project management.

The study (Wirth & Tryloff, 1995) also found that of these six standards, the PMI's and APM's documents covered the project management processes in the broadest manner. However the difference between the two guides were their approach; with the PMI guide focussing strictly on the description of project management subject matter, and the APM guide focusing more on the competencies needed by a project manager (Wirth & Tryloff, 1995).

Another study discussed the differences between the PMI guide and the IPMA (International Project Management Association) guide (Eberle, et al., 2011). The study found that although both discussed similar competence elements; the PMI guide gives more depth about the subject, and that readers of the IPMA guide have to find more detailed information somewhere else. The study also stated that the PMI guide is used worldwide (Eberle, et al., 2011).

Other studies have also mentioned the global use of the PMI guide. One study (Crawford & Pollack, 2007) states that the PMI guide has official recognition by various project management bodies, which is supported by another which mentions that a high percentage of professional make use of the PMI guide (De-Miguel, et al., 2015).

Since the PMI guide is used worldwide and it covers the subject of project management in great detail, for the purposes of this research the concepts as discussed in the PMI guide will be used and elaborated on further. The definition of a project and project management will be given and then project management elements such as stakeholders, processes and the areas of knowledge will be discussed.

2.3.1. Definition of Project and Project Management

The Project Management Institute's (PMI) guide to the Project Management Body of Knowledge (PMBOK guide) (PMI, 2008) gives the definition of a project as; *a project is a temporary endeavour undertaken to create a unique product, service or result.*

A project has a goal and that is to create a unique product service or goal, no project will be exactly the same, thus it is unique. Road building projects may be the same in principle, that is they will require the same equipment and materials, but every road has its own unique location and environment.

Further a project will have a definite beginning and end, due to its temporary nature. A project will end when its objectives or goals have been met or when it is terminated when it becomes apparent that the goals will not be met.

The PMBOK guide gives the definition of Project management as; *the application of knowledge, skills, tools, and techniques to the project activities in order to meet the project's requirements*. In order to apply the *knowledge, skills, tools, and techniques* it is necessary to know what they are (PMI, 2008).

This chapter will now further elaborate on certain key elements of the Project Management Body of Knowledge as discussed in the PMBOK guide. (PMI, 2008) The key elements that will be discussed are the following:

- Project Stakeholders.
- Project Processes.
- Projects Areas of Knowledge, with a special focus placed on:
    - Project Time Management.
    - Project Cost Management.
    - Project Scope Management.

2.3.2. Project stakeholders

A project stakeholder can be defined as a person or group of people who has a vested interest in the success of a project and the environment within which the project operates (Olander, 2007). The stakeholders are thus the persons or organizations who are actively involved or who are affected by the performance or completion of the project. These stakeholders may also influence the project and the performance of the project. It is thus important for the project management team to identify all the stakeholders in the project in order to determine the needs and the expectations of all the involved parties. According to the PMBOK guide the important stakeholders are the following (PMI, 2008):

- Project sponsor or client (provides the financial resources for the project).
- Project manager (responsible for communicating with other stakeholders and for the formulation of the project plan).
- Design team (responsible for the design of the project as well as monitoring and controlling the execution phase).
- Contractor (responsible for making the designs into reality).
- End user (will use the project when it is complete).

A study which focussed on the construction industry identified the three key stakeholders as clients, consultants, and contractors (Doloi, 2013). This is similar to the PMBOK guide; the end-user and the client are usually the same person or group, and project managers and the design team can both be grouped under consultants.

These are not however the only stakeholders; the community in which the project takes place, the construction workers, and the local government (if not the client) can also influence the project, even in a negative way (such as labour strikes and legal action). It is thus important for project managers to manage the expectations of all the stakeholders (Olander, 2007) (PMI, 2008).

2.3.3. Project processes

Project management is performed through the use of project management processes. The PMBOK guide defines the following five process groups (PMI, 2008):

- The initiation group (starting the project).
- The planning group (organizing and preparing for the project).
- The execution group (carrying out or doing the project).
- The monitoring and controlling group (track, review, and regulate the project).
- The termination group (closing of the project).

Other texts on project management define similar groups (Kerzner, 2009) (Newton, 2015).

These groups consist of various processes which will be executed in order to complete the project. The PMBOK guide defines a process as *a set of interrelated actions and activities performed to achieve a specific objective.* Each process has its own inputs and outputs for achieving its objective. However these processes aren't separate elements, they overlap and interact with each other. A change in one factor will mean that at least one other factor will change. Thus the project manager must be able to balance the demands in order to deliver a successful project (PMI, 2008).

The process groups are linked by the outputs they produce. Thus the output of one process becomes the input to another process. For example the planning process group develops the plans that the executing process group needs in order to complete its objectives (PMI, 2008). Figure 2.1 shows the interactive nature of the process groups.

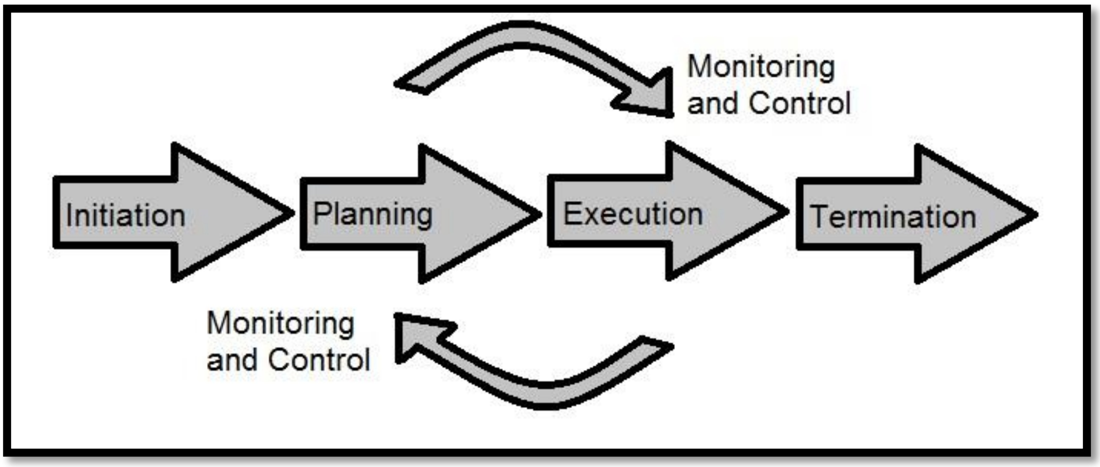

Figure 2.1 – Project process group interaction (PMI, 2008)

These process groups are not project phases, each phase of a large project will normally repeat all of the process groups. Thus during each phase of the project phase initiation, phase planning, phase execution, and phase termination, as well as phase monitoring and control is applied throughout. Once a phase is concluded, the project proceeds to the next phase and all the processes are repeated.

2.3.4. Project management areas of knowledge

The project management processes ensure the effective flow of the project throughout its existence. These processes use the tools and techniques of the knowledge areas. These knowledge areas are the focus areas of project managers when managing a project (PMI, 2008);

- Project integration management.
- Project scope management.
- Project time (schedule) management.
- Project cost management.
- Project quality management.
- Project human resource management.
- Project communication management.
- Project risk management.
- Project procurement management.

Table 2.1 reflects the placement of the project management processes into the 5 project management process groups and the 9 project management knowledge areas.

Failure in any of these groups may result in the project failing; however for the purpose of this research only the three which are most often the cause of failure will be studied. The three groups are project cost management, project time management, and project scope management (Kerzner, 2009) (Shenhar & Dvir, 2007) (Kharbanda & Pinto, 1996). The findings of these authors with regards to the three areas of knowledge will now be discussed in greater detail.

Table 2.1 – Project management process groups and knowledge area mapping (PMI, 2008)

Knowledge areas	Process groups				
	Initiation	**Planning**	**Execution**	**Monitoring and control**	**Termination**
Project integration management	*Develop project charter*	*Develop project management plan*	*Direct and manage project execution*	*Monitoring and control project work* *Perform integrated change control*	*Close project or phase*
Projects scope management		*Collect requirements* *Define scope* *Create WBS (work breakdown structure)*		*Verify scope* *Control scope*	
Project time management		*Define activities* *Sequence activities* *Estimate activity resources* *Estimate activity duration* *Develop schedule*		*Control schedule*	
Project cost management		*Estimate costs* *Determine budget*		*Control costs*	
Project quality management		*Plan quality*	*Perform quality assurance*	*Perform quality control*	
Project human resource management		*Develop human resource plan*	*Acquire project team* *Develop project team* *Manage project team*		
Project comunications management	*Identify stakeholders*	*Plan communications*	*Distribute information* *Manage stakeholder expectations*	*Report performance*	
Project risk management		*Plan risk management* *Identify risks* *Perform qualitative risk analysis* *Perform quantitative risk analysis* *Plan risk responses*		*Monitor and control risks*	
Project procurement management		*Plan procurements*	*Conduct procurements*	*Administer procurements*	*Close procurements*

2.4. Project cost management

2.4.1. Introduction

The processes involved in the project cost management knowledge area are all concerned with developing and managing the project's budget. Estimating what a project will cost and then ensuring that the project stays within that budget is a major function of the project manager and management team. The processes in this group all interact with each other and processes in other groups. The processes are (PMI, 2008):

- Estimate costs.
- Determine budget.
- Control costs.

On smaller projects estimating the costs and determining the budget are so tightly linked and often seen as one process. However they use different tools and techniques and are thus represented in the PMI guide as distinct processes (PMI, 2008). This part will describe the three processes as described in the PMI guide. Then it will explore the common causes of project cost overruns as discussed in other literature.

2.4.1.1. Estimate costs

The estimate costs process develops an estimate of the monetary resources required to complete each project activity. These estimates are predictions made on the information known at a given point in time. It will also include the identification and analysis of costing alternatives. Cost estimates should be refined as a project progresses; increasing the accuracy of these estimates. Estimating costs is thus an iterative process (PMI, 2008).

In order for a project manager to make good estimates of the costs, it is necessary to collect information before the estimating process. Typical information inputs include: project schedule, human resource plan, and the risk register. These inputs include information about what resources will available for the tasks, the attributes and rates of the required resources, and the risk mitigation costs if the resources suddenly become unavailable (PMI, 2008)

There are various tools and techniques used in estimating costs (PMI, 2008). One of these tools is the use of expert judgement or past experience; cost estimates are influenced by numerable variables, the expert judgement, backed by historical information, gives valuable insight about the project from older similar projects. Analogous or top down estimating is one technique that relies on the historical data of previous or similar projects (PMI, 2008). This method makes estimates without detailed engineering data (Kerzner, 2009). Another study confirms this, and also states that the method uses past experience of similar projects (Nicholas & Steyn, 2012).

Another tool or technique is called bottom up estimating also called definitive estimates; this method estimates the work packages with well-defined data including quotes, nearly complete plans, specifications, and unit prices (Kerzner, 2009). According to one study a well-defined work scope, schedule, and the estimated resources is essential for the creation of a bottom-up estimate (Fleming & Koppelman, 1998).

Costs are estimated for all resources to be charged to the project. This may include labour, materials, equipment, services, and facilities. There are also special categories for inflation allowances and contingency costs; which includes the pricing of the project risk. Thus a cost estimate is a quantitative assessment of the costs for the resources required to complete an activity (PMI, 2008).

According to one study the choice of estimating technique is dependent on various factors (Akintoye, 2000); with the most important being project complexity followed by technological requirements and available project information. Another study states that the top-down and bottom-up approaches can also be used in combination (Nicholas & Steyn, 2012); where pieces of a project which is well-defined using bottom-up estimating, and other less-defined portions using top-down estimating.

2.4.1.2. Determine budget

The budget determining process sums the estimated costs of all the activities in order to create a cost baseline for the project; the budget is thus a reconciliation of the estimates (Nicholas & Steyn, 2012). This baseline constitutes the funds authorised to complete the project and the project's cost performance will be measured against it (PMI, 2008).

An important input when determining the budget is the contracts. The applicable contract information regarding costs of products, services, or results that have been purchased will be included when doing the budget (PMI, 2008). Other studies confirm that the contract type affects the level of detail available to estimate the costs (Bajari & Tadelis, 2001), and also the amount of risk which must be factored into the cost estimation. (Love, 2002)

When determining the budget the reserves will also be analysed. This will establish the contingency and management reserves for the project. Contingency reserves are the allowances for unplanned but potentially necessary changes that can result from a risk realising. Management reserves are budgets reserved for unplanned changes to project scope and costs, they don't form part of the project cost baseline but may be included in the total budget for the project (PMI, 2008). According to Kerzner these reserves are used to counter balance the effect of any adverse changes in the project overhead rates (Kerzner, 2009).

Another study confirms the necessity of a contingency reserve in order to counterbalance the uncertainty of the project; the larger the uncertainty, the larger the contingency fund should be (Nicholas & Steyn, 2012). The contingency amounts can be developed for individual activities or for the project as a whole. Activity contingency is part of the mark-up on the individual activities, and covers for any scrap, wastage, and an increase in item cost due to scope changes and delays. The project contingency accounts for any external influences which may affect the project costs but which cannot be pinpointed (Kerzner, 2009) (Nicholas & Steyn, 2012).

The expenditure of funds must be reconciled with any funding limits for the project. Funding often occurs in incremental amounts that are not continuous. Thus funds will not always be available when needed which may result in rescheduling of work in order to level out the rate of expenditure. This reconciliation will allow the project manager to determine the funding requirements (see figure 2.8) for the project (PMI, 2008).

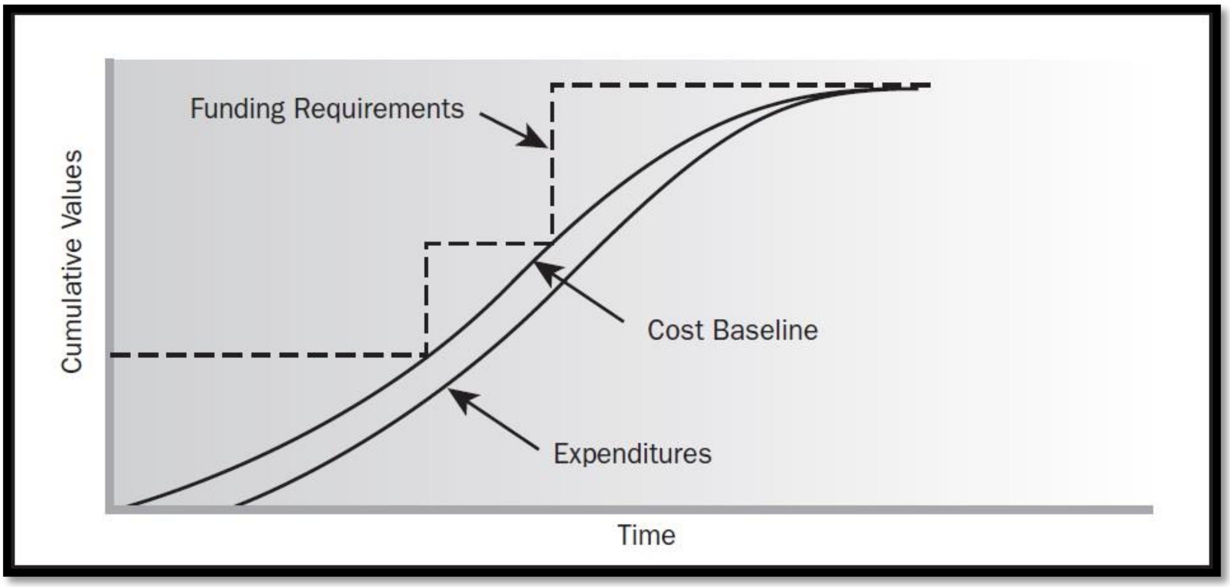

Figure 2.2 – Cost baseline, expenditure and funding requirements (PMI, 2008)

2.4.1.3. Control costs

During the execution of the project it is necessary to monitor the status of the project in terms of its cost baseline. Budget will be updated with the actual costs spent. Monitoring the expenditures of funds without regard of the value of the work done has little value to the project. Thus much effort is needed to assess the relationship between the spending of funds and the physical work being done for this expenditure. Project cost control includes (PMI, 2008):

- Influencing the factors that create changes to the cost baseline.
- Ensuring that all change requests are reacted on in time.
- Managing the changes as they occur.
- Ensuring that the expenditure does not exceed the funding, by funding period and in total.
- Monitoring cost performance to isolate and understand variances from the approved budget and cost baseline.
- Monitoring work performance against funds expended.
- Preventing unapproved changes from being included in the reported cost.
- Acting to bring the expected cost overruns within acceptable limits.

The three most useful tools to control the costs are earned value management, forecasting and to-complete performance index (PMI, 2008) (Kerzner, 2009) (Newton, 2015).

Earned value management (EVM)

Earned value management makes use of the project scope, cost, and schedule to assess and manage the project's progress and performance. An integrated baseline plan is needed for these assessments throughout the duration of the project. There are three key elements within each work package that will be monitored by the EVM; planned value (PV), earned value (EV), and actual cost (AC) (PMI, 2008).

Planned value (PV) is the budget assigned to the work package. It contains the details of the work which should take place as well as the budget for that work. The PV total is sometimes called the performance measurement baseline (PMB) or budget at completion (BAC) (PMI, 2008). Kerzner calls this the budget cost of work scheduled (Kerzner, 2009).

Earned value (EV) is the value of the work which has been completed as expressed in terms of the authorised budget for that work package. It is thus the authorised work that is completed with the authorised budget for that work. The EV will be measured against the PV baseline; it is expected to be on that baseline and cannot be greater than it. EV is sometimes used to describe the percentage completion of the project. EV is monitored not only to determine the current status of the project but also to determine the long-term performance trends of the project (PMI, 2008). The earned value can also be called budget cost for work performed (BCWP) (Kerzner, 2009).

Actual cost (AC) is the total cost actually incurred in performing the work package. Thus AC is the cost incurred to perform the work measured by the EV. The AC has to correspond with whatever was budgeted for in the PV and what was completed in the EV. However there is no upper limit for the AC; whatever was spent to perform the work will be measured (PMI, 2008). This dimension is called actual cost for work performed by Kerzner (2009).

The three dimensions, planned value (PV), earned value (EV), and actual cost (AC), allow the project manager to determine the variance from the stated baseline, i.e. the schedule variance and the cost variance.

Schedule variance (SV) is the EV minus the PV. This metric indicates whether a project is falling behind its baseline schedule. At the end of the project the SV will be Zero because all of the scheduled task will be completed. Schedule variance can be converted into an efficiency indicator, namely the schedule performance index (SPI). The SPI value is derived by dividing the EV with the PV. A value less than one will indicate that less work has been completed than what was planned and a value greater than one will indicate the opposite (PMI, 2008).

Cost variance (CV) is the EV minus the AC. It will thus indicate the project's actual expenditure for the project. It indicates the relationship between the physical work completed and the amount spent to complete it. The CV at the end of the project will be the difference between the BAC and the actual amount spent. Cost variance can also be converted into an efficiency indicator, namely the cost performance index (CPI). The CPI value is derived by dividing the EV with the AC. A value less than one will indicate a cost overrun for the work completed and a value greater than one will indicate the opposite (PMI, 2008).

A well-defined scope and budget are necessary in order to implement the earned value method (Fleming & Koppelman, 1998). This need for a well-defined scope is confirmed by other sources and they also emphasize that changes should be kept to a bare minimum for the method to be successful (Ferguson & Kissler, 2002).

Forecasting

As a project progresses the project manager can develop a forecast for the estimated cost at completion (EAC). This value may differ, due to the project's performance, from the project's budget at completion (BAC). Forecasting involves making estimates and predictions of the condition and events in the project's future. The EAC is typically based on the actual costs for the work completed, as well as the estimate to complete (ETC) the remaining work. The EAC will thus be expressed as the AC plus the ETC (PMI, 2008)(Kerzner, 2009).

Earned value management works well as a basis for forecasting. The EVM data can be used to provide statistical EAC. The three most common methods are (PMI, 2008)(Kerzner, 2009):

- EAC forecast for ETC work performed at budget rate. (EAC = AC + BAC – EV).
- EAC forecast for ETC work performed at current CPI. (EAC = BAC / CPI).
- EAC forecast for ETC work considering both SPI and CPI factors. (EAC = AC + [(BAC – EV) / (CPI x SPI)]).

Each of these methods can be correct for any project. It is up to the project manager to decide which method he follows and also to monitor further performance in order to determine if the correct method was followed. Forecasting allows the project manager to monitor cash flow throughout the project; this will allow the preparation of a plan that will ensure adequate funding for the duration of the project (Nicholas & Steyn, 2012).

To-complete performance index (TCPI)

The to-complete performance index is the projection of the cost performance the project has to achieve in order to meet the budget at completion (BAC) or estimated budget at completion (EAC). When the BAC is no longer feasible the project manager develops the EAC through forecasting, which once it is approved will supersede the BAC. The TCPI is when calculated on the BAC will be TCPI = (BAC - EV) / (BAC – AC). And when calculated on the EAC it will be TCPI = (BAC - EV) / (EAC – AC) (PMI, 2008).

2.4.2. Causes of cost overruns

According to Flyvbjerg (2003) nine out of ten transport infrastructure projects fall victim to cost overruns. The average cost overrun for all project types studied by them is 28%. The conclusion of their study was that cost estimates used in the decision making process are thus highly deceptive. Furthermore they found that the risks generated by these misleading cost estimates are typically ignored and this may lead to further cost escalation (Flyvbjerg, et al., 2003).

A follow up study done by Flyvbjerg et al (2004) has found that for bridges and tunnels, larger projects typically have a larger percentage of cost escalation, but that for all other project types, including roads projects, there was little difference between large and small projects. Secondly they also found that the longer a projects implementation phase lasts, the greater the cost escalation becomes (Flyvbjerg, et al., 2004). Lastly the study also focussed on the effect of the type of ownership. Their data did not support that public projects are more prone to cost overruns than private projects, with both types showing similar cost overruns (Flyvbjerg, et al., 2004).

Others have done similar studies, where Flyvbjerg focussed on the difference between the final cost and the preconstruction estimates; these other researchers studied the difference between the final cost and the awarded bid price.

Odeck (2004) studied 620 projects done by the Norwegian Public Roads Administration (NPRA). They found that 52.42% of the projects were affected by cost overruns for an average cost overrun of 7.88% (Odeck, 2004).

A study (Shresta, et al., 2013) was done on 236 transportation projects which occurred within Nevada, USA, which found that for transportation projects the average cost overrun was 3.23%.

Another study was done on 359 projects which occurred in Malaysia (Shehu, et al., 2014). The study found that 55% of the projects were affected by cost overruns, with an average cost overrun of 2.08%. Furthermore the study found that 22.8% of the projects had an overrun of more than 10%.

Recently a study was also conducted within the Netherlands (Cantarelli, et al., 2012). The study found that 38% of the projects overran their construction costs, for an average cost overrun of -4.5%, indicating that projects in the Netherlands tend to under run their costs.

A study was also done in Australia (Love, et al., 2014). Of the 58 project studied the average cost overrun was found to be 13.28%. Table 2.2 summarises the cost overrun research done by others.

Table 2.2 Summary of cost overrun research

Country	No. of Projects	% with an overrun	Average overrun (%)
Norway (Odeck, 2004)	620	52	7.9
USA (Shresta, et al., 2013)	236	unknown	3.2
Malaysia (Shehu, et al., 2014)	359	55	2.1
Netherlands (Cantarelli, et al., 2012)	Unknown	38	-4.5
Australia (Love, et al., 2014)	58	unknown	13.28

Cost overruns are a common occurrence and widespread. However the percentage of projects which overrun their costs seems to differ from country to country, as does the average cost overrun.

The effect of the project type and project duration on cost overruns has also been studied. A common trend identified by other research, is for large infrastructure projects, such as bridges and tunnels, to have larger cost overruns than smaller project such as road maintenance or resurfacing (Flyvbjerg, et al., 2004) (Love, 2002). Additionally the research also found that longer projects also tended to have larger cost overruns than shorter projects (Flyvbjerg, et al., 2004) (Shresta, et al., 2013).

2.4.3. Conclusion

Although various cost control methods exist (PMI, 2008) (Kerzner, 2009), projects still tend to overrun their cost (Flyvbjerg, et al., 2004). Much research has been done in how widespread and how large these cost overruns were and it was found that the occurrence and average of cost overruns differ from country to country. Researchers have also studied what effect the size and length of projects have on the cost overrun, and they have found that larger and longer projects tend to have greater cost overruns.

According to some authors (Kerzner, 2009) (Shenhar & Dvir, 2007) project cost management and schedule management are inseparable. This is also indicated by the high reliance of the cost management processes on inputs from the project schedule. Thus in order to get a holistic view of cost overruns, schedule overruns will need to be studied.

2.5. Project time management

2.5.1. Introduction

A project is a temporary endeavour, thus it has a clear starting point and finishing point. One of the project manager's main responsibilities is to ensure that the project is completed in time. However this is easier said than done. The project management environment is composed of numerous meetings, report writing, conflict resolution, continuous planning and re-planning, communications with other stakeholders, and crisis management. Disciplined time manage is thus a key to effective project management (Kerzner, 2009).

The project time management knowledge area includes all the processes needed for effective time management (PMI, 2008):

- Define activities.
- Sequence activities.
- Estimate activity resources.
- Estimate activity duration.
- Develop schedule.
- Control schedule.

A further discussion of each of these processes as discussed in the PMI guide will now be presented with comments from other sources, followed by a discussion from other literature on the causes of schedule overrun as well as an overview on the extent and size of the schedule overruns.

2.5.1.1. Define activities

The process whereby activities are defined identifies the specific actions needed to complete the work as set out in the WBS (the Work Breakdown Structure will be discussed in chapter 2.6). Once the work packages have been identified to the lowest level in the WBS, these work packages are then divided into smaller components called activities. Thus activities are the actions necessary to complete the work packages (PMI, 2008). The identification of activities can be an iterative process; by identifying the activities to be done, additional work packages may be discovered (Newton, 2015). These activities will form a basis for scheduling, estimating, execution, and controlling the project (Khan, 2006).

The outcome of this process is the development of the activity list, the activity attributes, and the milestone list. The activity list contains all schedule activities required for the project. The activity attributes are detailed descriptions of the work required needed to complete the activities; it also identifies all the other components associated with the activity. A milestone is a significant event in the project; the milestone list identifies all milestones and also states whether a milestone is a contractual obligation or an optional milestone (PMI, 2008).

2.5.1.2. Sequence activities

Every activity has a logical relationship with the other activities in the project. The sequence of activities process identifies these relationships and documents them. All the activities and milestones, except the first and last of the project, have a logical successor and predecessor. Sequencing is usually done using project management software; such as Microsoft Project (PMI, 2008).

A commonly used tool in activity sequencing is the network diagram, also called the precedence diagramming method (Kerzner, 2009) (Costin, 2008). A network diagram (see fig 2.3 for an example of a network diagram) uses boxes, called nodes, to represent activities, and connects them with arrows to show the logical relationship between activities.

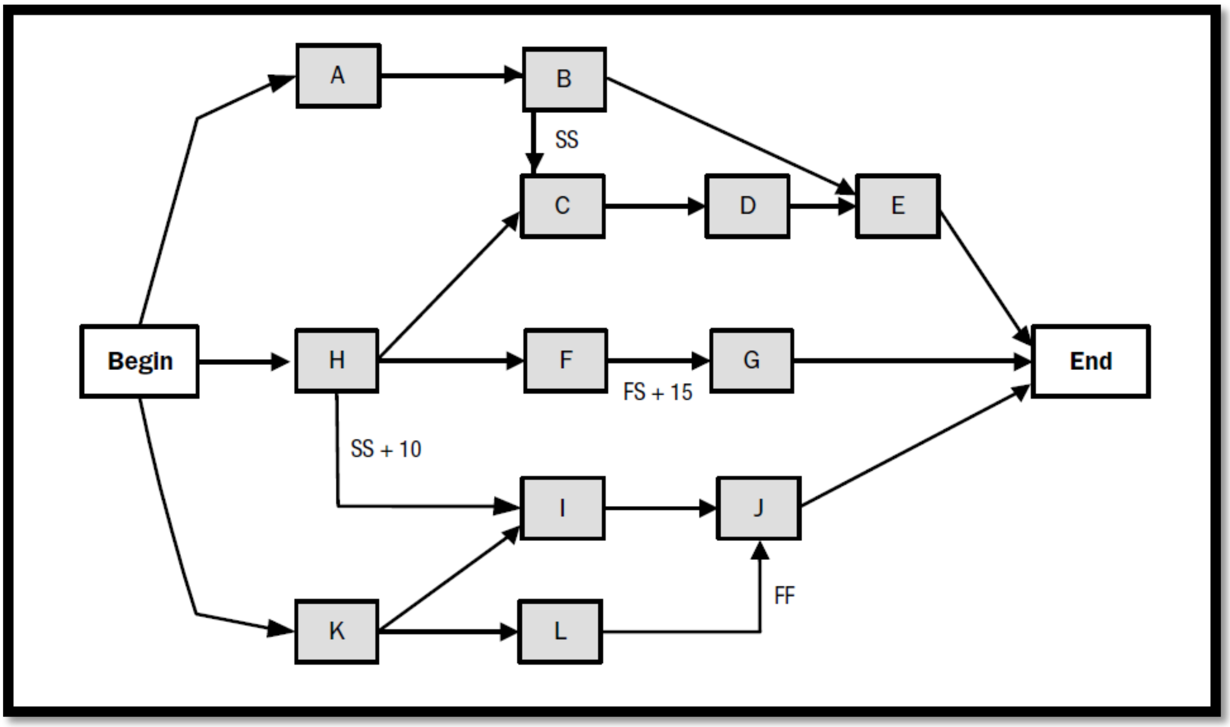

Figure 2.3 – Example of a network diagram (PMI, 2008)

A network diagram contains four sorts of dependencies or logical relationships (PMI, 2008):

- Finish-to-start (the initiation of successor activity depends on completion of predecessor).
- Finish-to-finish (the completion of successor activity depends on completion of predecessor).

- Start-to-start (the initiation of successor activity depends on initiation of predecessor).
- Start-to-finish (the completion of the successor activity depends on the completion of predecessor).

The finish-to-start relationship is the most commonly used relationship type. In contrast the start-to-finish is rarely used. Certain relationships may require a lead or lag to be accurately defined. A lead allows a successor activity to start a certain time before its predecessor is completed and a lag delays the start of a successor activity after its predecessor is completed (PMI, 2008).

Network schedules form the basis for all planning and help the project team to effectively manage its resources (Kerzner, 2009).

2.5.1.3. Estimate activity resources

Once the activities have been identified it is necessary to estimate the type and quantities of material, people, equipment, or supplies each activity will require to be completed. The estimate activity resources process is closely coordinated with the estimate costs process (see chapter 2.6.2.) (PMI, 2008).

Information on the availability of the resources (people, equipment, and material) during an activity's period is used to estimate the resources an activity will require. This information is usually found in a resource calendar; resource calendars specify when and how long a project resource will be available during the project. It may also include other attributes such as the experience or skill level of the resource (PMI, 2008).

Most project management software's, such MS Project, allow for resource allocation to activities. However these programmes are not subjected to resource levelling; which makes critical path identification as a result of the resource availability difficult (Braimah, 2014). Thus the critical path calculated by the software may be incorrect, due to the impact of the resource availability. It is thus necessary to estimate the resources accurately in order to limit the effect the resources will have on the project schedule (Costin, 2008).

2.5.1.4. Estimate activity duration

The process, during which the activity duration is estimated, will approximate the number of work periods needed to complete each of the activities with the estimated resources. The estimating of the activity durations will usually be done by the person on the project team that is most familiar with the specific work of the activity. Estimating is thus done through expert judgement using historical information on the type of work in the activity. The activity scope of work, required resource type, the estimated resource quantities, and the resource calendar are also used during this process (PMI, 2008).

Activity duration estimates can be improved by using the process of three-point estimates. This method uses three estimates to define a range for an activity's duration (PMI, 2008):

- Most likely (t_m): most realistic value given the resources to be assigned and the dependency on other activities.
- Optimistic (t_o): the best-case scenario.
- Pessimistic (t_p): the worst case scenario.

A weighted average of these three estimates is then calculated to determine the expected activity duration (t_e). The following formula is used for the calculation (PMI, 2008):

$$t_e = \frac{t_o + 4t_m + t_p}{6}$$

The estimates based on this formula may provide greater accuracy; with the three points providing the range of uncertainty (PMI, 2008).

2.5.1.5. Develop schedule

At this point the activities have been defined, sequenced, and their resource needs and duration estimates have been completed. Using this information it is now possible to create the project schedule. It will determine the planned start and finish dates of each activity and project milestones. Re-evaluation of duration estimates and resource requirements may be needed to develop a proper schedule. Developing a project schedule is often an iterative process. The developed schedule will serve as a baseline to track the project's progress (PMI, 2008).

An important technique in schedule development is the critical path method. This method determines the theoretical early start and early finish dates, as well as the late start and late finish dates of all the activities by performing a forward and backward pass through the schedule network. This will determine the activity's float; the amount of schedule flexibility of an activity. The float is the difference between the early and late completion dates of the activity. If an activity has zero float that activity is deemed to be on the critical path and will thus be a critical activity. The critical path is thus the activity path through the network with zero total float (PMI, 2008).

With the critical path known, it is possible to apply resource levelling and leads and lags on other activities not on the critical path. Resource levelling is concerned with the balancing of the supply and the demand of resources (Costin, 2008). Resource levelling will allow resources that will be shared by activities to be optimally assigned thus allowing the critical path access to these resources when necessary, and also keeping the resource usage constant. Leads and lags will refine the schedule and will have the same effect as the resource levelling (PMI, 2008).

Another technique used in scheduling is called schedule crashing. This technique will analyse cost and schedule trade-offs in order to compress the schedule with the smallest incremental change in cost. Some examples of crashing could include approving overtime and bringing in additional resources. This will only work on activities where additional resources will shorten the activity duration. However crashing is not always a viable alternative due the increased risks and costs it will create (PMI, 2008).

Project schedules are usually displayed by the use of Gantt charts (see figure 2.7). A Gantt chart is a bar chart displaying the activities plotted against time. It makes the schedule simpler to understand and is also the easiest way to track progress (Kerzner, 2009).

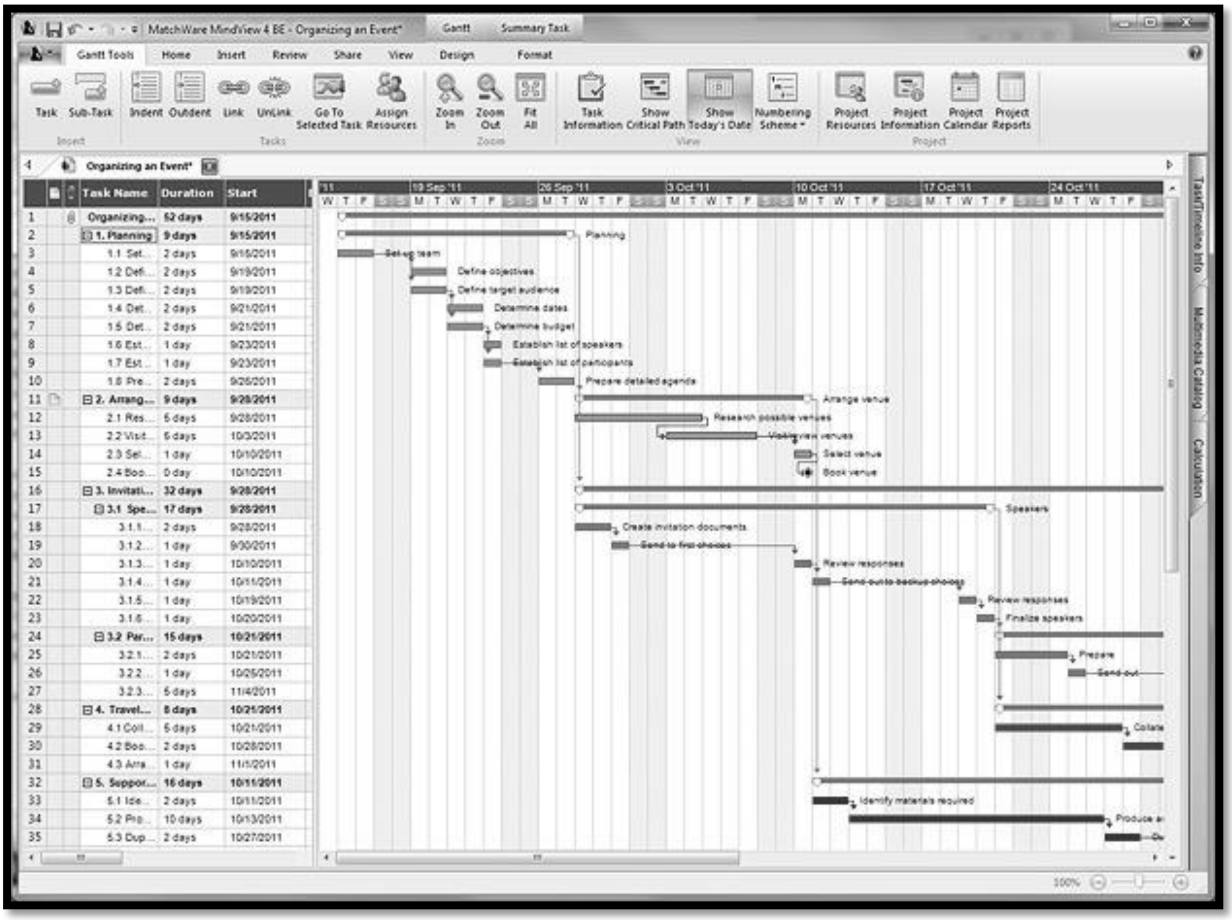

Figure 2.4 – Example of a Gantt chart (GanttChartExample.com, 2012)

2.5.1.6. Control schedule

Once the project gets under way it is important to track the schedule. The control schedule process monitors the status of the progress by updating the project progress and managing the changes to the project's baseline schedule. Thus schedule control is concerned with (PMI, 2008):

- Determining the current status of the project schedule,
- Influencing the factors that create schedule changes,
- Determining if the project schedule has changed, and
- Managing the changes if they occur.

Tracking the progress of the project is an important part of schedule control. This will allow the resetting of priorities if any variation does occur (Costin, 2008).

Certain variations won't need any correction; such as a delay during an activity not on the critical path, which may have little effect on the entire project (PMI, 2008). However even a small delay on the critical path or near critical path may require immediate action (Costin, 2008). Delays and schedule overruns will now be discussed in greater detail.

2.5.2. Schedule overruns

Delay during construction projects has been a popular research topic for many years. The research done on this topic can be divided into two groups; the first relating to the factors that cause delays and the second group relates to delay analysis (Doloi, et al., 2012). In this part the focus will first be on the literature relating to the factors that cause delays followed by the literature where the delays are analysed.

2.5.2.1. Delay causing factors

A survey questionnaire done by Kumaraswamy and Chan (1998) in Hong Kong identified 83 delay causing factors. These factors were then divided into 8 factor categories; project-related, client-related, design team-related, contractor-related, materials-related, labour-related, plant/equipment-related, and external factors (Kumaraswamy & Chan, 1998).

Another study done by Lo et al (2006) in Hong Kong identified 30 common causes of delay. These causes were then divided into seven factor categories; project-related, engineer-related, client-related, contractor-related, human-behaviour-related, resource-related, and external factors (Lo, et al., 2006).

Sumbasivan and Soon (2007) did a study on the causes and effect of delays in the Malaysian construction industry. In this study they identified 28 causes of delay which was also divided into 8 eight categories; client-related, contractor-related, consultant-related, material-related, labour and equipment-related, contract-related, contract relationship-related, and external factors.

Out of the 28 identified factors they found that the five most important causes were: contractor's improper planning, contractor's poor site management, inadequate contractor experience, late payment by client for completed work, and problems with subcontractors (Sumbasivan & Soon, 2007).

Doloi et al (2012) identified 45 factors that affected delays during construction projects in India. These factors were divided into 6 categories; project-related, site-related, process-related, human-related, authority-related, and technical issues. This study also found that one of the most critical factors of delay is the lack of commitment (Doloi, et al., 2012).

A study done in Turkey identified 34 delay causing factors (Kazaz, et al., 2012). These factors were then gathered under 7 factor groups; environmental-related, financial-related, labour-related, management-related, owner-related, project-related, and resource-related. According to the study the most important delay causing factor is design and material changes (Kazaz, et al., 2012).

There are thus many possible causes of delays; however most of them can be grouped under various factor categories. Table 2.2 summarises the different factor categories as discussed in the literature.

Table 2.3 Summary of the delay causing factors

(Kumaraswamy & Chan, 1998)	**(Lo, et al., 2006)**	**(Sumbasivan & Soon, 2007)**	**(Doloi, et al., 2012)**	**(Kazaz, et al., 2012)**
project-related, client-related, design team-related, contractor-related, materials-related, labour-related, plant/equipment-related, external factors	*project-related, engineer-related, client-related, contractor-related, human-behaviour-related, resource-related, external factors*	client-related, contractor-related, consultant-related, material-related, labour and equipment-related, contract-related, contract relationship-related, external factors	*project-related, site-related, process-related, human-related, authority-related, technical issues*	environmental-related, financial-related, labour-related, management-related, owner-related, project-related, resource-related

From table it is possible to develop the following 5 categories which encompasses all the above categories,

- Client-related – factors caused by the actions of the client such as changes to the project scope, late payment for completed work, etc.
- Consultant-related – factors caused by the actions of the consultant or engineer such late delivery of drawings, inconsistency in design documents, etc.

- Contractor-related – factors caused by the actions of the contractor such as poor site management, poor planning, and site accidents due to poor safety measures, etc.
- Resource-related – these delays are caused by any of the resources utilised by the project team, be it labour, materials, plant or finances. Some examples of these are late delivery of materials, poor quality of materials that are delivered, labour strike, cash flow problems, and poor productivity of labour.
- External causes – these delays are caused by factors that can’t be affected by the project team such as extreme weather, unforeseen site conditions, regulation changes, or inflation.

There will be a certain amount of overlap between these categories and some of the factor categories may also interact with each other; for example client decisions can affect the availability of labour, which in turn affects the contractor’s planning (Kumaraswamy & Chan, 1998).

Each of these researchers also studied the top delay causing factors within their regions. Table 2.4 lists the top 5 factors by author.

Table 2.4 Top 5 delay causing factors by Author

(Kumaraswamy & Chan, 1998)	**(Lo, et al., 2006)**	**(Sumbasivan & Soon, 2007)**	**(Doloi, et al., 2012)**	**(Kazaz, et al., 2012)**
Unforeseen ground conditions, *Poor site management,* Slow decision making, *Client initiated variations,* Necessary variations of work	*Inadequate resources due to lack of running capital,* Unforeseen ground conditions, *Exceptionally low bids,* Inexperienced contractor, *Existing services*	Improper planning, *Poor site management*, Inadequate contractor experience, *Delay in payments to contractors,* Problems with subcontractors	*Delay in material delivery,* Delay in drawings or design, *Contractors financial constraints,* Increase in the scope of works, *Obtaining permission from local authorities*	Design and material changes, *Delay of payments,* Cash flow problems, *Contractor's financial problems*, Poor labour

From table 2.4 it is apparent that the most important delay causing factors differ from country to country, as does the descriptions of the factors. Although some authors identified scope change as a delay causing factor, some of the other factors may also lead to changes to the scope. Factors such as unforeseen ground conditions or existing services may require additional work which was not initially part of the projects scope. Improper planning or slow decision making may also lead to scope changes. Thus it is necessary to investigate what effect changes to scope have on the schedule overruns.

According to some researchers project schedule and cost management is interdependent (Kerzner, 2009) (Shenhar & Dvir, 2007), thus any factor that causes a schedule overrun may also cause a cost overrun.

2.5.2.2. Delay analysis

Other studies have investigated how frequent and how large schedule overruns are. One such study (Ahsan & Gunawan, 2010) investigated delays during 100 development projects within four Asian countries: China (30 projects), India (20), Bangladesh (31) and Thailand (19). The study found that 86% of the projects were affected by schedule overruns and the average schedule overrun for these countries were; 13.6%, 55.7%, 34.4%, and 32.7% respectively, and the average was 33.4% for all.

The similar study investigated 58 transportation projects within Australia (Love, et al., 2014). The study found the average schedule overrun to be 8.91% for these projects.

A study was also conducted on 236 transportation project done in Nevada USA (Shresta, et al., 2013). The study found the average construction schedule overrun to be 1.1%. Table 2.5 summarises the schedule overrun information about the different countries.

Table 2.5 Summary of schedule overrun information

Country	**No. of Projects**	**% with an overrun**	**Average overrun (%)**
China (Ahsan & Gunawan, 2010)	30	86	13.6
India (Ahsan & Gunawan, 2010)	20		55.7
Bangladesh (Ahsan & Gunawan, 2010)	31		34.4
Thailand (Ahsan & Gunawan, 2010)	19		32.7
Australia (Love, et al., 2014)	58	unknown	8.9
USA (Shresta, et al., 2013)	236	unknown	1.1

From this table we observe that although schedule overruns appear widespread, developing countries seem to experience larger overruns than the more developed countries.

The results on the schedule overruns can also be compared to those found on cost overruns which is summarised in table 2.2. The average schedule overrun appears to be large than the average cost overrun, this may indicate that schedule overruns are more common than cost overruns

2.5.3. Conclusion

Although much research has been done on delays during construction it is still a common occurrence today. Most of the research had focussed on the causes of schedule overruns or delays. A large number of factors that cause construction delays have been identified. However every researcher uses their own definition of the factors.

Table 2.4 listed the top 5 factors of each of the studies. Although the factors appear to be completely different there are some similarity; most of the factors are either caused by or will lead to changes in the project scope. The following part will investigate project scope management.

2.6. Project scope management

2.6.1. Introduction

Project scope management is one of the most important functions of a project manager (Khan, 2006). It is concerned with defining and controlling of what forms and what does not form part of the project (PMI, 2008). Identifying and defining the correct project requirements at the start of a project will limit changes later on. Kerzner (2009) states that: the success of a project may depend on it being completed with a minimum number of, or a mutually agreed upon number of scope changes. However change is a certainty during projects, thus making it important to control the scope.

The PMI guide assigns five of the project management processes to project scope management, these are the processes required to ensure that the project includes all the work that is required, and only the work that is required, in order to complete project successfully (PMI, 2008). The processes are:

- Collect requirements.
- Define scope.
- Create work breakdown structure (WBS).
- Verify scope.
- Control scope.

The WBS is a ranked breakdown of the project into its basic elements. A detailed WBS usually has multiple levels, with each descending level being a more detailed definition of the project (PMI, 2008) (Khan, 2006).

The PMI processes are very similar to the five components of project scope management as defined by Khan (Khan, 2006):

- Project initiation.
- Scope planning.
- Scope definition.
- Scope verification.
- Scope change control.

These five components all interact through the work breakdown structure (WBS) (see figure 2.4).

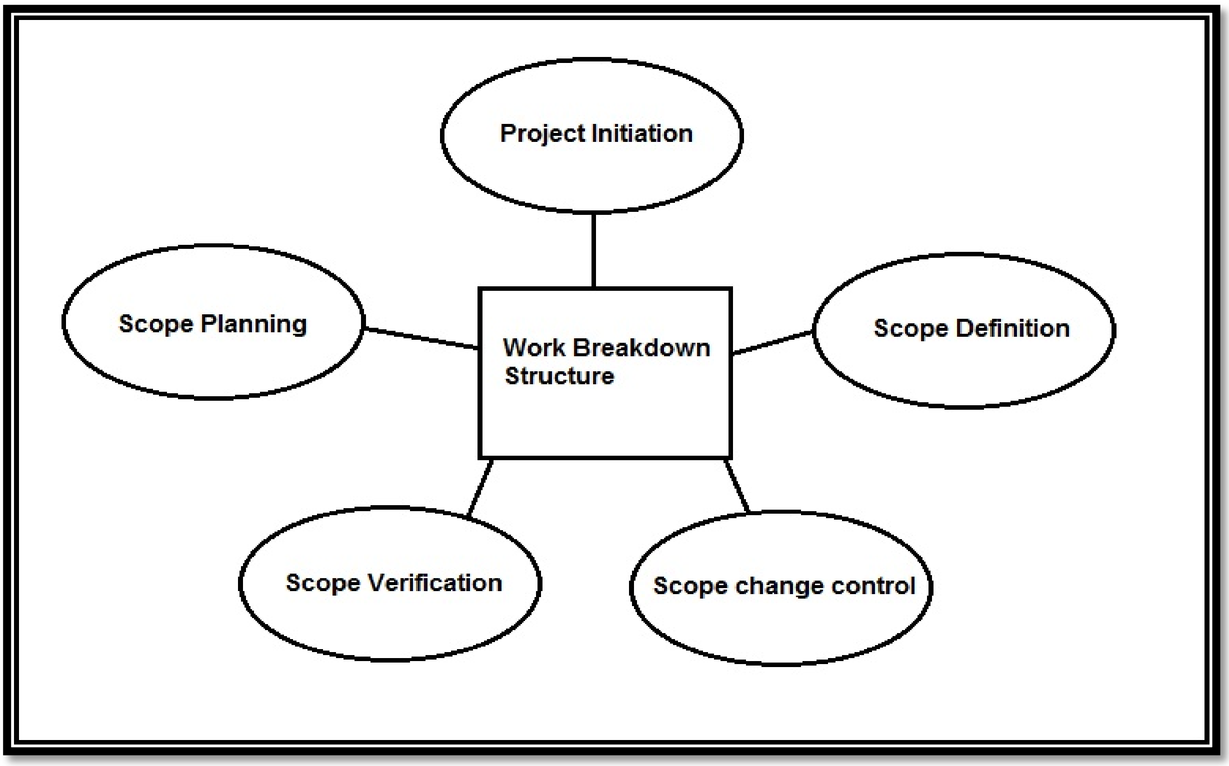

Figure 2.5 – Components of scope management interacting through the WBS (Khan, 2006)

Khan's definition of scope management is a simplified discussion of scope management with the WBS at its centre. The rest of this section will explore the five components of his definition of scope management (Khan, 2006).

Projects are initiated to satisfy a stakeholder's need. This need may arise due to a variety of different reasons, such as an opportunity to make a profit, change in the market environment, a new product, or changes to government regulations. Once the need has been identified, the project will be subjected to a feasibility analysis. This feasibility analysis comprises of three parts (PMI, 2008). (Khan, 2006);

- Technical feasibility (explores the availability of technical knowledge, competent management, as well as the availability of land, infrastructure, and resources).
- Economic feasibility (evaluates the cost-benefit ratio of different technological options and the rate of return for the project over its lifetime).
- Financial feasibility (assesses the availability of funds and the cost of borrowing money)

A detailed feasibility analysis allows the stakeholders to make the decision for a project to proceed or to be shelved (Khan, 2006). When the project finally does proceed, it is necessary to document the project requirements as well as the stakeholder's expectation. This forms the base on which the scope can be built.

The next step is to plan the scope. The project management team uses the requirements for the cost, schedule, and quality to form an intermediate level WBS. This sets out a summary of the work to be done. Scope planning is an iterative process; information gathered over time is constantly fed back into the process (Khan, 2006). The scope becomes more specific as more information is fed into the process (PMI, 2008).

Once the framework of the project's WBS has been completed, it is possible to develop a detailed definition of the scope. After scope definition the WBS will contain project work all the way down to individual work packages (see figure 2.5 for an example of a WBS). A comprehensive WBS contains all the work that needs to be done in order to complete the project. Thus anything not shown in the WBS is not part of the project scope (PMI, 2008).

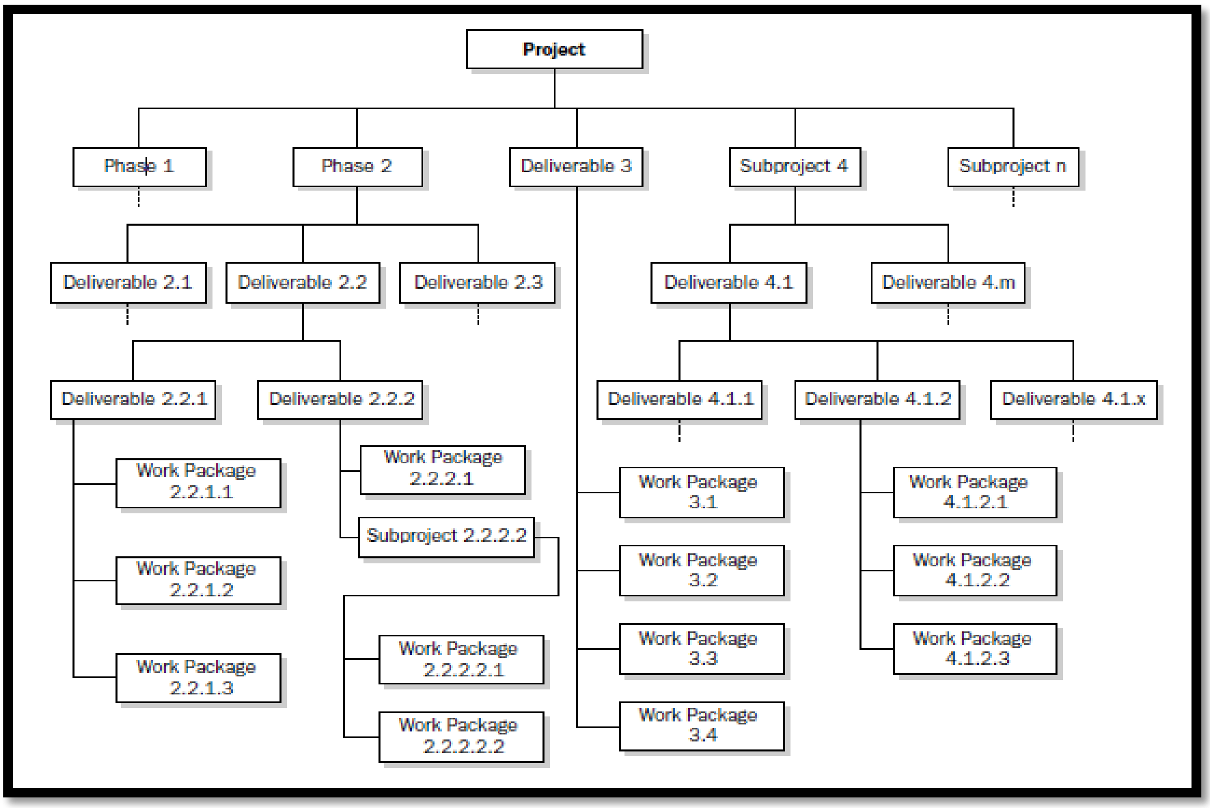

Figure 2.6 – Sample WBS (PMI, 2008)

Once work on the project starts it is necessary to verify the scope. Scope verification is the process of gaining acceptance for the work that has been completed, ensuring that the work has been completed satisfactorily (PMI, 2008). This process verifies that the work has been done as set out in the project scope and the WBS. Scope verification allows the project manager to check the project's progress in terms of the schedule and the costs, thus enabling the project manager to predict if there will be any schedule overruns or extra costs incurred (Khan, 2006).

The last part of project scope management is scope control, also called scope change control. Change is an inevitable occurrence during any project. It is thus important to implement a scope control plan from the start of the project (Khan, 2006). Scope control ensures that all the changes are managed when they occur and integrated into other the other processes of the project (PMI, 2008). One of the leading causes of project failure is scope creep, which refers to uncontrolled changes or continuous growth of the project scope (Khan, 2006) (Kerzner, 2009).

The remainder of this section will look into the different reasons for scope to change as well as the effect these changes can have on a project.

2.6.2. Scope change

Scope change is one of the few constants during a project (Warhoe & Giammalvo, 2010). Thus it is important to understand what cause these changes and also what effect these changes will have on the project.

2.6.2.1. Reasons for scope change

As mentioned earlier changes take place on most construction projects. Each of these changes is unique when compared to all the other changes on the same project. However commonalities between changes do occur.

One study carried out on heavy construction projects in the US lists the most common reasons as (Serag, et al., 2010):

- To provide for major quantity differences.
- To provide for unforeseen work, grade changes, or alterations in the plans.
- To change the limits of the construction to meet field conditions.
- To make the projects more functionally operational.
- Deterioration or damage to the project after design.

Another study done in Oman gives the most common reasons as (Alnuaimi, et al., 2010);

- Owner instructs additional work.
- Owner instructs modification to design.
- Poor communication between relevant government units and the owner.
- Design errors.
- Unrealistic design periods.

Although the two lists appear completely different there are some similarities. For example; in order to provide for major quantities can also be seen as the owner instructing additional work or modifying his original design. Thus common reasons can thus be found. One study (Warhoe & Giammalvo, 2010) classified these common causes of change into five categories, which are;

- Design deficiencies.
- Criteria changes.
- Unforeseen conditions, including differing site conditions.
- Changes directed by the owner.
- Other.

Table 2.6 shows how the important reasons listed above fit within the factor categories.

Table 2.6 Factors of scope change

Factor categories (Warhoe & Giammalvo, 2010)	**(Serag, et al., 2010)**	**(Alnuaimi, et al., 2010)**
Design Deficiencies	provide for major quantity differences	design errors unrealistic design periods
Criteria Changes	change the limits of the construction to meet field conditions	
Unforeseen Conditions	provide for unforeseen work, grade changes, or alterations in the plans, deterioration or damage to the project after design	
Changes directed by the owner		owner instructs additional work owner instructs modification to design
Other	make the projects more functionally operational	poor communication between relevant government

These factors are very similar to the delay causing factors identified by other researchers (see 2.5.2.1). This indicates a connection between scope change and schedule overruns.

A further description of each of these categories will now be given.

Design deficiencies

The design deficiencies category consists of those changes that are caused by incomplete designs or errors in the design that are not found until construction has already begun. These are usually caused by ineffective quality control during the design phase of the project, and in contrast to other types of change, are manageable (Warhoe & Giammalvo, 2010).

This is also the most common cause of change. This may be due to the financial pressure on clients to complete projects as soon as possible being transferred to the designer, who in turn has to complete the design in unreasonably small time (Warhoe & Giammalvo, 2010).

Criteria changes

Most owners, usually governments but also some private institutions, have well established standards for design and construction. However sometimes these standards are revised after construction has begun and the contractor or designer may have to make changes in order to abide by the new criteria (Warhoe & Giammalvo, 2010). According to another study these changes nearly always lead to a variation to the original cost or schedule (Kaming, et al., 1997).

Unforeseen conditions

Certain changes occur when hidden site conditions are uncovered after the contract has been concluded. These conditions were not previously anticipated and are thus not included in the design documents. A common example is when excavation uncovers objects or soil conditions that were unforeseen and which require extreme measures to accommodate. Unforeseen conditions are also mentioned as a cause of delays (Kumaraswamy & Chan, 1998) (Lo, et al., 2006).

Changes in scope directed by the owner

When the owner or client chooses to make changes to the final product after the design has been completed and the contractor has been appointed they will fall in this category. These changes were found to be the most common reason for scope change by one study (Alnuaimi, et al., 2010).

Other changes

There are other changes that don't easily fit into the categories already mentioned. These may include some of the following; administrative; contract options; new laws or regulations; currency re-evaluation; etc. (Warhoe & Giammalvo, 2010).

2.6.2.2. Effect of scope change

Changes to project scope can impact the project in various ways. Alnuaimi et al lists the six most important effects on the project as (Alnuaimi, et al., 2010):

- Delay completion date of the project.
- Causes claims and disputes.
- Cost overruns.

- Affects performance and morale of the labour.
- Contractors incur additional cost due to variations.
- Affects the quality of work.

A further description of each of these impacts will now be given

Construction delays

Construction delay is the most important effect of variation (Alnuaimi, et al., 2010). Changes will result in revision of plans, additional work, new decisions to be made, extra materials to be resourced, etc. all of which will take extra time to complete. Research done on the cause of delays also mentions scope change as an important factor (Kaming, et al., 1997) (Doloi, et al., 2012).

Claims and disputes

Changes can lead to confusion during the project. This confusion will cause disruptions, which in turn may cause claims and disputes. This is especially the case when new work activities are introduced which did not form part of the original scope of work. Many disputes also originate due to the client and the contractor not being able to agree on the impact of the change.

Standard forms of contract all make provision for claims and disputes, setting a sequence for the resolution of the contractor's claims (Povey, 2005). The GCC document created by the South African Institution of Civil Engineering (SAICE, 2010) is the standard form used most often in domestic civil engineering projects (Povey, 2005). The sequence followed for claims is the following (GCC 2010):

- An event occurs, giving rise to a claim, which must be submitted by the Contractor within 28 days. The submission must include all records of the circumstance of the claim.
- Within 28 days of the submittal of the claim the Engineer give a ruling on the claim; if ruled in favour of the Contractor it may lead to:
  - Additional time allowed for completion.
  - Additional cost which are to be included as a VO in the next payment certificate.
- Unresolved claims may lead to a dispute which can be settled by the following methods:
  - Engineer ruling.
  - Mediation.
  - Arbitration.
  - Litigation.

Cost overruns

The extra work may not have been part of the original scope. Thus any extra costs incurred due to the changes may cause the project to overrun its original budget. Furthermore the claims and disputes may also lead to additional expenditure. Both of the previous effects may also lead to additional cost.

Performance and morale of the labour

Labour may be directly or indirectly affected by changes to the project scope. Extra work, as well as redoing work that has already been completed, will negatively influence the morale of the labour. A low morale may cause the labour productivity to drop. According to one study the timing of changes is very important, with late changes being the most disruptive to labour productivity (Ibbs, 2005).

Additional costs due to changes

Additional costs due to changes usually occur when the change is due to unforeseen site conditions. The extraordinary measures needed to accommodate these circumstances may easily cost the contractor more money (Warhoe & Giammalvo, 2010)

Quality of work

The delays caused due to changes, as well as the work-rework cycle caused by some of these changes, puts the contractor under enormous pressure to complete the work. This may lead to the work being carried out in a hasty fashion with lower quality control (Alnuaimi, et al., 2010).

2.6.2.3. Effect of the frequency, type and timing of variation orders

As was seen in the previous parts of this chapter change can occur for multiple reasons and can affect a project in various ways. Most construction contracts deal with scope change by way of change or VO’s (Alnuaimi, et al., 2010). The most commonly used form of contract in civil construction projects in South Africa, GCC document from SAICE, makes use of VO’s.

While there are has been much research covering cost and schedule overruns, few have studied the effect of the frequency or type of VO has on the overruns (Anastasopoulus, et al., 2010) (Serag, et al., 2010). Only one study could be found where the timing of the VO's was considered (Serag, et al., 2010).

One study investigated the change order frequency during highway construction projects (Anastasopoulus, et al., 2010). The research studied 1939 project which occurred between 1996 and 2000. They found that on average these projects had 5.128 variation or change orders per project. The study also found that there is a direct relationship between the project size and VO frequency; with larger projects having more VO's than shorter projects. However the study does not elaborate on what effect this will have on the cost or schedule overruns.

Another study investigated 11 variables that might impact the increase in contract price due to change orders (Serag, et al., 2010). The two most important variables found by this study was (1) the timing of VO's and (2) the type of VO; with unforeseen conditions and provision for major quantity differences, being the two most significant reasons for change. The study did not however show how these factors affected the project schedule overruns.

2.6.3. Conclusion

Project scope management has a close relationship with time and cost management. Both time management and cost management are dependent on correct definition of scope. Thus any changes made to the scope will adversely affect the project's schedule and cost.

Factors which cause scope change are many and varied but can be summed up into 5 categories; i.e. design deficiencies, criteria changes, unforeseen conditions, changes directed by the owner, and other. These factors show similarities to the causes of delays, indicating interdependence between scope and time management.

Research was also studied about the effect of scope change; with delays, claims and disputes, and cost overruns mentioned as the three most important effects. This confirms that it is difficult to study cost and schedule overruns without considering scope changes.

VO's is the method used by construction contracts to track any changes to the project's scope. While much has been written about cost and schedule overruns, very little research has been done on the effect of VO's on these overruns.

2.7. Chapter Conclusion

Project cost management and project schedule management are important parts of project management, and according to Kerzner cost and schedule management are inseparable. Much research has been done on these subjects separately and together, with most of the studies focussing on the cost and schedule overruns.

From the literature it can be noted that not only are cost overruns widespread but they are also quite common. Furthermore schedule overruns are also widespread and common. Various researchers have studied these two subjects.

The literature on project management has also shown that project scope management plays an integral role in cost and time management, and that it is difficult to study cost and schedule overruns without also considering scope change.

VO’s is the contractual method used to implement and track changes to a project’s scope. While much has been written about cost and schedule overruns, very little research has been done on the effect of VO’s on these overruns. This study will use information gathered about VO’s during projects in order to see what effect change has on a project’s cost and schedule overruns.

3. Research Method

3.1. Chapter Introduction

Given the research objectives it was decided to make use of a quantitative research method. Thus data was gathered about completed projects and this data was analysed. This chapter will discuss two common research methods, followed by the reasons for choosing the relevant method.

3.2. Qualitative approach

The qualitative approach explores the meaning individuals or groups assign to a specific problem. A qualitative approach collects non numerical information; and makes use of phenomenology, ethnography, grounded theory, case studies, and narrative research. Thus the qualitative information can be observed but not measured (Cresswell, 2009).

Qualitative research is used to investigate a concept or phenomenon about which little research has been done and which is poorly understood. The aim of a qualitative research is thus to explore a topic that has never been addressed within a certain sample, group or area (Cresswell, 2009).

One advantage of qualitative research is that the results contain the contextual information about the gathered data. The reason for the results is part of the data collected. Another advantage is that respondents can respond freely, that is they are not bound by a predetermined set of answers (ACET, Inc., 2013).

The disadvantages of this approach is that it is often time consuming and expensive. Interviews take long and in order to gather a large enough sample many interviews will need to done. Furthermore additional time should be allowed to analyse and summarise the data (ACET, Inc., 2013).

3.3. Quantitative approach

Quantitative research is a means for testing theories by examining the relationship among variables. A quantitative approach, as the name suggests, concerns data which can be counted or quantified, and typically uses information gathered from surveys and experiments to study its goal (Cresswell, 2009).

Quantitative research is usually done to identify factors which affect an outcome, or to test a theory or explanation. The subject is usually well covered by others, and the aim is usually to prove the researcher own theory about a given subject (Cresswell, 2009).

An advantage of this method is that it is a very efficient method for gathering information, especially about a large group of projects. The researcher can send out a large number of questionnaires or data sheets to be completed by various parties. Further they don’t need to monitor the survey completion, due to the large amount of surveys send out the surveys which are completed will usually be sufficiently large enough sample (which accurately reflects the population) for the purposes of the study (ACET, Inc., 2013).

However due to the constraints of the survey questions or data sheets, this research method does not provide insight into the answers given (ACET, Inc., 2013). For example, respondents might be asked to "Rate the change inducing factor during construction" using the following scale: important (5) to insignificant (1). This question will collect quantitative data because it will be able to count how many people gave each of the answers, but knowing how many found a factor insignificant does not give the reason for its significance.

3.4. Comparison and Conclusion

Table 3.1 summarises the advantages and disadvantages of the two research methods discussed above.

Table 3.1 Qualitative and Quantitative Research: Advantages and Disadvantages

Research Method	Advantages	Disadvantages
Qualitative	Rich and in-depth description of subject	Small sample, Time consuming, Expensive
Quantitative	Large sample which is accurately reflects the population, More efficient	Data only reflects the trends and not the reason for it

The data needed for this research will have to meet the following requirements:

- In order to determine how common cost and schedule overruns are and what effect variations orders have on them it will be necessary to collect a large sample of projects.
- The required data needs to be measurable in order to draw statistical conclusions.

Thus for the purposes of this study a quantitative research method will be used; data will be collected about various projects, which will then be analysed in order to satisfy the research objectives. Having chosen a quantitative research method the study is structured in the following way.

- Literature was reviewed to find a connection between project cost, schedule, and scope. The effect of scope changes on the cost and schedule overrun was also investigated
- The different research methods were considered and a method was chosen, as motivated above.
- A database of 137 projects was collected with the relevant information in order to satisfy the research questions.
- The trends and the characteristics of the data were identified.
- The research results were then compared with the findings from the literature.
- Deductions were made from the gathered information.

4. Cost and Schedule Overruns

4.1. Introduction

Given the research objectives as stated above, the first task is to collect a large enough sample in order to allow statistical analyses of cost overruns and schedule overruns. The main problem with this is that the required information is quite difficult to collect. The following information will be required about each project in order to investigate the research questions.

- Project Name.
- Initial project budget.
- Final project cost.
- Project start date.
- Initial project completion date.
- Final project completion date.
- Information about project VO's:
    - A description of the VO.
    - Value of VO.
    - Date of VO

Road construction and maintenance projects are in the public domain and thus the client is most often a government entity. The few private road or maintenance projects that do take place usually keep their data classified, in order to keep information from the hands of competitors.

Furthermore for ease of access of information it was also decided to limit the scope to only projects that took place in the Western Cape. Thus the researcher approached the Western Cape Department of Transport and Public Works for information about projects.

The Western Cape Department of Transport and Public Works managed to supply a database of 137 projects with all the required information. The projects all occurred within the last 10 years; with the earliest starting project running from 24 November 2004 to 19 February 2008 and the latest finishing project running from 12 September 2011 to 10 March 2015. This chapter will now analyse, compare and discuss the data collected about the projects;

- Project costs and overruns will be investigated.
- Project schedules and overruns will be investigated.
- The effect of project costs on schedule will be investigated.
- The effect of project schedule on costs will be investigated

The data collected about the VO's will be discussed in Chapter 5.

4.2. Project Cost Overrun

The combined cost of the 137 projects was R 5 496 976 642.66. All the costs were actual construction costs. Furthermore due to all projects taking place within a 10 year period the effect of inflation was not taken into account, due to the relative short period in consideration. The size of the projects ranged from R 2 096 597.73 to R 661 052 069.03. The project's original tender amount was also given, and these values ranged from R 1 719 868.70 to R 471 315 264.41. The following figure shows the distribution of both the final cost and the tender amount.

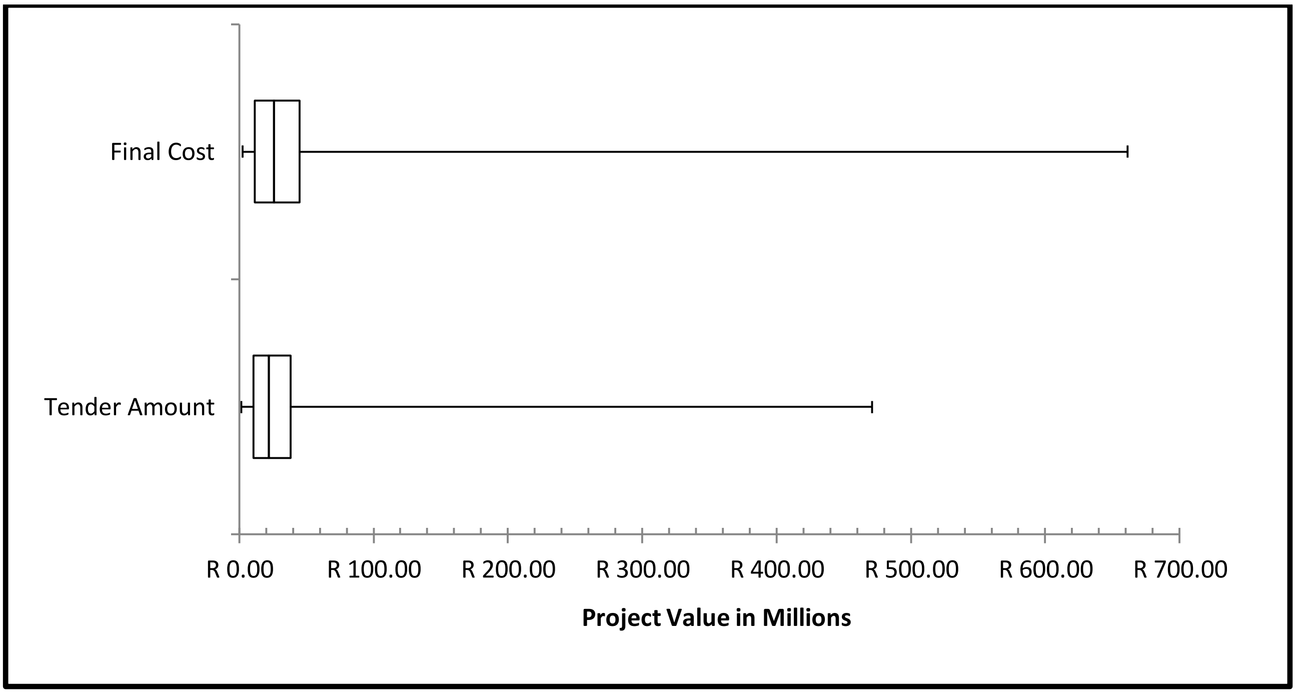

Figure 4.1 Project Values Distribution (Box and Whisker Plot)

The method chosen to display distributions in this paper is called a box and whisker plot. A box and whisker plot consists of a box which stretches from the first quartile (value higher 25% of all values) to the third quartile (value higher than 75% of all values). The median is indicated as a line within the box. The whiskers indicate the minimum and maximum values. This is one method of indicating the distribution of values, without making any assumptions of the statistical distribution (such as normal or lognormal distributions) of the data.

As can be seen from fig 4.1 most of the projects were distributed to the lower end of the cost scale.

The projects were divided into the following cost groups (by final cost) in order to compare the different sized projects with each other:

- < R20 million: 54 projects.
- R20 million – R40 million: 42 projects.

- R40 million – R80 million: 29 projects.
- >R80 million: 12 projects.

With both the tender amount and the final cost of the project known the cost overrun can now be calculated. The percentage overrun can be calculated with the following equation:

$$CO = \left(\frac{FC}{TA} - 1\right) \times 100$$

With CO being cost overrun, FC final cost and TA tender amount. Projects which were affected by cost overrun will have a positive percentage and projects which cost less than their tender amount will have a negative percentage. The following figure shows the distribution of the cost overruns.

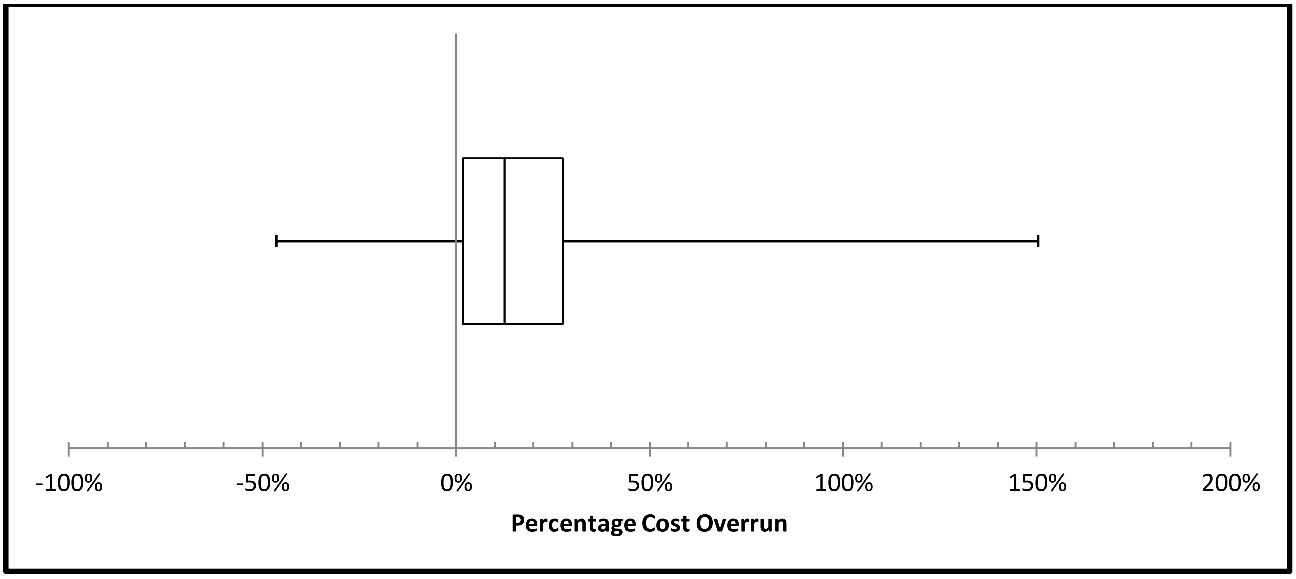

Figure 4.2 Project Cost Overrun Distributions (Box and Whisker Plot)

With the cost overrun calculated for each project the different cost groups will be compared to each other. Table 4.1 shows the percentage of projects in each cost group that overran its budget. It also indicates the mean, standard deviation and median of the Cost Overrun (CO).

Table 4.1 Cost Performance Summary.

Cost Group	**Number of projects**	**Number of projects with CO > 0**	**Percentage of projects with CO > 0**	**Mean CO**	**Standard Deviation**	**Median CO**
< R20 million	54	40	74.1%	13.5%	22.7%	9.7%
R20 million – R40 million	42	33	78.6%	16.3%	30.4%	15.2%
R40 million – R80 million	29	24	82.8%	17.9%	23.5%	16.1%
> R80 million	12	11	91.7%	29.3%	21.0%	31.7%
All	137	108	79%	17%	25%	13%

Nearly 80% of all the projects were affected by cost overruns, with a mean cost overrun of 16.7% and a median cost overrun 12.6%. The standard deviation is also high, indicating that there is a large variation between the cost overruns of the different projects. From this data it can be concludes that cost overruns are very common. The smallest projects overran their costs 74.1% of the time and had the lowest mean overrun (13.5%), indicating they overran their cost the least and by the least amount. In contrast the largest projects nearly all overran their original tender sums and with the largest mean cost overrun (29.3%). Thus not only do larger projects overrun their cost more often than smaller projects they also overrun it by a larger percentage than smaller projects.

4.3. Project Schedule Overrun

Data was also collected about the project start date, and the initial and actual completion dates. This will enable us to calculate both the project initial duration and final duration. The shortest project by final duration was 106 days long and the longest was 1308 days long. When studying the initial duration of the projects, the shortest project was 41 days and the longest was 1470 days. Figure 4.3 indicates the distribution of the both the final and initial durations across all 137 projects.

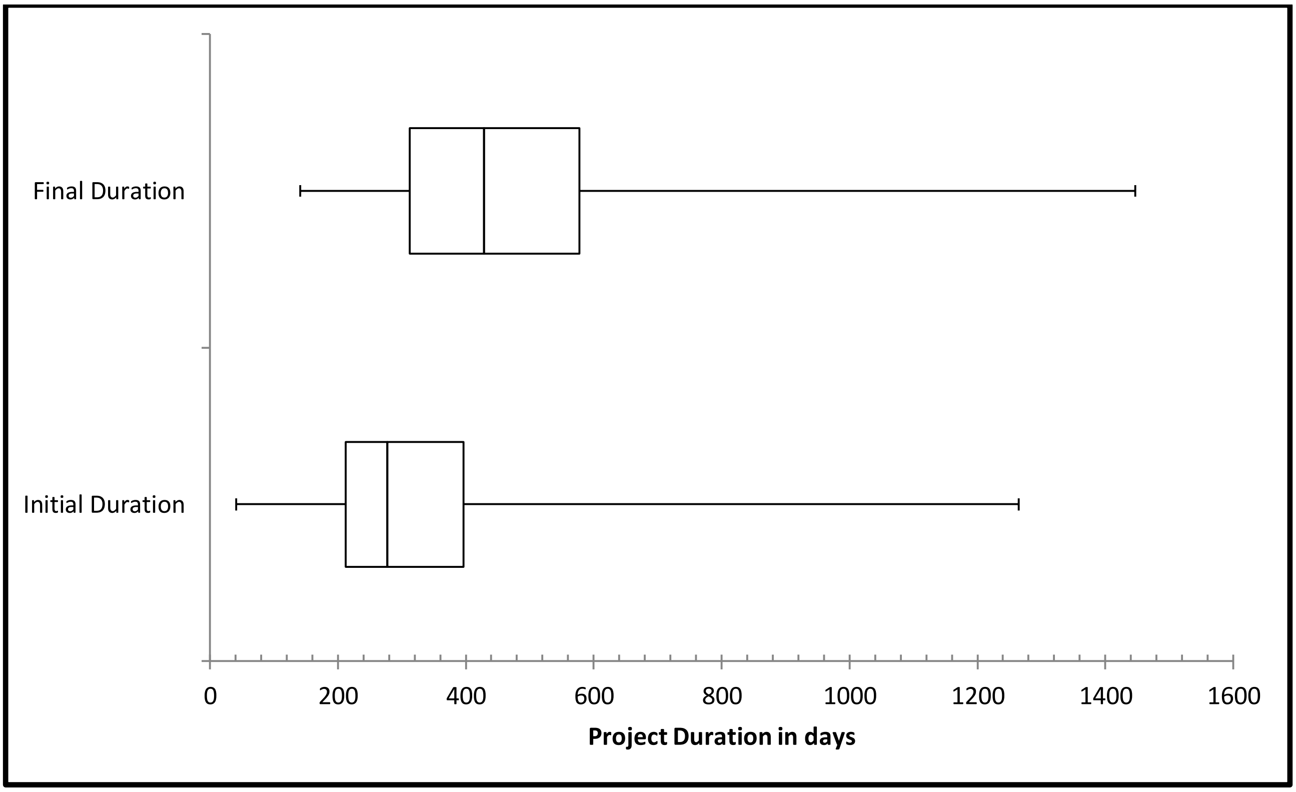

Figure 4.3 Project Duration Distributions (Box and Whisker Plot)

Already from figure 4.3 it becomes evident that projects tend to overrun their schedule by a significant margin. This can be seen by the large difference between the 2 boxes. In order to compare projects of different lengths, the researcher divided the projects into four schedule groups according to their final duration:

- 52 projects shorter than 365 days (1 year).
- 44 projects between 365 - 550 days (1 ½ years).
- 24 projects between 550 - 730 days (2 years).
- And 17 projects longer than 730 days.

A Schedule Overrun (SO) percentage was calculated to allow the comparison of overruns between the different project durations. The SO value was calculated with the following equation:

$$SO = \left(\frac{FD}{OD} - 1\right) \times 100$$

Where SO is schedule overrun, FD is final duration, and OD is the planned or original duration. A positive value for the SO will indicate a project which was affected by schedule overrun and a negative value will indicate a project that finished early. In figure 4.4 a box and whisker plot was drawn up for the schedule overrun percentage.

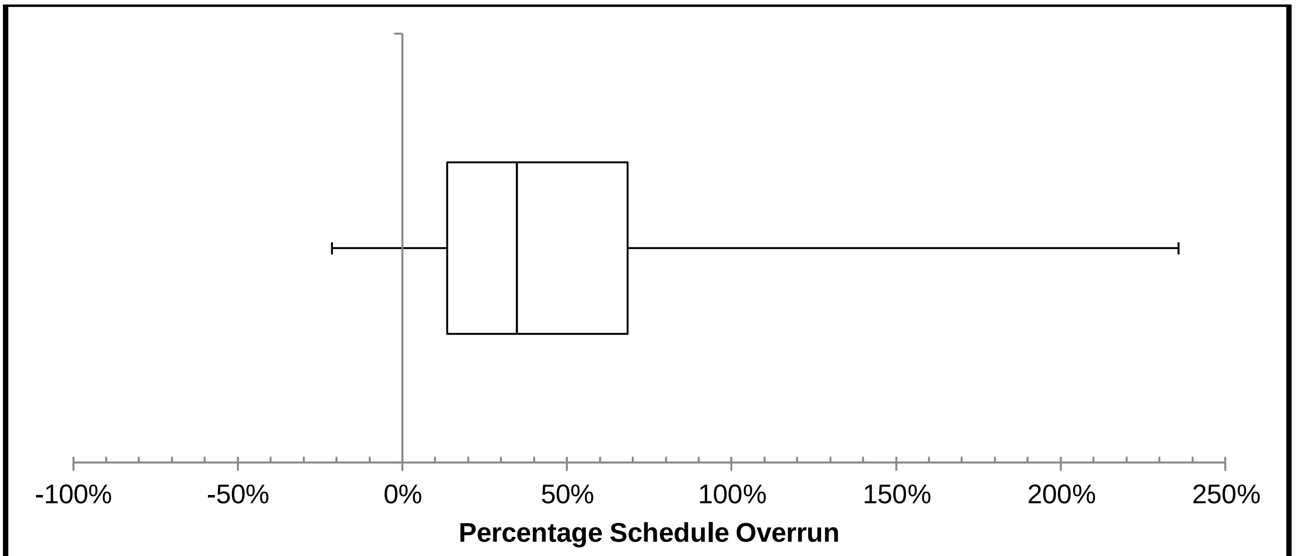

Figure 4.4 Project Schedule Overrun Distribution (Box and Whisker Plot)

Table 4.2 summarises the schedule performance of each of the different duration groups.

Table 4.2 Schedule Performance Summary

Schedule Group	Number of projects	Number of projects with SO > 0	Percentage of projects with SO > 0	Mean SO	Standard Deviation	Median SO
< 365 days	52	49	94.2%	43.0%	42.2%	31.4%
365 - 550	44	42	95.5%	45.2%	47.3%	32.7%

days						
550 - 730 days	24	22	91.7%	53.3%	51.0%	38.8%
> 730 days	17	16	94.1%	69.8%	64.7%	75.7%
All	137	129	94.2%	48.8%	48.8%	34.7%

Schedule overruns appear to be very common, with 94.2% of the projects studied being affected. Further more than half of the projects had an overrun of 30% or more (median 34.7%). The incidence of schedule overruns is universal between all the duration groups with none of them having an occurrence below 90% and all of them a median value above 30%. For projects longer than two years (730 days), the schedule overrun is even worse with more than half of the projects in that group having an overrun of over 75% (median value 75.7%). The large standard deviation indicates that projects schedule overruns are thinly distributed.

4.4. The effect of schedule and cost overruns on each other

In the previous two sections of the chapter cost and schedule overrun were investigated on their own. This section will study the effect of cost overruns and schedule overruns on each other. Since none of the projects were the same length or cost the same, the percentage overrun of the schedule and cost will be compared to each other.

4.4.1. Cost overruns effect on Schedule overruns

Of the 29 projects which were not affected by cost overruns 27 (93.1%) were still affected by schedule overruns. In comparison of the 108 projects that did have a cost overrun, 104 (94.4%) had a schedule overrun. This indicates that the occurrence of cost overruns does not significantly affect the occurrence of schedule overruns.

However since most of the projects (94.2%) were affected by schedule overruns it is also necessary to investigate the effect of the cost overrun on the size of the schedule overrun. The mean schedule overrun for projects with a positive cost overrun was 47.9%, and for projects without a cost overrun it was 52.2%. Figure 4.5 shows the box and whisker plot for the schedule overrun for both projects with a CO>0 and with a CO<0.

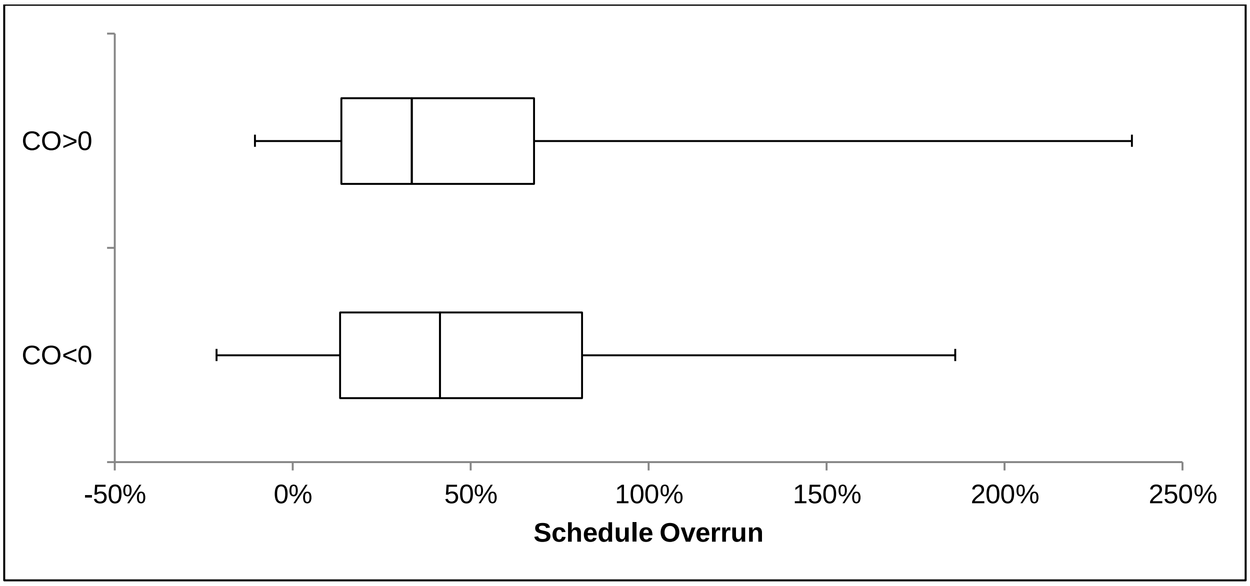

Figure 4.5 Schedule overrun distribution for both projects with and without a cost overrun

Figure 4.5 indicates that projects without a cost overrun usually had a larger schedule overrun than those with a cost overrun, though the projects with a cost overrun had the larger outliers. Thus from both the mean values and the box and whisker plot it can be concluded that projects with a cost overrun does not overrun their schedule by more than projects without a cost overrun.

4.4.2. Schedule overruns effect on Cost overruns

Since 94.2% of the projects were affected by schedule overruns, the researcher decided to use 15% as the split value for schedule overruns. Thus of the 38 projects with a schedule overrun below 15%, 30 (78.9%) had a positive cost overrun. In comparison of the 99 with a schedule overrun greater than 15%, 78 (78.8%) had a positive cost overrun.

Thus similar to the effect cost overruns had on schedule overruns, schedule overruns seems to have no effect on cost overruns. However when comparing the mean values to each other, 12% for projects with SO<15% and 18.5% for projects with SO>15%, it seems that the larger schedule overrun does have a greater effect on cost overruns. Figure 4.6 shows a box and whisker plot of these two schedule overrun groups.

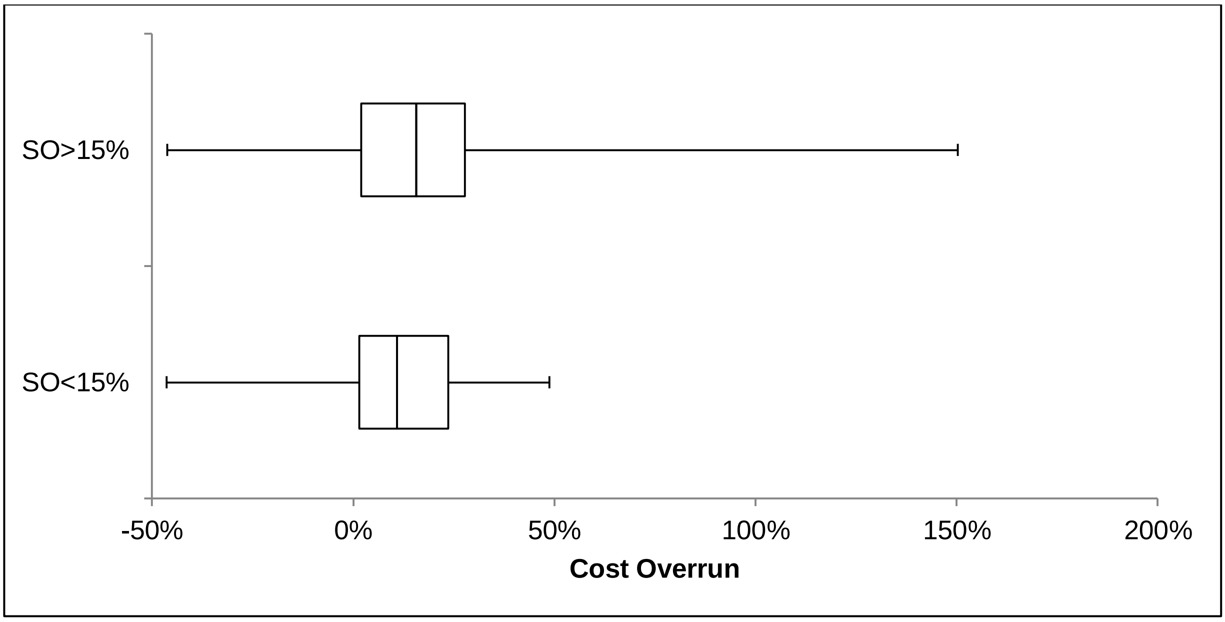

Figure 4.6 Cost overrun distribution for both projects with a schedule overrun above and below 15%

Similar to the mean values this figure indicates that the projects with the larger schedule overruns usually had the larger cost overruns as well as the larger outliers. From this information it can be concluded that although schedule overruns size does not affect the occurrence of a cost overrun, they do have an effect on the size of the cost overrun, with projects with larger schedule overruns also having larger cost overruns.

4.5. Chapter Conclusion

Given the sample of 137 projects it can be concluded that Cost overruns are quite common. As the size of the projects increased the cost overrun also increased, with 74.1% of projects below R20 million only going over and 91.7% of the projects over R80 million over running their cost. The larger projects also overran their costs by a larger margin, with the mean cost overrun being 29.3% for the largest projects (those over R80 million) compared to the 13.5% for the smaller projects (less than R20 million).

Furthermore schedule overruns are very common, with them occurring in 94.2% of the projects studied. Longer projects also had longer schedule overruns with projects over two years long having an average schedule overrun of 69.8% compared to the 43.0% schedule overrun of projects shorter than a year.

Lastly this chapter investigated the effect the cost overrun and schedule overrun had on each other. From the data studied it was inconclusive if the if projects with a schedule overrun were more prone to cost overruns and vice versa. The effect of the size of the respective overruns was also inconclusive.

A reason for costs not being affected by schedule overruns may be that additional costs due to late completion are sometimes incurred by the contractor, by way of fines or non-payment, if the delay was as a result of his own actions. Furthermore clients are normally more concerned about costs than schedule, and will allow schedules to overrun as long as the costs are kept within reasonable limits.

Since schedules escalation and cost escalation does not correlate to each other, another reason for the overruns and their size will need to be investigated.

5. Variation Orders and their effect on Cost and Schedule Escalation

From the previous section it became clear that the occurrence of the schedule overrun has no direct effect on the occurrence of the cost overrun, and vice versa. During the literature it was found that scope change was the most common cause of cost and schedule overruns. During construction projects the one way of tracking changes is through VO's. This Chapter will investigate the following:

- The effect the number of VO's has on cost and schedule overruns.
- The effect the type of VO has on cost and schedule overruns.
- The effect the timing of VO's has on the cost and schedule overruns.

5.1. Occurrence of Variation Orders

The 137 projects that were investigated had a total of 901 VO's. The investigated projects all had at least one VO, and the project with the most had 46 VO's. The following tables indicates the number of VO's, and the average and median number of VO's for each of the four project cost groups, as defined in the previous chapter.

Table 5.1 Number of VO's by Cost groups

	Number of Projects	Number of VO's	Average number of VO's	Standard Deviation	Median number of VO's
< R20 million	54	255	4.72	4.30	3.5
R20 million – R40 million	42	258	6.14	4.03	5
R40 million – R80 million	29	223	7.69	5.31	6
> R80 million	12	165	13.75	11.89	13.5
All	137	901	6.58	5.97	5

The average number of VO's is higher than the median number of VO's which indicates a skewness of the data to the right, meaning there are more projects with fewer than the average number of VO's than there are projects with more than the average. Secondly the average number and median number both increase with the as the project size increases, this indicates that the larger projects in terms of final cost had more changes than the smaller projects. This can be due to the size of the projects; larger projects have more things to change.

In table 5.2 the number of VO's, the average number of VO's, and the median number of VO's for each of the four project schedule groups, as defined in the previous chapter, will be investigated.

Table 5.2 Number of VO's by Schedule groups

	Number of Projects	**Number of VO's**	**Average number of VO's**	**Standard Deviation**	**Median number of VO's**
< 365 days	52	216	4.15	2.72	4
365 - 550 days	44	292	6.64	5.02	5.5
550 - 730 days	24	202	8.42	5.43	9
> 730 days	17	191	11.24	11.03	10
All	137	901	6.58	5.97	5

As with the cost groups, the median is lower than the average for most of the schedule groups, however this not the case with projects in the 550-730 day group; this indicates that the projects in that group were more evenly distributed than the rest of the projects. Another trend is that he longer projects tend to have more VO's than the shorter projects. Once again this can be due to the larger projects having more chances for a change to occur due to the length of the projects.

Since all projects had at least one VO, the frequency of VO's will be investigated. The following figure indicates the box and whisker distribution of the VO's, the project with 46 VO's was omitted from this graph, because the next highest was only 23.

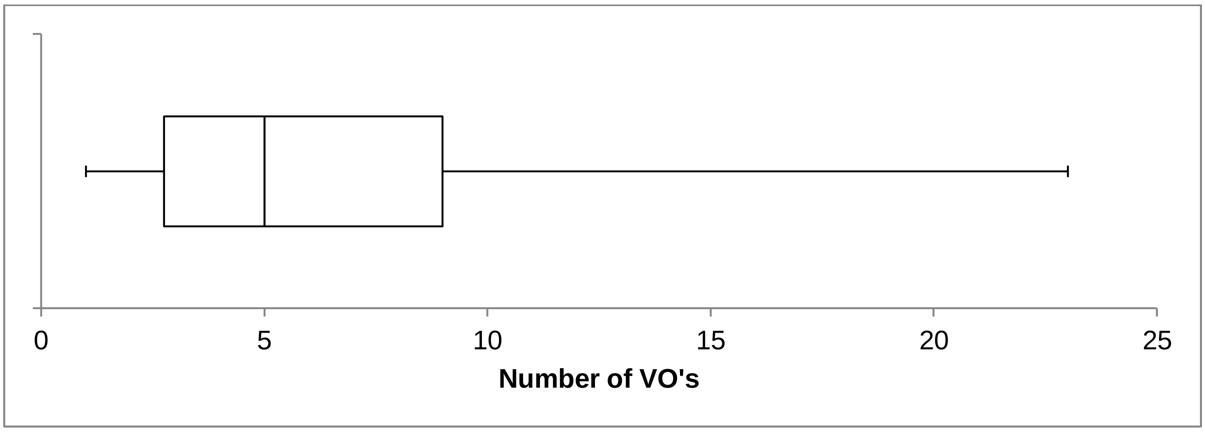

Figure 5.1 Number of VO's (Box and whisker plot)

Figure 5.1 indicates that 75% (1st quartile) of the projects had 3 or more VO's and 25% of the projects had 9 or more VO's, thus not only did all projects have a VO, but projects with multiple VO's were also quite common.

5.1.1. Cost impact of Variation Order occurrence

The projects will be divided up into groups by the number of VO's that occurred during them; table 5.3 shows this grouping as well as average cost overrun for these projects.

Table 5.3 Impact of VO's on Cost overrun

VO number	Number of Projects	Number with a Cost Overrun	Percentage with a Cost Overrun	Average Cost Overrun	Standard Deviation	Median Cost Overrun
3 or less	53	36	67.9%	9.4%	19.0%	9.1%
4 - 6	32	27	84.4%	17.4%	22.0%	10.2%
7 - 10	29	24	82.8%	22.4%	36.3%	18.6%
More than 10	23	21	91.3%	25.2%	23.0%	20.2%

Table 5.3 indicates that projects with more VO's are more prone to Cost overruns; those with more than 10 overran their costs 91.3% of the time. Compared to those with 3 or fewer VO's which only overran their cost 67.9% of the time. The following figure shows the cost overrun plotted against the number of VO's of each of the projects (the project with 46 VO's is not included in the figure).

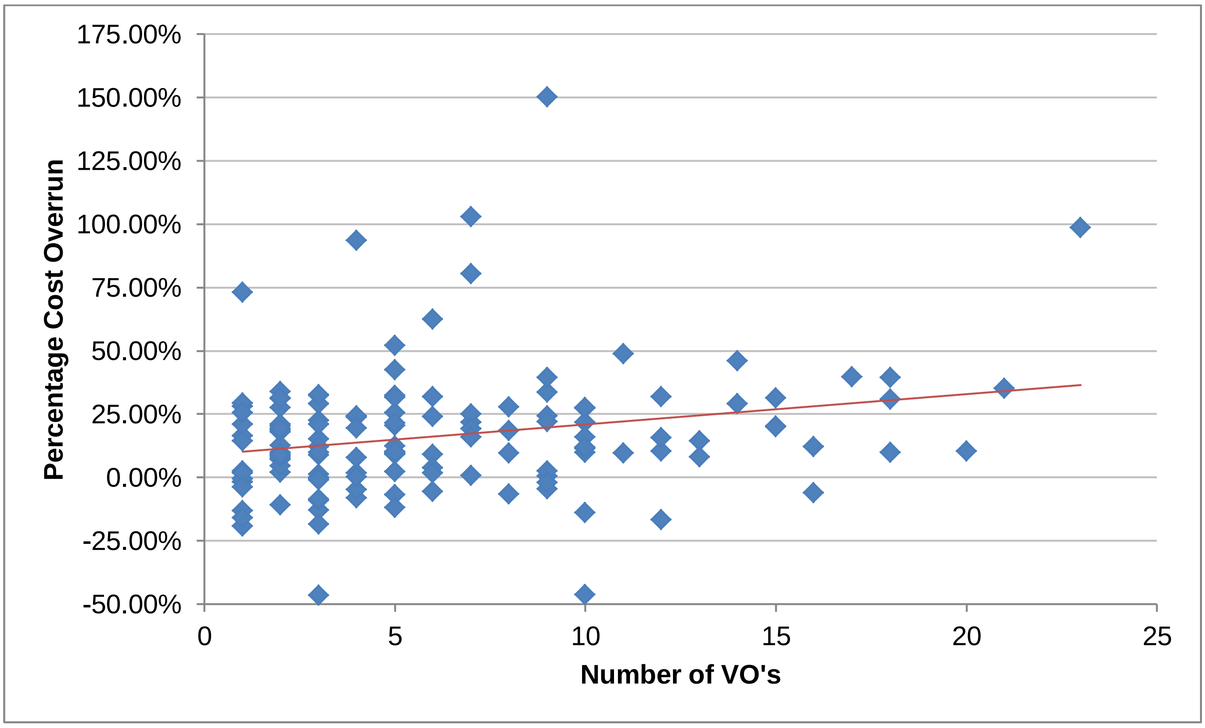

Figure 5.2 Cost Overrun per Number of VO's

As the number of VO's per projects increased the percentage cost overrun also increased. Projects with more than 10 VO's had an average cost overrun of 25.2 % and a median cost overrun of 20.2%. That is more than double the average and median cost overrun of the projects with 3 or fewer VO's, 9.4% and 9.1% respectively. Figure 5.2 also includes a trend line; which indicates that the more VO's a project has the greater the cost overrun will be.

Thus not only do more VO's per project make it more likely that a project will have a cost overrun, but it also causes a larger cost overrun.

5.1.2. Schedule impact of Variation Order occurrence

In order to investigate the schedule impact of the number of VO's per project the same grouping will be used as was used for the cost impact. Since most of the projects were affected by schedule overrun (94.2%), a 15% overrun will be used instead of the 0% overrun used for cost overruns in order to see the frequency of overruns.

Table 5.4 Impact of VO's on Schedule overrun

VO number	Number of Projects	Number with a Schedule Overrun > 15%	Percentage with a Schedule Overrun > 15%	Average Schedule Overrun	Standard Deviation	Median Schedule Overrun
3 or less	53	36	67.9%	40.5%	41.5%	27.7%
4 - 6	32	23	71.9%	57.6%	64.8%	36.5%
7 - 10	29	24	82.8%	62.1%	47.2%	51.0%
More than 10	23	16	69.6%	38.9%	40.7%	27.0%

The percentage of projects with schedule overruns over 15% increases with the number of VO's that occur during them. However the projects with more than 10 VO's had overruns of more than 15% just as frequently as those with 3 or fewer VO's. Projects with more than 10 VO's had an average overrun of 145 days compared to the 106 days of the projects with 3 or fewer VO's, meaning that the projects with 10 or more VO's were longer and thus the effect of the schedule overruns were lower. The following figure indicates schedule overrun plotted against the number of VO's per project (the project with 46 VO's is not included in the figure).

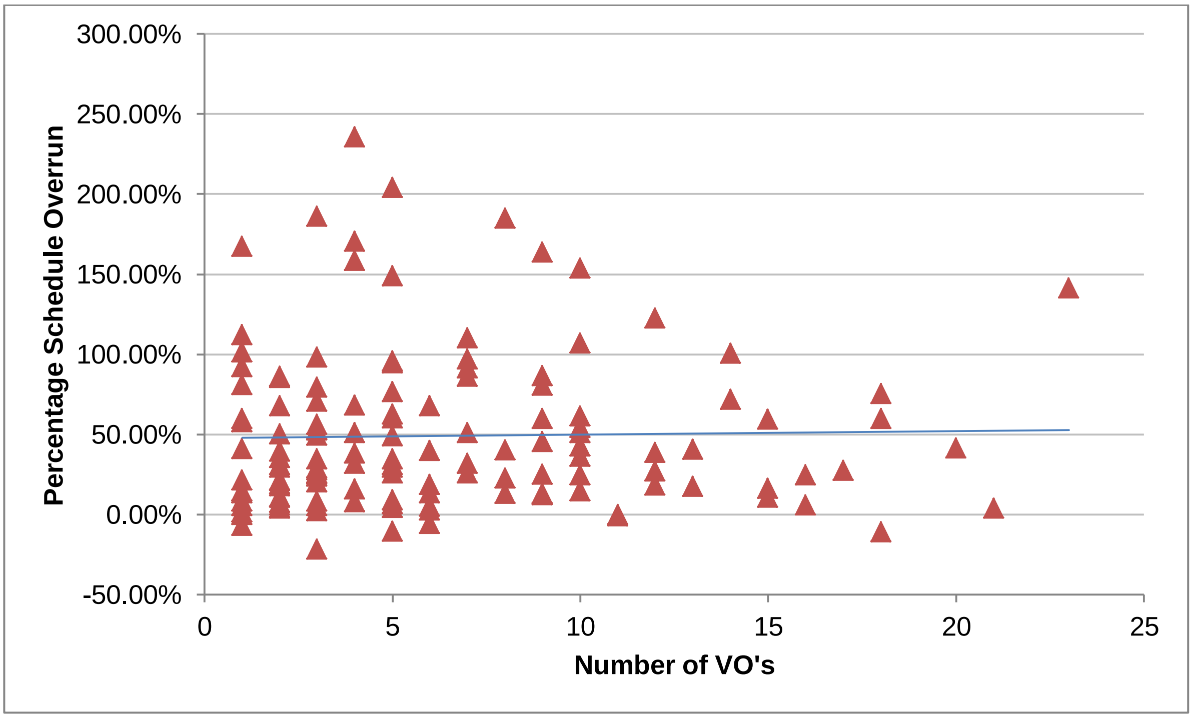

Figure 5.3 Schedule Overrun vs. Number of VO's

Compared to the effect of the number of VO's had on the cost overruns, there does not seem to be any effect on the Schedule overruns. The average schedule overrun for projects with three or fewer VO's was 40.5% and for those with more than 10 was 38.9%. The trend line in figure 5.3 only shows a slight increase in schedule overrun as the number of VO's increases. Thus the number of VO's does not seem to have a significant influence on the schedule overrun.

5.2. Types of Variation Orders

A VO can be issued for a variety of reasons. Table 5.5 lists the different reasons given for each of the VO's and also indicates the number of VO's with this reason, as well as the number of projects with at least one VO with this reason.

Table 5.5 Type of VO's

	Number of VO's	**Number of Projects**	**Percentage of Projects**
Additional work	527	124	90.5%
Omitted work	32	16	11.7%
Specification change	204	78	56.9%
Abnormal weather	34	23	16.8%
Industrial strike action	15	14	10.2%
Material shortage	12	8	6.6%
Abnormal soil conditions	2	2	1.5%
Other	75	56	40.9%

The most common reason among the 901 VOs studied was additional work, with 124 (90.5%) of the projects having at least 1 VO with this as a reason. Additional work is any work added to the scope which was not covered by the original BOQ. Of the124 projects, 97 had more than 1 VO with additional work as a reason, with the average number of VO's due to additional work in projects where they occurred being 4.25.

When any of the work covered by the original scope of the project is left out it is counted as omitted work. Though not as frequent as additional work it still occurred in 11.7% of the projects.

As seen from table 5.5, specification changes were the second most common reason. A specification change is changing any work which was already included in the original BOQ, such as changing the type of asphalt or the diameter of the pipe culvert to give two examples. Even though they occurred only in 78 (56.9%) of the projects, 48 of the projects had more than 1 VO with this reason given.

Most project specifications allow for a certain number of rain days. Abnormal weather is when the number of rain days during the project exceeds the number of days allowed for in the project specifications. Only 23 of the projects studied were issued a VO due to abnormal weather.

Labour unrest is a common occurrence in South Africa, however only 14 of the studied projects were affected by Industrial strike action.

Road construction is dependent on bitumen, an oil product. South Africa, not being an oil producing nation, occasionally undergoes bitumen shortages. If there is a nationwide shortage it may affect the projects where paving forms part of the critical path, which may lead to a VO. From the information collected about the projects, only 8 projects were affected by material shortages.

Unforeseen site conditions were mentioned by a few in the literature as a reason for change; however only two projects studied were affected by it. This may be due to more thorough pre investigation in recent years.

All reasons which can't be placed into one of the above mentioned categories were placed in other. Among these reasons the most common one given is unforeseen public holidays or voting days. Another reason that fell under other was the effect of the World Cup in 2010, which caused some projects to be extended.

5.2.1. Cost impact of Variation Order type

As mentioned there are various reasons for a VO to be issued, this part of the chapter will investigate the effect the type of VO has on the project's cost overrun. The following table lists the types of VO's and the average cost overrun for projects with and without a VO with that reason.

Table 5.6 Effect of VO type on Cost overruns

VO Type	Number of projects with	Average Cost overrun for projects with	Number of projects without	Average Cost overrun for projects without
Additional work	124	17.4%	13	9.6%
Omitted work	16	5.8%	121	18.1%
Specification change	78	17.6%	59	15.5%
Abnormal weather	23	24.2%	114	15.2%
Industrial strike action	14	19.7%	123	16.3%
Material shortage	8	7%	129	17.3%
Abnormal soil conditions	2	11.7%	135	16.8%
Other	56	15.9%	81	17.3%

The 124 projects with additional work overran their schedule on average by 17.4%, which is nearly double the 9.6% overrun affecting the 13 projects without additional work. In comparison projects with omitted work overran their initial budget by only 5.8%. Thus increasing or decreasing the amount of work to be done, will increase or decrease the final cost of the project.

Specification changes caused a 2.1% increase of the cost overruns, from 15.5% to 17.6%.

Projects affected by abnormal weather experienced a 24.2% increase in costs compared to the 15.2% cost overrun experienced by projects which were not affected by abnormal weather. Projects affected by strikes had a 3.4% higher cost overrun than those not affected by strikes. In contrast projects affected by abnormal soil conditions or material shortages showed lower average cost overruns than the projects not affected by them. Considering the small number of projects in this category, this should not be seen as a meaningful observation.

From this section it can be concluded that, except for added or omitted work, the type of VO does not significantly affect the occurrence or size of the cost overrun.

5.2.2. Schedule impact of Variation Order type

Next the effect, if any, the type of VO had on the schedule overrun will be investigated. Table 5.7 shows the average schedule overrun for the projects with and without each of the identified VO types.

Table 5.7 Effect of VO type on Schedule overrun

VO Type	Number of projects with	Average Schedule overrun for projects with	Number of projects without	Average Schedule overrun for projects without
Additional work	124	50.1%	13	36.4%
Omitted work	16	32.8%	121	50.9%
Specification change	78	48.3%	59	49.5%
Abnormal weather	23	45.0%	114	49.6%
Industrial strike action	14	33.3%	123	50.6%
Material shortage	8	51.3%	129	48.7%
Abnormal soil conditions	2	21.6%	135	49.2%
Other	56	51.4%	81	47.0%

As was the case with cost impact, projects with additional work showed a higher schedule overrun than projects without, and projects with omitted work showed a lower schedule overrun than projects without. Thus if the work to be done is increased the schedule overrun will also be increased, and if the work to be done is decreased the schedule overrun will be decreased.

The difference between the schedule overrun of the projects with and without specification changes, abnormal weather and material shortages is minimal. This means that these reasons do not necessarily affect the size of the schedule overruns.

Projects affected by industrial strike actions and abnormal soil conditions showed lower average schedule overruns than projects without these VO types.

Thus, except for added or omitted work, it can also be concludes that the type of VO does not significantly affect the size of the final schedule overrun.

5.3. Timing of Variation Orders

VO's can be issued any time during the projects before the issue of the final completion certificate. Thus it can take place right at the start of the project or as the projects or as the project starts to wind down. Although VOs are issued after the change has occurred they are usually issued within a week or two of the change, and are thus a good indication, if not very accurate, of the timing of the change. This part will investigate the timing of VO's compared to the projects' initial completion dates.

The VO's will be divided into three groups; those that occurred before half of the initial schedule has elapsed, those that occurred between halfway of the initial schedule and the initial completion date, and those that occurred after the initial completion date. Table 5.8 shows the distribution of all the VO's in the abovementioned groups.

Table 5.8 Distribution of VO' timing

	Number of VO's	Number of Projects	Percentage of Projects
<50%	255	77	56.8%
50-100%	355	107	78.1%
Total <100%	610	122	89.1%
>100%	291	86	62.58%

Two thirds of all the VO's occurred before the initial completion date in 89.1% of the projects. The largest number of projects had VO's in the second half of their original schedule. Projects with VO's after their initial completion date were also common. The following figure shows the box and whisker plot of the VO timings.

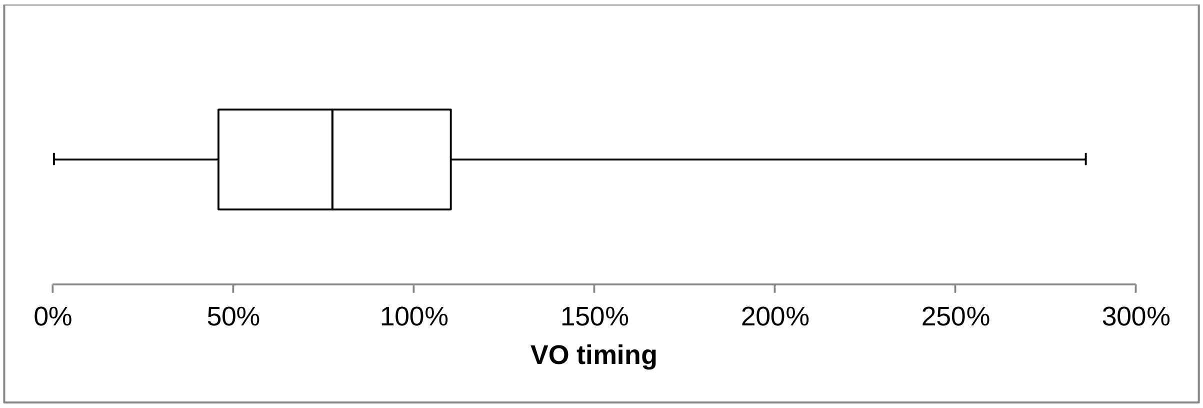

Figure 5.4 Distribution of VO's during a project

Even though most (610) of the VO's took place before the initial completion date, a large number still occurred after the initial completion date. This part of the chapter will now look at the impact on the project's cost overruns and schedule overruns the timing of the VO's had.

5.3.1. Cost impact of Variation Order timing

This part of the chapter will investigate what effect the timing of a VO, when it occurs, has on the cost overrun of a project. The VO's will again be divided into three groups, those that occurred before halfway of the original schedule, those occurring between halfway and the original completion date and those which occurred after the original completion date. The following table lists these three groups with the number of projects in which they occurred and the average cost overrun of those projects.

Table 5.9 Effect of the VO timing on Cost overruns

	Number of Projects	**Number with CO>0**	**Percentage with CO>0**	**Average CO**	**Median CO**
<50%	77	61	79.2%	16.4%	12.4%
50-100%	107	89	83.2%	16.7%	14.4%
>100%	86	73	84.9%	20.0%	15.8%

Projects with a VO occurring before the halfway mark of the original schedule overran their costs on 79.2% of the projects. This is lower than the other two timing categories. The average cost overrun at 16.4% and the median at 14.4% are also lower than the other two categories.

A larger percentage of projects with a VO after the initial completion date overran their costs than projects in the other two categories. This category also had a larger average cost overrun than the other groups; the 20% overrun is even larger than the global average.

The following table shows the same information as the previous table but for projects where 50% or more of the VO's occurred in the respective timing groups.

Table 5.10 Project of VO timings on Cost overruns (50% of VO's within a timing group)

	Number of Projects	**Number with CO>0**	**Percentage with CO>0**	**Average CO**	**Median CO**
<50%	32	23	71.9%	14.8%	14.1%
50-100%	56	43	76.8%	13.8%	12.0%
>100%	48	40	83.3%	18.9%	14.1%

When only considering projects where 50% or more of the VO's fell in the respective timing groups, the percentage of projects with a cost overrun decreased for all categories. The average cost overrun decreased for the two categories before the initial completion date.

In contrast the average cost overrun of projects with more than 50% of VO's occurring after the initial completion date increased.

From this it can be concluded that projects with VO's after the initial completion date are not only more prone to cost overruns but they also have a higher cost overrun than projects with a VO before the initial completion date.

5.3.2. Schedule impact of Variation Order timing

With the effect of the VO timing on the cost overrun studied, this part will now focus on the effect on the schedule overrun. The same cost timing groups will be used to study this effect. The following table lists these groups with the number of projects in which they occurred as well as the average and schedule overrun of those projects. The table also includes the number and percentage of projects where the schedule overrun was larger than 15%.

Table 5.11 Effect of VO's on Schedule overruns

	Number of Projects	**Number with SO>15**	**Percentage with SO>15**	**Average SO**	**Median SO**
<50%	77	53	68.8%	40.9%	27.4%
50-100%	107	75	70.1%	42.3%	29.5%
>100%	86	68	79.1%	59.8%	44.0%

Nearly 80% of the projects with a VO after the original completion date had a schedule overrun larger than 15%. The average and median schedule overrun was also larger for projects with a VO after the original completion date, at 59.8% and 44% respectively. From this it can be deduced that the later a VO occur the larger the schedule overrun will be.

Table 5.12 lists the number of project where 50% or more of the VO's occurred within the respective timing groups, it also list the average and median schedule overrun of these projects. Furthermore the number and percentage of these projects where the schedule overrun is larger than 15% is also listed.

Table 5.12 Effect of VO timings on Schedule overruns (50% of VO's within a timing group)

	Number of Projects	**Number with SO>15**	**Percentage with SO>15**	**Average SO**	**Median SO**
<50%	32	18	56.3%	28.5%	24.9%
50-100%	56	38	67.9%	36.4%	25.0%
>100%	48	41	85.4%	73.4%	59.2%

From table 5.12 the effect of late VO's is even more pronounced. Projects with 50% or more of their V.O.'s occurring after the completion date had a large schedule over (more than 15%) 85.4% of the time The mean and median overrun is 73.4% and 59.2% respectively, for those projects, which is more than double the mean and median for projects where 50% or more of the V.O's occurred before the initial completion date.

5.4. Chapter Conclusion

All projects are affected by VO's and with an average of 6.58 VO's per project they also occur frequently during a project. Large projects (>R80mil) tend to have more VO's than small (<R20mil) projects; with averages of 13.75 and 4.72 respectively. Similarly longer projects (>730 days) also tend to have more than shorter projects (<365 days); with averages of 11.24 and 4.15 respectively.

When studying the cost impact of the number of VO's it was found that projects with more VO's tend to have larger cost overruns than those with fewer VO's. However the effect of the number of VO's on the schedule was minimal.

The chapter also discussed the effect of the different types of VO's on cost and schedule overruns. Additional work and specification changes were the most common causes of VO's. It was found that projects with additional work VO's had greater cost and schedule overruns (17.4% and 50.1% respectively) than those without additional work (9.6% and 32.8% respectively), but the effect of specification changes were ambiguous; with cost overruns being slightly higher and schedule overruns slightly lower than in projects without specification changes. In contrast, projects with omitted work VO's had lower cost and schedule overruns (5.8% and 36.4%) than those without omitted work (18.1% and 50.9%). The other VO types investigated had little effect on the increase or decrease of the cost and schedule overruns.

Lastly the chapter investigated the timing of VO's. It was found that of the 901 VOs, 291 of them occurred after the initial completion date. Projects where VO's occurred after the initial completion date showed higher cost and schedule overruns, 20.0% and 59.8% respectively, than the average, 17.0% and 48.8% respectively. The difference for schedule overruns became even more pronounced when projects where more than 50% of the VO's occurred after the initial completion dates; with an average schedule overrun of 73.4%.

6. Research Findings and Discussion

6.1. Chapter introduction

This chapter will investigate each of the stated project objectives separately and compare the findings of this research with those found by others. The questions answered within this chapter will be:

- How common are projects with cost overruns, and how large are these overruns?
- How common are projects with schedule overruns, and how large are these overruns?
- Does schedule overruns affect the size of the cost overruns and does cost overruns affect the size of schedule overruns?
- How frequent are VO’s? Do all projects have VO’s, and what is the average number of VO’s per projects?
- Does the number of VO’s have an effect on the occurrence or the size of the cost and schedule overruns?
- Does the type of VO’s have an effect on the occurrence or the size of the cost and schedule overruns?
- Does the timing of VO’s have an effect on the occurrence or the size of the cost and schedule overruns?

6.2. Occurrence and size of cost overruns

From the literature it was seen that cost overruns are common and widespread. The results of the Western Cape research have shown that the same holds true for this part of South Africa. Table 6.1 summarises the results of this research and those found by others.

Table 6.1 Summary of cost overrun data

Country or province	No. of Projects	% with an overrun	Average overrun (%)
Norway (Odeck, 2004)	620	52	7.9
Nevada, USA (Shresta, et al., 2013)	236	unknown	3.2
Malaysia (Shehu, et al., 2014)	359	55	2.1
Netherlands (Cantarelli, et al., 2012)	Unknown	38	-4.5
Australia (Love, et al., 2014)	58	unknown	13.28
Western Cape, South Africa (this research)	137	79	17

From table 6.1 it appears that cost overruns are more common in South Africa than they are in other parts of the world, with 79% of the projects being affected by cost overrun. The average cost overrun is also larger. The study done in the Netherlands showed a negative average, which may indicate that cost underruns may be more common than cost overruns in that country.

One reason for the higher cost overruns is the project procurement method used in South Africa. Projects are awarded to the tenderer with the best score; which is based 90% on the lowest score and 10% on the tenderers BB-BEE status. The heavy weighting towards project price means that contractors are prone to undervalue prices in order to receive work, especially when competition for projects is high, and thus very little consideration is given if a contract can actually be completed at the tender amount.

6.3. Occurrence and size of schedule overruns

The literature and this research have also shown that schedule overruns are common and widespread. Table 6.2 shows a summary of the results from both the literature and this research.

Table 6.2 Summary of schedule overrun data

Province or Country	**No. of Projects**	**% with an overrun**	**Average overrun (%)**
China (Ahsan & Gunawan, 2010)	30	86	13.6
India (Ahsan & Gunawan, 2010)	20		55.7
Bangladesh (Ahsan & Gunawan, 2010)	31		34.4
Thailand (Ahsan & Gunawan, 2010)	19		32.7
Australia (Love, et al., 2014)	58	unknown	8.9
Nevada,USA (Shresta, et al., 2013)	236	unknown	1.1
Western Cape, South Africa (this research)	137	94.2	48.8

This research has shown that schedule overruns are more common in South Africa, with 94.2% of the projects being affected, than in the other studies. Furthermore only the study that had been done on projects in India have shown a higher average schedule overrun than this study, 55.7% and 48.8% respectively.

When compared to the cost escalation data, project overrun tend to overrun their schedules more often than and by a greater margin than their costs. Clients are usually more worried by costs than they are about schedule, thus cost control is implemented to a better degree than schedule control. Additionally clients can also penalise contractors for schedule overruns, which will lower the final cost of the project and thus also the cost overrun.

6.4. Effect of cost overruns and schedule overruns on each other

Although the literature on cost and schedule overruns provided information about the size and occurrence of these overruns, none of them has compared the effect of the overruns on each other. Though some researchers had mentioned that schedule overruns may lead to cost overruns (Kumaraswamy & Chan, 1998) (Sumbasivan & Soon, 2007).

Thus the research on the Western Cape projects investigated the effect of the cost overrun and schedule overrun on each other. From the data studied it was inconclusive if the projects with a schedule overrun were more prone to cost overruns and vice versa. The effect of the size of the respective overruns was also inconclusive.

A reason for costs not being affected by schedule overruns may be that additional costs due to late completion are sometimes incurred by the contractor, by way of fines or non-payment. These additional costs do not form part of the projects' final cost overrun since they are subtracted from the contract sum. Furthermore clients are normally more concerned about costs than schedule, and will allow schedules to overrun as long as the costs are kept within reasonably acceptable limits.

6.5. Occurrence of Variation Orders

Very few articles have been written about what the effect of the frequency of VO's is on cost and schedule escalation. One study has however investigated the frequency of VO's (Anastasopoulus, et al., 2010). That study found that on average projects had 5.13 VO's and that larger projects tend to have more VO's than smaller projects.

In the Western Cape research the frequency of VO's has also been studied. Table 6.3 summarises the number of VO's by the different cost groups and Table 6.4 by the schedule groups.

Table 6.3 Summary of VO's by cost groups

	Number of Projects	**Number of VO's**	**Average number of VO's**	**Median number of VO's**
< R20 million	54	255	4.72	3.5
R20 million – R40 million	42	258	6.14	5
R40 million – R80 million	29	223	7.69	6
> R80 million	12	165	13.75	13.5
All	137	901	6.58	5

Table 6.4 Summary of VO's by schedule groups

	Number of Projects	Number of VO's	Average number of VO's	Median number of VO's
< 365 days	52	216	4.15	4
365 - 550 days	44	292	6.64	5.5
550 - 730 days	24	202	8.42	9
> 730 days	17	191	11.24	10
All	137	901	6.58	5

From table 6.3 and 6.4 it can see that larger and longer projects tend to have more VO's than smaller and shorter projects. This matches the finding of the other research (Anastasopoulus, et al., 2010).

6.6. Effect of the Number of Variation Orders

The research also studied what effect the number of variation will have on cost and schedule overruns. None of the literature has quantified or investigated the effect of VO frequency on the cost or schedule overrun. However a few has mentioned change as an important factor causing cost and schedule overruns (Alnuaimi, et al., 2010) (Ahsan & Gunawan, 2010) (Doloi, et al., 2012) (Kazaz, et al., 2012).

Table 6.5 summarises the cost and schedule impact by the number of VO's during the projects.

Table 6.5 Summary of cost and schedule impact by number of VO's

VO number	**Number of Projects**	**Average Cost Overrun**	**Median Cost Overrun**	**Average Schedule Overrun**	**Median Schedule Overrun**
3 or less	53	9.4%	9.1%	40.5%	27.7%
4 - 6	32	17.4%	10.2%	57.6%	36.5%
7 - 10	29	22.4%	18.6%	62.1%	51.0%
More than 10	23	25.2%	20.2%	38.9%	27.0%

From table 6.5 it can be concluded that number of VO's do affect the cost overruns, with the cost overrun increasing as the number of VO's increased. However the effect of the number of VO's on the schedule overrun is inconclusive with the projects with the most VO's having nearly the same average schedule overrun as the projects with the fewest VO's.

6.7. Effect of the Variation Order Type

The effect the type of VO's has on cost and schedule overruns have not been studied by many. However some authors have investigated the more common causes of VO's (Alnuaimi, et al., 2010) (Serag, et al., 2010) (Warhoe & Giammalvo, 2010). One of the studies summarised the reasons for change into 5 groups (Warhoe & Giammalvo, 2010):

- Design deficiencies
- Criteria changes
- Unforeseen conditions, including differing site conditions
- Changes directed by the owner
- Other

According to another study the most important reason for change was to provide for unforeseen work, grade changes, or alterations in the plans (Serag, et al., 2010). The study found it was one of the most significant variables frequently leading to cost increase of over 5%.

In this research different type of VO's have also been studied as well as what the average cost or schedule overruns were for projects where these VO's occurred. This research found that the two most common reasons for VO's were additional work and specification changes. Table 6.6 summarises the cost and schedule overruns for projects with and without each of the identified VO types.

Table 6.6 Cost and schedule overrun by VO type

VO Type	Number of projects with	Average Cost overrun for projects with	Average Cost overrun for projects without	Average Schedule overrun for projects with	Average Schedule overrun for projects without
Additional work	124	17.4%	9.6%	50.1%	36.4%
Omitted work	16	5.8%	18.1%	32.8%	50.9%
Specification change	78	17.6%	15.5%	48.3%	49.5%
Abnormal weather	23	24.2%	15.2%	45.0%	49.6%
Industrial strike action	14	19.7%	16.3%	33.3%	50.6%
Material shortage	8	7%	17.3%	51.3%	48.7%
Abnormal soil conditions	2	11.7%	16.8%	21.6%	49.2%
Other	56	15.9%	17.3%	51.4%	47.0%

From table 6.6 it can be observed that projects with additional work VO's had greater cost and schedule overruns (17.4% and 50.1% respectively) than those without additional work (9.6% and 32.8% respectively). In contrast projects with omitted work VO's had lower cost and schedule overruns (5.8% and 36.4%) than those without omitted work (18.1% and 50.9%). The other VO types investigated had little effect on the increase or decrease of the cost and schedule overruns.

6.8. Effect of the Timing of Variation Orders

According to one study the timing of a VO is the most important variable when the cost increase of projects is considered (Serag, et al., 2010). The study found that the later a VO occurs the larger the project cost overrun will be.

This research also investigated the effect the timing of VO's have on cost overruns and schedule overruns. Table 6.7 summarises the results of this study.

Table 6.7 Summary of cost and schedule overruns by VO timing

	Number of Projects	**Average CO**	**Median CO**	**Average SO**	**Median SO**
<50%	77	16.4%	12.4%	40.9%	27.4%
50-100%	107	16.7%	14.4%	42.3%	29.5%
>100%	86	20.0%	15.8%	59.8%	44.0%

From this table it can be concluded that projects where VO's occurred after the initial completion date have a greater cost overrun and schedule overrun than average. The research also studied projects where 50% or more of the VO's occurred within the different timing groups. Table 6.8 summarises the results for those projects.

Table 6.8 Summary of cost and schedule overruns by VO timing (50% of VO's occurring)

	Number of Projects	Average CO	Median CO	Average SO	Median SO
<50%	32	14.8%	14.1%	28.5%	24.9%
50-100%	56	13.8%	12.0%	36.4%	25.0%
>100%	48	18.9%	14.1%	73.4%	59.2%

Even though projects where most of the VO's occurred before the initial completion date still showed cost and schedule overruns the average overruns for those projects were still lower than the global average. In contrast projects where most of the VO's occurred after the initial completion dates showed much larger schedule overruns than the average and only a slight increase in the average cost overrun.

7. Conclusion

This research investigated cost and schedule overruns during transportation construction projects within the Western Cape Province of South Africa. Through the study of the literature it was found that cost and schedule management are inseparable with the processes associated with each area of knowledge dependent on the other. The literature also showed that cost and schedule management are both dependent on scope management; with both areas of knowledge requiring a well-defined scope in order to be managed effectively.

The link between scope change and cost and schedule overruns was also studied; and it was found that scope changes can be seen as a major cause of cost and schedule overruns. Much research has previously been done on cost and schedule overruns however very little has been done on what effect the scope change will have on these overruns.

For this research, cost, schedule, and VO data was gathered from 137 projects from the Western Cape Department of Transport and Public Works.

Research Findings

The findings from the gathered data were the following:

- Cost overruns are very common, with the 79% of the studied projects being affected, and cost overruns are also large; an average cost overrun of 17% was observed.
- Schedule overruns are even more common than cost overruns; 94.2% of the projects were affected. The schedule overruns were also found to be greater; with an average of 48.8% observed.

- Neither the occurrence nor the size of either the overruns was found to affect the other in any significant way.
- The research found that VO's are also common; with every project studied having at least one, and the average number of VO's being 6.58 per project.
- The number of VO's was found to affect the size and occurrence of the cost overruns, with projects with more VO's having larger cost overruns. However, the effect of the number of VO's on the schedule overruns was inconclusive.
- The type of the VO was found to influence both of the overruns; with projects with added work, the most common reason for VO's, showing higher than average overruns than those without, and projects with omitted work showing lower than average overruns than projects without. Other types of overruns were also investigated but found to neither increase nor decrease the overruns significantly.
- Lastly the research studied the timing of VOs, and it was found the later a VO occur the more probable it is that the project will be affected by cost or schedule overrun and that the respective overrun will be large.

Proof of Hypothesis

Thus the hypothesis was proven to be correct:

The number of VO's does influence the size of the cost overruns. However, the effect on the schedule overruns was inconclusive

The timing of VO's also influences the size of the schedule and cost overruns.

Recommendations:

Considering the research findings it is possible to make the following recommendations:

- Changes should be kept to a minimum. Projects with more changes experienced cost and schedule overruns more frequently and to a greater degree. Thus by limiting the number of changes during the project, these overruns can be limited.
- If a change must occur it should be done earlier rather than later within a project. Projects where changes occurred later had larger cost and schedule overruns than those where the changes occurred earlier. Thus indicating that the later a change occurs the larger the effect will be on the cost or schedule overrun.

Limitations of the Research

Even though the research has proven its hypothesis there are still some limitations:

- The data was collected from a single source and a single geographical location. As was shown by the literature cost and schedule overruns differ from country to country, since this research data came from only one department it is difficult to apply the conclusions to all regions.
- Since the data came from a single source, only one type of client was investigated. All the projects were public projects; private clients may handle variations differently.

- Additionally the Western Cape government only uses one procurement method, design-bid-build, and one set of standard conditions of contract, the GCC. Thus other procurement types, such as design-and-build or public private partnerships, were not considered. Neither were other forms of contract documents, such as the JBCC, FIDIC, or NEC contracts; which handle variations by slightly different processes.
- Only construction phase data was collected. Projects are divided into various phases, and during each of these phases changes can occur. This research and its conclusions can thus only be applied to the construction phase.
- VO's can sometimes be issued a considerable time after a change has occurred. Contractors may issue a claim due to a change, which may lead to a dispute. The VO is only issued after the resolution of the claim or the dispute; thus the date of the VO is not a very accurate reflection of the timing of the change.

Recommendations for Future Research

Further research into the subject may overcome these limitations, and it can be recommended that the following future studies should be done:

- Similar studies should be done in the other provinces of South Africa so that the results can be compared to each other.
- Research can also be done on other types of projects such building or municipal services, such as water reticulation systems or water treatment system.

- Studies on the effect the type of client, procurement method or the contract document has on the number of changes or the size of the cost and schedule overruns will also be useful.
- Other studies can be done where the changes occurring during the design phase of a project are tracked, and the effect thereof on the project's cost and schedule is determined.

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Appendix A: Project Data

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0407.01: Rehab TR25/1 - Diep River/Malmesbury	R 28 318 171.00	R 32 412 905.74	22-Aug-11	23-Jul-12	336	07-Dec-12	473	VO01 - Design Spec/Change: Replacing 19mm + Slurry (Cape Seal) with Asphalt Surfacing	14-Oct-11
								VO02 - Design Spec/Change: New bridge balustrade cross-section	03-Feb-12
								VO03 - Design Spec/Change: Cutting of deeper slots in the bridge Deck	03-Feb-12
								VO04 - Additional Work: Provision of temporary seal for traffic accommodation	01-Feb-12
								VO05 - Additional Work: Concrete block paving on traffic islands	01-Feb-12
								VO06 - Additional Work: Terraforce Retaining System	15-May-12
								VO07 - Additional Work: Road Studs	02-May-12
								VO08 - Claim: Extension of time for bitumen shortage	19-Jun-12
								VO09 - Claim: Extension of time for hard rock excavation	28-Jun-12
								VO10 - Claim: Extension of time for abnormal climatic conditions	04-Sep-12
								VO11 - Claim: Extension of time for abnormal climatic conditions	02-Oct-12
								VO12 - Claim: Adjudicator's Decision - Extension of time for abnormal climatic conditions	07-Dec-12
								VO13 - Claim: Adjudicator's Decision - Extension of time for the replacement of asphalt	07-Dec-12
AC0415.03: Upgrade MR559 Port Service Corridor - Langebaan	R 65 865 521.45	R 73 889 372.36	28-Mar-11	28-Apr-12	397	22-May-12	421	VO01 - Additional Work: Relocation of special fences as requested in terms of the expropriation requirements	06-May-11
								VO02 - Design Spec/Change: Change the Cape Seal to Asphalt Surfacing in the urban areas	06-May-11
								VO03 - Extra Work: Upgrade and relocate existing WCDM water supply lines at km 8.4	04-Jul-11
								VO04 - Claim: Claim for Election day 18 May 2011	04-Jul-11
								VO05 - Design Spec/Change: Fully Galvanised smooth fencing wire	04-Jul-11
								VO06 - Design Spec/Change: G5 Gravel wearing coarse material for shoulder construction	04-Jul-11
								VO07 - Design Spec/Change: Section 1500 Base & Selected Subgrade layerworks imported from Commercial Sources	04-Jul-11
								VO08 - Extra Work: Texture slyrry for MR559 from km 6,1 to 12,840	04-Jul-11
								VO09 - Design Spec/Change: Asphalt Base 80mm thick 60/70 Pen Grade Bit 26.5 Max	16-Sep-11
								VO10 - Design Spec/Change: Rumble strips for by-pass MR233	16-Sep-11
								VO11 - Design Spec/Change: Excavation for open drain excavation to spoil 1km free haul	16-Sep-11
								VO12 - Design Spec/Change: Environmental Rehabilitation	30-Sep-11
								VO13 - Design Spec/Change: Kerbing and Concrete Miscellaneous Work	30-Sep-11
								VO14 - Additional Work: Rehabilitation of existing road MR559 at km4.5	30-Sep-11
								VO15 - Extra Work: Resurfacing of OP538 and rehabilitation of intersections	06-Jan-12
								VO18 - Additional Work: Extra Works on MR559 after completion	22-May-12

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0586: Rehab MR172 - Pniel/Simondium	R 57 853 340.16	R 63 927 490.44	14-Jan-09	14-Jul-10	546	10-Feb-11	757	VO01 - Additional Work: Resurfacing of Kylemore Access Road	01-Mar-10
								VO02 - Additional Work: Service Road to Access Properties at SV 10900	11-Mar-10
								VO03 - Additional Work: Road Crossings for Boschendal Watermain Service	21-Jul-09
								VO04 - Design Spec/Change: Soil Anchors at SV10600	13-Jan-10
								VO05 - Claim: Extension of Time and Additional Payment from Delays and Additional Work	24-Nov-09
								VO06 Extra Work: Additional Transport costs for importing of bitumen	02-Nov-10
								VO07 Design Spec/Change: Realignment of Stormwater drainage at graveyard	02-Nov-10
								VO08 Additional Work: Repairs to Old Section of MR172	02-Nov-10
								VO09 Additional Work: Raise level of railway line at intersection of MR172 & R45	02-Nov-10
								VO10 Claim: Extention of time and delays due to the Fifa World Cup	02-Nov-10
								VO11 - Additional Work: Extension of Municipal water main from 10.500 to 10.780	10-Feb-11
								VO12 - Additional Work: Opening Ceremony	10-Feb-11
AC0707.07: Safety Improvements to Wingfield, Monte Vista and Bosmansdam Interchanges	R 30 595 978.80	R 33 760 069.68	02-Sep-11	27-Jul-12	329	10-Dec-12	465	VO01 - Additional Work: Replacement of Gantry 2 at Bosmansdam Interchange	15-Nov-11
								VO02 - Design Spec/Change: N1 Median at Wingfield Interchange Precast Concrete Barriers	15-Nov-11
								VO03 - Additional Work: Construction of new sidewalk at Bosmansdam Interchange	15-Dec-11
								VO04 - Additional Work: Extension of N1 concrete median barrier	15-Dec-11
								VO04A - Claim: Extension of N1 Concrete Median Barrier	04-Jan-12
								VO05 - Design Spec/Change: Thrust boring at Bosmansdam interchange	03-May-12
								VO06 - Additional Work: Stormwater control at Wingfield interchange	03-May-12
								VO07 - Additional Work: Precast concrete trapezoidal drain at Monte Vista	03-May-12
								VO07B - Additional Work: Precast concrete trapezoidal drain at Monte Vista	10-Sep-12
								VO08 - Additional Work: Supervision of works - Additional Resources	30-Jul-12
								VO09 - Additional Work: Emergency repairs on N1 near Bellville	01-Aug-12
								VO09B - Additional Work: Settlement repairs on N1 near Bellville	10-Sep-12
								VO10 - Additional Work: Traffic signals at Bosmansdam Interchange	10-Sep-12
								VO11 - Additional Work: Sandblasting of thermoplastic roadMarking	10-Sep-12
								VO12 - Claim: Delay in issuing revised drawings for N1 Median Barrier	04-Oct-12
								VO13 - Claim: Delays due to strike action	04-Oct-12
								VO13a - Claim: Delays due to strike action	12-Nov-12
								VO14 - Claim: Abnormal climatic conditions affecting critical path	04-Oct-12
								VO14a - Claim: Abnormal climatic conditions affecting critical path	12-Nov-12
								VO15 - Design Spec/Change: Open graded survacing at N1 Median Barrier	14-Nov-12

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0708.09: Rehabilitation and Upgrade TR2/1 (M5)	R 87 117 903.73	R 121 771 488.54	21-Oct-10	21-Apr-12	548	18-Sep-12	698	VO02 - Extra Work: Learnership Programme	14-Jun-11
								VO03 - Extra Work: Valkenberg Bridge - West Abutment Rock Anchors	06-Jul-11
								VO04 - Claim: Voting Day 18 May 2011	27-Sep-11
								VO05 - Provisional Sum: Training	30-Jan-12
								VO06 - Extra Work: Relocation of new 11kv cables over the new Valkenberg Bridge	30-Jan-12
								VO07 - Extra Work: Lowering of 66kV cables at SV1390	30-Jan-12
								VO08 - Provisional Sum: Formalising the wetland area and extra landscaping	20-Mar-12
								VO09 - Extra Work: Design Review - Fatigue resistance of street light masts due to wind loading	20-Mar-12
								VO10 - Extra Work: N7 Emergency Repair Work	20-Mar-12
								VO11 - Additional Work: Sealing the median barrier and retaining wall joints	07-Jun-12
								VO12 - Additional Work: Settler's Way Bridge - Infill slab	07-Jun-12
								VO13 - Additional Work: Health & Safety protective measures for working in polluted Black River	07-Jun-12
								VO14 - Additional Work: Replace the bridge bearings at B2172	07-Jun-12
								VO15 - Additional Work: Official opening of M5 - Booking of the Crystal Towers Hotel Banquetting facility and catering	17-Jul-12
								VO16 - Additional Work: Install secondary traffic counting loops along M5	17-Jul-12
								VO17 - Additional Work: Install handrail on northern side of Valkenberg Bridge (western side of M5 northbound)	03-Aug-12
								VO18 - Additional Work: Claim No 3 - Construction of infill slab at Settler's Way Bridge	18-Sep-12
AC0708.10: TR2/1 Relocation of Services and Widening of Black River Parkway	R 51 857 677.00	R 27 887 368.43	13-Feb-09	13-Jan-10	334	04-Jun-10	476	VO01 - Extra Work: Alexandra Pedestrian Bridge - Balustrade & Precast Slabs	29-May-09
								VO02 - Claim: Additional Public Holiday - 22/04/2009	07-Jul-09
								VO03 - Extra Work: Selected Subcontract for Temporary Bearing Placement	23-Jul-09
								VO04 - Design Spec/Change: Claim Alexandra Additional Crane Cost	03-Jun-10
								VO05 - Design Spec/Change: Loffelstein Wall Additional Work	03-Jun-10
								VO06 - Design Spec/Change: Black River Additional Crane Cost	03-Jun-10
								VO07 - Omitted Work: Fix Service Beams to Substructure	03-Jun-10
								VO08 - Extra Work: Bypasses; Removal of Asphalt and G5	03-Jun-10
								VO09 - Additional Work: Sewer Tie-ins	03-Jun-10
								VO10 - Claim: Extension of Time - CBi Related	03-Jun-10
AC0733.03: Upgrade TR2/2 Hazelden Drive - Broadlands Rd	R 59 049 924.80	R 56 431 437.25	20-Oct-08	19-Apr-10	546	03-Sep-10	683	VO01 - Extra Work: Replace Old Stormwater Pipes That Collapsed and Broken at the Joints Due To Movement of Clay	24-Jun-09
								VO02 - Extra Work: Removal of Existing Unsuitable Material and Replacing with Suitable Sandfill	24-Jun-09
								VO03 - Additional Work: Supply and Construct Storm Water Pipes at Onverwaght Intersections	24-Jun-09
								VO04 - Additional Work: Supply and Construct Storm Water Pipes at Broadlands Intersections	24-Jun-09
								VO05 - Additional Work: CCTV Cameras	24-Jun-09
								VO06 - Claim: Voting Day/Proclaimed Public Holiday	24-Jun-09
								VO07 - Extra Work: ST3 Security	24-Jun-09
								VO08 - Claim: Claim for Providing Access to BP Garage	24-Jun-09
								VO09 - Additional Work: GPRS Modem Installation in Traffic Signal Controllers	29-Jun-10

PROJECT NAME	TENDER AMOUNT		FINAL COST		START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0733.04: Upgrade TR2/2 Broadlands Rd - Sir Lowry's Rd and i/s MR108	R	94 329 931.38	R	88 638 493.69	14-Jan-09	14-Sep-10	608	11-Feb-11	758	VO01 - Claim: Contractor's laboratory contributions	08-Feb-11
										VO02 - Additional Work: Directional Drilling for Electrical and Sewer Sleeves	01-Apr-09
										VO03 - Additional Work: Plastered Brickwork for Open Trapezoidal Stormwater Channel	01-Apr-09
										VO04 - Claim: Extension of Time Claim for Voting Day (22/04/2009)	14-May-09
										VO05 - Additional Work: VMS and CCTV Bases	20-Oct-09
										VO06 - Omitted Work: Guided Bridge Bearings and Waterstops - Firlands River Bridge	26-Nov-09
										VO07 - Omitted Work: Extension of Time Claim - Standing Time Cost	30-Mar-10
										VO08 - Additional Work: Provision of Security Services for Safeguarding of Electrical Installations	26-Mar-10
										VO09 - Additional Work: Concrete Protection for Electrical Cables in Trenches (Streetlighting and Traffic Signals)	30-Apr-10
										VO10 - Design Spec/Change: Supply and Install Welded Steel Fabric - Box Drain Floor Slab	30-Apr-10
										VO13 Omitted Work: Additional Payment due to unproductive work and establishment of plant	23-Aug-10
										VO14 Design/Spec Change: Supply and installation of timber plastic fencing	19-Aug-10
										VO15 - Additional Work: Precast Traperzoidal Drainage channels (Ditch liners)	09-Nov-10
										VO16 - Design Spec/Change: Supply and installation of Vuka Road Studs	07-Dec-10
										VO17 - Additional Work: Installation of ducts for underground services for Telkom on MR108	07-Dec-10
										VO18 - Additional Work: Additional miscellaneous items of work	08-Feb-11
AC0739.01: Flood Damage Repair of Herbertsdale Area	R	8 968 831.19	R	18 199 546.71	12-May-08	07-Feb-09	271	29-Sep-09	505	VO01 - Additional Work: Replace Scheduled Culverts with Superspan Culvert	14-Aug-08
										VO02 - Additional Work: Add to Causeways	14-Aug-08
										VO03 - Additional Work: Replace Scheduled Culverts with Superspan Culvert	22-Aug-08
										VO04 - Additional Work: Add to MR337 Culverts	10-Feb-09
										VO05 - Additional Work: Add to MR337 Culverts	07-Sep-09
										VO06 - Additional Work: Add to MR337 Culverts	07-Sep-09
										VO07 - Additional Work: Add to MR337 Culverts	07-Sep-09
AC0783: Upgrade - Algeria Road Phase I	R	26 744 897.68	R	31 557 542.72	05-May-08	05-Jun-09	396	23-Oct-09	536	VO01 - Design/Spec Change: Installation of Heavy Duty Catchpit Grates	08-Apr-09
										VO02 - Additional Work: Rehabilitation of Uitkyk Fill Slopes	20-Apr-09
AC0788: Upgrade - Marcuskraal Road	R	27 969 696.97	R	39 876 178.02	04-Jul-06	03-Jan-08	548	11-Jun-09	1073	VO01 - Additional Work: Relocation of Telkom poles, stays and overhead lines	01-Mar-07
										VO02 - Additional Work: Establishment of Gravel Maintenance Stockpile	11-Jun-07
										VO03 - Additional Work: Incorrect Levels DR2184 (SV11.36-12.22)	12-May-08
										VO04 - Additional Work: DR2184 Regravel - Extension of Time	12-May-08
										VO05 - Additional Work: DR2181, DR2178 & DR2184 Bitumen Surfacing - Borrow Pit Blasting	12-May-08
AC0789.01: Flood Damage repairs on DR1298 Genadendal & Replace Baviaans River Bridge	R	7 572 835.14	R	6 186 399.03	15-Mar-10	14-Oct-10	213	11-Feb-11	333	VO01 - Extra Work: Stockpiling of material and grouted stone pitching	30-Jun-10
										VO02 - Extra Work: Stockpiling of material and grouted stone pitching	30-Jun-10
										VO04 - Extra Work: Coring through existing structures to construct weep holes	12-Oct-10
AC0794.01: Reconstruction TR2/10 - White Bridge/Knysna	R	102 758 789.83	R	177 913 064.02	17-Jun-08	17-Dec-09	548	14-Apr-10	666	VO01: Design Spec/Change - Total Reconstruction of Two Insitu Concrete Culverts Instead of the Repair and Widening	15-Jun-09

PROJECT NAME	TENDER AMOUNT		FINAL COST		START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0799: Remediation of road cuttings on Chapman's Peak Drive	R	12 083 813.00	R	10 656 719.35	18-Sep-12	09-Apr-13	203	23-Apr-13	217	VO01 - Design Spec/Change: Additional Traffic signals at intersections within traffic single lane deviation area	10-Oct-12
										VO02 - Additional Work: Drainage and anchorage to Gabions, galvanising of mesh cabling	11-Feb-13
										VO03 - Design Spec/Change: Colour coding of catch fences and additional rope pressure grouting	11-Feb-13
										VO04 - Claim: Temporary re-opening of road for Cape Argus cycling race - 10 March 2013	12-Feb-13
										VO05 - Additional Work: Drainage and anchorage to gabions, galvanising of mesh cabling	09-Apr-13
AC0801: Reseal TR21/1 - Malmesbury/Hopefield	R	41 066 468.42	R	45 048 376.30	08-Oct-10	11-Jan-12	460	30-Jan-12	479	VO01 - Additional Work: Construction of Rut Filling	22-Nov-10
										VO02 - Claim: Voting day 18 May 2011	08-Sep-11
										VO03 - Claim: Imporation of 60/70 Pen Bitumen from Durban	07-Dec-11
										VO04 - Claim: Standing time costs of seal unit due to lack of bitumen	07-Dec-11
										VO05 - Claim: Re-establishment costs of milling and asphalt paving equipment	07-Dec-11
AC0802: Reseal TR21/2 - Hopefield/Vredenburg	R	32 715 650.00	R	41 130 896.30	24-Oct-11	19-Oct-12	361	07-Dec-12	410	VO01 - Additional Work: Installation of new expansion joints in bridges	02-Jun-12
AC0803: Rehab DR1254 - Karwyderskraal Road	R	29 486 933.74	R	30 265 087.55	15-Jan-09	15-Dec-09	334	10-Sep-10	603	VO01 - Design Spec/Change: Traffic Accommodation Signage	13-Feb-09
										VO02 - Design Spec/Change: Request for Submision of New Rates for Provision of Portal Culverts with Cast In-situ Concrete Base	26-May-09
										VO03 - Extra Work: Sand Fill - SV8.575 to SV9.535	01-Aug-09
										VO04 - Extra Work: Asphalt Base and Surfacing	25-Nov-09
										VO05 - Claim: Extension of Time with Cost - Voting Day	26-May-09
										VO06 - Claim: Extension of Time with Cost - Industrial Strike Action	07-Sep-09
										VO07 - Additional Work: Concrete Drains	25-Oct-09
										VO08 - Additional Work: Prefabricated Culverts - SV10.566	28-Feb-10
										VO09 - Additional Work: Prefabricated Culverts - Stake Value 10.558 - Heaving clays	05-Aug-10
AC0804.02: Reseal MR547 - Vredendal - Lutzville km32.5-44.05	R	12 801 251.53	R	16 776 317.99	01-Sep-11	24-Apr-12	236	26-Jul-12	329	VO01 - Design Spec/Change: Specification change Seal to patches and increase in quantities	01-Dec-11
										VO02 - Additional Work: Repair stripped areas in 13mm seal with additional grid seal and fog spray	06-Jun-12
AC0805.01: Rehab MR535 - Laaiplek/Elandsbaai	R	18 707 829.80	R	22 357 786.78	25-Jul-11	11-Nov-11	109	25-Jul-12	366	VO01 - Claim: Extension of time for delay in site handover	09-Dec-11
										VO02 - Additional Work: Rehabilitation of intersection of MR535 and Lofdal Street, Laaiplek	09-Dec-11
										VO03 - Additional Work: Rehabilitation of shoulders of the road over Rail bridges at km 24.5; km 38.7; km 56.3	30-Jan-12
										VO04 - Additional Work: Installation of Roadstuds	19-Mar-12
AC0806.01: Reseal TR33/2 - Hartenbos/Oudtshoorn	R	21 715 869.67	R	25 752 575.52	20-Sep-10	19-May-11	241	24-Aug-11	338	VO01 - Design Spec/Change: Galvanised Marker post	21-Jan-11
										VO02 - Additional Work: Transport of Local Labourers	21-Jan-11
										VO03 - Design Spec/Change: Change in seal binder type	25-Jan-11
										VO04 - Claim: Extension of time due to Election day	24-May-11
										VO05 - Extra Work: Geelbeksvlei causeway and approaches flood damage	14-Jul-11
										VO06 - Extra Work: Repairs to flood damage on Robinson Pass	14-Jul-11
										VO07 - Extra Work: Temporary by-pass on Garcia Pass at km 18,2	14-Jul-11
										VO08 - Extra Work: Extra over rate for dealing with unforseen oversized material in existing gravel shoulders and patches to the existing base	22-Aug-11
AC0806.02: Emergency Slope Remediation between Holgaten & Oudtshoorn	R	7 149 560.00	R	6 802 252.35	16-Aug-11	26-Sep-11	41	30-Nov-11	106	VO01 - Claim: Extension of time	20-Oct-11
										VO02 - Extra Work: Gabion Catch-wall at toe of cut face	20-Oct-11
										VO03 - Extra Work: Adjustment in protective mesh plate	20-Oct-11
										VO04 - Extra Work: Removal of rock debris from mesh drapery system after August 2012 rains.	30-Nov-11
AC0806.03: Emergency Slope Remediation on TR1/1 between George & Holgaten	R	10 954 212.26	R	9 213 724.28	26-Aug-11	15-Mar-12	202	26-Mar-12	213	VO01 - Extra Work: Removal of build-up of soft material from behind catch-wall after August 2012 rain	26-Mar-12

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0811.01: Flood Damage Repair MR401 - Uniondalepoort	R 35 657 120.20	R 28 820 493.87	29-Sep-09	28-Jun-10	272	04-Feb-11	493	VO01 - Claim: Extension of Time for Additional Work	07-Jun-10
AC0811: Reseal TR44/1 and Upgrade DR1834 - Uniondale	R 32 780 446.50	R 28 549 534.46	12-Jan-09	12-Dec-09	334	18-Feb-10	402	VO01 - Design Spec/Change: Bitumen Rubber (Class S-R1) Alternative	29-Jun-09
								VO02 - Additional Work: Additional Roadstuds & kilometre posts	10-Jul-09
								VO03 - Claim: Election Day - 22 April 2009	14-Jul-09
AC0814: Rehab/Reseal MR310 & DR01487 - Prince Alfred Hamlet/Op-die-Berg	R 24 870 778.11	R 32 964 204.78	01-Sep-10	30-Nov-11	455	26-Mar-12	572	VO01 - Additional Work: Maintenance patching on MR310 from km39.0 to km50.5	11-Mar-11
								VO02 - Claim: Extension of time for Election Day (18 May 2011)	04-Mar-11
								VO03 - Additional Work: Widening of sharp curves in Gydo Pass from km14.00 to km 20.00	12-Apr-11
AC0816: Rehab/Reseal DR1770, rehab DR1775, MR382 & MR390 - Plettenberg Bay	R 49 167 053.21	R 58 379 255.15	30-Aug-11	29-Sep-12	396	03-Sep-13	735	VO01 - Design Spec/Change: Change in surfacing type on portions of MR382 & DR1770	20-Sep-12
								VO02 - Design Spec/Change: Change in Road studs	12-Feb-13
AC0817.01: Reseal & Rehab MR224	R 63 054 226.47	R 84 485 159.20	26-Jan-12	26-Jul-13	547	05-Sep-13	588	VO01 - Additional Work: Rehabilitation of road from km 4.8 to km 10.3	23-Jul-12
								VO02 - Additional Work: Re-alignment of existing 300mm and 200mm diameter watermains at km 10.46	16-Aug-13
AC0819.01: Reseal DR1126 & DR1125 - Windmeul	R 24 045 665.00	R 20 910 890.42	25-Oct-10	24-Jun-11	242	24-Jun-11	242	VO01 - Design Spec/Change: Specification change of final surfacing from 13.2mm Single seal using bitumen rubber binder to 13.2/6.7mm Double seal using modified emulsion binder	11-Apr-11
AC0825: Rehabilitation of DR1529 & DR1532 (N2) near Mosselbay - Vleesbaai	R 60 907 580.00	R 74 327 407.62	01-Nov-11	26-Mar-13	511	31-May-13	577	VO01 - Additional Work: Repair of Flood damage to Structure 11299 on MR342 near Herbertsdale	06-Dec-11
								VO02 - Additional Work: Repair of Flood damage to Structure 5377 on MR337 near Herbertsdale	06-Dec-11
								VO03 - Additional Work: Repair of Flood damage to box culvert on TR33/1 (Louis Fourie Road), km 8.68 near Mosselbay	16-Mar-12
								VO04 - Additional Work: Repair of erosion at culvert on TR33/1 (Louis Fourie Road), km 7.11 near Mossel Bay	16-Mar-12
								VO05 - Claim: Claim for additional compensation - Unscheduled Declared Public Holiday	13-Apr-12
								VO07 - Claim: Extension of timedue to abnormal climatic weather conditions	11-Sep-12
								VO08 - Additional Work: Gouritz River Bridge eroded East Embankment repair	26-Nov-12
								VO09 - Additional Work: Replacing of fence along the Vleesbaai road - DR1532 & DR1529	31-Jan-13
								VO10 - Additional Work: Diluted emulsion spray on completed road	31-May-13
AC0829: Upgrade DR1119 - Bo-Dal Road	R 18 335 964.70	R 20 138 519.85	08-Nov-10	07-Nov-11	364	30-Nov-12	753	VO01 - Design Spec/Change: Replace/Relocate Diemersfontein Electrified fencing by specialist	21-Jan-11
								VO02 - Design Spec/Change: Box culverts' concrete mix design change	10-Mar-11
								VO03 - Claim: Delay due to withholding possession portion SAHRA Properties (19/11/2010-28/02/2011)	10-Mar-11
								VO04 - Claim: Voters Day 18 May 2011	18-May-11
								VO05 - Design Spec/Change: Installation of Precast Box culverts replacing pedestrian bridge	01-Nov-11
								VO06 - Design Spec/Change: Protection of existing 450mm diameter municpal watermain	01-Nov-11
								VO07 - Claim: Sandfill from commercial sources	25-Jan-12
								VO08 - Design Spec/Change: Tack coat required before asphalting	02-Mar-12
								VO09 - Additional Work: Supply and install grassblocks	12-Jan-12
								VO10 - Additional Work: Asphalt surfacing of side-walk	29-Aug-12

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0833: Regravel MR538, DR2180 & DR2184 - Het Kruis/Graafwater	R 25 932 017.54	R 46 817 735.58	08-Aug-11	08-Oct-12	427	22-Feb-13	564	VO01 - Additional Work: Heavy Maintenance and Regravel of DR2186	10-Feb-12
								VO02 - Extra Work: Remedial work to imporve the Wearing course on DR2180	20-Feb-12
								VO03 - Extra Work: Construction of various experimental sections on DR2180	07-Mar-12
								VO04 - Extra Work: Surfacing of sections of MR538 in the vicinity of 2 Schools	25-Apr-12
								VO05 - Extra Work: Rehabilitation of MR538 between km 38.85 and km 43.56	03-Aug-12
								VO06 - Extra Work: Reconstruction and surfaciing of a section of DR1280	01-Oct-12
								VO07 - Extra Work: Reconstruction and surfacing of experimental sections on DR 2180 (km 24.60 to km 26.90)	28-Nov-12
AC0837.02: Upgrade of MR582 km74-78	R 15 317 098.11	R 16 869 096.42	19-Jan-09	30-Jun-10	527	05-May-10	471	VO01 - Extra Work: Control Testing	19-Dec-08
								VO02 - Extra Work: Rumble Strips	29-Jul-09
								VO03 - Extra Work: 13.2mm Single Seal with Slurry	26-Aug-09
								VO04 - Extra Work: Road Studs	30-Sep-09
								VO05 - Extra Work: Repairs to Flood Damaged Existing Sections of MR582	29-Mar-10
AC0837.04: Drilling & Blasting of cuttings for MR582 - Central Karoo	R 8 043 360.00	R 8 193 559.08	11-Mar-13	10-Oct-13	213	25-Sep-13	198	VO01 - Additional Work: Adjudicator's Decision - Testing of crushed material and hiring of an excavator	27-May-13
AC0838.04: Upgrade MR269 - Hemel-en-Aarde	R 144 731 095.33	R 77 621 435.74	22-Dec-11	05-Sep-14	988	05-Feb-14	776	VO02 - Design Spec/Change: Layerworks change	22-Jun-12
								VO04 - Extra Work: Layerworks change	12-Nov-12
								VO07 - Extra Work: Regraveling of DR1257 from km 3,0 to km 6,0	21-Aug-13
AC0839.01: Upgrade DR1526 - Still Bay	R 15 919 218.50	R 16 022 650.60	19-Nov-08	22-Jan-10	429	19-Mar-10	485	VO01 - Additional Work: Claim for Extension of Time and Costs for Election Day (22/04/2009)	22-Apr-09
								VO02 - Additional Work: Omitting Conrete Centre Line Edging (km0.63 to km5.00)	13-Jul-09
								VO03 - Design Spec/Change: Construction of Double Grid Polymer Concrete Inlets	13-Jul-09
								VO04 - Additional Work: Provision for Laboratory Assistants for Duration of Contract	13-Jul-09
								VO05 - Additional Work: Furniture for Laboratory on Site	13-Jul-09
								VO06 - Additional Work: Install Silt Blankets to Prevent Silt from Washing into Goukou River	13-Jul-09
								VO07 - Design Spec/Change: Construction of Stormwater Kerb Inlet	13-Jul-09
								VO08 - Additional Work: Eradication of all Alien Vegetation in Road Reserve	05-Jan-10
								VO09 - Extra Work: Environmental Rehabilitation	14-Feb-10
AC0840: Regravel Roads - Eden Brandrivier Area	R 25 436 124.40	R 30 336 443.53	30-Sep-10	15-Sep-11	350	15-Dec-11	441	VO01 - Design Spec/Change: Supply and lay 300mm dia Type Ogee pipe Class 100d on class A bedding	14-Feb-11
								VO02 - Design Spec/Change: Supply and erect danger plates on posts at culverts (excluding DR1354)	04-May-11
								VO03 - Design Spec/Change: Extra Heavy Grid Rolling in addition to normal grid rolling	15-Dec-11
								VO04 - Extra Work: Drill holes for grouting dowels to fix bollards to existing low water bridge at SV16120	17-Jun-11
								VO05: Design Spec/Change: Corrosion protection of existing Armco culver SV3310 on MR322	25-May-11
								VO06: Claim - Extension of Time - Election Day 18/05/2011	23-May-11
								VO07: Additional Work: Game proof fence (Cape Nature type) along expropriated road reserve line at causeway	10-Dec-11

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0847: Upgrade DR1661 - Calitzdorp Phase I	R 26 057 141.24	R 21 698 267.94	10-Oct-08	10-Nov-09	396	21-Jan-10	468	VO01 - Extra Work: Transport of Labour to Site	06-Mar-09
								VO02 - Additional Work: Remove Oversize Material from Fill	06-Mar-09
								VO03 - Extra Work: Construction of Static Tank	20-Mar-09
								VO04 - Design Spec/Change: Installation of Duct Lines	20-Mar-09
								VO05 - Design Spec/Change: Specification Change to Fencing	10-Apr-09
								VO06 - Design Spec/Change: New Rate for Removal of Oversize Material Using Mechanical Screen	10-Jun-09
								VO07 - Design Spec/Change: New Rate for Shoulder Construction Using Stabilised Selected Material	22-Jun-09
								VO08 - Design Spec/Change: Additional Costs Associated with Signalised Night Time Traffic Accomodation	22-Jun-09
								VO09 - Design Spec/Change: Election Day	22-Apr-09
								VO10 - Design/Spec Change: Reinforcement Mesh Rates	01-Oct-09
								VO11 - Design/Spec Change: Asphalt Berm	01-Oct-09
								VO12 - Design/Spec Change: Road Signs	01-Oct-09
AC0861.01: Bridge Rehab - City of Cape Town and Paarl Area	R 11 175 586.40	R 14 269 581.17	04-Nov-10	05-May-11	182	09-Feb-12	462	VO01 - Extra Work: New handrail brackets and bolts for Lady Loch bridge B3007	16-Feb-11
								VO02 - Extra Work: Ultra High Pressure (UHP) cleaning of Lady Loch Bridge steel structure	09-May-11
								VO03 - Claim: Lady Loch Bridge - Extension of time claim due to postponed bridge closure	23-May-11
								VO04 - Claim: Local Government Election Day 18 May 2011	28-Jul-11
								VO05 - Extra Work: Wingfield Interchange Bridge (B2927) Deck voids cored drainage holes	28-Jul-11
								VO06 - Extrra Work: Steenbras River Bridge (B2604) Corrosion inhibitor treatment Sika Ferrogard 903	28-Jul-11
								VO07 - Extra Work: Refinery interchange bridge (B4247) New Impact damage repairs	28-Jul-11
								VO08 - Extra Work: Lady Loch bridge (B3007) Maintenance coating system to bridge superstructure	11-Oct-11
								VO09 - Extra Work: Steenbras River Bridge (B2604) 5-15m access range	28-Jul-11
								VO10 - Additional Work: Lady Loch Bridge (B3007) Additional strengthening work	28-Jul-11
AC0864.02: Repair Slope Failures MR295 - Burgers Pass	R 4 973 702.80	R 5 398 243.84	03-Aug-09	04-Mar-10	213	09-May-10	279	VO01 - Additional Work: Drilling of Ground Anchors	19-Nov-09
								VO02 - Design Spec/Change: Construct Concrete Lining to Cut Off Drain	19-Nov-09
AC0864.03: Bridge Rehab - Hex River Valley	R 13 129 113.39	R 16 005 292.62	10-Mar-10	09-Nov-10	244	05-Aug-11	513	VO01 - Design Spec/Change: Eikenhof Bridge Rehab	14-Sep-10
								VO02 - Design Spec/Change: Construction of three bridges in the Hex River Valley	22-Sep-10
								VO03 Extra Work: Shoring at Buffelskraal	29-Sep-10
								VO04 - Design Spec/Change: Curved Gabion Protection and Toe-Walls	24-Feb-10
								VO05 - Claim: Re-establish machines to clear Buffelskraal stockpile	25-May-11
								VO06 - Claim: Overhaul to Worcester dumpsite	08-Jun-11
								VO07 - Design Spec/Change: Eikenhof design change EOT and costs	09-Jun-11
AC0864.04: Flood Damage Repair - Valley Road	R 3 244 000.55	R 3 740 895.89	12-May-10	10-Nov-10	182	04-Apr-11	327	VO01 - Additional Work: Borehole 1	27-Aug-10
								VO02 - Extra Work: Construction of new inlet and outlet to pipe culvert at SV10.07	27-Aug-10
								VO03 - Extra Work: Additional Piling Work	20-Oct-10

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0865.03: Flood Damage MR346 near Buffels Bay	R 4 559 011.15	R 4 661 248.71	09-Mar-10	08-Sep-10	183	28-Feb-11	356	VO01 - Additional work: Construction of Stabalisiing Platform with a Geosynthetic Reinforcing Grid	17-May-10
								VO02 - Omitted Work: New Rates for items omitted from the original Bill of Quantities	12-Aug-10
								VO03 - Claim - General Time-related and Standing Time Costs due to Application for Permits	02-Feb-11
								VO04 - Claim - General Time-related and Standing Time costs due to Waterlogged in-situ Roadbed	02-Feb-11
								VO05 - Claim: General time-related costs due to unavailability of bitumen products	14-Feb-11
AC0865.04: Flood Damage Repairs to Slope Failures in the Groot River Pass	R 27 317 307.75	R 24 355 237.72	05-Oct-09	06-Oct-10	366	15-Nov-10	406	VO01 - Design Spec /Change: Change of Compaction Specification and Items Not Measured	05-Mar-10
								VO02 - Design Spec/Change: New Tollgate	08-Mar-10
AC0865.06: Flood Damage to Structures in Mossel Bay LM Area	R 6 668 498.72	R 7 509 408.42	08-Sep-08	12-Jun-09	277	17-Dec-09	465	VO01 - Additional Work: Reconstruction of Geelbeksvlei Causeway 10647 and Gabion Protection to Road Embankments and Downstream Outlet	28-Aug-09
								VO02 - Additional Work: Extension of Time Plus Associated Costs for the Election Day As Well as Extension of Time for Inclement Weather (Rain Days)	23-Sep-09
AC0865.08: Flood Damage to Geelhoutboom Area	R 9 792 985.00	R 8 966 353.25	01-Sep-09	31-Aug-10	364	10-Dec-10	465	VO01 - Additional Work: Flood Damage Repairs to DR1615 (Hoogekraal Road) near Sedgefield	01-May-10
								VO02 - Omitted Work: Extra and/or omitted work at new and existing areas	15-Jul-10
								VO03 - Extra Work: Remedial work to Waboomskraal River Causeway No. 11500 on Minor Road 6878	30-Aug-10
AC0865.10: Flood Damage Repairs to Slope Failures in the Bloukrans River Pass	R 10 929 100.88	R 8 829 901.75	01-Jul-10	30-Apr-11	303	02-Sep-11	428	VO01 - Extra Work: Allowance for the payment of toll fees	02-Aug-10
AC0880.04: Upgrade - Table Bay Boulevard	R 104 359 696.46	R 145 618 077.78	17-Sep-08	17-Sep-10	730	01-Jul-10	652	VO01 - Additional Work: Alteration of Construction Method	10-Oct-08
								VO01a - Additional Work: Alternative Design	04-Feb-09
								VO01b - Additional Work: Alternative Design	10-Oct-08
								VO01c - Additional Work: Alteration of Construction Method	06-Nov-09
								VO01d - Additional Work: Reinforced Earth Wall at SV 4400	11-Aug-09
								VO01e - Additional Work: Installation of Split Precast Median Barriers	15-Oct-09
								VO02 - Additional Work: Acceleration	10-Oct-08
								VO02a - Additonal Work: Acceleration	17-Apr-09
								VO03 - Additional Work: WBHO Standing Time	09-Jul-09
								VO04 - Additional Work: Extension of Time - Meek Strike Claim July 2009	11-Aug-09
								VO05 - Additional Work: Interest Claim for Late Submission of Certificate #10	11-Aug-09
								VO06 - Additional Work: Additional Piling at Piers 16 & 17	11-Aug-09
								VO07 - Additional Work: 915mm Watermain Joint Repair Costs	11-Aug-09
								VO08 - Additional Work: Paarden Eiland Pedestrian Bridge - Extension of Time Claim due to National Industrial Strike	14-Aug-09
								VO09 - Additional Work: Tree Felling including Removal of Stumps along N1	05-Oct-09
								VO10 - Additional Work: Encasement of Existing Telkom Services and of Services Movement for Stormwater Crossings	05-Oct-09
								VO11 - Additional Work: Soft Landscaping and Irrigation Works	19-Feb-10
								VO12 - Claim: Rain Days EOT - 10 Days	25-Jun-10

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0880: Upgrade - Koeberg Interchange Phase I & Landscaping	R 471 315 264.41	R 661 052 069.03	06-May-08	23-Oct-11	1265	05-Dec-11	1308	VO01 - Claim: Accelerated Programme Costs for Completion of Ramp A by 31st March 2010	16-Aug-08
								VO01a - Extra Work: Schedule D4 - Salt River Canal Revised Construction Methodology	10-Jul-09
								VO02 - Extra Work: Cost Associated with Transplanting Plant on C880	18-Sep-08
								VO03 - Extra Work: Relocation of Sewer Rising Main (Open Trench Option)	04-Sep-08
								VO04 - Extra Work: Relocation of Telkom Ducts (Open Trench Option)	04-Sep-08
								VO05 - Extra Work: Removal and Relocation of Streetlighting	04-Sep-08
								VO06 - Extra Work: Stormwater Culvert Deviation at A7 Pier Foundation	30-Jun-08
								VO07 - Extra Work: Locating Existing Services within Railway Reserve Including Supply & Erection of New Security Fence	12-Sep-08
								VO08 - Extra Work: Material Orders for C708.10 (M5) - Spigot & Socket Stormwater Pipe Culverts	10-Mar-09
								VO09 - Extra Work: Material Orders for C708.10 (M5) - 132 Electrical Cable and Accessories	17-Mar-09
								VO10 - Extra Work: Additional Drilling Investigation	11-Mar-09
								VO11 - Extra Work: Cost on Late Payments	23-Apr-09
								VO12 - Extra Work: M5 Elastomeric Expansion Joints	18-May-09
								VO13 - Extra Work: Relocation of Trees on the Salt River Canal Bank	27-May-09
								VO14 - Extra Work: M5 Viaduct Widening - Cross Beam Strengthening of Existing Deck	19-Jun-09
								VO15 - Extra Work: Piling for Pier 17 M5 Widening at Koeberg Interchange - Alternate Design	07-Jul-09
								VO16 - Extra Work: Claim for Extension of Time Due to National Industrial Strike Action 8-15 July 2009	10-Aug-09
								VO17 - Extra Work: Rehabilitation Work	02-Jul-09
								VO18a - Extra Work: Irrigation Duct Installation by Directional Drilling	10-Jul-09
								VO18b - Extra Work: Electrical Street Lighting Duct Installation by Directional Drilling	10-Jul-09
								VO19 - Extra Work: Supply Material to C880.04	29-Sep-09
								VO20 - Extra Work: Extension of Time for Completion Claim for Abnormal Climatic Conditions	18-Aug-09
								VO21 - Design Spec/Change: Steel Gantries for Overhead Variable Message Signs	02-Sep-09
								VO21a - Design Spec/Change: ITS Ducts for Variable Message Signs	20-Jan-10
								VO22 - Additional Work: N1 Southbound Widening between Existing Ramp 2 and New Edge 7	18-Sep-09
								VO23 - Additional Work: Locate, Deviate Existing Services at B20 Pier Foundation and Construct to New Design	18-Jan-10
								VO24 - Additional Work: Supply and Install Street Lighting by Specialist Sub Contractor	19-Feb-10
								VO24A Design Spec/Change: Street Lighting Sub-Contractor no C880.05 - Acceleration for delivery of poles in order to complete Ramp A by 24 May 2010 and Additional Kiosk	02-Aug-10
								VO24B - Design Spec/Change & Omitted Work: Street lighting sub-contractor on C880.05	21-Feb-11
								VO25 Design Spec/Change: Cost Adjustment to billed class "W" concrete rates for change over from "Corex" cementitious extender to PFA ex-Gauteng (W-40/19, 40/26 & 50/19MPa-Concrete	10-Mar-10
								VO26 Omitted Work: Soft Landscaping and Manual irrigation works by Specialist Sub-Contractor no C880.06	19-Jul-10
								VO26A Additional Work: Soft Landscaping and manual irrigation works by Specialist Sub-Contractor no C880.06 for Contract C880	07-Oct-10
								VO26B - Additional Work: Soft Landscaping and manual irrigiation works by Specialist Sub-Contractor no C880.06 of rcontract C880	09-Dec-10
								VO27 Extra Work: Dowel installation at M5 Piers 1 & 2 by specialist Sub-contractor Franki Africa (Pty) Ltd.	20-Sep-10

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0880: Upgrade - Koeberg Interchange Phase I & Landscaping	471315264.4	661052069	39574	40839	1265	40882	1308	VO32 - Additional Work: Installation of Secondary Traffic Counting stations on the N1 South- and Northbound Caariageways by Specialist Contractor	20-Jun-11
								VO33 - Extra Work: Re-establishment and additional work to place M5 beams on rail crossings due to 33kv overhead restriction	22-Jun-11
								VO34 - Additional Work - Rehabilitation of N1 outbound and existing bridges 5887, 5889, 5890 and 9041	15-Aug-11
								VO35 - Claim: Extension of time for completion due to rain delays and other circumstances for Claims 2, 4 & 5	19-Aug-11
								VO36 - Extra Work: Structural report to damaged M5 beam at Voortrekker Road	08-Sep-11
								VO37 - Extra Work: Palisade fence next to railway reserve	26-Sep-11
								VO38 - Extra Work: Transport of free issue portal culverts to Department of Transport and Public Works Paarl Depot	03-Oct-11
								VO39 - Extra Work: Repairs to Damaged Balustrades	05-Dec-11
								VO40 - Extra Work: Repairs to Damaged Balustrades	05-Dec-11
								VO41 - Extra Work: Repairs to Damaged Balustrades	05-Dec-11
								VO42 - Extra Work: Koeberg Stormwater problems (remedial work)	05-Dec-11
								VO43 - Extra Work: Replacement of broken Balustrade TBB- M5	05-Dec-11
AC0882.03: Upgrade Plantation Road - Heuwelkroon/Greyton Area	R 5 769 768.90	R 6 340 733.88	12-May-08	04-Feb-09	268	14-Jul-09	428	VO01 - Claim: Extension of Time for Delay with Identification and Appointment of CLO	29-Aug-08
								VO02 - Claim: Extension of Time for Abnormal Rainfall for Month of September 2008	20-Oct-08
								VO03 - Design Spec/Change: Concrete Pipe Culverts - Change of Pipe Type and Diameter	20-Oct-08
								VO04 - Design Spec/Change: Excavation of Open Drains and Intermediate Excavation for Subsoil Drains	20-Oct-08
								VO05 - Extra Work: Increase in Mass Earthworks Quantity as a Result of Site Conditions	20-Oct-08
								VO06 - Design Spec/Change: Construction of Precast Concrete Kerbline in Lieu of In-situ Casted Concrete V-Channel	20-Oct-08
								VO07 - Extra Work: Provision of Traffic Calming Measures to Improve Safety	20-Oct-08
								VO08 - Extra Work: Provision of Guardrails to Improved Safety of Properties	20-Oct-08
								VO09 - Extra Work: Construction of Gravel Sidewalk Behind Kerbline	20-Oct-08
								VO10 - Extra Work: Relocation of Existing Irrigation Channel	20-Oct-08
								VO11 - Extra Work: Relocation of Existing Watermain	20-Oct-08
								VO12 - Claim: Time Related Preliminary and General Charges for the December Holiday Break	20-Oct-08
								VO13 - Claim: Contract Price Adjustment - Extension of Tender Validity to 18 Weeks (126 days)	20-Oct-08
								VO14 - Claim: Extension of Time for Increase in Quantities and Extra Works	20-Oct-08
								VO15 - Claim: Extension of Time for Abnormal Rainfall for Month of October 2008	20-Nov-08
								VO16 - Claim: Extension of Time for Abnormal Rainfall for Month of November 2008	10-Dec-08
								VO19 - Claim: Extra Work (Gabion Protection) and Extension of Time for Extra Work	04-May-09
								VO20 - Claim: Payment of Standing Time for Plant - Election Day 22 April 2009	15-May-09

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0884.06: Construction of Roads/Sidewalks - Kwanokuthula, Riversdale	R 2 511 203.01	R 3 049 969.63	12-Nov-10	12-Sep-11	304	15-Dec-11	398	VO01 - Design Spec/Change: Alternative Precast Drain to cast in-situ drain	31-Oct-11
								VO02 - Design Spec/Change: ETB by mechanical method	31-Oct-11
								VO03 - Claim: Voting date 18 May 2011	31-Oct-11
								VO04 - Claim: Realignment and setting out of Dahlia Street	31-Oct-11
								VO05 - Claim: Additional work on Mfuleni Road	31-Oct-11
AC0898: Reseal TR9/2 near Rawsonville	R 16 845 136.34	R 21 059 708.64	15-Nov-10	15-May-11	181	07-Nov-11	357	VO01 - Additional Work: New G2 Basecourse km 47,3 to km 49,1	14-Feb-11
								VO02 - Additional Work: Repairs to Bainskloof Gantry	14-Apr-11
								VO03 - Design Spec/Change: SCE2 (Wintergrade binder)	12-May-11
								VO04 - Claim: Voting Day	06-Aug-11
								VO05 - Design Spec/Change: Contractor's contribution towards laboratory testing	06-Aug-11
								VO06 - Claim: Extension of Time	07-Nov-11
								VO07 - Additional Work: Weighbridge asphalt repair	07-Nov-11
AC0899.01: Reseal TR73/1- Leeu Gamka	R 18 634 225.00	R 22 463 847.82	18-Oct-10	17-Jun-11	242	09-Sep-11	326	VO01 - Design Spec/Change: Reconstruction and upgrading of existing gravel shoulders	02-Feb-11
								VO02 - Additional Work: Roadstuds for centreline	02-Feb-11
								VO03 - Additional Work: Flood damage repairs to TR73 at km56	02-Feb-11
								VO04 - Design Spec/Change: The use of winter grade bitumen rubber	12-Apr-11
								VO05 - Additional Work: Installation of bridge expansion joints and Marking of yellow lines	12-Apr-11
AC0900: Reseal TR65/1 - N2/Barrydale	R 25 816 142.80	R 29 929 383.20	06-Oct-11	03-Aug-12	302	06-May-13	578	VO01 - Additional Work: Additional repair and reseal of 5.1km of MR286	09-Jan-12
								VO02 - Claim: Extension of time for Practical Completion due to shortage of bitumen	23-May-12
								VO03 - Claim: Extension of time for Practical Comletion due to shortage of bitumen	23-May-12
								VO04 - Additional Work: Repair of all sub-standard culverts along TR65/1 and MR286	23-May-12
								VO05 - Design Spec/Change: Stone required for Grit Seal application	23-May-12
								VO06 - Additional Work: Repair of major culvert	21-Aug-12
								VO07 - Additional Work: Extension of time due to embargo period and extra concrete culvert repairs	18-Sep-12
AC0901: Reseal TR31/1 - Worcester/Robertson	R 22 084 691.11	R 29 536 629.61	01-Sep-10	27-Dec-11	482	02-Aug-12	701	VO02 - Omitted Work: Removal of pine tree and trimming of fig tree branches	15-Nov-10
								VO03 - Design Spec/Change: Demolition of existing concrete encased pipe culvert at SV3840 on DR1426	15-Nov-10
								VO04 - Design Spec/Change: Installation of bio barrier for fig tree roots	15-Nov-10
								VO05 - Design Spec/Change: Elimination of proposed asphalt surfacing on TR31/1 by patching with BTB only	26-Jan-11
								VO06 - Extra Work: Relocation of vineyard supports along DR1400	27-Jan-11
								VO07 - Design Spec/Change: Repairs to gravel shoulders on TR31/1	27-Jan-11
								VO08 - Design Spec/Change: Alternative surfacing to bellmouths and adjacent areas	27-Jan-11
								VO09 - Claim: Claim for delays on DR1400	05-Aug-11
								VO10 - Design Spec/Change: Change to surfacing spec from a BR double seal to a BR and SBS asphalt wearing course	23-May-12

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0902: Reseal and Rehab TR21/3 - Vredenburg/Velddrift	R 21 340 825.00	R 28 162 798.00	08-Sep-10	09-May-11	243	02-Mar-12	541	VO01- Design/Spec change: Bitumen Rubber 13.2mm Single Seal	16-Nov-10
								VO02 - Design/Spec change: Extra Over for COLTO Medium	21-Nov-10
								VO03 - Design/Spec change: Straw stabilisation	21-Nov-10
								VO04 - Design/Spec change: Sand Blasting	17-Nov-10
								VO05 - Extra Work: Widening of St Helena intersecton	10-Jan-11
								VO06 - Extra Work: Afrimat Intersection	10-Jan-11
								VO07 - Extra Work: Rehabilitation of TR77/01 - km 133,5 to 135,5	10-Jan-11
								VO08 - Extra Work: Upgrade of Dwarskersbos Intersection	10-Jan-11
								VO09 - Claim: Extension of Time	05-May-11
								VO10 - Additional Work: W401 Signboards	05-May-11
								VO11 - Claim: Temporary suspension of contract & extension of time	31-May-11
								VO12 - Design Spec/Change: Change in Surface Treatment OP7645	27-Sep-11
AC0903: Reseal TR55/1 - Clanwilliam/Lamberts Bay	R 31 999 369.90	R 41 338 522.94	04-Oct-10	04-Aug-11	304	05-Jun-12	610	VO02- Extra Work: The repair of the fill slopes of the approaches of the road over rail bridge crossing at km 59.56	10-May-11
								VO03 - Extra Work: The surfacing of farm accesses	10-May-11
								VO04 - Extra Work: The spraying of weed killer on the gravel shoulders	10-May-11
								VO05 - Additional Work: The removal of damaged Armco down chutes	10-May-11
								VO06 - Additional Work: The removal of asphalt berms	10-May-11
								VO07 - Additional Work: The reconstruction of the portion of road between km 0.650 and km 2.850	10-May-11
								VO08 - Design Spec/Change: The installation of E80 C bridge expansion claw-type joints opposed to type BSP 40 expansion joints on Bridge 4513 over the Olifants River	10-May-11
								VO09 - Design Spec/Change: The construction of a 9.5mm single seal of Main Road 543, Divisional Road 2191 and Divisional Road 2193	10-May-11
								VO10 - Additional Work: The Construction of a 9.5mm single seal on MR543, DR2191 & DR2193	10-Jun-11
								VO11 - Additional Work: Construction of new down chutes	22-Aug-11
								VO12 - Additional Work: De- and re-establishment of chip & spray team due to embargo period	22-Aug-11
								VO13 - Claim: Election date - 18 May 2011	22-Aug-11
								VO14 - Additional Work: Construction of subsoil drains at SV5150 to drain water from layerworks	05-Jun-12
								VO15 - Additional Work: Construction of premix layer at the IS between TR55/1 and the spoornet service road at SV59870 (RHS)	05-Jun-12
AC0904: Reseal MR526 - Porterville/Eendekuil	R 21 143 727.71	R 27 849 080.56	13-Oct-10	12-Jun-11	242	15-Dec-11	428	VO01- Design Spec/Change: Rut filling and patching to destressed areas	30-Nov-10
								VO02 - Extra Work: Bridge Work & Tree Felling	14-Apr-11
								VO03 - Design Spec/Change: Suspension of Works	13-Apr-11
								VO04 - Additional Work: Additional Work	09-Oct-11
								VO05 - Additional Work: Additional unforeseen work at cutting (km 7.7)	15-Dec-11

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0906: Reseal TR31/5 - Ladismith/Calitzdorp	R 73 448 866.68	R 107 218 706.46	05-Oct-11	10-Oct-12	371	03-Jul-13	637	VO01 - Claim: Claim for additional cost due to labour strike of 23 November 2011	13-Mar-12
								VO02 - Additional Work: Additional cost for the relocation of Telkom services	30-Apr-12
								VO03 - Design Spec/Change: Additional cost for the installation of rock bolts at Site 1: Garcia Pass Slope Remediation (TR83/1 at km 18.26)	13-Aug-12
								VO04 - Design Spec/Change: Pavement rehabilitation km 44,665 to km 45.290	28-Sep-12
								VO05 - Claim: Cost of wages due to pyublic holiday of 27 December 2011	06-Sep-12
								VO06 - Design Spec/Change: Additional cost for 13mm surfacing stone from Brewelskloof	13-Sep-12
								VO07 - Additional Work: Vleiland Flood Damage Repair Work	03-Dec-12
								VO08 - Additional Work: Pavement Rehabilitation at km 25 on TR31/5	03-Dec-12
								VO09 - Design Spec/Change: Core drilling at Seven Weeks Poort Bridge	03-Dec-12
								VO10 - Claim: Extension of time due to consequential delays (drying of base)	03-Dec-12
								VO11 - Design Spec/Change: Additional cost for Cape Seal	03-Dec-12
								VO12 - Additional Work: Landscaping & various new rates	26-Jun-13
								VO13 - Additional Work: Extension of time due to rehabilitation at km 25 and additional cost for pioneer material from commercial sources	26-Jun-13
								VO14 - Additional Work: Additional work during the Defects Liability Period	03-Jul-13
AC0907: Reseal MR174 - Klipheuwel/Malmesbury	R 15 162 679.43	R 16 539 057.26	13-Sep-10	12-May-11	241	22-Jul-11	312	VO01 - Additional Work: Installation of Guardrails and removal of existing roadstuds	10-Nov-10
								VO02 - Additional Work: Maintenance on MR224 (Malmesbury to Darling)	29-Nov-10
								VO03 - Additional Work: Reinstatement of shoulder material	14-Apr-11
								VO04 - Design Spec/Change: Use of SE-2 Binder for penetration coat	03-Mar-11
								VO05 - Design Spec/Change: Use of 40mm Asphalt overlay at intersection with MR188 and DR1126 in place of 19mm+9.5mm seal	03-May-11
AC0908: Reseal MR188 - Durbanville/Klipheuwel	R 39 849 624.07	R 44 726 071.17	16-Sep-11	16-Jul-12	304	13-Dec-12	454	VO01 - Extra Work: Sealing of construction joints between concrete side drains & road surface	05-Mar-12
								VO02 - Extra Work: Provision and operation of Traffic Accommodation Escort vehicles	17-Apr-12
								VO03 - Extra Work: Provision and operation of Traffic signals at night	17-Apr-12
AC0909: Reseal TR88/1, MR368 & MR404 - De Rust/N9	R 58 800 000.00	R 56 524 432.55	13-Oct-11	30-Nov-12	414	17-Dec-13	796	VO01 - Claim: Standing time claim due to incorrect survey	01-Nov-12
AC0916.01: Reseal of MR234 - Hopefield/Velddrift km 17.8 - km 38.6	R 10 456 799.31	R 12 664 957.27	28-Oct-11	11-Apr-12	166	30-May-12	215	VO01 - Design Spec/Change: New rates for night-time traffic accommodation and straw stabilisation of side drains	19-Jan-12
								VO02 - Repairs to Stormwater drainage (chutes) on fill at road-over-rail bridge (km 35.6 - km 36.3)	19-Jan-12
AC0918.01: Upgrade TR33/3 & MR359 - Dysselsdorp Intersection	R 6 253 100.05	R 6 218 176.66	09-Sep-11	02-Apr-12	206	13-Mar-13	551	VO01 - Additional Work: Replacement of existing G5 quality basecourse material with 200mm of G2 on TR33/3	02-Dec-11
AC0958: Flood Damage Repairs to Structures in CW: Worcester/De Doorns Area	R 6 956 747.70	R 8 888 936.28	03-May-11	02-Feb-12	275	04-Apr-12	337	VO01 - Claim: Voting day 18 May 2011	10-Aug-11
								VO02 - Additional Work: Cut-off wall below Malherbe St Bridge Deck	10-Aug-11
								VO03 - Additional Work: Gravel Surfaces on De Vlei bypass	23-Sep-11
								VO04 - Additional Work: New bridge Deck at De Vlei	01-Dec-11
								VO05 - Design Spec/Change: New Deck bollards at Alfiesdrif	07-Feb-12
								VO06 - Additional Work: Extension of time for additional work at Alfiesdrift, Brandwacht School & Lemoenpoort	24-Feb-12
								VO07 - Extra Work: Extra work to repair erosion damage at drainage channel at Orchard Bridge	27-Feb-12
								VO08 - Extra Work: Recovery of costs arising from steel strike	02-Mar-12
AC0959: Flood Damage Repairs to Structures in CW: Montagu/Koo Area	R 8 658 501.50	R 17 208 079.26	09-May-11	09-Mar-12	305	14-May-13	736	VO01 - Design Spec/Change: KK02 Additional Work	09-Dec-11
								VO02 - Design Spec/Change: KK03 Additional Work	09-Dec-11
								VO03 - Design Spec/Change: KK05 Additional Work	09-Dec-11

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC0959: Flood Damage Repairs to Structures in CW: Montagu/Koo	8658501.5	17208079.26	40672	40977	305	41408	736	VO04 - Design Spec/Change: PF19 Additional Work	15-Dec-11
								VO05 - Design Spec/Change: KK06 Additional Work	27-Feb-12
								VO06 - Design Spec/Change: KK07 Additional Work	27-Feb-12
								VO07 - Design Spec/Change: PF01 Additional Work	27-Feb-12
								VO08 - Design Spec/Change: PF02 Additional Work	27-Feb-12
								VO09 - Design Spec/Change: PF03 Additional Work	27-Feb-12
								VO10 - Design Spec/Change: PF07 Additional Work	27-Feb-12
								VO11 - Design Spec/Change: PF08 Additional Work	27-Feb-12
								VO12 - Design Spec/Change: PF09 Additional Work	27-Feb-12
								VO13 - Design Spec/Change: MP02 Additional work	27-Feb-12
								VO14 - Design Spec/Change: MP12 Additional Work	27-Feb-12
								VO15 - Design Spec/Change: KA08 Additional Work	27-Feb-12
								VO16 - Design Spec/Change: MP20 Additional Work	08-May-12
								VO17 - Design Spec/Change: PF11 Additional Work	08-May-12
								VO18 - Design Spec/Change: PF12 Additional Work	08-May-12
								VO19 - Design Spec/Change: PF13 Additional Work	08-May-12
								VO20 - Design Spec/Change: MP10 Additional Work	08-May-12
								VO21 - Design Spec/Change: Pipe culverts on road to site office	08-May-12
								VO22 - Claim: Extension of time due to weather and public holiday	08-May-12
								VO23 - Extra Work: Ceres area flood damage repairs	08-May-12
AC0960: Flood Damage Repairs to Structures in CW: Nuy/Robertson Area	R 10 966 997.15	R 16 676 991.54	04-May-11	03-Feb-12	275	19-Mar-13	685	VO01 - General Time related and standing time costs due to Public Holiday 18 May 2011	20-Feb-12
								VO02 - Additional Work: Repair of side slop failure on R44 near Audacia	07-Sep-12
								VO04 - Storm damage repairs on TR2/9 at km 2.1 Grootbrak	17-Sep-12
								VO05 - Additional Work: Construction of Drift No 11791 on DR 1377 at km 6.39	10-Jul-12
								VO06 - Claim: Payment of additional time-related General Items and other costs as a result of various extentions of time	19-Mar-13
AC0961: Flood Damage Repairs to Structures in CW: Robertson/Bonnievale Area	R 10 425 118.90	R 26 097 967.10	11-Jul-11	11-Apr-12	275	05-Jul-13	725	VO01 - Design Spec/Change: Boesmans River Site C14 (Bridge 6011) Elastomeric Bearings, 40MPa, Steel Nosings	17-Jul-12
								VO02 - Additional Work: Middelriver Site C22 - Additional causeway replacement site	17-Jul-12
								VO03 - Additional Work: Koningsriver Site C05a - Box culvert extention, pipe culvert repairs and making safe	17-Jul-12
								VO04 - Additional Work: Site C20 - Culvert 11744 on Mr287 at km 10.01	17-Jul-12
								VO05 - Design Spec/Change: Site C05b - Causeway 11743 on DR1353, km 0.35	17-Jul-12
								VO06 - Additional Work: Site C17 - Culvert 11716 on OP5942, km 0.70	17-Jul-12
								VO07 - Additional Work: Site C02 - Stilling basin at outlet on DR1363, km 12.4 near Klaas Voogds Station	17-Jul-12
								VO08 - Claim: Extension of time - Environmental authorisation and additional works (5 months)	17-Jul-12
								VO09 - Additional Work: Repair of Slip failure at km 30.02 TR32, Section 1	13-Jan-13
AC0993.01: Slope Failure Remediation TR00101 - Outeniqua Pass	R 10 633 333.34	R 11 462 228.30	19-Oct-12	15-May-13	208	06-Jun-13	230	VO01 - Claim: Additional cost due to excess grout usage at ground anchors	10-Apr-13
								VO02 - Extra Work: Additional pavement repair	08-Apr-13
AC413.04: Wingfield - Malmesbury N7 North Rehab km12-18	R 13 100 000.00	R 12 870 866.91	10-Oct-06	09-Mar-07	150	08-Aug-07	302	VO01 - Additional Work: Milling off UTFC layer	24-Apr-07

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC552: Malmesbury - Hermon TR24/1 11km	R 45 858 452.95	R 53 219 349.78	02-Oct-06	02-Nov-07	396	22-May-08	598	VO01 - Extra Work: Repair of slip between SV525 to SV720	01-Nov-06
								VO02 - Extra Work: Access to culverts and Drainage of excavations	01-Nov-06
								VO03 - Extra Work: Stockpiling of topsoil	02-Nov-06
								VO04 - Extra Work: Rockfill required as pioneering layer	24-Nov-06
								VO05 - Additional Work: Replacement of single seal with modified double seal	30-Nov-06
								VO06 - Additional Work: Stabilisation of shoulder	26-Jan-07
								VO07 - Additional Work: Repair work to bridges	13-Mar-07
								VO09 - Extra Work: 75m Drainage layer and Repair of slip failure	31-Aug-07
								VO10 - Extra Work: Stabilisation of in situ centre line	31-Aug-07
								VO11 - Extra Work: Failures on Existing Road (km0-16)	13-Dec-07
AC574.17: Upgrade of Beaufort West Weighbridge	R 18 940 968.40	R 22 068 319.39	14-Nov-06	13-Nov-07	364	14-Dec-07	395	VO01 - Design Spec/Change: Increase length of WIM clabs & Deeper scale pit	07-Sep-07
AC585.02: Bridge Handrails Phase II	R 5 034 921.75	R 4 756 570.70	13-Sep-06	13-Jun-07	273	27-Jun-07	287	VO01 - Extra Work: B4831 Grootvadersbosch - Coring	10-Nov-06
								VO02 - Extra Work: B4831 Grootvadersbosch - Crack injection	27-Feb-07
								VO03 - Extra Work: Patch Repair to Existing Bolt Areas	22-Mar-07
								VO04 - Extra Work: Additional Patch Repair to Existing Bolt Areas	10-May-07
								VO05 - Extra Work: Painting balustrades at Bridge 4543 over the Kars River4543	15-May-07
								VO06 - Extra Work: Painting of Existing Balustrades	27-Jun-07
AC636: Wellington - Hermon Rehab MR23 21km	R 97 639 319.85	R 117 347 301.13	20-Mar-06	20-Jan-08	671	02-Apr-08	744	VO07 - Omitted Work: Extra over Item B43.01(d)(ii)	21-Feb-07
								VO08 - Omitted Work: Relocation of existing watermain in Wellington	03-Nov-06
								VO09 - Omitted work: Insitu reconstruction of existing pavement layers	21-Dec-06
								VO10 - Omitted work: 900mm x 450mm precast portal culvert	22-Dec-06
								VO11 - Omitted Work: Removing and re-laying existing pipes	22-Dec-06
								VO12 - Omitted Work: MSP-1 Prime coat	22-Dec-06
								VO13 - Omitted Work: Provision of shelters and radios for flagmen at intersections	22-Dec-06
								VO14 - Omitted Work: Training	22-Dec-06
								VO15 - Omitted Work: Fill obtained from commercial sources compacted to 93% Mod AASHTO density	22-Dec-06
								VO16 - Omitted Work: Gravel subbase for sidewalks	22-Feb-07
								VO17 - Additional Work: Re-construction & upgrading of intersection (MR23/MR27)	12-Jun-07
								VO18 - Additional Work: In situ repainting of re-used guardrails	01-May-07
								VO19 - Claim: Extension of Time for Consequential Delays: August 2005	05-Feb-08
								VO20 - Claim: Extension of Time for Adverse Weather Conditions: Winter Months of 2007	02-Apr-08
								VO21 - Omitted Work: Various Items	02-Apr-08
AC638: Rehab Mr227 - Riebeeck West/Moorreesburg	R 55 959 330.16	R 73 819 917.50	03-Mar-08	03-Jun-09	457	08-May-09	431	VO01 - Design/Spec change: Alternative pavement structure	17-Mar-08
								VO02 - Claim: Extension of Time Claim - Labour	05-May-08
								VO03 - Additonal Work: Side Drains and Pipe Culverts at Accesses	08-Aug-08
								VO04 - Design Spec/Change: Alternative Wearing Course (40mm AC vs 18mm UTFC)	08-Aug-08
								VO05 - Additional Work: Repair of TR24/1 Bothmaskloof Pass - Bleeding	10-Dec-08
								VO06 - Additional Work: Repairing Slip at km 14,7	08-May-09
AC682: Potsdam Interchange Phase I	R 57 127 097.40	R 62 222 516.78	02-Jan-06	03-Oct-07	639	18-Oct-07	654	VO08 - Addditional Work: Additional cost due to increase in bridge Deck reinforcement quantities	25-May-07
								VO09 - Additional Work: Extending existing N7 median cable barrier	18-Oct-07
								VO10 - Claim: Extension of Time Due to Unforeseen Subsurface Conditions and Additional Permanent Works	18-Oct-07

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC708.06: Rehab N2 - Westbound Phase II	R 49 645 394.96	R 67 092 003.68	10-Jan-06	10-Jul-07	546	31-Jul-07	567	VO01 - Design/Spec Change: Replace Coarse Graded Wearing Coarse with Medium Graded	19-Dec-05
								VO02 - Design/Spec Change: Steel Connection Plates with Bolts and Nuts for Moveable Concrete Barriers	14-Feb-06
								VO03 - Other: Standing Time Costs Due to Additional Public Holiday	28-Mar-06
								VO05 - Other: Additional Time Related P&G for Extension of Time Due to Delays	19-Sep-06
								VO06 - Additional Work: Extending Southern Pier at Airport Bridge	03-Jul-06
								VO07 - Other: Additional Cost Incurred Due to Change in Diesel Price	21-Sep-06
								VO08 - Additional Work: Layerworks in Widened Eastern Approach to Kapteinsklip Bridge	11-Jan-07
								VO10 - Extra Work: Importing Pioneer Material	10-Mar-07
								VO11 - Extra Work: Lay Kerbs on Airport Approach Road	10-Mar-07
								VO12 - Claim: Health & Safety for Concrete Lined Side Drain	10-Mar-07
								VO13 - Claim: Pave SBS Wearing Course at Western End	04-May-07
								VO14 - Design Spec/Change: Revised Binder for UTFC Tack Coat	04-May-07
								VO15 - Claim: Taxi Violence on 26 October 2006 - Delay	04-May-07
								VO16 - Claim: Variation in Pavement Layers - Claim 9	13-Jun-07
								VO17 - Design Spec/Change: Change in Reflective Sheeting Specification on Road Sign Gantries	04-Jul-07
								VO18 - Design Spec/Change: Placing 40mm Popcorn (Drainage) Layer - Borcherd's Quarry Bridge Deck	04-Jul-07
								VO19 - Extra Work: Downshutes at Kapteinsklip Approach Fill	04-Jul-07
								VO20 - Additional Work: Additional Cost of Moving Temporary NJB Barriers in Two Stages	04-Jul-07
								VO21 - Additional Work: Additional Security Related Costs	13-Jun-07
								VO22 - Addditonal Work: Bonteheuwel Pedestrian Bridge	31-Jul-07
								VO23 - Extra Work: Fibre Optic Cable Repair	31-Jul-07
AC708.08: N2 Rehab km2.88-8.40 Phase IV	R 37 624 136.59	R 46 727 212.66	03-Oct-06	18-Apr-07	197	15-May-07	224	VO01 - Claim: Extension of time	15-May-07
								VO02 - Additional Work: Extent western limit of construction from km2.88 to km2.516	15-May-07
								VO03 - Omitted Work: Change eastern limit of construction	15-May-07
								VO04 - Additional Work: SBS thickness increase from 40mm to 50mm	15-May-07
								VO05 - Additional Work: Mill and fill Bhunga Road within N2 road reserve	15-May-07
								VO06 - Extra Work: Use of glass grid reinforcement at concrete joints	15-May-07
AC740: Lynedoch Intersection Improvements	R 9 345 500.00	R 11 626 601.45	28-Jan-08	29-Sep-08	245	23-Feb-09	392	VO1 - Design Spec/Change: Supply and Lay 1200mm x 600mm Culverts	15-Jun-08
								VO2 - Design Spec/Change: Construction of Manholes MH5 and MH6	15-Jun-08
								VO3 - Design Spec/Change: Rental of Land for Site Office	15-Jun-08
								VO4 - Desgin Spec/Change: Roadbed Preparation	15-Jul-08
								VO5 - Design Spec/Change: Additional Water Fittings and Pipes	15-Jul-08
								VO6 - Design Spec/Change: Road Marking Specification Revised	13-Aug-08
								VO7 - Additional Work: Encasement of Telkom Sleeves	13-Aug-08
								VO8 - Claim: Cost for Standing Time - Additional Public Holiday	13-Aug-08
								VO9 - Additional Work: Addional Work to MR25	28-Aug-08
AC749.01: Paarl - Franschhoek Reseal 14km	R 10 910 981.35	R 11 200 382.95	10-Apr-06	09-Sep-06	152	06-Dec-06	240	VO01 - Additional Work: Respraying of roadMarkings Franschhoek Pass	06-Dec-06

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC751.03: Wolseley - Mitchells Pass Resheeting TR22/1	R 30 879 946.67	R 28 825 337.59	16-Nov-06	02-May-07	167	24-May-07	189	VO01 - Design Spec/Change: Placing of 37.5mm LAMBS in patches	16-Apr-07
								VO02 - Extra Work: Shoulder Improvement	16-Apr-07
								VO03 - Extra Work: Re-galvanise inlet grids in Mitchells Pass	16-Apr-07
								VO04 - Extra Work: Re-align road over rail crossing at km23.73	16-Apr-07
								VO05 - Design Spec/Change: Tack coat for UTFC - change in bitumen grade	16-Apr-07
								VO06 - Design Spec/Change: Culvert stitching	16-Apr-07
								VO07 - Extra Work: Patches in Mitchells Pass km33-36	16-Apr-07
								VO08 - Additional Work: Maill & fill km35.6-35.9 in Ceres	16-Apr-07
AC754.01: Piketberg - Elands Bay Rehab MR531 27km	R 51 434 469.05	R 67 555 767.15	04-Oct-06	04-Jul-07	273	13-Dec-07	435	VO01 - Design Spec/Change: G4 material from commercial source for make-up layer	02-Nov-06
								VO02 - Extra Work: Removal of unsuitable clay layer	02-Nov-06
								VO03 - Additional Work: Reinstatement of trenches crossing road	28-Nov-06
								VO04 - Design Spec/Change: Extra-over 100% compaction on CIR layer	28-Nov-06
								VO05 - Design Spec/Change: Extension of time	27-Feb-07
								VO06 - Design Spec/Change: Extra work on G4 make-up layer	21-Mar-07
								VO07 - Additional Work: Armour seal to shoulders	20-Feb-07
								VO08 - Additional Work: E1 Edgings to bellmouths	11-Apr-07
								VO09 - Additional Work: Premix paving to bellmouths/ intersections	11-Apr-07
								VO10 - Additional Work: Milling to intersections	11-Apr-07
								VO11 - Additional Work: Seals using winter grade binders	17-Apr-07
								VO12 - Additional Work: Extension of time for increase in shoulder quantity	17-Apr-07
								VO13 - Additional Work: New culvert at km32	07-May-07
								VO14 - Extra Work: New irrigation pipe plus sleeve	05-Jul-07
								VO15 - Additional Work: Revised preliminary and general cost	13-Dec-07
AC772: West Coast Regravel Contract 22km	R 12 337 598.10	R 12 212 804.54	24-Nov-04	11-Jan-06	413	19-Feb-08	1182	VO04 - Additional Work: Inlet Grids	19-Feb-08
								VO05 - Other: Drain Claim	19-Feb-08
								VO06 - Other: Base Claim	19-Feb-08
AC776.01: Upgrade - Gansbaai (Bredasdorp - Elim) Phase I	R 74 561 403.51	R 96 424 629.59	09-Jan-06	08-Jan-08	729	24-Apr-08	836	VO05 - Additional Work: Presidential visit to site	16-Nov-07
AC781.01: Flood Damage in Calitzdorp and Oudtshoorn Area	R 6 386 098.43	R 7 657 922.49	18-Aug-08	18-Apr-09	243	28-May-09	283	VO01 - Omitted Work: Skew End Culvert Units	01-Sep-08
								VO02 - Design Spec/Change: Doornkloof Various Items	06-Mar-09
								VO03 - Design Spec/Change: Vleirivier Various Items	06-Mar-09
								VO04 - Design Spec/Change: St Helena Retaining Wall Various Items	06-Mar-09
								VO05 - Design Spec/Change: St Helena Causeway (Rietvlei) Various Items	06-Mar-09
								VO06 - Design Spec/Change: Waboomskraal Causeway Various Items	06-Mar-09
								VO07 - Design Spec/Change: Mount Hope Causeway Various Items	06-Mar-09
								VO08 - Claim: Claim 1 - St Helena Extension of Time	17-Apr-09
								VO09 - Claim: Claim 2 - Weather Related Delays	17-Apr-09
								VO10 - Design Spec/Change: St Helena Retaining Wall Various Items (II)	28-May-09
								VO11 - Extra Work: Doornkloof Causeway Fencing	28-May-09
								VO12 - Extra Work: Urgent Causeway Repair near Rietvlei	28-May-09
								VO13 - Claim: Claim 3 - Extension of Time with Cost (Voting Day)	28-May-09
								VO14 - Claim: Claim 4 - Survey Delay	28-May-09
								VO15 - Claim: Claim 5 - Extra Over for Concrete Ex George	28-May-09

PROJECT NAME	TENDER AMOUNT		FINAL COST		START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC781.02: Flood Damage in Oudtshoorn and De Rust Area	R	6 729 997.09	R	7 376 007.19	18-Aug-08	18-Apr-09	243	18-Apr-09	243	VO01 - Omitted Work: Skew End Culvert Units	01-Sep-08
										VO02 - Design Spec/Change: 25MPa Blinding Concrete In Lieu of 15MPa	01-Oct-08
										VO03 - Design Spec/Change: Kleinrivier Retaining Wall Design Change	22-Oct-08
										VO04 - Extra Work: Foundation Fill at Kleinrivier Causeway	20-Oct-08
										VO05 - Omitted Work: Stabilised G5 at Kammanassie Causeway	03-Nov-08
										VO06 - Extra Work: Service Duct at Drinkrivier	03-Nov-08
										VO07 - Extra Work: Kleinrivier Retaining Wall	06-Mar-09
										VO08 - Extra Work: Kleinrivier Causeway - Dowels	06-Mar-09
										VO09 - Extra Work: Kamanassie Various Items	06-Mar-09
										VO10 - Extra Work: Drinkrivier Fencing	06-Mar-09
										VO11 - Claim: Claim 1 - Extra Over for Concrete Ex George	18-Apr-09
AC781: Oudtshoorn Area Bridges Rehab	R	30 443 398.94	R	37 069 028.24	19-Sep-06	19-Sep-07	365	30-Apr-08	589	VO01 - Design Spec/Change: Revised Strategy for Surfacing Approached and Bridge Decks on Gravel Roads	02-Apr-07
										VO02 - Design Spec/Change: Additional Nosing Repairs at Bridge B4376 (Volmoed)	06-Jul-07
										VO03 - Design Spec/Change: Amendment in Neoprene Compression Joint Seal Size at Bridge B4691	06-Jul-07
										VO05 - Additional Work: Amended Extension of Time and Addition of Emergency Culvert Repairs at Culvert C11057	21-Feb-08
										VO06 - Additional Work: Additional nosing repairs at various bridges	21-Feb-08
										VO07 - Additional Work: Sand blasting of bridge parapets and sidewalks prior to painting	18-Sep-07
										VO08 - Additional Work: Amendments to bridge coatings	28-Sep-07
										VO09 - Additional Work: Additional joint repairs at scheduled rates	27-Nov-07
										VO10 - Additional Work: Additional work at bridges at daywork rates	29-Jan-08
										VO11 - Claim: Asphalt Quantity Reduction	15-Apr-08
AC784: Bain's Kloof Pass Bridges Repair	R	8 126 917.50	R	8 933 038.31	01-Oct-07	01-Aug-08	305	25-Sep-08	360	VO01 - Additional Work: Rehabilitation of Bain's Kloof Barrier Wall System (km22.6 - km30.0)	23-Apr-08
										VO02 - Additional Work: Rehabilitation of Bain's Kloof Barrier Wall System (km32.24 - km34.00)	25-Sep-08
AC785.01: Sedgefield - Karatara Repair Slip Failure DR1627	R	2 406 558.20	R	2 577 921.63	24-Oct-06	18-Feb-07	117	18-Apr-07	176	VO01 - Additional Work: Replacement of 'Armco' culvert with concrete portal culvert - MR355 (km34.47)	09-Feb-07
										VO02 - Additional Work: Installation of guardrail	03-Mar-07
AC785: Huis River Pass Repair of Slopes	R	12 231 174.60	R	23 676 213.93	27-Aug-07	20-Mar-08	206	08-Aug-08	347	VO01 - Design Spec/Change: Revised temp rockfall protection barrier details	12-Oct-07
										VO02 - Extra Work: Pressure grout to rockbolts	09-Nov-07
										VO03 - Extra Work: Additional work resulting from storm damage	10-Mar-08
										VO04 - Extra Work: Extention of Time Due to Additional Work After VO3	18-Jun-08
AC789: Greyton - Genadendal Surfacing DR1298	R	12 280 327.00	R	15 430 015.25	21-Aug-06	21-Aug-07	365	04-Sep-09	1110	VO01 - Additional Work: Reinstate flood damaged section	18-Oct-06
										VO02 - Design/Spec Change: Use of MC10 (CB10) vs MSP1	25-May-07
										VO03 - Extra Work: Improvements to sidewalk between SV860 & SV1260	04-Sep-07
										VO04 - Additional Work: Flood Damage	25-Jan-08
										VO05 - Extra Work: Flood Damage	27-Mar-09
AC791: Overberg Flood Damage	R	7 907 877.01	R	8 049 120.60	20-Feb-07	19-Oct-07	241	19-Feb-08	364	VO01 - Extra Work: Installation of subsoil drains	27-Aug-07
										VO02 - Extra Work: Re-alignment of existing 160dia. uPVC Watermain	03-Sep-07
										VO03 - Additional Work: Additional Work at Culverts	19-Feb-08
										VO04 - Extra Work: Extra Work at Culverts	19-Feb-08
AC800: Beaufort West Reseal TR35/1 35km	R	18 208 615.00	R	23 323 115.32	13-Nov-06	12-May-07	180	30-Nov-07	382	VO01 - Additional Work: Reseal km51 - km58	13-Apr-07

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC802.01: St Helena Bay Rehab MR533 and TR77/1 9km	R 22 391 781.75	R 28 513 615.54	15-Jan-07	15-Dec-07	334	07-Mar-08	417	VO01 - Additional Work: Extention of Time Claim	01-May-07
								VO02 - Additional Work: Increasing Depth of Cut-off Drain on Western Side of MR533	01-May-07
								VO03 - Design Spec/Change: Increase in thickness of the crushed stone base layer	01-May-07
								VO04 - Additional Work: Asphalting of Laingeville Intersection on MR533 and TR77 Velddrif Intersections	01-May-07
								VO05 - Additional Work: Installation of a 110mm Diameter uPVC Duct	01-May-07
								VO06 - New Rate: Increase in RoadMarking Rates	01-May-07
								VO07 - Additional Work: Extension of Time	01-May-07
								VO08 - Additional Work: Storm Damage Repairs at Headwalls on MR533	01-May-07
								VO09 - Additional Work: Extension of Time for Abnormal Rainfall During Contract Period	01-May-07
								VO10 - Additional Work: Extension of Time for Abnormal Rainfall During Contract Period	01-May-07
AC804: Vredendal Area Reseal 73km	R 29 184 261.48	R 31 854 732.74	01-Nov-06	01-Feb-08	457	13-Feb-08	469	VO01 - Design Spec/Change: Grit seal and Ralumac	26-Feb-07
								VO02 - Extra Work: Upgrade of DR2216 - Ebenhaezer	06-Jun-07
								VO03 - Extra Work: 9mm Seal on MR547	10-Jul-07
								VO04 - Extra Work: Repair flood damaged catchpit, additional signage and repair of rail crossings	14-Oct-07
								VO05 - Claim: Standing time due to delays at borrowpit	14-Oct-07
								VO06 - Extra Work: 13mm Seal to arrest and prevent further bleeding	14-Oct-07
AC805: Elands Bay Area Reseal 95km	R 38 448 530.00	R 57 188 724.97	03-Oct-06	02-Jun-08	608	27-May-08	602	VO01 - Design/Spec Change: Supply of material for shoulders and subbase of MR535	20-Nov-06
								VO02 - Design/Spec Change: Micropave in lieu of ultra thin friction layer	06-Feb-07
								VO03 - Design Spec/Change: Provide asphalt wearing course at high stress areas	06-Feb-07
								VO04 - Design Spec/Change: Change double seal to single seal	06-Feb-07
								VO05 - Design Spec/Change: Additional 9km of seal work for MR535	06-Feb-07
								VO06 - Design Spec/Change: Additional 4.5km of MR538 to be upgraded to surfaced standard	06-Feb-07
								VO07 - Additional Work: Relocate existing watermain at MR538 Borrowpit (Maans Visser)	15-Mar-07
								VO08 - Design Spec/Change: Replace asphalt surfacing to sidewalks with concrete block paving	17-Jul-07
								VO09 - Design Spec/Change: Yellow edge lines along both sides of all re-sealed roads	17-Jul-07
								VO10 - Design Spec/Change: Hand applied slurry at agricultural entrances on single seals	31-Jul-07
								VO11 - Design Spec/Change: Pre-coating required for single seal	05-Nov-07
AC806: Oudsthoorn - Mossel Bay Reseal TR33/2 26km	R 20 772 398.02	R 19 122 756.26	12-Oct-06	08-May-07	208	13-Jul-07	274	VO01 - Claim: Extention of time related to commencement of contract	28-Mar-07
								VO02 - Claim: Additional Temporary Road Signs	28-Mar-07
								VO03 - Extra Work: Stormwater repair of flood damage at km37.8	25-Jun-07
								VO04 - Extra Work: Slope stabilisation LHS km37.2	25-Jun-07
AC808: Barrydale Reseal TR31/4 45km	R 20 495 753.85	R 21 423 753.93	11-Sep-06	11-Sep-07	365	28-Nov-07	443	VO01 - Additional Work: Repair and protection of culverts	25-Aug-07
								VO02 - Additional Work: Installation of new signage and road studs	25-Aug-07

PROJECT NAME	TENDER AMOUNT		FINAL COST		START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC810: Bottelary Rehab MR187 and MR189 12km	R	59 061 580.15	R	50 848 979.50	20-Nov-06	21-Jul-07	243	30-Nov-07	375	VO01 - Additional Work: Road Construction Warning Signs	05-Mar-07
										VO02 - Extra Work: Broken Culvert at km8.15	22-Mar-07
										VO03 - Extra Work: Installation of 300mm sleeve for irrigation pipe at km8.15	18-Apr-07
										VO04 - Extra Work: Tie in of existing accesses with new road levels	25-Aug-07
										VO05 - Design Spec/Change: Surfacing of major intersections	25-Aug-07
										VO06 - Omitted Work: Extension of existing box culvert at Claybrick entrance	25-Aug-07
										VO07 - Design Spec/Change: Delineators	06-Nov-07
										VO08 - Additional Work: Extension of time for culvert & outlet structures	06-Nov-07
										VO09 - Additional Work: Extension of time to repair flood damge	06-Nov-07
										VO10 - Additional Work: Extension of time for finishing of road & road reserve	06-Nov-07
AC812: Firgrove Rehab TR2/1 20km	R	26 490 089.82	R	26 838 939.02	23-Oct-06	23-Jun-07	243	13-Jul-07	263	VO01 - Design Spec/Change: Density increase 100% to 102% MOD AASHTO	15-Jun-07
										VO02 - Claim: Extension of time due to additional testing	25-Jun-07
										VO03 - Design Spec/Change: Bi-directional road studs	25-Jun-07
AC813: Helshoogte Pass Reseal MR172 8km	R	17 404 374.00	R	17 748 969.94	17-Oct-06	07-May-07	202	15-May-07	210	VO01 - Omitted Work: Installation of Zubree Rings at Telkom manholes	28-Feb-07
										VO02 - Additional Work: Reclearing/Recleaning of drains & slopes	15-May-07
AC822.01: Grootbrak Slope Failure	R	3 589 508.55	R	4 465 274.18	15-Aug-08	06-Feb-09	175	06-Mar-09	203	VO01 - Design Spec/Change: Revised Piling Detail and Installation of Soil Nails	07-Oct-08
										VO02 - Design Spec/Change: Extension of Time and Revised Socket Detail	02-Dec-08
										VO03 - Design Spec/Change: Reduced Rate for Piling and New Rates for Gabions and Guardrails	04-Feb-09
										VO04 - Extra Work: Treatment of Shrinkage Cracks in Wall and Balustrade	06-Mar-09
AC842: Upgrade Roads - Pakhuis Pass Area	R	54 571 929.85	R	56 632 656.71	12-Jan-09	11-Feb-10	395	26-Apr-10	469	VO01 - Claim: Election day (22/04/2009)	14-Jul-09
										VO02 - Additional Work: Additional Sealwork	24-Nov-09
										VO03 - Additional Work: Repair Pavement Failures on Existing MR542 and DR2189	24-Nov-09
										VO04 - Claim: Bitumen Supply Shortage	24-Nov-09
										VO05 - Claim: Weather Related Extension of Time	10-Mar-10
										VO06 - Additional Work: Additional Sealwork	10-Mar-10
AC844: Ceres - Karoo Regravel 93km	R	16 035 885.16	R	21 218 705.75	10-Apr-07	09-Apr-08	365	24-Nov-08	594	VO01 - Additional Work: MR319 Regravel km100-km107	22-Jun-07
										VO02 - Additional Work: Bridge Rehabilitation on C844	28-Jan-08
										VO03 - Extra Work: Supply and Installation of Road Signs	09-Nov-07
										VO04 - Extra Work: Realignment of a Section of Road on MR316	11-Apr-08
										VO05 - Additional Work: Construction of Concrete Edge Beams at gravel Drifts - Option 1	22-Jul-08
AC864.01: Flood Damage Doorn River Bridge and Buffeljags Causeway	R	4 656 157.99	R	5 941 714.07	04-Sep-07	04-Apr-08	213	15-May-08	254	VO03 - Claim: Flooding 21 December 2007 - Extension of Time Claim	28-Jan-08
										VO04 - Extra Work: Buffeljags Approach Slabs and Cut-off Walls	07-Mar-08
AC865.02: Flood Damage to Structures in Hessequa LM Area	R	7 524 645.16	R	9 106 703.10	05-May-08	08-Dec-08	217	17-Apr-09	347	VO01 - Additional Work: Required at Duivenhoks Causeway No 10920 on Dr1328	05-May-08
AC866.01: Flood Damage to structures in Prince Albert District	R	12 978 793.85	R	14 844 486.23	21-Aug-07	20-Aug-08	365	25-Aug-08	370	VO01 - Design Spec/Change: Change in Scope of Works at Kouka Causeway at km30.04 and at km25.81	04-Mar-08
AC880.03: Koeberg Interchange Relocation of Services	R	1 719 868.70	R	2 129 300.54	26-Feb-08	07-Jun-08	102	28-Nov-08	276	VO01 - Design Spec/Change: Connection of New Rising Main into Existing	16-Apr-08
										VO02 - Claim: Security on Public Holidays	29-Jul-08
										VO05 - Claim: Adjustment of Time Related Items for Extension of Time	29-Jul-08
										VO05 - Extra Work: Additional Work for Telkom Manholes	04-Nov-08
AC882.01: Klapmuts Sidewalks	R	2 429 115.00	R	2 919 179.75	12-May-08	20-Nov-08	192	28-Nov-08	200	VO01 - Claim: Extension of Time for Abnormal Rainfall for Duration of Contract	20-Nov-08
										VO02 - Claim: Contract Price Adjustment - Extension of Tender Validity to 18 Weeks (126 days)	20-Nov-08
AC882.02: Bella Vista, Ceres Sidewalks	R	2 060 861.00	R	2 525 805.89	21-Jul-08	13-Jan-09	176	16-Apr-09	269	VO01 - Claim: Contract Price Adjustment - Extension of Tender Validity to 18 Weeks (126 days)	25-Nov-08

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
AC882.02: Bella Vista, Ceres Sidewalks	2060861	2525805.89	39650	39826	176	39919	269	VO02 - Claim: Extension of Time for Abnormal Rainfall for September 2008	20-Nov-08
								VO03 - Claim: Extension of Time for Abnormal Rainfall for September 2008	25-Nov-08
AC883.05: Gegund, Vredendal Upgrade of Access Rd & Sidewalks	R 5 166 258.13	R 4 819 366.42	10-Sep-08	31-Mar-09	202	08-Jul-09	301	VO01 - Design Spec/Change: Use Standard Drawings as Adopted by Stellenbosch Municipality	27-Oct-08
								VO02 - Omitted Work: Modification of Stormwater Clashes and Sormwater Outlet	27-Oct-08
								VO03 - Omitted Work: Convert Existing Stormwater Manholes into Catchpits	21-Nov-08
								VO04 - Design/Spec Change: Construct Additional Catchpit and Stormwater Pipe	21-Nov-08
								VO05 - Omitted Work: Modification of Waterclash Due to Clash With Proposed Stormwater Line	27-Nov-08
AC884.01: Ladysmith CBD and Nissanville Sidewalks	R 2 096 909.10	R 2 096 597.73	02-Jun-08	02-Dec-08	183	12-Dec-08	193	VO01 - Design Spec/Change: Re-align Existing Road with Barrier Kerbs and Channels	03-Sep-08
								VO02 - Additional Work: Installation of Ducts; Construction of Stormwater Catchpits and Adjust Level of Existing Manholes	07-Oct-08
								VO03 - Additional Work: Installation of Terraforce Structure Along Sidewalk & Construction of Stairs	04-Nov-08
AC896.02: De Nova, Kraaifontein Sidewalks	R 3 096 581.00	R 3 091 262.78	09-Jun-08	09-Dec-08	183	17-Apr-09	312	VO02 - Design Spec/Change: Omission of Section of LHS and RHS Sidewalk	25-Jul-08
								VO03 - Additional Work: Grass Cutting	25-Jul-08
								VO04 - Additional Work: Stormwater Pipe Crossing	09-Sep-08
AC905: Reseal TR77/1 Cape Town - Velddrif	R 26 839 425.45	R 24 394 635.29	19-Jan-09	18-Aug-09	211	13-Mar-10	418	VO01 - Design Spec/Change: Alternative Patching Method - Mill & Fill, Geotextile Membrane	12-Feb-09
								VO02 - Design Spec/Change: Reduced General Obligations During Seal Embargo; Rates for Roving Flagmen	17-Apr-09
								VO04 - Claim: Extension of Time Claim for Bitumen Shortage (Sep,Oct & Nov 2009)	13-Mar-10
C0634: Rehab TR22/1 & Reconstruct MR305 - Nuwekloof/Wolseley	R 179 457 861.25	R 200 115 477.30	01-Mar-11	14-Feb-13	716	31-May-13	822	VO01 - Design Spec/Change: Traffic deviation surfacing seal upgrade	21-Apr-11
								VO02 - Claim: Public Holiday 18 May 2011	03-Jun-11
								VO03 - Design Spec/Change: Fill construction - additional compaction	14-Jun-11
								VO04 - Design Spec/Change: Commercial sand for backfill at pipe culverts	11-Apr-12
								VO05 - Omitted Work: Drainage at StructuresL Pay item 1.03 not scheduled	07-May-12
								VO06 - Design Spec/Change: Shoring at culverts C11707 7 C11708	07-May-12
								VO07 - Omitted Work: Vertical formwork to cas in situ S/W channels - Wolseley	12-Nov-12
								VO09 - Claim: Extention of time - farm worker's unrest	11-Mar-13
								VO10 - Extra Work: Replace Transverse Handrails at B4084	15-Apr-13
								VO11 - Extra Work: Deflection kerbs in Wolseley	15-Apr-13

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
C0747.02: Rehab MR302 and MR201 - Worcester/Bainskloof	R 205 671 632.64	R 237 775 246.44	12-Sep-11	12-Jun-14	1004	10-Mar-15	1275	VO01 - Extra Work: New Rates	25-Jul-12
								VO02 - Additional Work: Reseal of MR302 km 0.0 and km 1.5 and repairs to Bridge B3071	24-Oct-12
								VO03 - Additional Work: Supply and install temporary Variable Message Sign	15-Jan-13
								VO04 - Additional Work: Additional Structural Works Items	10-Apr-13
								VO05 - Additional Work: Temporary Sidewalk for Pedestrians	16-Apr-14
								VO06 - Claim: Industrial Strike Action by the National Union of Mineworkers	12-Jun-14
								VO07 - Additional Work: Asphalt Road Repairs at Existing Bergsit T-Intersection (MR201), LOC Rail Bridge Ceres Ramp and Emergency Repair Work (Previously included in VO2)	17-Jul-14
								VO08 - Claim: Claim for extension of time due to the Declaration of a Public Holiday for the Voting Day on 7 May 2014	17-Jul-14
								VO09 - Additional Work: Rehabilitation MR 302 Km 28.94 to Km 29.49	17-Jul-14
								VO10 - Additional Work: Upgrade Bergsig Access Road	15-Sep-14
								VO11 - Additional Work: New Rates	10-Nov-14
								VO12 - Additional Work: New rates	20-Jan-15
C0820.01: Rehabilitation of steel bridge B3057 (ROOIBRUG) on MR 289 at km 0.35 over the Breede River near Bonnievale	R 6 634 705.83	R 7 454 790.56	13-May-14	13-Oct-14	153	27-Oct-14	167	VO01 - Additional Work: Additional Traffic Accommodation	23-Jul-14
								VO02 - Design Spec/Change: Construction of Bridge Expansion Joints	28-Aug-14
								VO03 -Extra Work: Repairs to Bridge Joints	15-Sep-14
									13-Oct-14
								VO05 -Additional Work: Repairs to existing abutments and parapet walls	15-Oct-14
C0822.04: Flood Damage Repairs on DR1578 near Botlierskop (South) between km 5 - km 7	R 8 498 807.00	R 9 372 780.00	07-Feb-14	14-Jul-14	157	12-Sep-14	217	VO02 - Claim: Extension of time due to voting day 7 May 2014	15-Jul-14
								VO03 - Claim: Extension of time due to gabion quantities	25-Aug-14
								VO04 - Additional Work: Various new rates (Guardrails and Landscaping)	25-Aug-14
	R 8 498 807.00	R 9 372 780.00	07-Feb-14	14-Jul-14	157	12-Sep-14	217	VO01 - Claim: Extension of time due to abnormal climatic conditions during April & May 2014	15-Jul-14
C0824: Rehab MR166 - Winery Road	R 34 510 936.44	R 33 852 663.27	14-Nov-11	14-May-13	547	01-Sep-14	1022	VO01 - Additional Work: Lease of land for temporary labour	18-Apr-12
								VO02 - Additional Work: Lease of land for temporary labour	18-Apr-12
								VO03 - Additional Work: Rockfill at temporary culvert and new bridge	21-Apr-13
								VO04 - Extra Work: Upgrading the drainage capacity of Culvert No. 11906 on DR1039	16-Apr-13
								VO05 - Claim: Amicable settlement claim no. 3 for delay in the progress of works at MR166 SV 0+220 to SV 0+720	29-Jul-13
								VO06 - Omitted Work: Installing concrete lined side drains, including subsoils drains, on MR166	16-Aug-13
								VO07 - Design Spec/Change: Remove the existing surfacing on MR165 and replace with A-E2 Modified asphalt between TR2/1 (km 0.2) and MR166 (0.91)	07-Feb-14
								VO08 - Design Spec/Change: Amended intersection design (MR27/MR166 Intersection)	07-Feb-14
								VO09 - Claim: Claim No. 7 Strike Action 26 August 2013 to 16 September 2013	07-Mar-14
C0834.03: Upgrade DR2222 km 0-0.9 - Lutzville Area using Labour Intensive Methods	R 7 361 822.36	R 8 034 512.35	05-Nov-13	21-Apr-14	167	12-Sep-14	311	VO01 - Design Spec/Change: Cape Seal Surface	11-Jun-14
								VO03 - Claim: Additional work	27-Jun-14

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
C0841.02: Regravel Roads in the Overberg Area - Phase 2	R 38 428 377.07	R 42 093 437.02	15-Jan-13	14-Jan-14	364	22-Aug-14	584	VO01 - Claim: Extension of time due to inadequate quantity and quality of material in borrow pit DR1265/14.78/L/100	23-Oct-13
								VO02 - Claim: Extension of time due to Strike in the Civil Engineering Industry	23-Oct-13
								VO03 - Claim: Extension of time due to inclement weather	24-Mar-14
								VO04 - Extra Work: Excavation of hard material at borrow pit DR1278/1.4/R/0	03-Jun-14
								VO05 - Additional Work: Additional Regravelling DR1259 km 12 to km 18	27-Jun-14
C0843.01: Regravel Roads - Graafwater Area	R 29 295 693.78	R 38 526 174.70	26-Jun-13	26-May-14	334	04-Aug-14	404	VO01 - Design/Spec Change: Scope change and additional work on contract C843.01	30-May-14
								VO02 - Claim: Contractors claim for non-scheduled public holiday	30-May-14
C0910: Reseal MR189 - Paarl/Klapmuts & MR201 - Paarl/Franschhoek	R 55 605 640.00	R 72 729 085.28	11-Oct-10	20-Mar-12	526	22-Apr-13	924	VO01 - Additional Work: Construction of Traffic by-pass on MR201	11-Apr-11
								VO02 - Additional Work: MR201-Removal, storage and re-instatement of single railway track by nominated subcontractor	13-Apr-11
								VO03 - Additional Work: Claim 1 MR189 & 201 Extension of time for completion and associated payment due to instruction to complete emergency maintenance base repairs on MR201	21-Jul-11
								VO04 - Claim: Public Holiday 18 May 2011	22-Jul-11
								VO05 - Design Spec/Change: Amendment to Scope of Works MR189 km16.6 to km21.4. Alternative rehabilitation strategy	25-Jul-11
								VO06 - Extra Work: Pruning of Trees - Tree Line along MR189	14-Feb-12
								VO07 - Additional Work: Shoulder strengthening (MR201)	21-Feb-12
								VO08 - Additional Work: Compensation (time related) following site instruction to undertake remedial works on tomporary should widening - MR189	14-Mar-12
								VO09 - Additional Work: Capacity improvements and signalisation of the intersection of MR189/MR27 in the Klapmuts area	15-Mar-12
								VO10 - Claim: Public Holiday 27 December 2012 - Claim no 9	27-Mar-12
								VO11 - Additional Work: MR201 - Wemmershoek River Bridge	30-May-12
								VO12 - Extra Work: Extension of limit of construction MR189 Section 4 - CIR(Emulsion)	30-May-12
								VO13 - Additional Work: MR189 Dual Carriagewway - Erection of new median cable barrier	25-Apr-12
								VO14 - Additional Work: MR189 Intersection MR27, Klapmuts - Supply, installation and commissioning of streetlighting installation at intersection	22-Oct-12
								VO15 - Additional Work: MR189 & MR201: Grass Cutting/Mowing road reserve	22-Oct-12
								VO16 - Claim: Settlement of Contractor's Final Completion Statement	22-Apr-13
								VO17 - Extra Work: MR189 & MR201 Road Markings - Hot-melt plastic material	22-Apr-13
								VO18 - Extra Work: MR189 & MR201 Road Markings - Additional Works	22-Apr-13
C0915: Rehab MR282 Stormsvlei - Bonnievale	R 57 319 840.92	R 76 019 397.11	12-Aug-13	11-Nov-14	456	28-Feb-15	565	VO01 - Extra Work: Emerging Contractor Development	29-Aug-14
								VO02 - Claim: Voting day - 7 May 2014	29-Aug-14
								VO03 - Additional Work: Repair of Geotechnical slip in Trappieshoogte	30-Sep-14
C0916: Rehab MR234 - Hopefield/Velddrift km 0.0 - km 17.8	R 51 350 838.20	R 61 249 300.76	05-Jul-13	06-Oct-14	458	03-Nov-14	486	VO01 - Extra Work: Provision of Facilities for Site Laboratory	03-Sep-13
								VO02 - Extra Work: New Rates for Omitted and Extra Work as well as work for which the specifications were amended	29-May-14

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
C0919: Rehab MR177 - Blackheath/Stellenbosch	R 76 961 702.49	R 83 177 060.23	25-Jun-13	24-Sep-14	456	12-Dec-14	535	VO01 - Design Spec/Change: Concrete Berm MK10	08-Oct-13
								VO02 - Claim: Extension of Time due to Nationwide Industrial Strike Action	05-Dec-13
								VO03 - Claim: Change from 50/70 binder to A-E2 binder in asphalt surfacing	17-Dec-13
								VO04 - Additional Work: Construction of Additional Layer Works in Vlaeberg Road	11-Apr-14
								VO05 - Claim: Voting Day	06-Aug-14
								VO06 - Additional Work: Grass Cutting	21-Nov-14
								VO07 - Additional Work: Remove and Replace Guardails During Construction of Layerworks	21-Nov-14
								VO08 - Extral Work: Provision of Security at Camp Site	12-Dec-14
								VO09 - Claim: Extension of time resulting from abnormal rainfall	12-Dec-14
								VO10 - Additional Work: Directional Drilling	12-Dec-14
								VO11 - Additional Work: Rock Grid	12-Dec-14
								VO12 - Additional Work: Pioneer Layer	12-Dec-14
								VO13 - Design Spec/Change: Polymer Balustrade	12-Dec-14
C0958.01: Flood Damage Repairs in the Riversdale Region	R 12 370 660.99	R 17 264 035.51	18-Jun-13	04-Jul-14	381	20-Aug-14	428	VO01 - Additional Work: EOT for foundation excavations and filling	10-Oct-13
								VO02 - Claim: Extension of time for flooding of 8 August 2013	30-Oct-13
								VO03 - Claim: Extension of time for extended flooding at R1A Novo A following flood of 8 August 2013.	30-Oct-13
								VO04 - Extra Work: Roadslabs at Kuils River Causeway	13-Feb-14
								VO05 - Extra Work: EOT for flooding in Oct - Nov 2013	19-Feb-14
								VO06 - Extra Work: EOT for flooding in January 2014	19-Feb-14
								VO07 - Extra Work: Repair Causeway Road Slabs on Divisional Road 1316 at km 43.1 (van Deventer)	26-Mar-14
								VO08 - Extra Work: Repair Apron Slabs on Divisional Road 1577 at km 8.52 (Kruis River A)	29-Apr-14
								VO09 - Extra Work: EOT for General Elections	10-Jun-14
C0961.02: Flood Damage Repairs to Structures in Eden Region: Hartenbos Area	R 10 277 326.44	R 13 271 883.96	22-May-13	21-May-14	364	25-Sep-14	491	VO01 - Claim: Extension of time and time related costs for flood damage delays at Structure No. C11839 (M7)	13-Nov-13
								VO02 : Additional Work: Repairs to Culvert 11842 (M10) on Minor Road 6820 at km 0.98 over the Ruiterbos River	13-Jan-14
								VO04 - Additional Work: Emergency Repairs due to Flood Damage at Structure M7 on divisional road 1586 at km 15.5 over the Palmiet River	13-Mar-14
C0983: Reseal TR03106 between Calitzdorp & Oudtshoorn	R 26 676 697.32	R 32 279 594.85	04-Jun-13	04-Feb-14	245	16-Apr-14	316	VO01 - Additional Work: Extra over for Acceleration of Item 34.04 (j) (i)	28-Oct-13
								VO02 - Additional Work: Remedial work at Km22.7 - Pavement Failure	23-Jan-14
								VO06 - Additional Work: The Repair of flood damage to Touw River Bridge	24-Feb-14
C0985: Reseal TR07701 between Langebaan & Velddrif	R 45 123 726.03	R 44 823 396.29	24-Jun-13	10-Feb-14	231	13-Jun-14	354	VO03 - Design Spec/Change: Submission of new rate for BTB required at intersections	04-Oct-13
								VO04 - Claim: Extension of time due to industrial strike action	29-Oct-13
								VO05 - Claim: Extension of time due to increased Scope of Work as approved in Variation Order 2	29-Oct-13
C0986: Reseal sections of TR02701 from i/s with TR02801 to Rooi Els	R 34 613 397.13	R 37 304 312.71	14-Oct-13	31-May-14	229	18-Jun-14	247	VO01 - Extra Work: Extra work at widenings	21-Jan-14
								VO02 - Extra Work: Asphalt surfacing at Arabella Intersection	18-Feb-14
								VO03 - Design Spec/Change: Asphalt Surfacing	20-Mar-14
								VO04 - Cliam: Claim for extension of time	20-May-14

PROJECT NAME	TENDER AMOUNT	FINAL COST	START DATE	INITIAL COMPLETION DATE	INITIAL DURATION	ACTUAL COMPLETION DATE	FINAL DURATION	VO NUMBER	VO DATE
C0987: Reseal TR03201 between Ashton and Swellendam & MR00283 access road into Swellendam	R 32 823 763.95	R 53 306 079.79	16-Sep-13	21-Apr-14	217	15-Sep-14	364	VO01 - Additional Work: Reconstruction of the portion of road between Km 35,000 and Km 37,500	31-Jan-14
								VO02 - Additional Work: Backfill underneath concrete lined side drains	11-Jul-14
								VO03 - Additional Work: Construction of Stormwater pipes under seven farm accesses	11-Aug-14
								VO05 - Claim: Claim for Extension of Time due to Voting Day	15-Sep-14
								VO06 - Design/Spec Change: Thermo Plastic RoadMarking	15-Sep-14
								VO07 - Claim: Extension of Time due to Inclement Weather and Weather Affected Delays	15-Sep-14
C0990: Resurfacing TR08101 (R300) between Vanguard Dr & Swartklip Interchange	R 36 454 545.45	R 36 770 123.83	17-Jul-13	26-Jan-14	193	05-May-14	292	VO01 - Extra Work: Increase in patching quantity	21-Oct-13
								VO02 - Extra Work: Removing guardrails and clearing vegetation from road edge	22-Oct-13
								VO03 - Design Spec/Change: Amended scope of work to bridges	29-Oct-13
								VO04 - Claim: Approved Claims	20-Jan-14
								VO06 - Extra Work: Approved Claims	29-Apr-14
								VO07 - Claim: Inclement Weather Days	16-Apr-14
								VO08 - Extra Work: Approved Claims	29-Apr-14
C0994: Reseal TR02501 between Paarl and Malmesbury & MR00027 between Klapmuts and Windmeul	R 36 693 779.91	R 41 032 054.26	20-May-13	19-Feb-14	275	30-May-14	375	VO01 - Extra Work: Klapmuts Intersection to SANRAL boundry	30-Oct-13
								VO02 - Additional Work: Windmeul Reseal	30-Oct-13
								VO03 - Additional Work: Reseal on TR 25 up to MR27/TR25 intersection	30-Oct-13
								VO04 - Extra Work: Reconstruction Sections	25-Oct-13
								VO05 - Extra Work: Bridge overlay on TR25, bridge joints and maintenance	25-Oct-13
								VO06 - Design Spec/Change: Cape Seal on accesses (13mm)	30-Oct-13
								VO07 - Additional Work: Sub-surface drainage crossings	28-Nov-13
								VO08 - Omitted Work: Removal of Roadstuds	19-Mar-14
								VO09 - Additional Work: Grass Cutting	19-Mar-14
								VO10 - Additional Work: Asphalt Overlay on MR27 & TR25 Intersection	27-Mar-14
C1002: Rehab DR02151 Camp Road in Saldanha Bay	R 27 891 422.15	R 30 750 007.99	17-Jan-14	17-Sep-14	243	19-Nov-14	306	VO01 - Additional Work: Relocation of Saldanha Bay Municipality 200mm AC water main adjacent to Camp Street (DR2151)	12-Mar-14
								VO02 - Additional Work: Drainage, shoring and dealing with water during Construction of the Bok River Culvert	12-Mar-14
								VO03 - Claim: Election day costs 7 May 2014	24-Mar-14
								VO04 - Design Spec/Change: Type 14A Channel: 600mm diameter Class 100D storm water pipes, Geojute for erosion control	01-Sep-14
								VO05 - Extra Work: Time Related & Other Costs for Extension of Time for Neotel and SBM Electrical Sleeve Delays	23-Oct-14
C1045: Reseal of MR177 from km 8.17 - 16.52 and MR133 from km 8.76 - 10.03	R 58 826 793.24	R 59 892 594.89	17-Jan-14	17-Aug-14	212	10-Nov-14	297	VO01 - Design Spec/Change: 3D Scan Survey required as input to design (Geometric Design) tie-ins details with regards to secondary roads at the intersections	26-Feb-14
								VO02 - Intersections Only During Night Time: Change binder type from A-R1 Bitument Rubber and 50/70 Penetration Grade Bitument to A-E2 Polymer Modified binder with reference to the 40mm Asphalt Overlay, Base and Surface Patching respectively	26-Feb-14
								VO03 - Design Spec/Change: Sealing cracks in the existing asphalt surfacing with 400mm wide Geotextile Strips (Sealgrid)	26-Feb-14
								VO04 - Design Spec/Change: Switching of bitumen rubber paving from day shift to night shift	28-Feb-14
								VO05 - Design Spec/Change: Fitting of 3D Milling Depth Control Instrucment to 2 meter Milling Machine	19-May-14
								VO06 - Design Spec/Change: Removal, relocation and reinstatement of existing traffic monitoring stations and vehicle detector loops at all relevant intersections on MR177	19-May-14

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C1049.01: Reseal of MR174 km 47.21 - km 58.49	R 23 695 374.80	R 26 053 213.68	22-Jan-14	23-Jun-14	152	31-Jul-14	190	VO01 - Extra Work: UTFC overlay of Helshoogte road	19-Feb-14
								VO02 - Extra Work: Sandringham Road over Rail bridge repair works	19-Feb-14
								VO03 - Extra Work: MR174 Shoulder Repair & Realignment of Guardrails	09-May-14
C1054.01: Flood damage repairs and installation of landslide mitigation measures on Franschoek Pass - CW/Stellenbosch (SMEC)	R 19 843 886.52	R 21 776 769.98	04-Mar-14	01-Jul-14	119	06-Feb-15	339	VO01 - Additional Work: Flagmen Training	21-May-14
								VO02 - Design Spec/Change: Slope Stabilisations	30-Jun-14
								VO03 (Revised) - Design Spec/Change: Slope stabilisation - Cutting km 28.4	04-Dec-14
								VO04 - Additional Work: Additional payment items unforseen at tender stage	02-Dec-14
								VO05 - Claim: Extension of time due to rain delays	02-Dec-14
								VO06 - Design Spec/Change: Asphalt Surfacing Repairs	06-Feb-15
								VO07 - Extra Work: Additional Masonry Stone Walls	06-Feb-15
								VO08 - Extra Work: Road Marking	06-Feb-15