RESEARCH REPORT:

The degree of project manager's project system compliance and project performance in Eskom distribution asset creation project execution department in the Limpopo Operating Unit

By:

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[redacted]

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DECLARATION

I Maggy Baloyi student number 201533155 declare that the in terms of the University Of Limpopo student regulations that this mini dissertation is my own research and that the opinions contained herein are my own and not necessarily those of Eskom Holding.

All assistance received from other individuals and organizations has been acknowledged and full reference is made to all published and unpublished sources used. This thesis has not been submitted previously for a degree at any Institution.

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Signature Date

ABSTRACT

Project systems allow project managers to carry out work in a professional and well organised manner. These systems are created and maintained to advance project performance. Eskom spends a lot of resources on the creation and maintenance of project systems. The literature on project systems shows that, in spite of advancement in project managements processes, systems and tools, project success has not significantly improved. This problem raises questions about the value and effectiveness of project systems. Therefore this paper reports about the correlation between the degree of project manager's compliance to project systems and project performance in Eskom Distribution Limpopo Operating Unit.

The study looked at the performance of 10 projects and used empirical data on designers, planners, managers and project managers working in Eskom Distribution LOU to measure the compliance level of employees to project systems when carrying out the 10 chosen projects or any other projects not listed.

A total of 45 completed questionnaires were analysed. Correlation analysis tests found a negative correlation between project manager's project systems compliance level and project performance in terms of schedule and cost. The conclusion found was that as the compliance level on project systems increases, project performance decreases. Meaning there is an inversely proportional relationship between project system compliance level and project performance.

Additionally, a lower level of knowledge than expected on the project managers, designers, and planners was found.

Keywords: Project performance, Project systems, Correlation, Adherence,

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TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ACRONYMS

ACNAC	Acquire Customer and Network Asset Creation Workflow Tool
BPO	Business Process Overview
CI	Cost Index
CRA	Concept Release Approval
DRA	Definition Release Approval
DC	Direct Customer
DPA	Development Plan Approval
ERA	Execution Release Approval
EA	Environmental Assessment
EMP	Environmental Management Plan
EIA	Environmental Impact Assessment
EFQM	European Foundation of Quality Management's Business Excellence Model
FRA	Finalization Release Approval
HOA	Hand Over Approval
IC	Investment Committee
ISO	International Standards Organization
IDC	Interests During Construction
KPI	Key Performance Indicators
LLTM	Long Lead Time Material
MEW	Major Engineering Works
NSM	Network Service Manager
LOU	Limpopo Operating Unit
NACVC	Network Asset Creation Value Chain
NDP	Network Development Plan
OU	Operating Unit

SOC	Self-Organized Critically
SHEQ	Safety Health Environment and Quality
SI	Schedule Index
TEF	Technical Evaluation Forum
TQM	Total Quality Management
PRF	Planning Review Forum
PM	Project Manager
PMP	Project management Performance Model
RPM	Resource Planning Meeting

1. CHAPTER 1: INTRODUCTION AND BACKGROUND

Since the turn of the century, companies are developing a growing interest in improving the efficiency and quality of their internal business processes and standards. A business process is a set of structured and hierarchical activities designed for reaching business goals (Radgui, 2012). Business processes are mainly used to improve the productivity of the company. On the other hand standards are increasingly regarded as an important building block in modern organisations. They are expected to help harmonise divergent terminology and different understanding about processes and methods (Ahlemann, 2008).

The success and failure of a project manager is determined by whether the deliverable was realised within time, cost and quality constraints (PMBOK, 2008). Project management principles Eskom are in line with the Project Management Body of Knowledge; therefore it is the responsibility of a project Manager to be knowledgeable of these principles. It is the responsibility of Eskom Project managers must take leadership role to ensure the team performs to its best; however this can only be attained by knowing every team member's roles and expected deliverables. (Eskom.CIP, 2012)

Smith (2003) says, by placing business processes on centre stage, corporations can gain the capabilities they need to innovate, reenergize performance and deliver the value today's market demand. Although this may be theoretically true, the question to ask is will it yield the same results when put to practice? In today's competitive business world where technology is advancing at a high rate, every organisation needs to make sure that the amount of energy and resources invested in creating project systems and, implementing a standard or a process is justifiable based on the results it yields (K. A. Demir, 2008). So one needs to always question the value added to every carried activity.

Eskom is a well-structured organisation which has enough documentation on standards and processes saved on its server readily available to project managers. Eskom's project systems include Acquired Customer and Network Asset Creation Value Chains (ACNAC), Capital Investment Process (CIP), Distribution Technology website, Safety Health Environmental and quality (SHEQ) policy etc. Even with these standards and processes in place, Eskom projects still do not meet time lines, are over budget and experience scope revision resulting in quality being compromised. Do these standards and internal processes have an impact on project performance? The literature highlights that large projects have been plagued by cost and schedule overruns and that final project costs

have been higher than the planned costs in too many cases.(Love, 2013) calculated cost overruns from 276 construction and engineering projects and revealed a mean cost overrun of 12.22%.

The performances of 10 randomly selected projects which are in the commercial operation phase were closely studied. The concentration on the performance was based on the cost and schedule indexes, where Cost Index is defined as actual cost divided by planned cost and schedule index as actual duration divided by planned duration of the project. The cost and schedule indexes are a representation of the performance because the more the actual cost or schedule varies from the approved cost or schedule the more performance can be categorised as good or bad.

1.1. Research problem statement and research objectives

1.1.1. Problem statement

The preliminary investigation suggests that there is a gap in the literature which links human factor behaviour in the correlation between the degree of adherence to project systems and the respective project performance. The literature has concluded that there is a statistically significant positive relationship between Project Management (PM), Project Lifecycle Management Processes and Project Success (Farzana Asad Mir, 2014) but it does not indicate whether the level of adherence to these processes will have an influence on the conclusion drawn. For example, whether a 75% compliance level is as good as a 98% compliance level in terms of its impact on project success or a 10% compliance level is as good as a 50% compliance level. In order to address the above problem, the following research questions were proposed:

- Is there a correlation between the level of compliance to project systems and project performance (in terms of cost and schedule)?
- What is the level of compliance to project systems by Eskom technicians, engineers and project managers?
- What is the knowledge level of employees about the project systems?

1.1.2. Research objectives

This research aims to investigate if there is a correlation between the degree of project manager's compliance to project systems and project performance in terms of cost and schedule. To determine the degree of project manager's compliance and the level of knowledge they have on the respective project systems in terms of locating, understanding and applying them. The level of knowledge might influence their ability to

comply. In order to address the above problem, a research project with the following objectives was proposed:

The objective of this research is to determine the correlation between the degree of project manager's compliance to project systems and project performance.

In order to effectively address the above problem, the following hypotheses needs to be tested:

- Project systems are always applied by project manager's during the project life cycle
- Employees are familiar with the different project systems.
- The higher the level of compliance to project systems the better the project performance.

1.2. Rational for the study

The literature highlights the importance of processes and the goals organisations aims to reach when implementing and adhering to them. But yet project overruns and over budget issues are escalating, resulting in companies being reactive than proactive on every project.

Eskom invests a great deal of energy and resources in development of processes and standards yet Eskom's projects experience budget overrun and schedule non-compliance. The non-compliances experienced are outside the limits of project variability indicated above. With all these processes in place, why is the business still having cost and schedule overruns? Historical research doesn't go into detail about the human factors involved in the application of these project systems and the linkage between the degree of compliance to them and project performance, therefore triggering the research for the correlation between the levels of adherence to projects systems and project performance.

1.3. Significance of the study

The research will contribute towards knowledge of project manager's roles as a project leader and competencies required in Project Execution Department in LOU. There is a need to explore whether if there is a correlation between the degree of project manager's compliance to project systems and project performance in terms of cost and schedule. To determine the degree of project manager's compliance and the level of knowledge they

have on the respective project systems in terms of locating, understanding and applying them. The level of knowledge might influence their ability to comply

1.4. Limitations of the study

The focus of this research will only be for Eskom Distribution Limpopo Operating Unit (LOU), Eskom Transmission, Generation and Enterprise will not be covered. The data for the research was obtained from the Limpopo Operating Unit (LOU). This creates the limitation that the finding from this research cannot be generalised.

1.5. Population

Yin (1994:34) defines a population of a research study as the entire group of persons that is of interest to the researcher, and which meets the criteria for inclusion in the study. Project execution management are responsible for ensuring that projects are completed within time, cost and quality constraints. The population in this study will comprise of 45officials who are directly responsible for effective project management Eskom Distribution in the Limpopo Operating Unit (LOU). The officials include Planners, Engineers and Project Managers

1.6. Aim of the study

The aim of the study is to assess the degree of project manager's project system compliance and project performance in Eskom Distribution in LOU. Eskom Distribution Limpopo Operating Unit must comply with ISO 2000 quality standard when executing projects within the time, cost and scope constraints. This research aims to investigate if there is a correlation between the level of compliance to project systems and project performance in terms of cost and schedule. To determine the level of compliance and the level of knowledge employees have on their respective project systems in terms of locating, understanding and applying them. The level of knowledge might influence their ability to comply.

1.7. Choice and rationale of research design

Quantitative and qualitative are the basic approaches to doing research. These research approaches have evolved to fulfil specific research aims and functions, and specific methodological styles and conventions have developed within each tradition. They are concerned with understanding, analysing, explaining, natural observation and controlled measurement and view the subject exploration of reality from the perspective of an insider (Maree, 2007).

This study will use the quantitative approach to inquire about the degree of project manager's technical and project management knowledge in Eskom Distribution in the Limpopo Operating Unit (LOU)

1.8. Study area

The focus of this research will only be for Eskom Distribution in the Limpopo Operating Unit (LOU)

1.9. Sample, sampling methods and sample size

The study will use the census method because the entire population of the study is small. Shepard and Robert (2003) define a census as a "procedure of systematically acquiring and recording information about the members of the entire target population". The use of the census method will give the participants equal opportunity to participate and is capable of yielding representative results. Census are commonly used for research and other related fields, as well as a baseline for sampling surveys. In this study, 45 officials who directly work with projects in the LOU project execution will be given questionnaires. These include the project managers, planners and engineers.

1.10. Data collection

Data was collected through the use of questionnaires, books, journal articles and Eskom's internal processes and standards. These data collection methods chosen will be used to acquire opinion, perceptions and assumptions of participants with regard to this research.

1.11. Ethical considerations

Ethics is a set of moral principles and rules aimed at protecting the interests of the respondents when conducting a research (Green, 2007). The study considers ethics as follows:

Permission:

- Firstly, permission to conduct the study is sought from the Eskom Distribution LOU Asset creation Senior Manager prior to conducting the study.

Informed Consent:

Consent means that everyone who participates in the study should be informed about the purpose of the study and should have freely consented to participation, without being coerced or unfairly pressurised.

- It is in this vein that the study, as well as its purpose, will be explained to the research participants to get their consent prior to conducting interviews.

- Participants ought to be informed of their right to withdraw from the study at any point should they wish to do so.

Confidentiality:

- It is not always easy or even possible to measure the dangers of a certain context to a given population, let alone to individuals.
- It is, therefore, essential to protect the identity of the person from whom the researcher gathers information.
- If collected, the identity of the participants must be protected at all times and not be left lying around in notebooks or un-protected (Green, 2007).
- The identity of participants will, as much as possible not be kept on record. Their information will be kept confidential and will not be deliberately used to harm them in any way.
- The results of the study will be made available and accessible to interested stakeholders

1.12. Outline of the research report

The research approach entails a review of the existing project performance studies (achieved data on cost and schedule indexes), project systems and adherence tendencies in the organisation. The literature review was based on books, journal articles and Eskom internal processes and standards, findings of which are presented in Chapter 2. Chapter 1 discusses the research problems, rational behind the study, research questions, research hypothesis as well as the objective which the study aims to achieve.

A conceptual model is then developed in chapter 3, which indicates the various inputs and output of the research. Project systems will be an input to both the level of use of project systems and the level of knowledge of project systems. The degree of project manager's compliance together with project performance will be analysed for correlation. The outcome of the correlation will then be the output. Chapter 4 presents the research design and methodology of the study. In Chapter 5, the results of the study collected via surveys in the form of questionnaires and archived data of the 10 randomly selected projects presented and analysed. In Chapter 6, conclusions are drawn and recommendations are made on the findings of the study.

1.13. Conclusions

The focus of this chapter was to introduce the research topic of getting to understand the level of project manager's project system compliance and project performance in Eskom

distribution Limpopo Operating Unit. The basis of the study will be from the literature survey which follows in the next chapter. The literature review will be built around the existing project performance studies (achieved data on cost and schedule indexes), project systems and adherence tendencies in the organisation.

2. CHAPTER2: LITERATURE REVIEW

2.1. Introduction

Farzana (2014) investigated the link between project management performance and project success. Through bivariate correlation and multiple regression tests he found a positive influence of project management performance and its contributing variables on project success. Natasa (2009) investigated the linkages between manufacturing strategy, benchmarking, performance measurement and business process reengineering in 2009. His results confirmed the need for strategically-driven business process reengineering approach and the positive impact of performance measurement on business process reengineering performance. In 2013 Jing Tang investigated the effects of business process orientation on organizational innovation performance. The result of his study suggested that Business process Overview (BPO) significantly influences organizational innovation performance and identified the underlying mechanism for the effect. Clearly there is a link between business processes and project performance. But there is a gap for linking the compliance level to process and project performance in the literature.

The advantages of project management have been well documented, but project failure rates still remain high (K. A. Demir, 2008). This suggests continued exploration of new processes models and organization structures to nurture strong project performance. Much literature has been published on internal business processes and standards. It is thoroughly explained how these would benefit organisations that make an effort to have them in place. The internal and external environmental human factor that may have an influence on the acceptance and application of these processes and standards is not well covered in the literature. The level of compliance to these processes is also not indicated in literature regarding its influence to project systems.

Nino Grau (2013) argued that if the use of standards guarantees the excellent performance of a project or is the results just a good and acceptable project quality. Can we assume that after implementing a standard all projects will have no flaws in accordance with the standard? Doganata (2011) says the quality of product and services cannot be ensured in a business if the processes and standards used do not conform to design goals and comply with the rules and regulations.

Ahlemann et al (2008) made the statement that since projects are generally perceived to be unique, it cannot be expected that the same set of processes and standards will foster

the success of each and every project. During Dai and Wells (2013) study they concluded that there is strong evidence that project management standards and methods are most highly correlated with project performance. But the question to ask is, what is the level of adherence of these project management standards and methods and the overall project systems? The literature also discusses the correlation between the call for standards on the other hand and that of excellence.

Most theories do emphasize that there is a lag between management intent and execution when it comes to processes and standards (Smith, 2003). The theory available also indicated that it is very difficult to verify whether these standards will be successful before using them during real engagements. As a result we end up with a lot of revisions in a very short period of time which could be confusing to other stakeholders. On the other hand business processes need to be closely managed in order to achieve most companies desires or objectives. Smith (2003) emphasizes that the Business Process Management System success does not depend that much on whether it implements one standard or another, for standards acronyms are only fully understood by members of esoteric committees, but on the capability it provides to business which are performance and robustness. This in turn does not depend on the detail of individual standards, but on adherence to the logic required from process management to work in practice.

Not every business process or standard will result in the desired impact on the business (K. A. Demir, 2008). Maryam et al (2012) says that business processes are usually big and complex models which make them unreadable; he further says that they cannot be easily understood and maintained. The possible project success to result from these project systems will be interpreted in different ways depending on who is analysing the performance, therefore a framework or criteria needs to be developed for each organisation to facilitate consistency.

2.2. Overview of the project performance assessment criteria and indicators methods

Performance measurement criteria differ from organisation to organisation, as a matter of fact they differ from project to project. Nonetheless, there has to be a commonly agreed framework of project performance measurement in an organisation. The framework will assist in establishing a common ground because project success has different meaning to different stakeholders working for one company. To clarify some ambiguities related to the scale of project success, Lim and Mohamed (1999) argue that there are two possible viewpoints: macro-level success and micro-level success whereby he macro level is the

viewpoint of project beneficiaries and takes care of the question “does the original concept tick?” and the micro level pertains to traditional triangle of whether the project is on time, within budget and according to scope. The scope of this study will be focusing more on macro level project success. Project success will be defined by defining both the success criteria and success factors.

J.Musser (2007) highlights the difference between the success criteria and success factors. Success factors are those which contribute to achieving success on a project. On the other hand, success criteria are the measures by which the success or failure of a project will be judged. The study will focus on the factors constituting the success criteria. The key performances that will be looked at in this study are the budget index and cost index of the 10 selected projects. Cost index is defined as the actual cost divided by the planned cost and the schedule index is defined as the actual schedule divided by the planned schedule.

2.2.1. . Cost and schedule over-runs in projects

Cheng (2014) pointed out that historically, large projects have been plagued by cost and schedule overruns. Shane (2009) stated that final project costs have been higher than the cost estimates prepared in too many cases. (Love, 2013) Calculated cost overruns from 276 construction and engineering projects and revealed a mean cost overrun of 12.22%. No significant differences for cost overruns were found among contract size, project type, and procurement method.

Aziz (2013) indicated that the construction industry has a very poor reputation in coping with delays. He also states that time delays are directly linked to cost overruns whereby delay analysis is either ignored or done subjectively by simply adding a contingency. As a result many major projects fail to meet schedule deadlines. This fully substantiates the selection of cost and schedule index as the performance measurement for the research project performance. Cheng (2014) also discussed the key cost influencing factors; he ranked them and indicated the level of severity for each group. Among the 16 cost influencing factors, Cheng spoke about the coordination capability and the understanding of operational procedure of the project team and the management of time which the former is a project system (processes and standards) and the latter is a schedule problem. This links to the adherence of process systems and the substantiation of the closer look into schedule index.

Table 2-1.1 below shows that clearly defined scope of work in the contract and cost control are the most important cost impact factors with a severity index of 94.78 and

ranked at number 1, contract dispute being the second highest. This is because if the scope of work is not clearly stated in the contract, it might lead to too many misunderstanding between both parties resulting in disputes after construction proceeds. For projects with longer periods, which might even be delayed, price fluctuations will be another factor for cost overruns due to interests during construction (IDC) and overheads.

Table 2.2-1 Ranking of the key cost-influencing factors (Cheng, 2013)

Ranking of the key cost — influencing factors.

N0	Factor	SI (Severity Index)	Rank
B-1	Clearly define the scope of project in the contract	94.78	1
D-1	Cost control	94.78	1
B-3	Contract dispute (unclear drawings or guidelines/regulations)	93.04	2
A-4	High fluctuation in commodity	89.57	3
C-1	The gap between the construction plan and the reality is too great	89.57	3
C-2	Material shortage or supply delay	89.57	3
D-5	Time management	88.70	4
D-3	Practical experience	87.83	5
B-2	Modifications to the scope of construction	86.96	6
B-4	The level of demand on quality	86.96	6
D-6	Project team (coordination capability and the understanding of operational procedure)	86.96	6
D-2	Project valuation does not match the collected payment	86.09	7
D-4	Procurement contract	85.22	8
A-3	Geology, topography	84.35	9
A-1	Climate factor	82.61	10
A-2	Natural disaster	80.00	11

The literature and the actual 10 selected projects indicate that project cost overruns and schedule delays are common problems in many organisations. Consequently addressing these two issues will be an umbrella to more hidden problems. Cheng (2014) argues that if companies can effectively control these two key factors and formulate prevention strategies, it is possible not only to avoid cost overruns, but also to increase the overall profit for the project. Therefore analysing the correlation between project systems and project performance might lead to the solution to these costs and schedule overruns which in turn could lead to more profits for the project if the correct prevention strategies could be formulated.

Aziz (2013) revealed that successful construction projects should be completed before project due dates and within budget. Emphasizing the need to understand and manage time delay and cost overruns. He then categorized 99 contributing factors into 9 major categories that cause delay in construction projects in Table 2-2 below.

Table 2.2-2: Contributing factors to time delay (Aziz, 2013)

Category item	Total number of category factors
Consultant Related Factors Category	08
Contractor Related Factors Category	13
Design Related factors Category	11
Equipment Related Factors Category	07
External Related Factors Category	17
Labor Related Factors Category	09
Material Related Factors Category	09
Owner Related factors Category	19
Project Related Factors Category	06

Factors causing time delay have been identified in Table 2-2 above by (Aziz, 2013) and evaluated in the last decade; however a deeper understanding is still needed to overcome this issue. Examining possible factors that are related to project performance (schedule issues) might be a key to a deeper understanding to time and cost overruns of projects. These are some of the 99 project delay causes as explained by (Aziz, 2013)

- Lack of consultant experience
- Conflicts between consultant and design engineer
- Delays in approving major changes in scope of work by consultants
- Inaccurate site investigation
- Inaccurate project management assistance
- Poor communication and coordination between owner and contractor
- Frequent change of sub-contractor
- Inadequate contractor experience
- Ineffective project planning and scheduling
- Obsolete technology
- Equipment allocation problem
- Accidents during construction
- Late ordering and delivery of material

- Long period between design and time of tender
- Complexity of projects

2.3. . Eskom's internal processes and standards

Companies create value for customers and shareholders (value streams) via the effectiveness and efficiency of activities that flow across organization boundaries often called as the firm's cross-functional business processes (Maria Hove, 2015). This section will consequently focus on the different processes and standards of Eskom. What they are, how and when they should be implemented and the benefits of applying them. More emphasis was on Eskom's internal processes and standards that influence project performance. These are the Capital Investment Process (CIP) and the ACNAC project work flow system. The purpose of the CIP is to set out the defined governance procedures that will enable Eskom Distribution to deliver the required outputs of the business projects (Eskom.CIP, 2012).

Whereas the purpose of the ACNAC workflow is to ensure standardised action in the environment and ensure that accountability, responsibilities, activities, Key Performance Indicators (KPIs) and financial control points are clear at any stage of the CIP process (Eskom.ACNAC, 2013). Eskom uses ACNAC as the tracking tool for the project status and to move the project along its life cycle. ACNAC tracks all activities that need to be completed at a specific project phase and require the specific Form to be signed before the project can move to the next phase. In this form the stakeholders are aware of the project progress as it moves between various departments and project phases. Each project is classified accordingly and follows a specific work stream through its life cycle. As the project progresses, different stage gates are then introduced by the CIP with their respective requirements. The CIP process then informs all the stakeholders of their roles and responsibilities during the project life cycle. The next section will discuss the CIP process in detail.

2.3.1. Capital Investment Process

To effectively manage the investment programme in the Distribution Business Walker (2011) developed a well-defined process with approval bodies at specific points in the process where technical or financial approval must take place. The CIP process covers the governance process for the pre-planning phase through to project closure during the finalisation phase. It includes the approval processes, as well as the content to be approved at the various gates.

. 2.3.1.1 Eskom Project Life Cycle

Walker defined the standard project life cycle in Figure 2-1 below. The standard project life cycle comprises of four phases. Each phase has a gate that is applicable to the pre-defined Eskom governance and divisional management structures authorised to allocate additional resources, approve additional financial investment and take on additional risk for projects

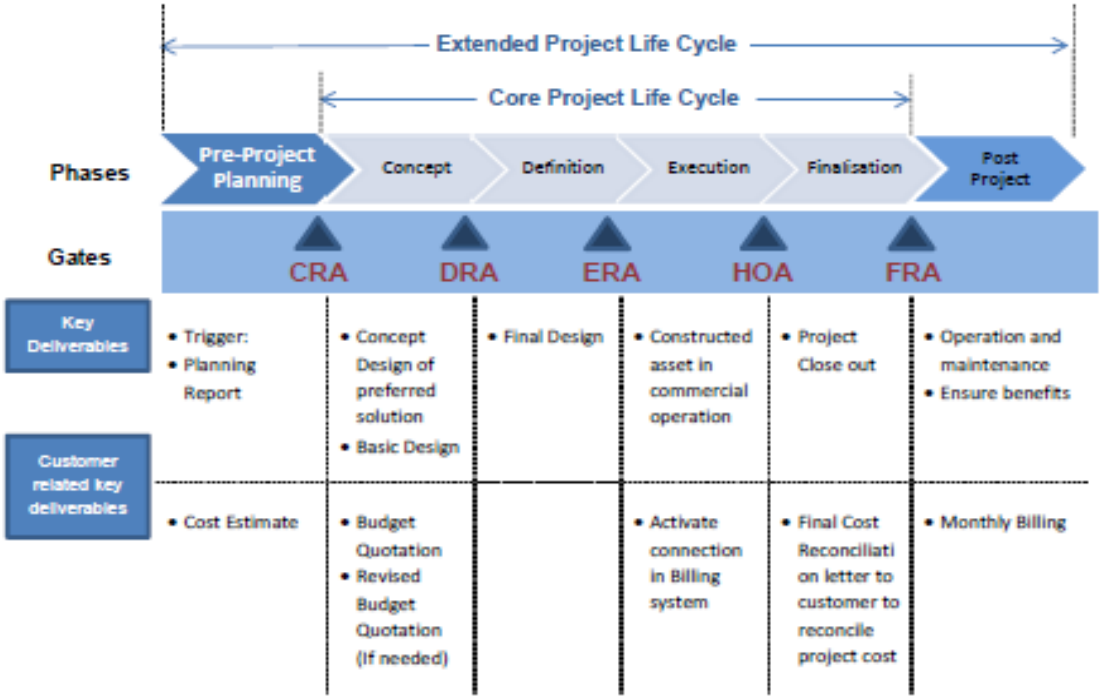

Figure 2-1: Eskom Standard Project Life Cycle (Eskom.CIP, 2012)

The four phases of the standard core project life cycle are as follows: concept phase, definition phase, execution phase and finalisation phase. The five gates of the project life cycle in the project phases are as follows: Concept release approval (CRA), Definition Release Approval (DRA), Execution Release Approval (ERA), Handover Approval (HOA), and Finalisation Release Approval (FRA).There is a pre-project-planning phase which precedes the core project life cycle and a post-project phase which follows after project completion (Eskom.ACNAC, 2013).

The standard project life cycle including the pre-project-planning phase and the post-project phase is called the extended project life cycle. There are key deliverables at each phase of the extended project life cycle, as indicated in Figure 2-1 above. These key

deliverables differ depending on the type of project at hand (Direct Customer, strengthening or refurbishment).

There are various committees that exists within the distribution environment, these includes the Investment Committee (IC) and the Technical Evaluation Forum (TEF). These committees are responsible for steering the project forward between the different phases. Investment approval committees exist at different levels in the Distribution Business and their purpose is to make effective decisions on how to ensure maximum return on investment while maintaining acceptable quality of supply. The Investment Committees are not required to make technical decisions on projects. A Technical Evaluation Forum (TEF) is required to make technical decisions on the project and this is done prior the DRA phase which then approves the project proposal (Eskom.CIP, 2012).

2.3.1.2. Project life cycle management

Before the extended project life cycle phase can start, three activities needs to be carried out. These activities are the Network Development Plans, Refurbishment Plans and the project planning prioritization. The output of these activities is used to initialise and classify projects. The distribution environment has three types of projects namely strengthening projects, refurbishment projects and Direct Customer projects. A project is defined as one or more interdependent Jobs, which are identified at the Network Development Planning stage or as a result of a Customer Application, and eventually initiated as a Project with one or more Jobs (Eskom.ACNAC, 2013). A Project may only have one Business category, but may have one or more Job categories. Each Job must have its own CRA Form, DRA Form, ERA Form and FRA Form. Strengthening projects originates from Network Development Plans (NDPs) and are projects that are initialised to strengthen the network. Refurbishment projects originate from refurbishment plans and are projects that are initiated to refurbish the old equipment and install new equipment. Direct Customer (DC) projects originate from customer applications and take a priority over strengthening and refurbishment projects in the business (Eskom.CIP, 2012).

Perform Network Development Planning and Refurbishment Plans

Network Development Planning (NDP) is a regional engineering responsibility, residing with the Network Planning department (Eskom.ACNAC, 2013). All distribution networks in a region should be covered (wall-to-wall) by Network Development Plans. While the Network Planning section has the primary responsibility to coordinate and compile the NPDs for the region, other sections have the responsibility to participate in the process and to provide valuable and necessary inputs. Strengthening projects originates from

these NDPs. Once the NDP is approved the project prioritisation commences. Refurbishment plans are done exactly similar to NDPs, the difference is that the engineering responsibility of developing refurbishment plans resides with Plant department (Eskom.ACNAC, 2013).

Manage Project Planning Prioritization

This process addresses the steps after the approval of the development plans and Development Plan Approval Form at the Regional Planning Review Forum (PRF) (Eskom.CIP, 2012). The intent of this process is to capture the approved projects and their associated jobs into the Planning Prioritisation Register (PPR). The PPR needs to have a separate listing for each Business Category. The PPR also needs to be reviewed at least bi-annually. The total value of projects released must always be within the allocated budgets per business category per year. Direct Customer (DC) projects and essential emergency projects can follow a separate process where a Planning Proposal is produced which identifies the project and associated jobs that are required to meet the customer or emergency requirements. The project thus identified will be placed as the highest priority in the respective business category of the PPR and released immediately for initiation in the Project Preparation Process. Planning Proposals produced for these Direct Customer and emergency projects must still be presented to the next PRF for information and recording (Eskom.CIP, 2012).

2.3.1.3. Pre-project-planning phase

The primary purpose of this phase is to initiate projects into the project life cycle by the release of the CRA when the resources have been allocated and the triggers that led to the need or investigation are about to be realised (Eskom.CIP, 2012). The investment process starts with the identification of needs. A need could result from customer service, field service, plant, network or grid delivery processes, compliance with the network or grid code, customer complaints, general load growth, etc. This is the first approval phase in the CIP process.

The analysis of these needs results in defined projects. Customer or emergency projects are automatically included in the development plans. The development plan is summarised on a Development Plan Approval (DPA) Form. The development plan and the DPA Form must be presented to the PRF for the identified projects to be approved. The output is a development plan or a planning report depending on the nature of the project. The development plan can contain many projects, each of which must be prioritised within the operating unit.

For direct customer projects, when a customer submits an application form and the request is identified as a possible customer related project, the customer will be given a cost estimate based on a network solution from planning and utilising standard costs at module level. The intent of the cost estimate is to give the customer an indication of the costs in order for the customer to make an informed decision on whether to request a budget quotation or not. The approved CRA Form will be registered into the portfolio plan only once a signed copy of the customers' instruction to proceed with the budget quotation has been received and the estimation quotation fee has been paid.

Information regarding the project total costs, costs to cover concept and basic design, total environmental costs, land valuation costs, land acquisition baseline cost, servitude registration cost, cadastral survey cost, initial survey costs, and geotechnical studies, delivery dates (including the DRA Form approval date and the required completion date) should be captured on the CRA Form for approval. The CIP indicates that the section and departmental review meetings need to take place before a planning proposal or design document can be submitted to either the designers or project managers. One cannot move to the next phase before the current phase is approved. The transaction from the pre-project-planning phase to the concept release approval is a planning proposal, approved schedule and CRA Form.

2.3.1.4. Concept release approval (end of pre-project-planning phase)

The objective of the pre-project-planning phase is to ensure that an optimal design alternative has been agreed to before the concept designs and the project becomes part of the fixed plan of the 36 month rolling capital plan. At this stage planning options have already been considered and the reasons for opting for the preferred planning option approved at the PRF as input onto the needs statement. The appointed team must meet and agree on the target dates to be scheduled for the completion of the concept design, preliminary design, and definition release approval. The environmental report will be the critical factor in determining these target dates.

The concept design must be based on the site or route recommended in the Environmental Impact Assessment (EIA). The concept design details are recorded in a report referred to as the planning design report. The preliminary design must be based on the planning report. The preliminary design is recorded in a report referred to as the preliminary design report.

For direct customer projects the budget quotation is to be based on the approved planning design. The planning design must provide an accurate project cost, established from a scope that has a 65% confidence level. The team needs to commit to a detailed design and construction duration that will be quoted to the customer. If the quotation is accepted by the customer, Eskom will be committed to supply the customer in accordance with the terms stated in the quotation.

Then Fees are approved in the CRA Form for resources to investigate all possible requirements that need to be considered for the project. An amount for LLTM may also be approved at the CRA stage where it is deemed to be necessary for the timeous completion of the project. The CRA Form/s are presented to a Resource Planning Meeting (RPM) where both financial and human resource requirements are considered and captured on the CRA, and thereafter submitted for approval.

The network planning manager and Investment Committee are responsible for the approval of this form. They need to make sure that the initial quote is accepted and paid in full for customer projects before approval is granted.

At this stage of the project, CRA IC should request the budget required for completion of the concept phase for the specific project, and in exceptional cases, it could include LLTM. Environmental and Land Development (servitude) requirements for the project need to be clearly defined at this stage.

All customer projects need to be approved at an IC. A non-binding cost estimate is to be delivered within 90 calendar days of the application date. The cost estimation letter should also indicate the duration required for Eskom to provide the customer with a budget quotation from the date of acceptance of the cost estimate by the customer. The quote fee as per the cost estimate is to be accepted and paid in full before CRA approval can take place.

2.3.1.5. Perform Preliminary Design Phase (DRA Form)

This is the second approval phase in the CIP. The resources identified on the approved CRA Forms will thoroughly investigate the concept defined in the CRA, involving all necessary stakeholders. The various disciplines produce project proposals upon completion of the investigation process and Land Development submits the required reports for environmental approval to the environmental authorities. These Project

Proposals consider various design alternatives, which are then presented to TEF to consider and approve the optimal design solution for the defined need.

Once the TEF has approved the project, the respective DRA Forms are prepared, summarising the approved project proposals. The scope of work should have an 85% confidence with accurate costing. The detailed design fees and any LLTM are identified and approved for release in the DRA Form. The project will then be presented to the relevant IC for approval. The IC needs the DRA Forms and project proposal to make a financial decision on the project. The IC should request the budget required for the completion of the definition phase for the specific project; these includes the LLTM and land acquisition costs. The relevant IC must make sure that an Environmental Assessment (EA) has been received
and that all land owners have signed options for the servitudes required for the project before approval by the relevant IC, because should this be ignored, it will have tremendous consequences on the schedule of the project.

The DRA Form must address the following: the total costs to cover the detailed designs, the estimated costs to cover the complete project, ERA Form approval date, construction start date, completion date, the release of funds for Long Lead Time Material (LLTM) may be requested on the DRA Form if deemed necessary to meet project need dates. For direct customer projects, the budget quotation, budget quotation acceptance, proof of up front or phased payments and the signed agreements will serve as input for definition release approval.

In the case of direct customer projects, the budget quotation will be based on the preliminary design. The related costs and schedules are done as part of the preparation for the quotation. The budget quotation must be delivered in the period specified in the cost estimate letter. The budget quotation will be the only biding document between Eskom and the customer. Before the DRA can be approved the quoted fee and conditions as per the budget quotation must be accepted and paid by the customer. A revised budget quotation may be provided to the customer if the project scope changed significantly from the original basic design done. The revision will also be required if the costs are outside the 85% confidence level, accepted as part of the original budget quotation by the customer.

The Investment Committee is responsible for the approval of this Form. In the case of direct customer projects the budget quotation must be accepted and paid in full before approval is granted.

2.3.1.6. Manage Detailed Design Phase (ERA Forms)

This is the third approval phase in the Capital Investment Process. The main purpose of the definition phase is to convert the approved preliminary design into a detailed design and then construct the requested asset. The detail design is used to enable a qualified contractor to prepare a quotation for carrying out the construction of the required asset. Should the scope change significantly during the detail design, the project needs to be presented again for approval at TEF. The project scope at ERA stage must have a 95% confidence level relative to the final project scope. The detail design is packaged into a tender document and is issued to the relevant market after ERA approval. The successful tender values will be used to update the ERA Form. The detail design should have the following:

- The approved DRA Form and preliminary design
- Any environmental approvals must have been received and advertised for public comment. The detail design must be based on the outcome of the environmental process outcome.

Checks are done to explain any significant variances from the DRA approved amount and official market benchmark costs. Scheduled dates are confirmed with the project construction team before capturing onto the ERA Form. It is only on the ERA Form that the project team will commit to the date when an asset will be available for commercial operation. After the ERA Forms have been approved and funds released, the projects are released into the execution phase.

2.3.1.7. Execute construction and commissioning phase

Final handover documents are to be signed by the asset owners responsible for operating and maintaining the created asset. Outages should already have been arranged during the concept and definition phases, but should be finalised when the interim or final handover documents have been signed. These documents will serve as the trigger for the commencement of the specific outage.

For direct customer projects, customer executives are responsible for notifying the customer when the point of supply will be made available and to initiate the first bill. All metering details must be correctly recorded and submitted to the relevant resources for capturing and processing.

The resource requirements to handle the construction of the new asset are then processed. After construction the clerk of works must perform quality checks of the constructed asset. The newly created asset is then energised and commissioned. The asset is then transferred into commercial operation. The IC should request the budget required to execute the project to completion. In the case of DC projects, the project will only be released for execution if all the contractual budget quotation acceptance conditions have been met.

2.3.1.8. Perform Project Close out Phase (FRA Form)

This phase is the project close-out, which signifies the end of the construction and commissioning of the project in the CIP . All related costs from registration to completion of the project need to be recorded and all assets must be transferred to the asset register. All projects must have a project reconciliation report; the report entails the analysis of all the supported FRA Forms associated with the project. The report must look at the expenditure and scope for the whole project, and compare it with the overall approved project amount and scope, which is the last approved ERA Form.

The project performance evaluation report is compiled and it requires the following to be included:

- Comparison of planned costs, physical volumes, and time with the actual expenditure, physical volumes, and time and explanations of variances
- A reconciliation of all planned versus actual material costs
- A reconciliation of all planned versus actual contractor payments
- The number of revisions of each project ERA Form
- Duration to complete each supported project FRA Form
- Document lessons learnt, and ensure that these lessons are fed back to
- The relevant resources to analyse and test current policies, procedures, and training material.

The values in the report need to align with the values on each project FRA Form.

For direct customer projects, a final cost reconciliation letter will be sent to the customer. The actual cost of the project needs to be checked so that the customer contribution can be recalculated. The customer needs to settle the payment to Eskom should the amount paid by the customer be lower than the actual customer contribution, and this needs to be done within one month of written notice. Otherwise a refund must be processed for the full excess payment to the customer within six months after project completion date.

The compilation and presentation of the FRA Forms to the relevant IC are the accountability of the assigned portfolio manager. The FRA Form needs to be completed and submitted to the relevant managers for acceptance, support, and final approval. This is the fourth approval phase in the Capital Investment Process. All contracts related to the project must be finalized and all materials reconciled and dealt with appropriately. All outstanding payments must be paid and a final project costing must be derived. The final project scopes (and variations to previously approved) and costs must be completed on the FRA Forms for the entire project and submitted for approval. Project Review must report on the findings. The project must be presented to the relevant IC within 180 calendar days after the HOA date of the last interdependent project or job. This initiative needs to be submitted for approval in the form of an FRA to the relevant manager or IC.

In the case of direct customer projects, the final cost reconciliation letter is to be sent to the customer indicating the project cost reconciliation versus customer payment. Payment to the customer must be refunded within six months after the project completion date.

When all jobs associated with a project have supported FRA Forms, then the FRA Forms are presented to the IC as a project review and each FRA Form is approved. The IC is responsible for the approval of this form. A reconciliation Form requires the following to have been done:

- A summary of all the job costs clearly showing the ERA and FRA values for each job.
- A total project expenditure picture compared to the approved project value Actual completion dates per job relative to the approved project completion date
- The number of revisions of each job ERA Form
- · Duration to complete each supported job FRA Form

2.3.1.9. Post-project phase – business solution review report

A business solution review is carried out on a sample of projects annually. The project business solution review report will analyse whether the initial assumptions made for project investment approval, such as load growth and revenue, have been realised and whether the correct network solution was selected for the original need. This review should be carried out 12 to 24 months after commercial operation.

2.3.1.10. Variances between the Forms

Where the variances exceed the values presented by Table 2.3, the relevant IC level must be satisfied with the reason for the variance before approving the Form to the next project stage.

Table 2.3-1: Acceptable Variances (Eskom.CIP, 2012)

	DPA/PPR	CRA	DRA	ERA	FRA
DPA	0%	15%	35%	45%	50%
CRA		0%	20%	30%	35%
DRA			0%	10%	15%
ERA				0%	5%

ERA to FRA variances – the portfolio manager is responsible for the approval of this Form. All projects that are 5% under spent with only one job and those projects completed within 30 days of the approved completion date can be approved by the portfolio manager. The other cases can only be supported by the portfolio manager and referred to IC for approval.

Because the ERA Form releases the full job value for expenditure, any cost variances outside the limits defined above will require an ERA Form revision to be approved at the appropriate IC. Revision of the ERA is also required should the delay in time be more than 4 months.

2.3.1.11. Management of cost and time variations

The high number of delays experienced in project execution has resulted in a substantial increase in submissions to IC requesting modifications. To increase transparency on delay and cost implications, all cost incurred as a result of delays in completing a project must be captured and analysed. Apart from IDC, additional cost implications that result from, for example, market movements and contract obligations must be considered and quantified for the duration of the time delay. The general rule is that CRA and DRA Forms should not be revised for cost and time variations unless the scope of work changes dramatically

CRA Forms

Cost variances

CRA costs variances are normally minimal; they are normally caused by unforeseen design-related costs, unforeseen Environmental Impact Assessment (EIA) costs or additional funds for LLTM.

Time variances

The delivery date of the DRA is the approved date on the CRA Form. The CRA Form must be revised when the estimated delivery date of the DRA is increased by more than four months. Should the delay be less than four months from the latest approved CRA Form, then a timely submission to the IC of a notification of project delay letter will be required. If the letter is not submitted, then a CRA revision will be required.

DRA Forms

DRA costs and time revisions are treated the same as CRA costs and time revisions.

ERA forms

ERA Forms must be revised when it is anticipated that the cost and time mandates may be exceeded.

Cost variance

The full value of the project is released during this stage, therefore any variances (excluding overhead and IDC) outside the limits defined above will require the timely revision of the ERA Form to be prepared and approved at the appropriate IC.

Time variances

The HOA date is the approved date on the ERA Form. The ERA Form must be revised when the estimated HOA date is increased by more than four months. A project delay letter will be required for submission should the delay be less than four months.

FRA Forms

Interdependent project FRAs are required to be submitted for approval in the form of an FRA to the relevant manager or IC within 180 calendar days after the actual HOA date. Otherwise a delay letter must be submitted to the IC explaining the reason for the delay. If the letter is not submitted then an ERA revision will be required.

2.3.1.12. Confidence level

The confidence level of the scope of work has a direct relationship with the cost and schedule variance of the project. Walker (2011) defines the boundaries for the confidence level for the scope of work during each phase of the project jobs as follows:

NDP/DPA/PPR 50% scope confidence

CRA stage 65% scope confidence

DRA stage 85% scope confidence

ERA stage 95% scope and cost confidence

FRA stage 100% Actual scope and cost

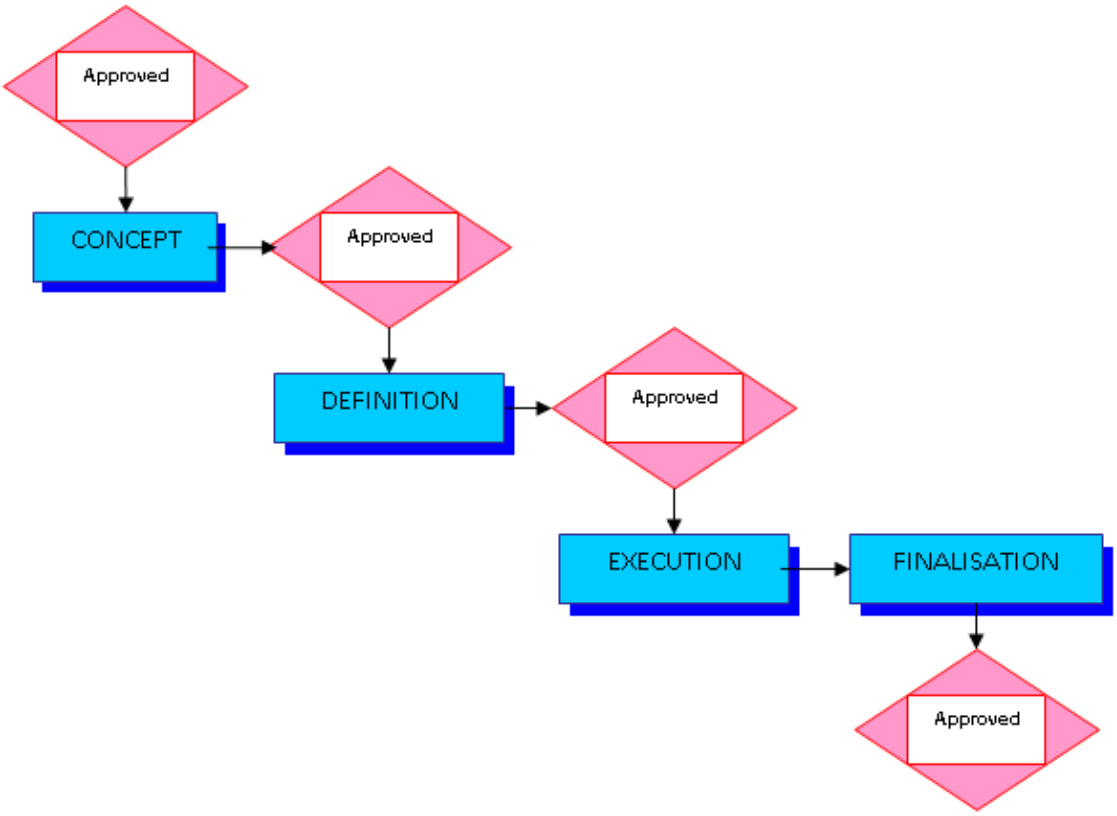

Figure 2-2: Approved major standard project process (Eskom.CIP, 2012)

2.3.1.13. Process for monitoring

The CIP is monitored by the Network Asset Creation Value Chain (NACVC) index and the Acquire Customer and Network Asset Creation (ACNAC) workflow reporting, this will also be supported by internal and external audits. The NACVC and ACNAC managers will schedule a number of process reviews per year, with a minimum of one process review per work stream per region per year to monitor the adherence to this Capital Investment Process by employees involved. This process review will also correct any incorrect practices found, but

will also highlight best practices.

2.3.1.14. Summary of the CIP

The diagram below summarises the various phases involved in the project life cycle, the scope confidence level at each phase of the project, the different IC and TEF taking place at different stages of the project life cycle. It also indicates where during the project life cycle the funds are being released at different approval stages. It shows the outputs of

different stages with tender evaluation being part of the output at DRA approval. It is basically an overview of the entire rolling plan.

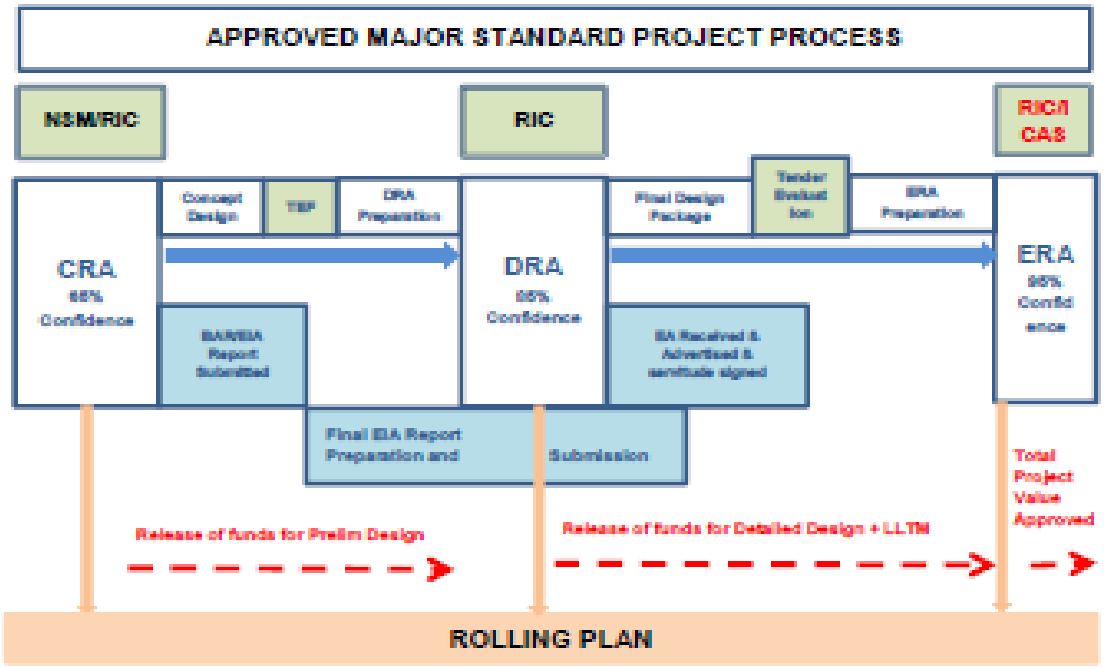

Figure 2-3: Approved major standard project process (Eskom.CIP, 2012)

CIP indicates that the development plans and projects need to be presented at the Regional Planning Review Forum before a project can qualify to be registered on the system as a project. The planners need to generate their planning proposal based on the outcome of the PRF, the designers need to base their design document on the submitted planning proposal and the recommendation of the EIA, the project managers need to construct according to the design document and report any modifications to the designer for approval before implementation. It further stipulates what needs to be done at which stage of the project life cycle, for example a project schedule needs to be generated at the pre-project phase and confirmed at the concept phase. The schedule needs to be followed and used to populate the required dates. When challenges are faced, the schedule need to be updated and shared to all the stakeholders involved. The ACNAC workflow that converts the CIP requirements into activities within phases will be discussed in detail in the next section.

2.3.2. . ACNAC System

ACNAC is an online web help facility to assist users to understand the five work streams available on the system. It maintains the project life cycle processes which are planning; preliminary design; detailed design; construction; commissioning and close out phases.

ACNAC is a custom built workflow system that processes customer applications for supply and other requests for energy, maintenance, refurbishment and strengthening.

The application enables both the minor and major processes which integrate across both Group Customer Service and Engineering business areas. The system is distributed across 9 operating units and provides workflow and resource management from quotation to connection of electricity supply requests .ACNAC comprises of five processes, namely: Direct Customer major and minor Process; Strengthening and Refurbishment Process; Electrification Process; and Bulk Process. Each application project must follow one of these processes to completion.

Each Process is made up of phases and the phases have different project Forms that need approval. The phases in turn, are made up of a number of activities, that are made up of a number of tasks that have to be completed before that activity can be submitted to the next activity in that phase of that process. Project Forms have to be signed off for all major processes before progressing to the next Form phase. Once approved, most of the fields will be locked and users will not be able to add or change any information in these fields, unless the user requests to do a revision to the project Form. Revised Forms need to go through the full acceptance and approval processes again.

Once all approvals have been completed and the Form is submitted, the Form will be progressed to the next stage. ACNAC will give error massages should an attempt to move to the next stage be made without completion of the previous stage activities. Only once the specific Form has been fully signed will the users be allowed to move to the next phase.

Within ACNAC one can perform the following activities (Ayesha, 2015):

- Add or stop a customer application
- Manage Forms applicable to different stages in the project life cycle
- Perform project and maintenance audits
- Assign activities to different users in different departments
- Link users to activities based on their areas
- Revise and cancel a project
- · Set project types
- · Move a project to different activities within a phase
- · Escalate if one encounters a problem
- · Report on complete and incomplete projects or applications

- · Report on user performance

2.3.2.1. The Initiation Of A Project

Direct customer applications originate from Customer Care and I (CC&I) system, which is a system that builds a relationship between Eskom and customers in terms of communication. The application is carried out by staff at the contact centre, walk-in centre, or a customer executive, key customer executive, or any staff member who has access to CC&I. While strengthening, refurbishment, electrification and bulk processes are started from within the ACNAC system. The type of process to start will be determined from the business category assigned to the project.

For Direct Customer process, the workflow process is automatically initiated and added to the work list, when the application is sent from CC&I. Associated to each of the processes are standard project Forms, namely: DPA Form, CRA Form,DRA Form, ERA Form, FRA Form and PCA Form.

2.3.2.2. Project Form Revision

Project Form revision is a process within ACNAC that facilitates the revision of a project Form. The revision process should only be used where the original scope has changed significantly and the scope and costs need to be revised at the previously approved Form status. There are various activities in ACNAC that are a responsibility of different resources.

ACNAC controller is the person responsible for the corrections in the workflow in terms of redirecting activities to the responsible person. The ACNAC controller willselect the Form to be revised; this will automatically initiate a revision where the acceptance of finance, land development, project engineering, network planning; control plant and project management is needed. The preparation of the Form for IC agenda will be done simultaneously with the former acceptance from different departments. The revision will be presented to IC where it will either be approved or rejected. If the revision is rejected it will go back to ACNAC controller, if approved it will be captured into project systems. The approved revision will then go back to activity and user where the revision was requested.

The functionality to send a project to the ACNAC controller is standard for all ACNAC activities since the initial investigation can only be performed by the ACNAC controller should there be any misunderstanding during the course of the workflow

2.3.2.3. Process activities

The processes for Strengthening, Direct Customer and Refurbishment are indicated in the process flow below. The difference between the strengthening and refurbishment process is that strengthening projects originate from approved NDP's and refurbishment projects originates from a refurbishment plan.

Strengthening process

The project triggers are confirmed for projects in the prioritisation list and then they are sent to ACNAC controller or planner to initiate the work flow in ACNAC. Once the project is initiated and classified as strengthening, the workflow starts with its activities. The activities for strengthening process are presented in Figure 2-3 below.

Direct Customer Processes

Sub Process: Generate initial quotation (CRA Form)

This process entails the processing of the customer request and preparation of the conceptual plan. The engineer is to compile the conceptual design with Network Planning input, and populate the design results on the CRA Form. The necessary approval needs to be obtained. The RPMs need to be conducted. The engineer must generate provisional Cost Estimate or Budget Quotation and process customer's acceptance. The CRA Investment Committee approval must be obtained. Once the project is initiated and classified as a customer project, the workflow starts with the activities. The activities for direct customer process are presented in Figure 2-4 below.

Sub Process: Manage customer payments.

Once the customer has accepted the Provisional Cost Estimate (Initial Quotation phase), the Final Budget Quotation (Preliminary Phase) or the Final Quotation (Detailed Design Phase) in writing, the customer needs to be billed for the
indicated quoted amount. Payment should be confirmed before the next phase or construction can proceed.

Refurbishment Process

Once the project is initiated and classified as refurbishment, the workflow starts with activities. The activities are presented by Figure 2-5 below. Table 2-4 below summarises the Forms acceptance option that are available for different roles during the project life cycle in the workflow. Conceptual models to be adapted to the study are discussed in the next section.

Table 2.3-2: Summary of the Forms acceptance options and roles in the workflow

Form		Acceptance role	Acceptance options		
			Approved	Supported	Rejected
Project initiator		Project initiator		x	x
CRA Form	Project initiator manager Acceptance	Initiator Manager	x	x	x
	Job acceptance	NED Manager		x	x
		Program Manager		x	x
	Job Approval	Network Planning Manager	x	x	x
		IC Chairperson	x		x
DRA Form	Job acceptance	Program Manager		x	x
		NED Manager		x	x
		Capital Finance Manager		x	x
	Job Approval	IC Chairperson	x		x
ERA Form	Job Acceptance	Land Development Manager		x	x
		Program Manager		x	x
		Capital Finance Manager		x	x
	Job Approval	Capital Program Manager	x	x	x
		IC Chairperson	x		x
FRA Form	Job Finilization Acceptance	Program Manager		x	x
		Capital Finance Manager		x	x
	Job Approval	Capital Program Manager	x	x	x
		IC Chairperson	x	x	x
PCA Form	Job Cancellation Acceptance	Planning/NED Manager		x	x
		Land Development Manager		x	x
		Network Planning Manager		x	x
		Project Co-ordinator		x	x
		Program Manager		x	x
	Job Cancellation Approval	Network Planning Manager	x	x	x
		IC Chairperson	x	x	x

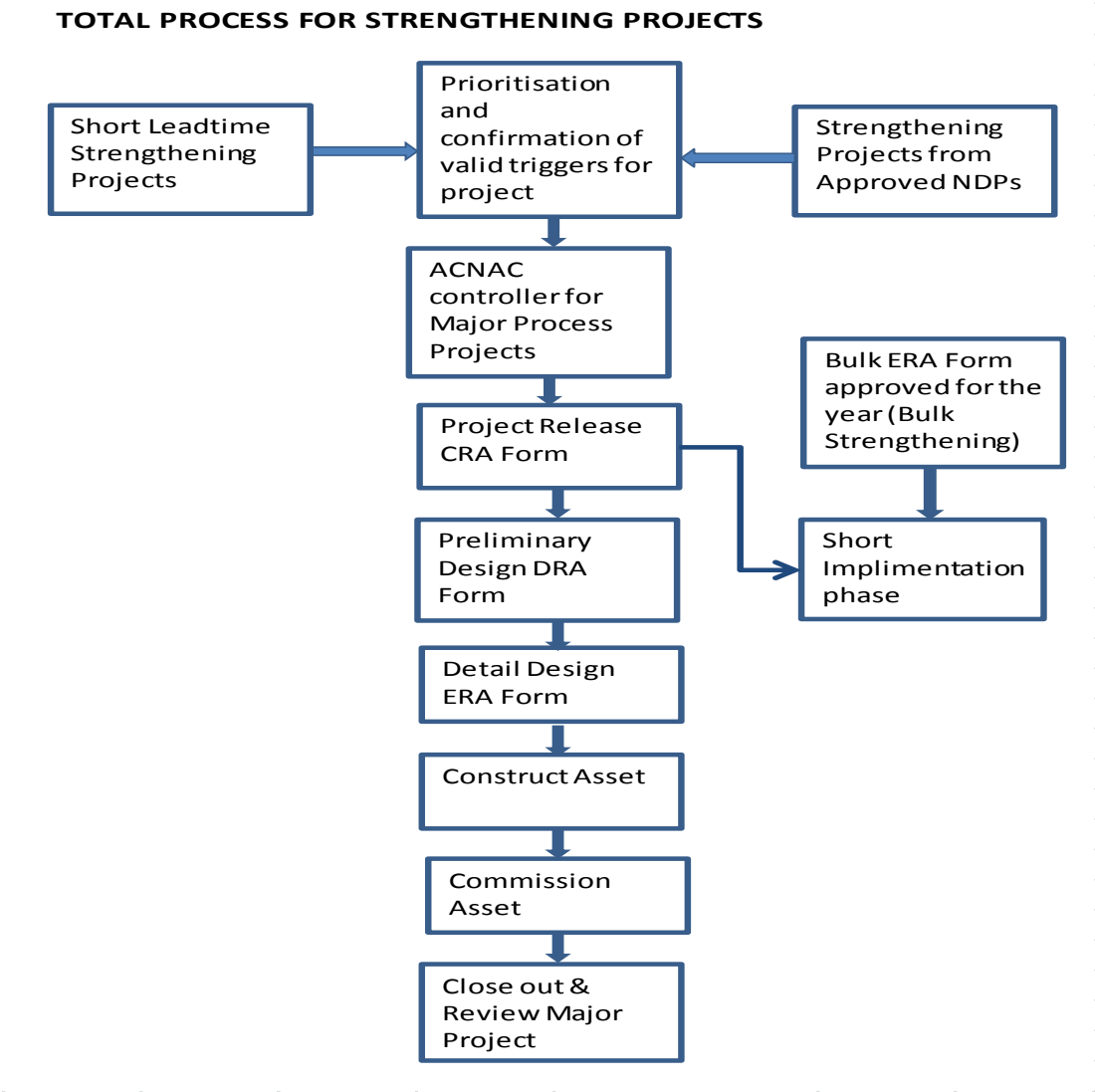

Figure 2-4: ACNAC process for strengthening projects (Eskom.ACNAC,2013)

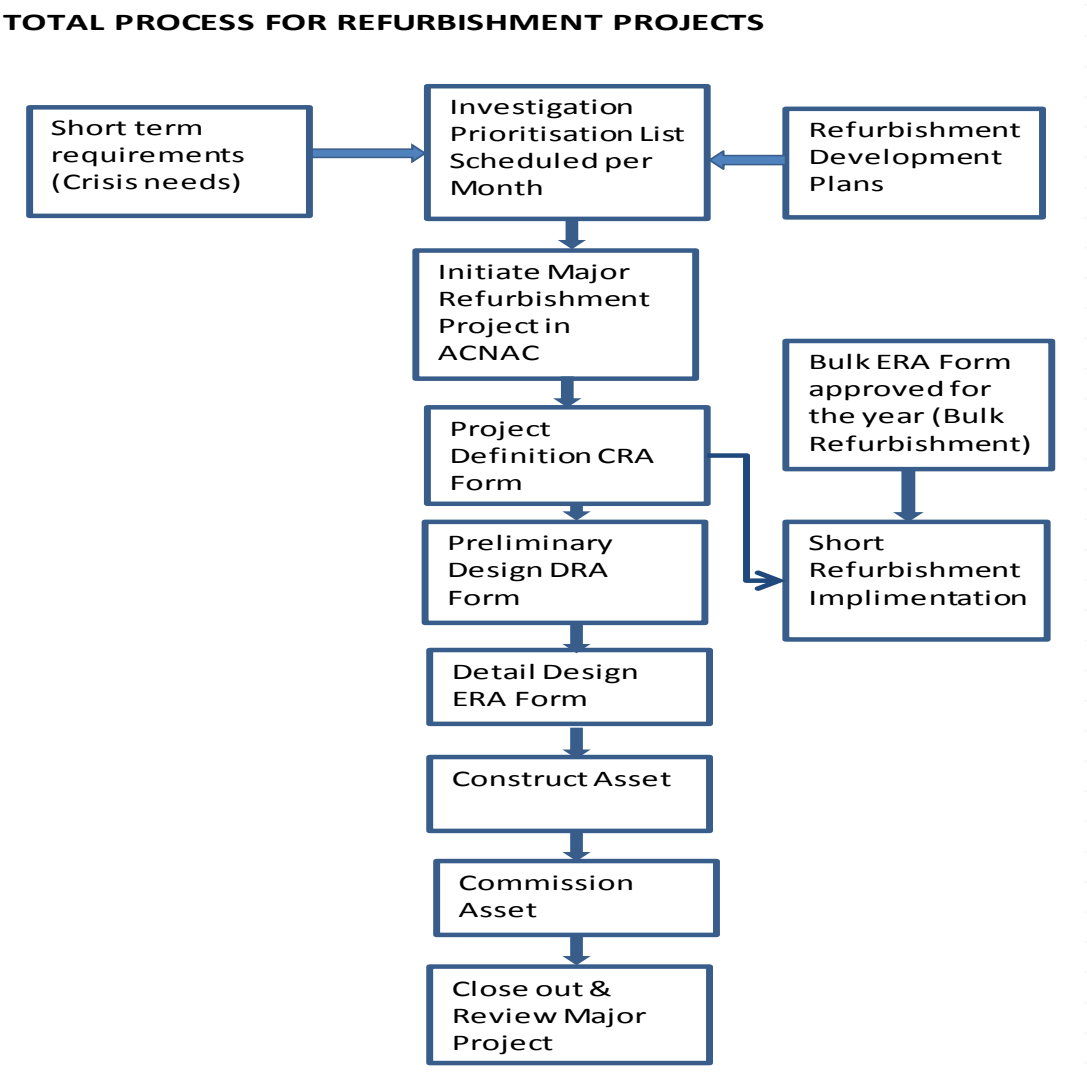

Figure 2-5: ACNAC process for refurbishment projects (Eskom.ACNAC,2013)

2.4. Research Model for correlational analysis

Models are a representation of a system that allows for investigation of the properties of the system and, sometimes, prediction of future outcomes. Models are often used in qualitative analysis and technical analysis, and sometimes also used in fundamental analysis.

The Business Process Overview Model

Below is a model proposed by Jing Tang, to investigate whether and how Business Process Overview (BPO) influences organizational innovation performance. The model conceptualizes BPO in terms of process view, process jobs, and process management and measurement. Jing Tang then identified cross-functional integration, customer integration, and employee innovativeness to be the three important effects of BPO. And these three are expected to influence organizational innovation performance. Jing Tang then hypothesized the relationship between the following:

- Process view and customer integration
- Process view and cross-functional integration
- Process jobs and customer integration
- Process jobs and Employee Innovativeness
- Process jobs and cross-functional integration
- Process Management and Measurement with employee innovativeness
- Process Management and Measurement with customer integration
- Process Management and Measurement with cross-functional integration
- Cross-functional integration and organizational innovation performance
- Customer integration and organizational innovation performance
- Employee innovativeness and organizational innovation performance

These hypotheses are presented in the model below

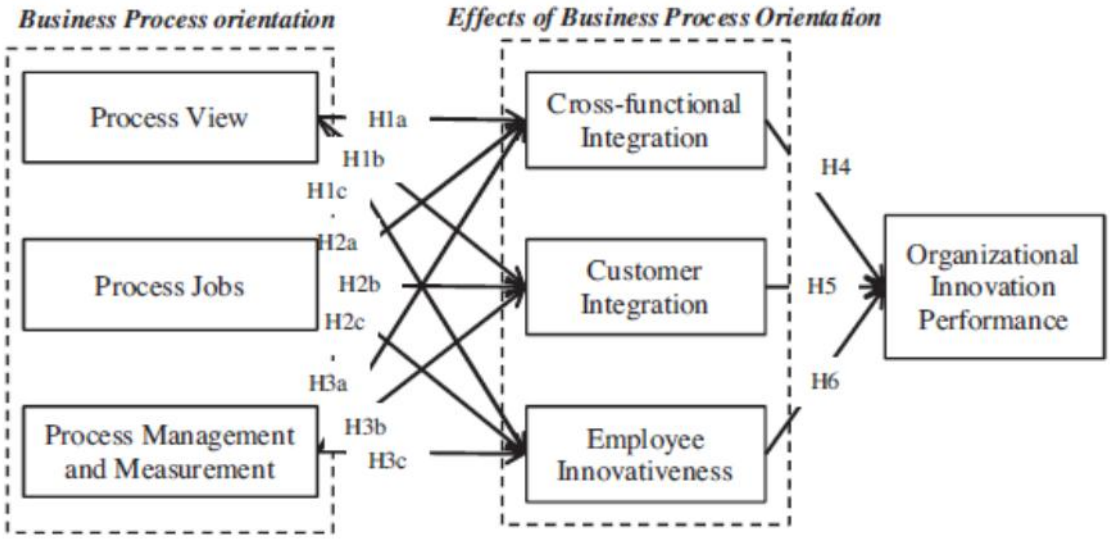

Figure 2-6: Research Model (Jing Tang L. P., 2013)

The data for assessing the proposed model were collected through a survey of organizations in Japan.

2.4.1.1. Measurements of the model

Business Process Orientation

- **Process view**

The measurement was on whether business processes are defined and documented and are used in communications.

- **Process jobs**

They are measured by the extent to which jobs are multidimensional, involve problem solving and require learning.

- **Process management and measurement**

The item that measure this phenomenon assess the extent to which process goals are identified, process measures are defined, and process performance is measured and used in decision making about resource allocation.

2.4.1.2. Effects of BPO

- **Cross-functional integration**

It is measured by assessing the extent to which an organization engages in cross-functional skills, and integrates cross-functional unit or project management

- **Customer integration**

The items measure the extent to which an organization communicates with customers to collect information about customer needs and feedback.

- **Employee innovativeness**

The measurements assess the extent to which employees engage in innovative activities.

2.4.1.3. Organizational innovation performance

Organizational innovation performance is assessed in terms of product innovation regarding the quality of new products or services and process innovation in terms of quality of new business process.

All of the items were measured on five-point Likert scales with the two extremes anchored by strongly disagree and strongly agree.

2.4.1.4. Findings of the model

Jing Tang (2013) hypothesized that BPO influences organizational innovation performance through promoting cross-functional integration, customer integration, and employee innovativeness. The result of the survey of organizations in Japan indicated that process jobs and process management and measurement influences organizational innovation performance through customer integration and employee innovativeness. Contrary to the expectations, process view did not have a significant effect. Additionally

cross-functional integration did not have a significant effect on organizational innovation performance. The second model to be discussed below is the Project Management Performance model.

The Project Management Performance Assessment Model

The Project Management Performance model (PMP) is based on the European Foundation of Quality Management's Business Excellence model (EFQM). The EFQM model was used to link Total Quality Management (TQM) and Project Management (PM) practices by (Bryde, 2003b). The PMP model consists of 5 enablers and 1 result. The enablers are of high PM performance, and are as follows: PM leadership, PM staff, PM policy and strategy, PM partnerships and resources and project life cycle management process. The results consist of the final area in the PMP model which is the Key Performance Indicators (KPIs). The KPIs are the practices by which actual achievement is measured.

The PMP model is presented in Figure 2- below.

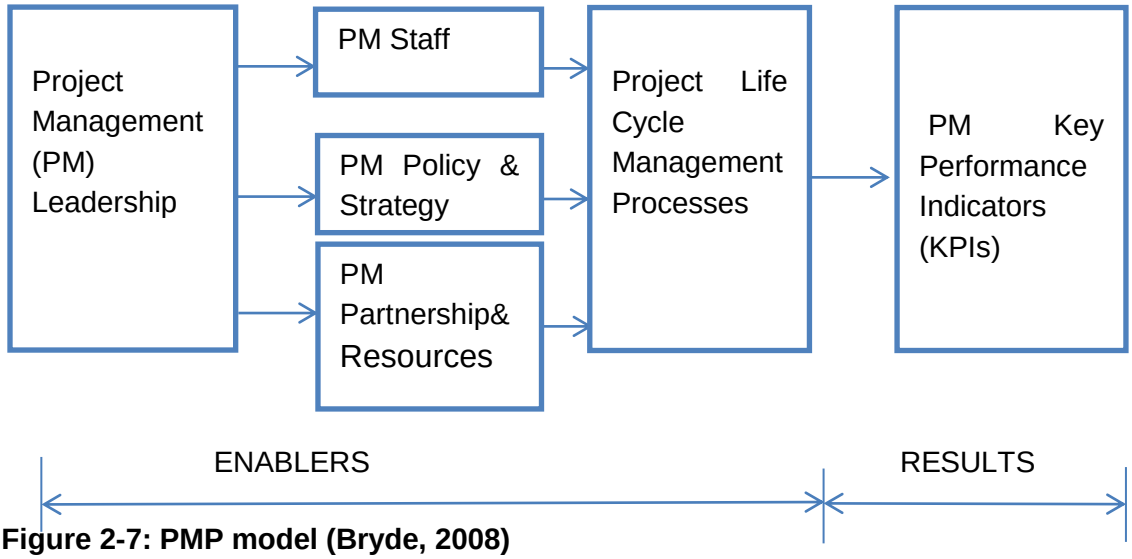

Figure 2-7: PMP model (Bryde, 2008)

The integral part of the PMP model is explained by (Bryde, 2008) in (Farzana Asad Mir, 2014) as follows:

PM Leadership - PM leadership is explained as a way of ensuring that PM system supports the development of open, two-way partnerships with customers and suppliers and a shared, common project language culture.

PM Staff - the PM staff needs to be managed in a way that incorporates methods for rewarding performance relating to PM. This will enhance performance and staff morale.

PM Policy and Strategy – Focuses on how the development of PM, across an organization, is introduced in a systematic fashion ensuring the linkage between strategic, organizational level and the tactical, project level.

PM Partnership and Resources – The partnership needs to be effective in terms of PM strategy, and they have to be equally beneficial between all stakeholders.

Project Lifecycle Management Process – incorporates processes which are required to manage the whole project life cycle.

PM Key Performance Indicators – KPIs are used to indicate results achieved in relation to meeting the requirements of project stakeholders and the method used within the PM systems to improve performance against the KPIs.

- **Propositions and Hypothesis of the model**

The model introduced seven hypothesis and three propositions to be able to analyse the relationship between PM performance and Project Success. The propositions and the hypothesis were as follows:

Proposition1. There is a positive influence of Project Management performance on Project Success.

Hypothesis1. There is a positive statistical relationship between PM performance and project success.

Proposition2. The variables of the PM Performance construct have a positive influence on Project Success construct.

Hypothesis2. There is a statically significant positive relationship between PM Leadership and Project Success.

Hypothesis3. There is a significantly positive relationship between PM staff and Project Success.

Hypothesis4. There is a significantly positive relationship between PM Policy and Strategy, and Project Success.

Hypothesis5. There is a statistically significant positive relationship between PM partnerships and Resources, and Project Success.

Hypothesis6. There is a statistically significant positive relationship between PM Project Lifecycle Management Processes and Project Success.

Hypothesis7. There is a statistically significant positive relationship between management of KPIs and project success.

Proposition3. The individual Project performance variables have a positive influence on individual project success elements.

Findings of the PMP model

The study found a positive influence of PM performance and its contributing variables on project success using the PMP model. The model was found to be a good representation of the variables studied, however the model have not been extensively researched.

Referring to Table 2-3 below, among all ten projects, none has an average schedule index value as close as possible to 1. Zeerust Munic and Delareyville have the best performance in terms of Schedule Index (SI) among the 10 with a schedule Index of 0.77 and 0.60 respectively. Matlosana has the worst performance (SI) among the 10 with a SI of 0.42. On average the SI of all the ten projects is 0.52. The projects with the best Cost Index (CI) are Khuma substation and Zeerust Munic with a CI value of 0.92 and 0.96 respectively, while the project with the worst performance (CI) is Charles Shaft with a CI value of 0.18. The average of the CI for all ten projects is 0.64. The schedule performance is more of a problem than the cost performance for the selected 10 projects. Eskom's Capital Investment Process (CIP) document states that, the boundaries for schedule variances ought to be 0% between the same phases, indicating that the accuracy of the schedule within those phases should be 100%. The document further states that project variances of each phase with reference to the Finalization Release Approval (FRA) phase should be 35% for Concept Release Approval (CRA), 15% for Definition Release Approval (DRA) and 5% for Execution Release Approval. Refer to Table 2-3 of this document for these figures. The schedule index in Table 2-3 was

calculated between the same phases, while the cost index was calculated between different phases with reference to the FRA.

Based on the information in Table 2-3 there is a call for concern as these projects cost and schedule overruns are outside the boundaries of project expected variances. It was also noted that of all 10 listed projects none of them were approved on the planned date. The calculations in Table 2-3 below were as follows:

- Schedule index = actual duration of the project divided by the planned duration of the project at a specific phase.
- Cost Index = actual cost of the project divided by the planned cost of the

Table 2.4-1: Indication of project performance in Eskom

Project phase	Actual Approval date	Planned Approval date	Schedule Index	Actual delay	Actual Cost	Cost Index
Delareyville						
CRA	2010/03/20	2008/03/12	0.20	24 months late	2 134 259.12	0.36
DRA	2012/04/28	2011/04/18	0.50	12 months late	4 133 360.06	0.70
ERA	2012/06/25	2012/03/22	0.80	3 months late	5 904 800.08	1.00
FRA	2012/11/30	2012/10/25	0.92	0.5 month late	5 904 800.08	
Total project delay			0.60	40 months late	Average CI	0.69
Moffat						
CRA	2010/03/31	2009/10/29	0.54	5 months late	606 238.98	0.41
DRA	2012/03/15	2011/04/01	0.55	10 months late	1 332 263.70	0.90
ERA	2014/03/31	2013/04/02	0.52	11 months late	1 199 037.33	0.81
FRA	2014/11/21	2014/09/21	0.50	6 months late	1 480 293	
Total project delay			0.53	32 months late	Average CI	0.71
Fochville krallkop						
CRA						0.00
DRA	2010/07/02	2010/03/02	0.75	4 months late	2 207 770.68	0.91
ERA	2012/09/19	2011/06/08	0.45	15 months late	1 022 313.60	0.42
FRA	2013/02/22	2012/12/12	0.34	12 months late	2 434 079.99	
Total project delay			0.51	31 months late	Average CI	0.66
Gopani mine						
CRA	2012/04/07	2010/02/15	0.19	26 months late	1 901 837.74	0.06
DRA	2014/02/30	2013/01/07	0.48	13 months late	3 322 408.98	0.11
ERA	2014/03/31	2014/01/16	0.86	2 months late	24 092 201.32	0.81
FRA	2015/05/31	2014/09/31	0.46	7 months late	29 743 458.42	
Total project delay			0.50	48 months late	Average CI	0.33
KLD North						
CRA	2009/02/10	2008/12/24	0.80	1.5 month late	11 650 340.12	0.78
DRA	2011/08/03	2010/04/06	0.43	16 months late	12 007 071.20	0.80
ERA	2013/11/14	2012/09/01	0.46	14 months late	13 958 220.27	0.80
FRA	2015/08/31	2014/05/30	0.25	18 months late	15 008 839	
Total project delay			0.49	50 months late	Average CI	0.79
Matlosana						
CRA	2010/06/30	2008/03/11	0.18	27 months late	17 256 842.10	0.41
DRA	2012/07/31	2011/08/15	0.52	11 months late	29 571 820.82	0.70
ERA	2014/02/31	2013/12/01	0.80	3 months late	29 400 415.81	0.70
FRA	2015/04/31	2014/08/30	0.17	9 months late	42 000 594.02	
Total project delay			0.42	72 months late	Average CI	0.60
Mabatho bulk						
CRA	2008/04/15	2008/03/11	0.85	1 month late	1 950 978.40	0.86
DRA	2009/05/19	2008/04/10	0.48	13 months late	1 810 962.40	0.80
ERA	2013/09/13	2010/09/28	0.25	36 months late	679 110.90	0.30
FRA	2014/07/28	2011/05/28	0.24	38 months late	2 263 703.00	

2.5. . CONCEPTUAL MODELS

2.5.1. . Introduction

It is highlighted in the literature study that project systems make a very important part of an organisation. And also that project performance in terms of cost and schedule overruns is still a bigger problem in most organisations. However the level of compliance to project systems by employees is not linked to project performance in the past and current literature. Therefore the study aims at establishing if there is a correlation between the level of project systems compliance and project performance by making use of hypothesis testing and correlational analysis.

After detailed study of the BPO model and the PMP model (Farzana Asad Mir,2014) discussed in the second chapter, the BPMO model was selected for this study as the preferred model for the analysis of the correlation between the level of compliance to project systems and project performance. BPMO model has a closer resemblance to this study because it is comprehensive enough to cover all of the aspects identified in the current study. Furthermore, though the PMP model has been validated by (Qureshi, 2009) and (Din, 2011), the PMP model does not fully represent the parameters in the current study, and has not been extensively researched. The PMP model looks at the Project Life Cycle Management Process as an enabler and the performance as the results, but does not look at the measurement in terms of the extent or the level of the management processes. The BPOM model studies the business process orientation, its effects on organizational parameters and finally the overall effect on organizational innovation performance. It looks at the measurement of extent to which an organization engages in cross functional skills and the measurement of the extent to which employees engage in innovative activities. It then uses the result of the measurement to conclude on the innovation performance. This is in line with what this study aims to achieve.

The theoretical model, which hypothesizes the relationship between the level of adherence to project systems and project performance, is therefore developed based on an adapted conceptual method suggested by (Jing Tang, 2013). The project systems explained in detail in the previous chapter, was used to generate the questionnaire which then assisted with measuring the level of compliance and the level of knowledge of various employees on project systems. The project performance explained in detail in the first chapter was used together with the level of compliance to come to a conclusion regarding the correlation. Therefore the model in Figure2-8-1 was developed. The model

also hypothesizes the level of knowledge of internal project systems as the second hypothesis and the level of use of project systems as the third hypothesis.

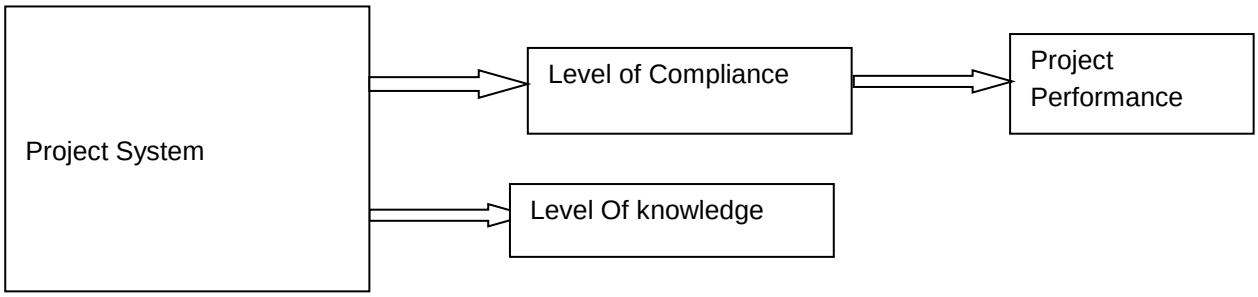

Figure2-8: Conceptual methods to investigate the correlation between the level of compliance to project systems and performance. (OWNSOURCES, 2016)

2.5.2. Project Systems

Project Systems are an input to the level of their use and the level of knowledge employees have regarding project systems.They are simply a set of structured and hierarchical activities designed to improve the productivity of the company. They are expected to help harmonise divergent terminology and different understanding about processes and methods (Ahlemann, 2008). The fundamentals of most projects in Eskom are similar in nature. Hence having a uniform way of executing these projects should result in an easier and quicker solution. The project systems discussed in chapter 2 forms an important building block of the project systems in the organisation. In every single project, these project systems forms part of the project life cycle. Therefore evaluating the level of adherence to these project systems will be an overall indication of other minor processes which form part of Eskom project systems.

The contents of these projects systems will be converted into a survey questionnaire for each of the 10 selected projects at every milestone of the projects. The employees who were involved in the project will be questioned on the level of use and level of knowledge about that particular project system during the specific project carried out. It was investigated for example at planning stage: the requirement of CIP at this stage will be stated in the questionnaire where the planner and project manager will be asked if they met any of the requirement at planning stage indicated by CIP during that specific project.

2.5.3. Project Performance

The key Project performance metrics that are evaluated are cost and schedule variances for this study. A higher performance will be indicated by either a cost index or schedule index closest to 1. Historical data of the 10 selected projects were studied with the cost

and schedule variances calculated for each project. This was then a representation of that specific project performance.

The study will concentrate more on the difference between the different stages of the project, and the overall performance of the project which is the average of the different stages. The literature study discussed the key factors influencing cost and those influencing schedule. Cheng (2013) indicated clear definition of the scope in the contract and cost control having the highest severity with natural disaster having the lowest severity on cost. Looking at his list and the Eskom's reason for cost overruns the following similarities are observed:

Material shortage or supply delay

- Additional material were needed in 3 of the 10 projects
- Material delay due to scope change

Clearly defined scope of work

- External construction constructed more than what the scope of work phase in phase one and phase two specified

Cost control

- Budgeting for higher costs for projects than actually required.

Project team

- Inadequate site investigation
- Inadequate monitoring of the project by project management in 4 of the 10 projects

Practical Experience

- Labour costs exceeded because of the number of outages needed were way more than the planned outages.
- Changes in bill of material(BOM)

Aziz (2013) categorized ninety-nine (99) contributing factors into nine (9) major categories that cause delay in construction projects. Looking at his list and Eskom's reasons for time delays the following similarities are observed:

Material Related Factors Categories

- Changes in bill of material
- Material delay due to scope changes

Contractor Related Factors Category

- Rewiring by the contractor in order for the drawing and panel to speak same language

External Related Factors Category

- Theft

Owner Related Factors Category

- Project management monitoring concentrated only on the execution phase of the project.

Design Related Factors Category

- Scope of work modification
- Inadequate site investigation

Table 2-9 below presents the reasons and challenges faced during the various project life cycles. These challenges can be linked to the challenges explained in chapter 2 in terms of the cost and schedule overruns.

Table 2.5-1: Cost and schedule overruns for Eskom projects

Projects	Reason for time delay	Reason for cost overruns
Mmabatho Bulk	Changes in bill of material, project management,	Engineering costs, material costs, Internal and external contracts, overheads and IDC,
Fochville Kraalkop refurbishment	Scope of work modification, Inadequate side investigation, Project Management.	Costs were actually saved.
Moffat	Project management (interdependent projects), business structure changes. Proper project management between different operating units	Additional material,
Delareyville Munic	Internal resources for project manage was planned for, but consultants were utilised, material process, External construction constructed more than the scope of work phase 1 and 2.	
Zeerust Munic	Changes in bill of material, Project management monitoring issues	Internal resources utilised,
Gopani Mine	Change in bill of material, monitoring of project by project management was not done correctly.	Contractor site establishment was done twice due to the delay of the material.
Klerksdorp North	Handover process from central OU led to major scope changes, resulting in the revision of the detail design. Communication with customer was done only in the final stage of the project creating further delays.	Overheads and IDC, additional material needed, invoicing from both GOU and NW OU for the detail designs.
Charles Shaft	Scope reduction due to new cost saving rules, material delay due to scope change, contractor wiring needed to be corrected as it was not done according to the drawings issued by the design engineer.	
Khuma	Late completion was due to theft.	The contingency costs were not used, major cost savings in primary plant material as it was supplied by Eskom. Estimated costs for contractor were higher than actual, transportation of material exceeded due to additional trips for transporting additional cable. There was a duplicate mistake In the estimation of electricity delivery material. Labour costs exceeded because of the number of outages needed were way more than the planned outages.

2.5.4. Level of compliance

Business process compliance emerged as a hot topic in research during the last few years (Linh Thao Ly, 2014). The literature on environmental regulation suggests three general motivations for compliance namely: calculated, normative (moral) and social (Kim Peterson, 2014). Kim Peterson, 2014 further explains the calculated compliance as cost of compliance, likelihood of detection and likelihood of fine. Social compliance is then explained as the desire of regulates to earn the approval and respect of significant others. In Eskom compliance audits are conducted manually and therefore perceived as a

burden. Some of the project systems are enforced, which increases the likelihood of detection and the cost of
fine and others can easily be bypassed. (Linh Thao Ly, 2014) also mentioned that compliance requirements on business systems stem from different sources such as laws, regulations or guidelines that are actually available as textual descriptions.

The level of compliance to project systems will be measured by asking the subjects if they have used any of the project systems during the course of the 10 selected project life cycle. The level to which they have used them will also be indicated on a scale from 1 to 5 in steps of 1, with 1 representing never and 5 always. With the project systems discussed in chapter 2, the level of compliance will be measured using for example cost and schedule variability between different project life cycle phases as indicated by (Walker, 2011) in Table 2-3
It was investigated if the project followed the requirements of the project systems,
and the following was investigated for the level of compliance:

- The requirement needed before handing over to the next phase of the project life cycle.
- If the project went through all the investment and technical committees at the right time and significant scope changes were re-presented at TEF.
- The output of different stages of the project life cycle.
- All the requirements needed before the presentation of any stage of the
- project
- The process for monitoring through process review
- The schedule issues as they have a major effect on project performance

2.5.4.1. Ability to comply

Ability to comply depends on awareness of the project systems and understanding of the consequences of non-compliance. This was measured with a survey where awareness of different project systems was tested. The training issues were also covered with the survey. Two options were provided, which were yes or no. and it was also investigated whether employees received formal training (classroom training provided by an Eskom specialist in that field) or informal training (an employee explaining the process to a new employee). Potential for response bias due to fears about non-compliance are expected to be minimal.

2.5.5. The linkage between project systems compliance and project performance

Michael Recht(2013) investigated whether process improvement efforts could improve key performance indicators in a large academic MR Imaging department, and found this to be true. The literature also indicated that there is a correlation between project management processes and project performance. (Farzana Asad Mir, 2014) also indicate from his discussion that project success and PM performance are distinct yet inter-related concepts and a positive relationship between them is sought. Therefore based on the above a positive hypothesis is proposed:

H1: The higher the level of adherence to project systems the better the project Performance

2.5.6. The linkage between the project systems and the level of application

Based on the literature review, with project systems having monitoring measures for compliance audits the following hypothesis can be safely proposed:
H2: Project systems are always applied by employees during the project life cycle.
Meaning the level of adherence is high and falls in the category of 4 and 5.

2.5.7. The linkage between the project systems and the level of knowledge

This linkage is addressed with the following positive hypothesis:

H3: Employees are knowledgeable about the different project systems
Meaning this hypothesis will only be accepted if the knowledge level falls in the category of 4 and above.
A detailed model of the developed conceptual model is presented in Figure 3-2 below.

2.5.7.1. Detail model for the collection and analysis of data

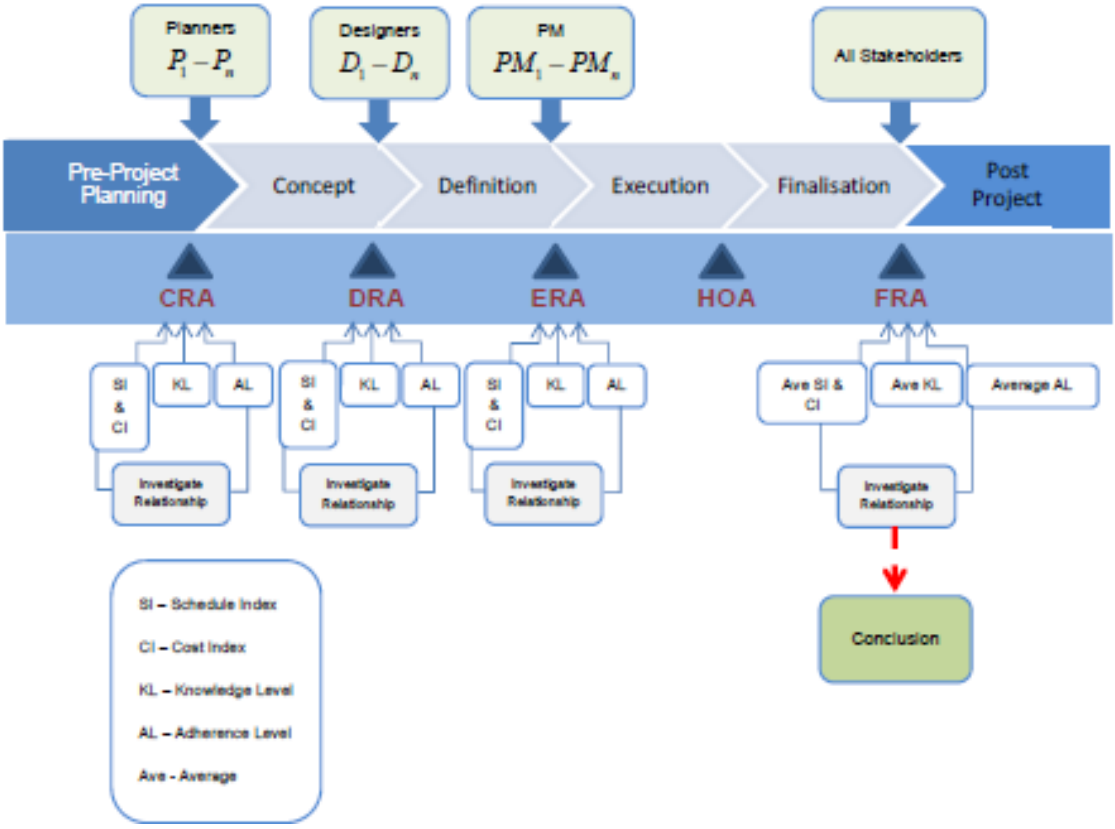

Figure 2-9 conceptual flow of data collection and analysis (Ayesha, 2015)

The flow diagram in Figure 2-9 above indicates how the study was carried out. It is a more detailed version of the conceptual model in Figure2-8. Data pertaining to the adherence level, knowledge level and project performance (SI and CI) was collected through the questionnaire and archives at each phase of the PLC excluding the HOA. Planners are extensively involved only during the pre-project planning phase and are responsible to get the CRA approved. The knowledge level and the adherence level during this phase were collected from the planners. Designers are extensively involved during the concept phase and are responsible for the DRA approval.

The knowledge level and the adherence level during concept phase were collected from the designers. PMs are extensively involved during the definition, execution and finalisation phase and are responsible for the ERA approval. The knowledge level and the adherence level during these phases were collected from the PMs. The adherence level from each phase was used to investigate its relationship with project performance (SI and CI) at that specific phase. The average of the adherence level from different phases was used to investigate the relationship between them and the average project performance (SI and CI) to draw a conclusion. The average of the different knowledge level was then

used as the overall knowledge level for the conclusion. The average adherence level was used to conclude as the compliance level of the employees.

2.6. Summary and conclusion

The literature and the actual 10 selected projects above indicate that project cost overruns and schedule delays are common problems in many organizations. The literature analysis highlights that there is a correlation between project systems and project performance.

Performance measurement criteria vary from organisation to organisation in fact they vary from project to project. In order to reach the objective of this study, only the cost and schedule key performance indexes were studied. Because it was indicated that many construction organisations struggle to manage cost and schedule overruns. The key cost influencing factors were discussed and ranked according to the severity of their influence. A clearly defined scope of work and cost control were the most important cost impact factors with a severity index of 94.78 and ranked at number 1. Aziz (2013) categorized ninety-nine (99) contributing factors into nine (9) major categories that cause time delay in construction projects.

Eskom processes and standards were studied these includes the CIP and ACNAC systems. These are the main tools used in Eskom to effectively manage the overall projects life cycle. All employees involved in projects need to have a crystal clear knowledge of the contents and application of these tools in order for these tools to serve the perceived purpose. If the users do not understand the project systems then the management of the project will become close to impossible. CIP entails the standard project life cycle, approved major standard project process; the boundaries for cost and schedule variability are indicated in this process together with the scope confidence level at each stage of the project life cycle. The four phases of the standard core project life cycle were discussed together with the five gates of the project life cycle in the project phases. The pre-project-planning phase and the post-project phases were discussed as well. There are various committees that exists within the distribution environment, these includes the IC and TEF. These committees are responsible for steering the project forward between the different phases.

CIP indicates that the development plans and projects need to be presented at the Regional Planning Review Forum before a project can qualify to be registered on the system as a project. The planners need to generate their planning proposal based on the

outcome of the PRF, the designers need to base their design document on the submitted planning proposal and the recommendation of the EIA, the project managers need to construct according to the design document and report any modifications to the designer for approval before implementation.

All projects must have a schedule, which needs to be followed and used to populate the required dates. When challenges are faced, the schedule needs to be updated and shared with all the stakeholders involved. In order to promote quality, section and departmental review meetings needs to take place before a planning proposal or design document can be submitted to either the designers or project managers. Secondly the processes stipulates that the projects must be presented at TEF for approval after a major project scope change for projects that have been previously TEF approved .

A post construction environmental audit needs to be completed before commissioning and energizing of the asset on the system. Then finally the process for monitoring adherence to this process is looked at and the monitoring is done through process reviews. Project reconciliation, project post-mortems, a project performance evaluation report and a business solution review needs to be in place for continuous improvement. All these activities are carried out through the ACNAC workflow.

The five ACNAC processes were explained. Only three of the five processes were studied in detail. All project need to be initiated by either the ACNAC controller or the planner on the system, this will assist in sending reminder to the customer should the customer not respond to the quotation in time. All project fees need to be confirmed by the planning manager before the approval of the CRA Form. In terms of managing time, ACNAC makes a provision to confirm ACNAC Forms dates with the current running schedule and construction teams to make sure that delays are noticed and managed accordingly. The date issue becomes even complicated if the users do not understand the meaning of the dates that need to be populated. The project systems summarised above can be used as an input to the measurement of the adherence level and knowledge level of the employees. This could be best represented by a model.

Two models were discussed and those are the BPO model by Jing Tang (2013) and the PMP model proposed by (Farzana Asad Mir, 2014). A model was developed for this study; more details regarding the model will be discussed in the next chapter.
A summary of the literature study, Eskom Project Systems and conceptual methods will be discussed in the next section.

This chapter also introduces an adopted framework from (Jing Tang, 2013) which provides a useful conceptual method in investigating the correlation with hypothesis testing on the linkage of project systems and knowledge on them, linkage between the level of compliance to these project systems and project performance, and evaluating the overall compliance level on project systems.

For hypothesis testing, project data for different projects was examined. The level of adherence to the system processes and the level of knowledge of project systems for each project will be assessed by making use of questionnaires in a survey. Then the performance of the respective projects will be looked at in terms of cost and schedule indexes. The correlation was investigated by testing the hypotheses indicated above. The establishment of an appropriate research methodology is required to investigate the problem statement above and reach the study's main objective

3. CHAPTER 3. RESEARCH DESIGN AND METHODOLOGY

3.1. . Introduction

This chapter gives an overview of the research design, strategy and methodology followed in the execution of the study. It also explains the reasoning behind the appropriate choice of the design and methodology for this research problem. It outlines the instrument used to collect the data, the tools used for data analysis and presentation. The population and sample for the study are also described.

3.2. Research strategy

The approach used for this study was mainly a quantitative approach. Burns and Grove (1993) define quantitative research as a formal, objective, systematic process to describe and test relationships and examine cause and effect interactions among variables. The research objectives of this study, aims to investigate the correlation between the level of adherence to internal project systems and their respective project performance. Therefore adopting a quantitative research approach suits the purpose of this study.

Westerman (2014) argues that qualitative methods are especially helpful for examining how meaningful phenomena appear in different context, whereas quantitative methods are specifically well-suited for situations in which we want to further our understanding of those meaningful phenomena by concretely specifying them or when we want to make systematic comparisons (Westerman, 2014).

This study aims to characterize one phenomenon in terms of how it relates to other phenomena's rather than what the phenomena is like in itself. Hence the selection of a qualitative approach is once again justified. A greater extent of the information required for this study will be based on the experience of personnel involved with engineering projects.

Even though qualitative research seeks depth over breadth and attempts to learn subtle nuances of life experiences as opposed to aggregate evidence. Qualitative research is contextual and subjective versus generalizable and objective (Robin Whittemore, 2001).The means of data collection chosen for this study also to a greater extent dictates the research design to be adopted.

Welman etc. al (2005) indicated that we may use survey questionnaires to obtain different information from respondents and those included but not limited to typical behaviour,

attitudes and beliefs. This is well suited for this research study; asurvey treats the data as discrete and controllable making it easy to collect relevant information. Therefore a survey design was chosen to meet the objective of the study with ease, which is to determine the correlation between two phenomenon through the knowledge and views of employees.

An illustration of the research strategy adopted for this study is presented in Figure 3-1 below by Welwyn (2013). The highlighted blocks demonstrates research approach used in this study.

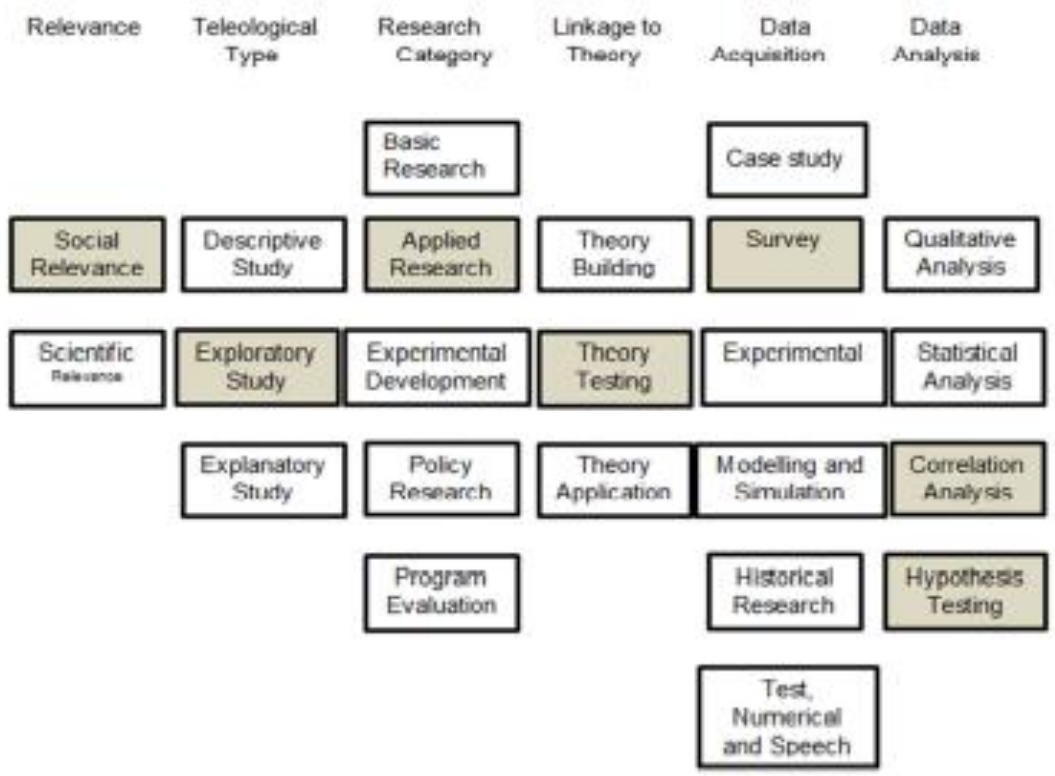

Figure 3-1: Research Strategy (Welwyn, 2013).

3.3. Research design and instrument

There are different types of research designs namely explanatory, exploratory, descriptive, correlational and causal-comparative study. An exploratory study was chosen for this study. The research study was experimental in nature and was performed in the field for a more natural setting. Questionnaires were used as the research instrument to conduct surveys.

Questionnaires make it easier to collect the relevant information that one is looking for from respondents. The questionnaire was structured in a way that makes it easier to answer the research problem and test the hypothesis. Questionnaires will make it easier

for respondents to respond because most people are familiar to questionnaires, therefore increasing the response rate.

3.4. . Population and Sampling

The target population is employees from engineering department in Eskom Distribution LOU. The departments are asset design, project management, planning, plant management, land development and environmental. The employees include technicians, engineers, technologists, engineering managers and project management. The participants need to have a minimum of two years working experience in Eskom with an added benefit of been involved in the projects to be studied.

The reason of such a specific group of employees is firstly because project systems are mostly applied in their field of work and secondly they should have a better understating of these project systems, therefore are able to substantiate their reasoning for their choice of answer during an interview or survey. Thirdly if a particular project is being investigated it will be easy for the respondents to have been part of the project to give the correct input. A non-probability sample was used in this study because the sample was chosen based on the research objective. Therefore by choosing this subset of the population the chance of getting relevant feedback increases. A survey questionnaire was compiled and sent to a sampling frame of 50 participants with a sample size of 90% expected to respond. The Demographic data of the participants will also be assessed in the survey for better data categorization.

3.4.1. Data Sources

There are two classifications of data, the primary data and the secondary data. Primary data is explained as data observed or collected directly from first-hand experience and secondary data is explained as published or archived data. Primary and secondary data was collected for this study. Secondary data was collected from the archives, the project files and ACNAC workflow was specifically looked into. Primary data was collected from a survey questionnaire conducted within the engineering fraternity. Primary data was used to investigate the level of compliance to project systems by the participants whereas secondary data was used to measure the performance of the projects being investigated. Both the primary and secondary data was used to analyse and therefore conclude on this study.

3.5. Pilot survey

A pilot survey was conducted to test the suitability of the proposed questions against the required data. A few survey questionnaires were circulated to a few randomly selected personnel in the engineering departments. The sample size for this pilot survey was 10 participants scattered around the population, these includes: the technician, engineer, technologist, engineering management and project management. The participants were also interviewed in order to refine the survey to be more understandable and yield meaningful and useful data. The pilot survey assisted with the validation of the time it takes to complete the questionnaire, as this information makes life easier for the participants to know approximately how long the survey will take for them to complete.

3.6. Data presentation and Analysis

Once one has collected the data one needs to make sense of it by organising and coding it in order to ease the analysing process. The method chosen to analyse the data was correlation analysis using line fitting in Excel. The LINEST function calculates the statistics for a line by using the "least squares" method to calculate a straight line that best fits the given data, and then returns an array that describes a straight line represented by the equation below:

$$y = mx + c$$

A graph indicating a correlation between compliance level and Schedule Index (SI) or Cost Index (CI) should have a gradient of 5 and an R-squared value of 1. When the R-squared value is as close as possible to 1 a stronger relationship is indicated and as the R-squared value decreases to zero the strength of the relationship decreases. Correlation analysis and hypothesis testing was also applied in the data analysis process. Tables and graphs were employed in presenting the data for ease of understanding.

3.7. . Validity and Reliability

Validity refers to the accuracy and trustworthiness of instruments, data and findings. In this case are the surveys and interviews valid instruments to measure the level of adherence to internal project systems? The validity of the conclusion was tied to the validity of the data and hence the instrument, therefore one need to make sure that the instrument is valid.

Validity was ensured by making sure that the questions and instructions for completing the questionnaire are clear and straight to the point. Simple English was also used in the questionnaire for ease of understanding. Most of the participants completed their questionnaire in the presence of the researcher for more clarity should they not fully understand the questions or the instructions.

Reliability refers to whether you get the same answer by using an instrument to measure something more than once. Reliability was insured by assuring that the questions in the questionnaire were structure in a way to retrieve objective and reliable data. The answers will differ from person to person but it should stay the same if the questions are repeated on the same participant for the same project.

3.8. . Research limitations

Eskom is a broad organisation with 9 different OUs. The core project systems are standardised throughout the operating units, but due to the scope of this study and the nature of the organisation at hand, it was not possible to study all the nine OUs and hence do a comparison between them. Therefore the result in this study cannot be generalised. The focus for the projects was on the LOU.

3.9. . Ethical Considerations

The organisation gave consent for the study to be conducted. All participants were adults and gave informed consent for participating in the survey. They were also well informed that they were participating in a research study for a master's dissertation which might be published. The participants were informed that they could withdraw their consent at any time during the course of the research project. Another ethical consideration was making sure that the participants are unharmed during the research project by ensuring confidentiality and anonymity. The records of the survey and interview will be safely stored and not shared with anyone unless permission is obtained.

3.10. Conclusion

This chapter explained the research methodology chosen for this study. The research design and strategy used in the study was justified. The type, source and means of collecting and analysing the data were also explained. Then finally the validity, reliability, limitations of the study and ethical considerations were detailed.

4. CHAPTER 4: RESULTS AND DISCUSSION OF RESULTS

This chapter presents and discusses the results of the survey. The survey measured two parameters; firstly it measured the level of compliance to project systems. Secondly it measured the knowledge of employees about project systems. The results of the level of compliance to selected projects were then used to analyze if there is a correlation between the level of adherence to project systems and project performance. The respondents were received from different participants in the engineering field who are employees of Eskom Distribution North West Operation Unit.

A total of 50 questionnaires were distributed. Only 45 responded and included responses from planning, plant, project engineering and project management sections. The respond rate was 90% as expected. The Demographic data of the participants were also captured and presented next.

4.1 Demographic data

The following are the characteristics of the respondents:

Table 4.1-1: Designation

Technicians	44.44%
Engineers	8.89%
Managerial level (including PM)	46.67%

Table 4.1-2: Age

25-30	42.22%
31-40	42.22%
41-60	15.56%

Table 4.1-3: Gender

Male	57.78%
Female	42.22%

Table 4.1-4: Highest qualification

N4-N6	4.44%
National Diploma	37.78%
B-Tech	26.67%
BSc/BEng	11.11%
Honours	15.56%
MSc/MEng/MBA	4.44%
others	0

Table 4-4.1-5: Number of years' experience and completed projects

	Number of years of experience	**Number of projects completed**
Less than 5	20.%	6.67%
Between 5-10	35.56%	17.76%
More than 10	44.44%	75.56%

Table 4.1-6: Training on the Eskom project systems

Participants	**Training level**
Overall	50.37%
Designers	45.2%
Planners	52.3%
Project Managers	63.3%

Table 4.1-7: Type of training received of the 50.37%

Formal	36.50%
Informal	13.87%

4.1.1 Summary of Demographic data

Majorities (91.11%) of the participants were technicians and managers, engineers were few (8.89%) due to the lack of engineers in organizations. The age group was between 25 and 40 years with a fair gender division. Most of the respondents have national diplomas and B-Tech with a few with MSc and BSc. Majority of the respondents have more than 10 years of work experience and have completed more than 10 projects. The overall training on project systems of the respondents is 50.37% with PMs having the highest training level percentage, followed by planners then lastly designers. Of the 50.37 respondents who received training 36.5% received formal training. Formal training is referring to classroom training conducted by an Eskom specialist on the project systems.

Questionnaire analysis

Below is a list of projects with their respective numbers.

Table 4.1-8: Project with corresponding numbers

Project numbers	**Corresponding projects**
1	Mmabatho Main
2	Fochville Kraalkop
3	Moffat
4	Delareyville Munic
5	Khuma Substation
6	Gopani Mine
7	Matlosana Mall
8	Klerksdorp North
9	Charles Shaft
10	Zeerust Munic
11	Other

Analysis for correlation

The compliance scores were tabulated from the questionnaires and summarized in the tables below. These scores were categorized according to their respective phases and were used together with the respective SI and CI, to evaluate correlation using line fitting in Excel.

The LINEST function calculates the statistics for a line by using the "least squares" method to calculate a straight line that best fits the given data, and then returns an array that describes a straight line represented by the equation below:

$y = mx + c$

A graph indicating a 100% correlation between compliance level and SI or CI should have a gradient of 5 and an R-squared value of 1. When the R-squared value is as close as possible to 1 a stronger relationship is indicated and as the R-squared value decreases to zero the strength of the relationship decreases. R-squared values were considered only up to two decimal places. A zero R-squared value indicates no correlation. A gradient with a negative value will indicate an inverse correlation. A graph that does not seem to be following a trend indicates no correlation.

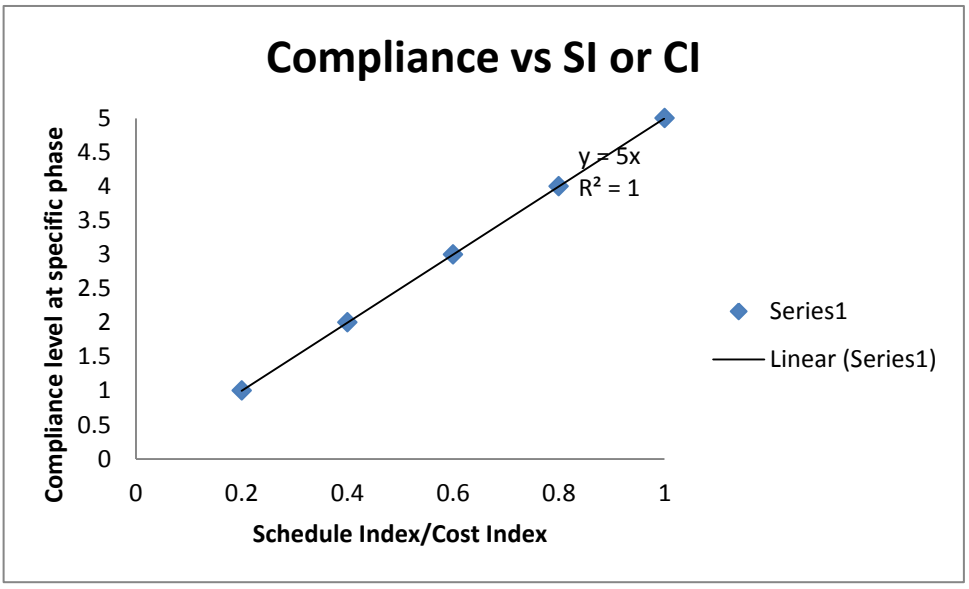

Figure 4-1: 100% relationship between compliance level and project performance (SI and CI)

The following is a summary of the responses received from different participants per project stage category:

4.1.2 Pre-project planning phase CIP

This phase of the questionnaire was applicable to planners.

Table 4-4.1-9 to Table 4.1-21 below shows the number of planners who scored certain scores, ranging from 1 to 5, with 1 indicating never and 5 indicating always. It also indicates the projects that the planners were involved in by their corresponding project numbers. The average of the score is calculated and displayed in the table together with the corresponding SI and CI.

4.1.2.1 Did you present the development plan and projects at the Regional Planning Review Forum (PRF)?

A total of 7 planners responded to this question.

Table 4-4.1-9: CRA Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			3					3	3	0.85	0.86
2	2			4		4		10	3.3		
3						5		5	5	0.54	0.41
4		5						5	5	0.2	0.36
5				5				5	5		
6			3					3	3	0.19	0.06
7		3				5	5	13	4.3	0.18	0.41
8	4							4	4	0.8	0.78
9					5			5	5	0.26	0.23
10					3			3	3	0.85	0.88
Average compliance level score for this question									4.1		

4.1.2.2 When delivering a cost estimate letter to the customer, do you do this within 30 calendar days from the time you receive the application?

This question was answered by a total of 7 planners.

Table 4-4.1-10: CRA Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			2					2	2	0.85	0.86
2	2			2		4		8	2.6		
3						5		5	5	0.54	0.41
4		5						5	5	0.2	0.36
5				4				4	4		
6			3					3	3	0.19	0.06
7		2				4	4	10	3.3	0.18	0.41
8	2							2	2	0.8	0.78
9					5			5	5	0.26	0.23
10					2			2	2	0.85	0.88
Average compliance level score for this question									3.2		

4.1.2.3 Did you conduct section project review meetings before submitting the planning proposal to the designers?

This question was answered by a total of 7 planners.

Table 4.1-11: CRA Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			2					2	2	0.85	0.86
2	1			1		1		3	1		
3						1		1	1	0.54	0.41
4		2						2	2	0.2	0.36
5				1				1	1		
6			1					1	1	0.19	0.06
7		1				1	1	3	1	0.18	0.41
8	1							1	1	0.8	0.78
9					1			1	1	0.26	0.23
10					1			1	1	0.85	0.88
Average compliance level score for this question									1.18		

4.1.2.4 Did you conduct departmental project review meetings before submitting the planning proposal to designers?

This question was answered by 7 planners.

Table 4.1-12: CRA Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			1					1	1	0.85	0.86
2	1			1		1		3	1		
3						1		1	1	0.54	0.41
4		1						1	1	0.2	0.36
5				1				1	1		
6			1					1	1	0.19	0.06
7		1				1	1	3	1	0.18	0.41
8	1							1	1	0.8	0.78
9					1			1	1	0.26	0.23
10					1			1	1	0.85	0.88
Average compliance level score for this question									1		

4.1.2.5 Did you handover a project with CRA Form approved, schedule and planning proposal?

This question was answered by 7 planners.

Table 4.1-13: CRA Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			1					1	1	0.85	0.86
2	3			3		3		9	3		
3						3		3	3	0.54	0.41
4		4						4	4	0.2	0.36
5				1				1	1		
6			1					1	1	0.19	0.06
7		1				1	3	5	1.6	0.18	0.41
8	1							1	1	0.8	0.78
9					1			1	1	0.26	0.23
10					1			1	1	0.85	0.88
Average compliance level score for this question									1.87		

4.1.2.6 Conclusion for the CIP Process

The results from the pre-project planning phase CIP indicated an average score of 2.27 for the level of compliance, while the average performance during this phase indicated an SI of 0.56 and a CI of 0.49. Figure 4-2 indicates that the gradient of the SI graph is negative with an R-squared value of 0.28. This means that there is an inversely proportional relationship between compliance level and schedule performance. The CI graph shows a similar trend as the SI graph, Figure 4-3 indicates a less negative gradient with an R-squared value of 0.21. Therefore it can be concluded that the Capital Investment Process at CRA phase showed a negative correlation between project system

compliance level and project performance (schedule and cost). The relationship between the compliance level and schedule performance is stronger than the relationship between compliance level and cost performance.

Table 4.1-14: CRA CIP Average Compliance level results with Schedule Index and Cost Index

Projects	Q1	Q2	Q3	Q4	Q5	Average score
1	3	2	2	1	1	1.8
2	3.3	2.6	1	1	3	2.18
3	5	5	1	1	3	3
4	5	5	2	1	4	3.4
5	5	4	1	1	1	2.4
6	3	3	1	1	1	1.8
7	4.3	3.3	1	1	1.6	2.24
8	4	2	1	1	1	1.8
9	5	5	1	1	1	2.6
10	3	2	1	1	1	1.6
Average scores for the CIP in CRA						2.27

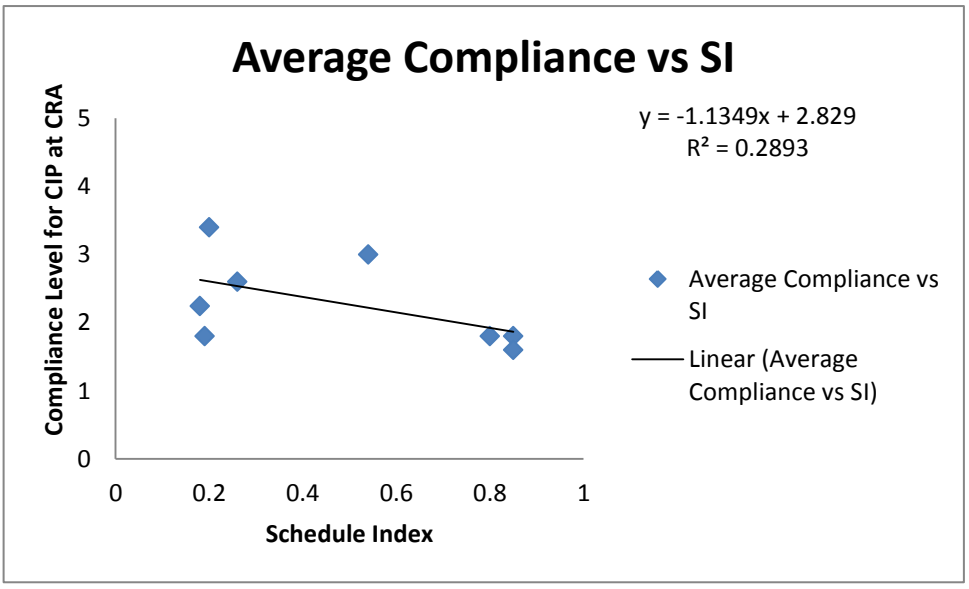

Figure 4-2: Compliance vs SI for CIP at CRA (OWNSOURCES, 2016)

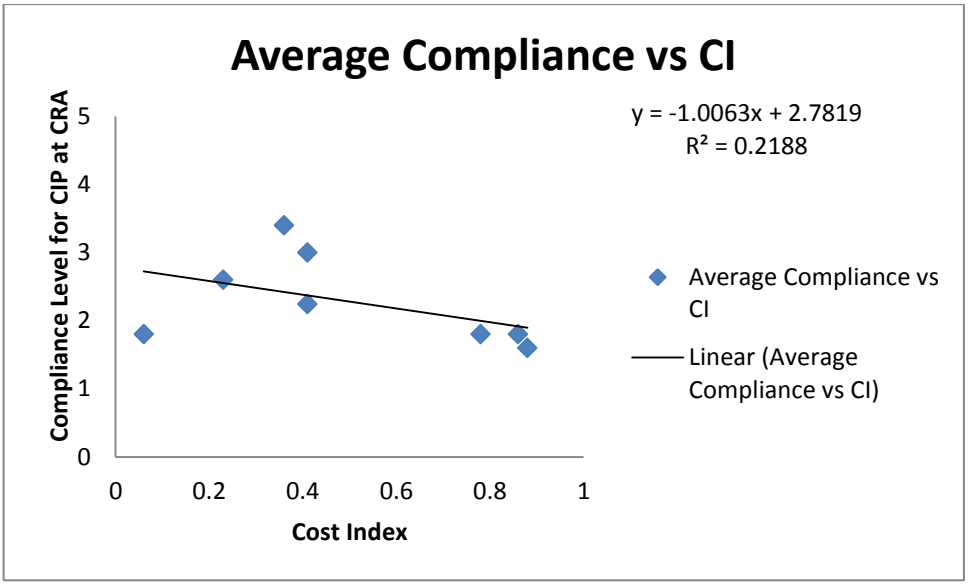

Figure 4-3: Compliance vs CI for CIP at CRA (OWNSOURCES, 2016)

4.1.3 Pre-project planning phase (ACNAC)

This phase of the questionnaire is only applicable to planners.

4.1.3.1 AS an ACNAC controller or planner do you initiate the work flow in ACNAC by registering the CRA Form?

This question was answered by a total of 7 planners.

Table 4.1-15: CRA ACNAC Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			1					1	1	0.4	0.86
2	2			3		5		10	3.3		
3						5		5	5	0.71	0.41
4		5						5	5	0.37	0.36
5				5				5	5		
6			1					1	1	0.32	0.06

7		4				4	3	11	3.6	0.44	0.41
8	1							1	1	0.92	0.78
9					3			3	3	0.8	0.23
10					1			1	1	0.52	0.88
Average compliance level score for this question									2.72		

4.1.3.2 Did you send a reminder to the customer after 21 days of receipt of the feasibility quote for the acceptance or rejection of the Feasibility Quote?

This question was answered by a total of 7 planners.

Table 4.1-16: CRA ACNAC Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			1					1	1	0.4	0.86
2	3			3		4		10	3.3		
3						5		5	5	0.71	0.41
4		5						5	5	0.37	0.36
5				5				5	5		
6			1					1	1	0.32	0.06
7		2				1	3	6	2	0.44	0.41
8	1							1	1	0.92	0.78
9					1			1	1	0.8	0.23
10					1			1	1	0.52	0.88
Average compliance level score for this question									2.44		

4.1.3.3 Did you confirm that the fees allocated to the project are reasonable before approving the CRA on the system?

This question was applicable to 7 planners.

Table 4.1-17: CRA ACNAC Compliance level results with Schedule Index and Cost Index

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			1					1	1	0.4	0.86
2	3			4		3		7	3.5		
3						3		3	3	0.71	0.41
4		4						0	4	0.37	0.36
5				4				4	4		
6			1					1	1	0.32	0.06

7		1				1	3	5	1.6	0.44	0.41
8	1							1	1	0.92	0.78
9					2			2	2	0.8	0.23
10					1			1	1	0.52	0.88
Average compliance level score for this question									2.37		

4.1.3.4 Did you confirm the contracted CRA approval date on the system after the schedule is approved?

This question was answered by a total of 7 planners.

Table 4.1-18: CRA ACNAC Compliance level results with SI and CI

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			3					3	3	0.4	0.86
2	1			1		1		3	1		
3						3		3	3	0.71	0.41
4		5						5	5	0.37	0.36
5				1				1	1		
6			3					3	3	0.32	0.06
7		1				1	2	4	1.3	0.44	0.41
8	3							3	3	0.92	0.78
9					3			3	3	0.8	0.23
10					3			3	3	0.52	0.88
Average compliance level score for this question									2.53		

4.1.3.5 Do you understand the meaning of the dates you are required to populate on the CRA Form? (contracted approval date, job required completion date and contracted completion date)

This question measured the level of knowledge and was answered by 7 planners.

Table 4.1-19: CRA ACNAC Compliance level results with SI and CI

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			5					5	5	0.4	0.86
2	2			2		3		7	2.3		
3						4		4	4	0.71	0.41
4		5						5	5	0.37	0.36
5				3				3	3		
6			5					5	5	0.32	0.06
7		3				5	5	13	4.3	0.44	0.41
8	5							5	5	0.92	0.78

9					5			5	5	0.8	0.23
10					5			5	5	0.52	0.88
Average compliance level score for this question									4.19		

4.1.3.6 Does the CRA Form get approved by the IC chairperson on the contracted CRA approval date indicated on the CRA Form?

This question was applicable and answered by a total of 7 planners.

Table 4.1-20: CRA ACNAC Compliance level results with SI and CI

Projects	P1	P2	P3	P4	P5	P6	P7	Total score	Average score	SI	CI
1			1					1	1	0.4	0.86
2	2			1		1		4	1.3		
3						1		1	1	0.71	0.41
4		3						3	3	0.37	0.36
5				1				1	1		
6			1					1	1	0.32	0.06
7		1				1	1	3	1	0.44	0.41
8	1							1	1	0.92	0.78
9					2			2	2	0.8	0.23
10					1			1	1	0.52	0.88
Average compliance level score for this question									1.48		

4.1.3.7 Conclusion for ACNAC process

The results from the pre-project planning phase ACNAC indicated an average score of 2.29 for compliance; while the average performance during this phase indicated a SI of 0.56 and a CI of 0.49. Figure 4-5 below indicates that the gradient of the SI graph is negative with an R-squared value of 0.18. This means that there is an inversely proportional relationship between compliance level and schedule performance. The CI graph in Figure 4-5 shows a similar trend as the SI graph, but the CI graph has a less negative gradient with an R-squared value of 0.12. Therefore it can be concluded that the Capital Investment Process at CRA phase showed an negative correlation between project system compliance and project performance (both schedule and cost). The relationship between the compliance level and schedule performance is stronger than the relationship between compliance level and cost performance.

Table 4.1-21: CRA ACNAC average Compliance level results with SI and CI

Projects	Q1	Q2	Q3	Q4	Q6	Average score	SI	CI

1	1	1	1	3	1	1.40	0.86	0.86
2	3.3	3	3.5	1	1.3	2.48		
3	5	5	3	3	1	3.40	0.41	0.41
4	5	5	4	5	3	4.40	0.36	0.36
5	5	5	4	1	1	3.20		
6	1	1	1	3	1	1.40	0.06	0.06
7	3.6	2	1.6	1.3	1	1.90	0.41	0.41
8	1	1	1	3	1	1.40	0.78	0.78
9	3	1	2	3	2	2.20	0.23	0.23
10	1	1	1	3	1	1.40	0.88	1.12
Average compliance level score						2.29	0.56	0.49

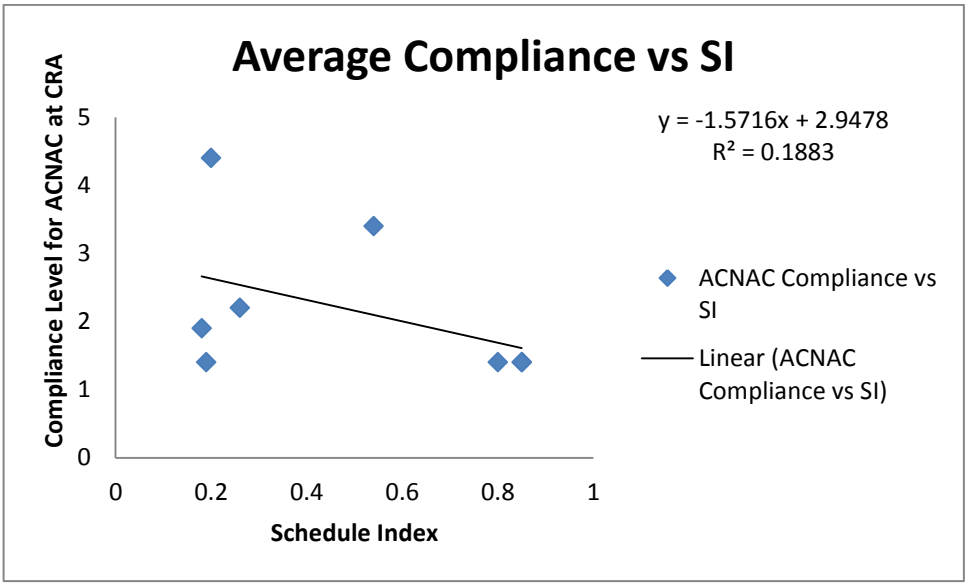

Figure 4-4: Compliance vs SI for ACNAC at CRA

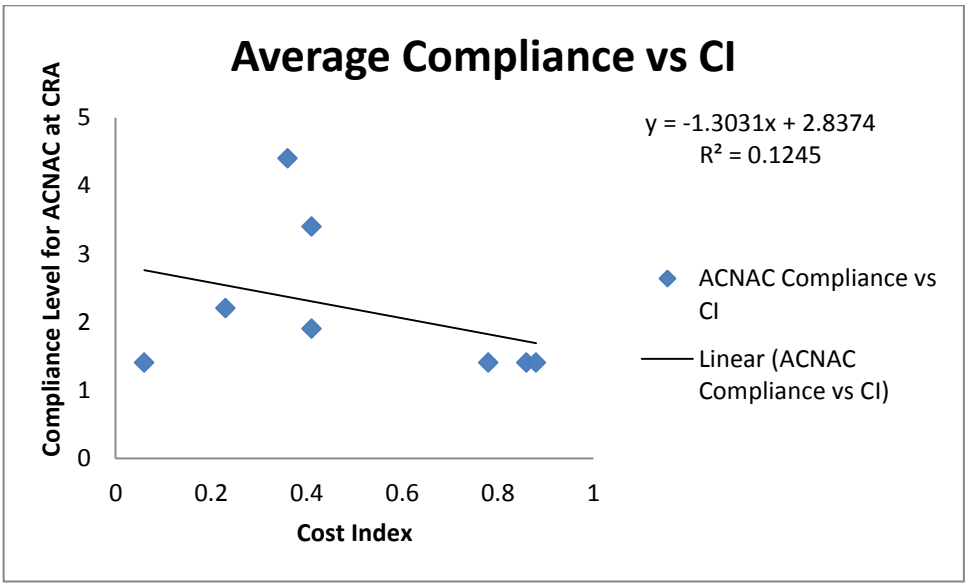

Figure 4-5: Compliance vs CI for ACNAC at CRA

4.1.3.8 Conclusion for overall CRA phase

The results from the pre-project planning phase for CIP and ACNAC indicates that the overall CRA stage compliance level is 2.28, while the knowledge level is 4.19 shown in Table 4.1-19 and the average performance during this phase of the project life cycle is 0.49 for CI and 0.56 for SI. Both the CIP and ACNAC showed a negative correlation between project systems compliance and project performance. Therefore a conclusion of a negative correlation can be drawn based on the subsections in the CRA phase of the project. The relationship between the compliance level and schedule performance is stronger than the relationship between compliance level and cost performance.

Table 4.1-22: CRA Average Compliance level for CIP and ACNAC with SI and CI

Projects	ACNAC	CIP	Average	SI	CI
1	1.4	1.8	1.6	0.40	0.86
2	2.4	2.1	2.2		
3	3.4	3	3.2	0.71	0.41
4	4.4	3.4	3.9	0.37	0.36
5	2.2	2.4	2.3		
6	1.4	1.8	1.6	0.32	0.06
7	1.9	2.24	2.07	0.44	0.41
8	1.4	1.8	1.6	0.92	0.78
9	2.2	2.6	2.4	0.80	0.23
10	1.4	1.6	1.5	0.52	0.88
Average score			2.28	0.56	0.49

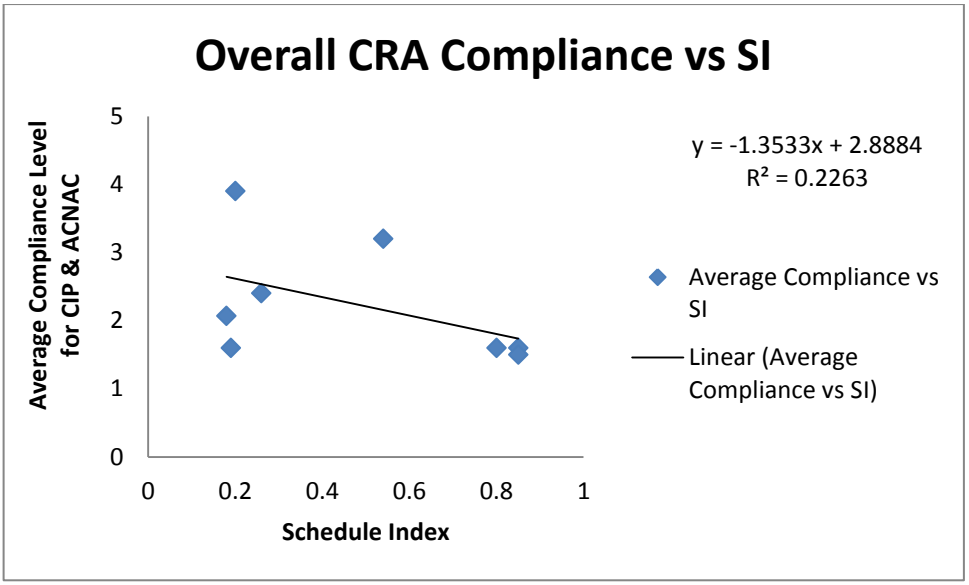

Figure 4-6: Average CRA Compliance vs SI for CIP and ACNAC

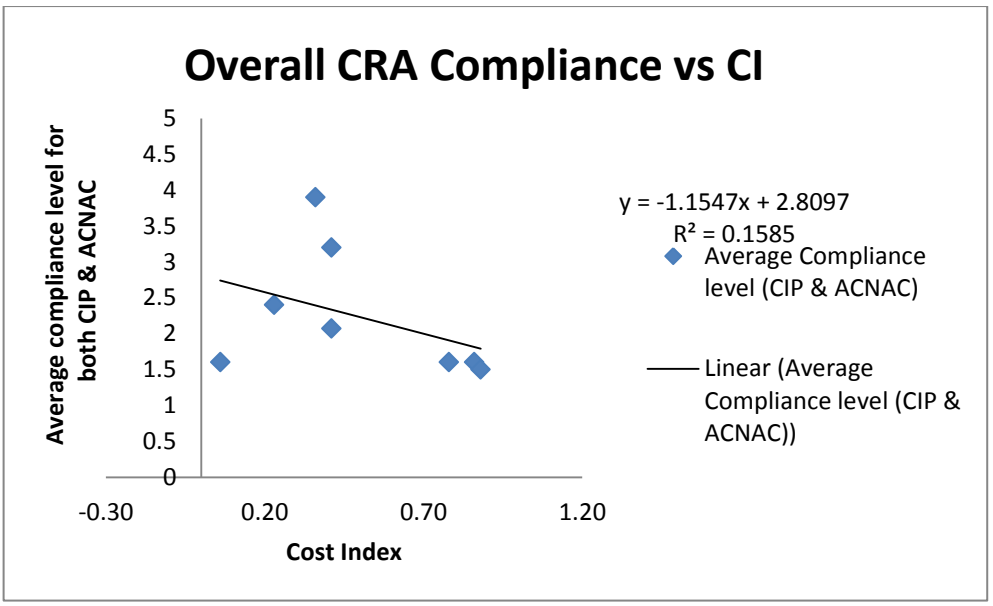

Figure 4-7: Average CRA Compliance vs CI for CIP and ACNAC

4.1.4 Concept Phase CIP

Table 4.1-23 to Table 4.1-39 below indicates the number of designers who scored certain scores, ranging from 1 to 5, with 1 indicating never and 5 indicating always. It also indicates the projects that the designers were involved in by their corresponding project numbers. The average of the score is calculated and displayed in the table together with the corresponding SI and CI.

4.1.4.1 Did you present the CRA Form(s) to a Resource Planning Meeting (RPM)?

A total of 28 designers responded to this question

Table 4.1-23: DRA CIP Compliance level results with SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	5													5															5	5	0.48	0.8
2						2							2																2	2		
3																												1	1	5	0.55	0.9
4			1	3						2																		6	2	0.49	0.7
5																																
6					2									2										1	2				7	3	0.48	0.1
7									1	1		1	2												2		1		8	1.3	0.52	0.7
8						5	1																		2		1		9	2.25	0.43	0.8
9	1	1																					1						3	1		
10																					2				2	2	1		7	1.75	0.75	1
11															5	2	2	5	5	3		4							26	3.7		
Average compliance level score for this question																														2.7		

4.1.4.2 Did you base the concept design on the site recommended in the Environmental Impact Assessment (EIA)?

Table 4.1-24: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	4													4															4	4	0.48	0.84
2						2							2																4	2		
3																												5	5	5	0.55	0.86
4			1	1						1																			3	1	0.49	0.67
5																																
6					2									3										3	4				12	3	0.48	0.10
7								1	3	3	1	1	2																11	1.8	0.52	0.70
8						3	2																	3	3				11	2.75	0.43	0.84
9	3	3																					3						9	3		
10																					5					5	5	4	19	4.75	0.75	1.00
11															1	5	5	5	5	3		4							28	4		
Average compliance level score for this question																														3.13		

4.1.4.3 Did you schedule the project at the Concept phase (PPM)?

A total of 28 designers responded to this question.

Table 4.1-25: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1															2	1	0.48	0.8
2						3							3																3	3		
3																												4	4	5	0.55	0.9
4			2	1						1																			4	1.33	0.49	0.7
5																																
6					1									2										1	2				6	1.5	0.48	0.1
7								1	1	1	1	1	3																8	1.3	0.52	0.7
8						3	1																	3	4				11	2.75	0.43	0.8
9	1	1																					1						3	1		
10																					2					3	4	3	12	3	0.75	1
11															3	2	2	5	5	3		4							24	3.4		
Average compliance level score for this question																														2.33		

4.1.4.4 Should there be a schedule, do you follow the dates on the schedule?

A total of 28 designers responded to this question.

Table 4.1-26: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1															2	1	0.48	0.8
2						2							3																5	2.5		
3																												1	1	1	0.55	0.9
4			1	1						1																		1	4	1	0.49	0.7
5																																
6					1									1										3	3				8	2	0.48	0.1
7								2	1	1	1	1	2																8	1.3	0.52	0.7
8						1	1																	1	1				4	1	0.43	0.8
9	1	1																					1						3	1		
10																					2					2	2	3	9	2.25	0.75	1
11															5	1	3	3	3	1		1							17	4.5		
Average compliance level score for this question																														1.76		

4.1.4.5 When compiling the preliminary design, do you base it on the planning report?

A total of 28 designers responded to this question.

Table 4.1-27: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1															2	1	0.48	0.8
2						5							5																10	5		
3																												5	5	5	0.55	0.9
4			1	5						5																		5	16	4	0.49	0.7
5																																
6					2																			5	5				12	4	0.48	0.1
7								2	3	2	5	3	5																20	3.3	0.52	0.7
8						5	2																	1	3				11	2.75	0.43	0.8
9	1	5																					1						7	2.3		
10																					5					5	4	1	15	3.75	0.75	1
11															3	1	5	5	3	4		1							22	4.5		
Average compliance level score for this question																														3.56		

4.1.4.6 Did you do section project review meetings before submitting the design package to project management?

A total of 28 designers responded to this question.

Table 4.1-28: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1														2	1	0.48	0.8
2						1							1																2	1		
3																												1	1	1	0.55	0.9
4			1	1						1																		1	4	1	0.49	0.7
5																																
6					1																			1	1				3	1	0.48	0.1
7								1	1	1	1	1	1																6	1	0.52	0.7
8						1	1																	1	1				4	1	0.43	0.8
9	1	1																					1						3	1		
10																					1					2	1	1	5	1.25	0.75	1
11															1	2	1	1	1	2		2							10	1.42		
Average compliance level score for this question																														1.07		

4.1.4.7 Did you conduct departmental project review meetings before submitting the design package to project management?

A total of 28 designers responded to this question.

Table 4.1-29: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1														2	1	0.48	0.8
2						1							1																2	1		
3																												1	1	1	0.55	0.9
4			1	1						1																		1	4	1	0.49	0.7
5																																
6					1																			1	1				3	1	0.48	0.1
7								1	1	1	1	1	1																6	1	0.52	0.7
8						1	1																	1	1				4	1	0.43	0.8
9	1	1																					1						3	1		
10																					1					1	1	1	4	1	0.75	1
11															1	2	1	1	1	1		1							8	1.3		
Average compliance level score for this question																														1.03		

4.1.4.8 Did you (IC) make sure that that all land owners have signed options for the servitudes required for the project before approval of the project?

A total of 7 design managers responded to this question.

Table 4.1-30: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	n													3															3	3	0.48	0.8
2						n							5																5	5		
3																												n			0.55	0.9
4			n	n																								n	n	5	0.49	0.7
5																														5		
6					3																			n	n				3	3	0.48	0.1
7								n	n	3	n	1	5																9	3	0.52	0.7
8						n	3																						3	3	0.43	0.8
9	n	n																					n						0	5		
10																					n					n	n		0	3	0.75	1
11															n	n	n	n	n	n		5							5	5		
Average compliance level score for this question																														3.64		

4.1.4.9 Did you present the project at TEF for approval after a major project scope change for projects that have been previously TEF approved?

A total of 28 designers responded to this question.

Table 4.1-31: DRA CIP Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1															2	1	0.48	0.8
2						1							1																2	1		
3																												1	1	1	0.55	0.9
4			1	1						1																		1	4	1	0.49	0.7
5																														1		
6					1																			1	1				3	1	0.48	0.1
7								1	1	1	1	1	1																6	1	0.52	0.7
8						1	1																	1	1				4	1	0.43	0.8
9	1	1																					1						3	1		
10																					1					1	1	1	4	1	0.75	1
11															1	1	1	1	1	1		1							7	1		
Average compliance level score for this question																														1		

4.1.4.10 Conclusion for Concept Phase for the Capital Investment Process

The results from the concept phase CIP indicated an average score of 2.24 for the compliance, while the average performance during this phase indicated a SI of 0.52 and a CI of 0.71. **Figure 4-8** indicates that the gradient of the SI graph is positive with an R-squared value of 0.12. This indicates that there is directly proportional relationship between compliance level and schedule performance, therefore concluding that

there is a positive correlation between compliance level and schedule performance. The CI graph in **Figure 4-9** showed a negative gradient, with an R-squared value of 0. This indicates that there is no correlation the CIP process and the cost performance of a project.

Table 4.1-32: DRA Average CIP Compliance level results with DRA SI and CI

Projects	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Average score	SI	CI
1	5	4	1	1	1	1	1	3	1	2	0.48	0.84
2	2	2	3	2.5	5	1	1	5	1	2.5		
3	5	5	5	1	5	1	1		1	3	0.55	0.86
4	2	1	1.3	1	4	1	1	3	1	1.7	0.49	0.67
6	3	3	1.5	3	4	1	1	5	1	2.5	0.48	0.1
7	1.3	2	1.3	1.3	3.3	1	1	3	1	1.67	0.52	0.7
8	2.3	3	2.8	1	2.8	1	1	3	1	1.94	0.43	0.84
9	1	3	1	1	2.3	1	1	5	1	1.81		
10	1.8	5	3	2.3	3.8	1.3	1	3	1	2.42	0.75	1
Average scores for the CIP in DRA										2.24	0.52	0.71

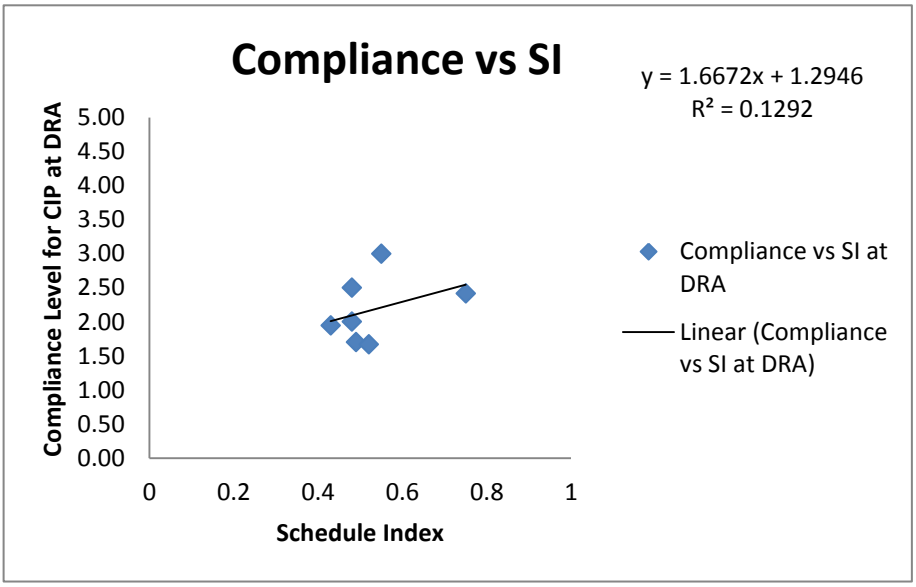

Figure 4-8: DRA CIP Compliance vs SI (OWNSOURCES, 2016)

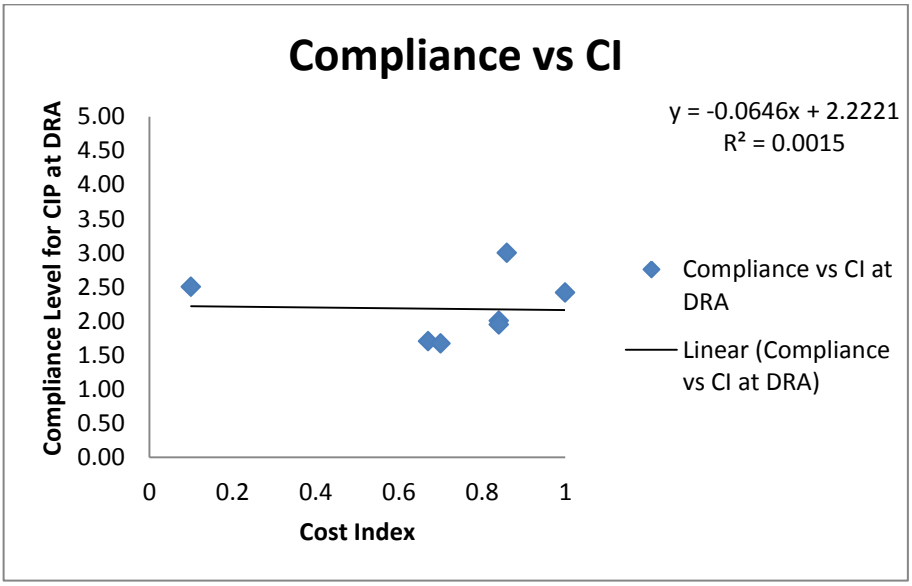

Figure 4-9: DRA CIP Compliance vs CI (OWNSOURCES, 2016)

4.1.5 Concept Phase (ACNAC)

4.1.5.1 Did you as a manager verify project costs against the costs and schedule variances explanations?

A total of 28 designers responded to this question.

Table 4.1-33: DRA ACNAC Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1															2	1	0.48	0.8
2						4							4																8	4		
3																												4	4	4	0.55	0.9
4			n	1						1																		1	3	1	0.49	0.7
5																														1		
6					4																			4	3				11	3.6	0.48	0.1
7								3	1	1	1	3	4																12	2	0.52	0.7
8						5	4																	5	5				19	4.75	0.43	0.8
9	5	3																					5						13	4.3		
10																					5					n	4	4	9	3	0.75	1
11															2	n	4	3	2	3		n							14	2.8		
Average compliance level score for this question																														2.86		

4.1.5.2 Do you understand the meaning of the dates you are required to populate on the DRA Form? (Contracted approval date, job required completion date and contracted completion date)?

A total of 28 designers responded to this question and it is measuring the level of knowledge.

Table 4.1-34: DRA ACNAC Knowledge level with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	2													2															4	2	0.48	0.8
2						4							4																4	4		
3																												2	2	2	0.55	0.9
4			1	1						1																		1	4	1	0.49	0.7
5																																
6					4																			3	2				9	3	0.48	0.1
7								1	n	n	1	1	4																7	1.75	0.52	0.7
8						4	2																	3	2				11	2.75	0.43	0.8
9	2	1																					1						4	1.33		
10																					2					5	3	2	12	3	0.75	1
11															2	2	4	1	2	3		3							17	2.4		
Average compliance level score for this question																														2.11		

4.1.5.3 Did you use the dates on the schedule to populate the contracted, job required completion and job contracted completion dates on the DRA Form?

A total of 28 designers responded to this question.

Table 4.1-35: DRA ACNAC Compliance level results with DRA SI and CI .

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1															1	4	0.48	0.8
2						4							4																3	4		
3																												2	5	4	0.55	0.9
4			1	1						1																		1	2	1	0.49	0.7
5																																
6					1																			4	3				8	3.6	0.48	0.1
7								1	1	1	1	1	3																6	1.75	0.52	0.7
8						1	1																	5	2				9	2.25	0.43	0.8
9	1	1																					1						3	2		
10																					1					4	5	5	10	3	0.75	1
11															5	3	1	5	5	3		1								2.5		
Average compliance level score for this question																														2.55		

4.1.5.4 Should there be a schedule, do you receive a copy of the schedule?

A total of 28 designers responded to this question.

Table 4.1-36: DRA ACNAC Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1															2	1	0.48	0.8
2						2							2																4	2		
3																												1	1	1	0.55	0.9
4			3	2						3																		2	10	2.5	0.49	0.7
5																																
6					3																			4	3				10	3.3	0.48	0.1
7								n	2	1	n	1	2																6	1.5	0.52	0.7
8						2	1																	3	3				9	2.25	0.43	0.8
9	2	1																					1						4	1.3		
10																					3					2	2	2	9	2.25	0.75	1
11															5	5	5	1	1	5		3							25	3.5		
Average compliance level score for this question																														1.87		

4.1.5.5 Should the project be late, is the schedule updated?

A total of 28 designers responded to this question.

Table 4.1-37: DRA ACNAC Compliance level results with DRA SI and CI

Projects	D1	D2	D3	D4	D5	D6	D7	D8	D9	D 10	D 11	D 12	D 13	D 14	D 15	D 16	D 17	D 18	D 19	D 20	D 21	D 22	D 23	D 24	D 25	D 26	D 27	D 28	Total score	Average score	SI	CI
1	1													1														2	1	0.48	0.8
2						1							1																2	1		
3																												2	2	2	0.55	0.9
4			1	1						1																		1	3	1	0.49	0.7
5																															
6					1																			2	2				5	1.6	0.48	0.1
7								n	1	1	1	1	1																5	1	0.52	0.7
8						2	3																	1	3				9	2.25	0.43	0.8
9	1	n																					1						2	1		
10																					4					3	3	2	12	4	0.75	1
11															3	1	4	4	1	3		2								2.5		
Average compliance level score for this question																														1.58		

4.1.5.6 Conclusion for Concept Phase ACNAC workflow

The results from the concept phase ACNAC indicated an average score of 2.19 for compliance, while the knowledge level was 2.55. The average performance during this phase of the project life cycle is 0.52 for SI and 0.71 for CI. Figure 4-10 indicates that the gradient of the SI graph is positive with an R-squared value of 0.11. This means that there is a directly proportional relationship between compliance level and schedule performance. The CI graph in Figure 4-11 showed a negative gradient with an R-squared value of 0. This indicates that there is no relationship between the compliance level and the CI performance. It can therefore be concluded that there is a positive correlation between ACNAC process and schedule performance, and that there is no correlation between the ACNAC workflow and the cost performance of a project.

Table 4.1-38: DRA Average ACNAC Compliance level results with DRA SI and CI

Projects	**Q1**	**Q3**	**Q4**	**Q5**	**Average score**	**SI**	**CI**
1	1	4	1	1	1.75	0.48	0.84
2	4	4	2	1	2.75		
3	4	4	1	2	2.75	0.55	0.86
4	1	1	2.5	1	1.38	0.49	0.67
6	3.6	3.6	3.3	1.6	3.03	0.48	0.1
7	2	1.75	1.5	1	1.56	0.52	0.7
8	4.75	2.25	2.25	2.25	2.88	0.43	0.84
9	4.3	2	1.3	1	2.15		
10	3	3	2.25	4	3.06	0.75	1
Average scores for the ACNAC in DRA					2.2	0.52	0.71

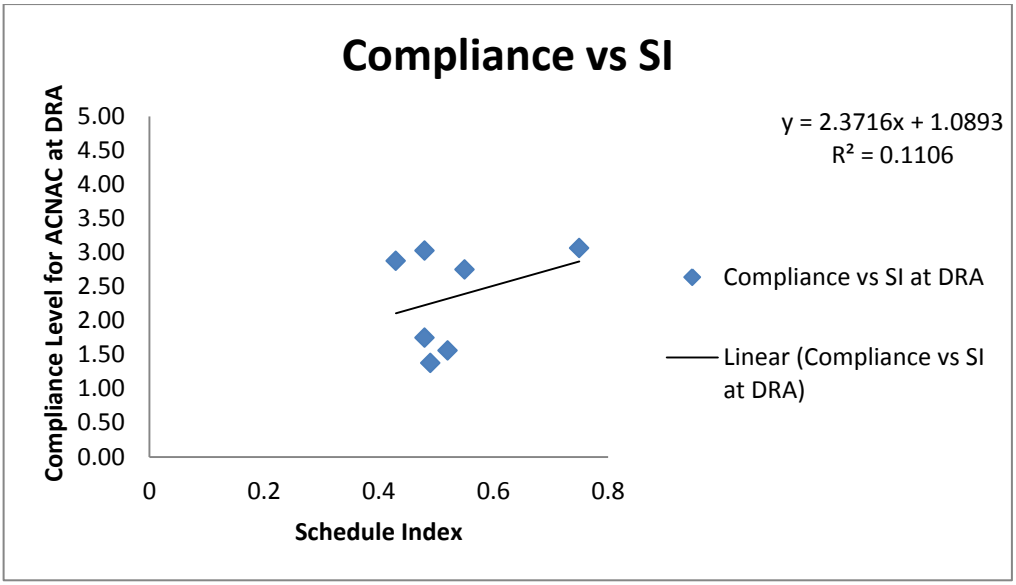

Figure 4-10: DRA Average ACNAC Compliance vs SI

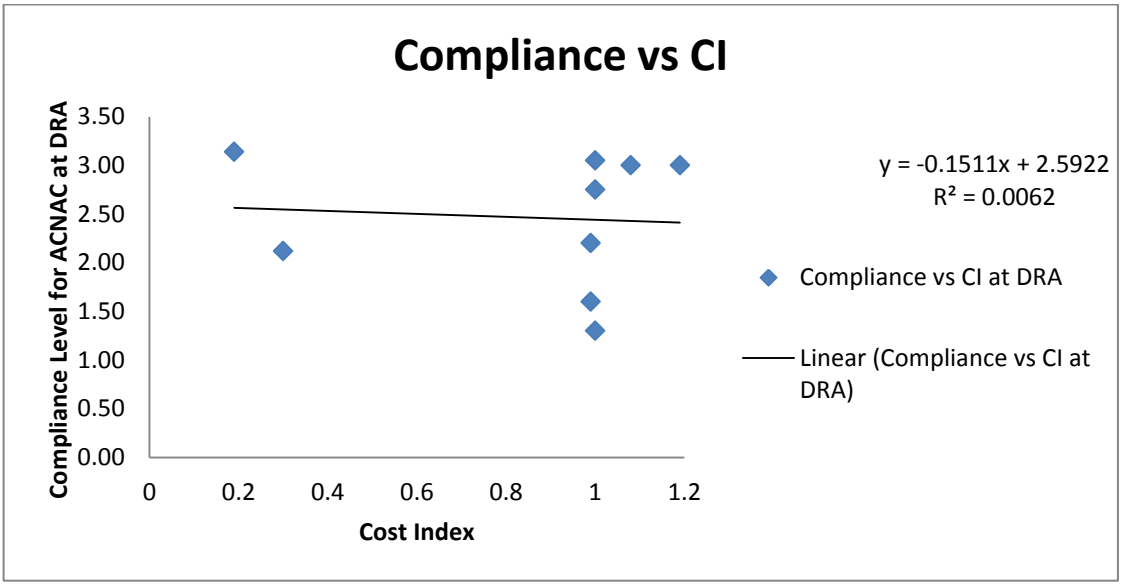

Figure 4-11: DRA ACNAC Average Compliance vs CI

4.1.5.7 Conclusion for the overall Concept phase

The results from the concept phase CIP and ACNAC indicated an overall adherence level of 2.2, while the average performance during this phase was 0.52 for SI and 0.71 for CIP. Figure 4-12 indicates the average of the CIP and ACNAC with SI graph showed a positive gradient with an R-squared value of 0.12. This indicates that there is a directly proportional relationship between the average of CIP and ACNAC with SI. The average of the CIP and ACNAC with CI graph showed a negative gradient with an R-squared value of 0. This indicates that there is no relationship between the average of CIP and ACNAC with CI. Therefore a conclusion can be drawn that there is a positive correlation between

the DRA process (CIP and ACNAC) and schedule performance and no correlation between the DRA process (CIP and ACNAC) and cost performance. Table 4.1-34 indicates that the level of knowledge is 2.55 for the concept phase.

Table 4.1-39: DRA Average Compliance level for CIP and ACNAC with DRA SI and CI

Projects	CIP-concept	ACNAC	Average	SI	CI
1	2	2.2	2.1	0.48	0.84
2	2.5	3	2.75		
3	3	3	3	0.55	0.86
4	1.7	1.3	1.5	0.49	0.67
6	2.5	3.14	2.82	0.48	0.1
7	1.67	1.6	1.63	0.52	0.7
8	1.94	2.75	2.34	0.43	0.84
9	1.81	2.12			
10	2.42	3.05	2.73	0.75	1
			2.2	0.52	0.71

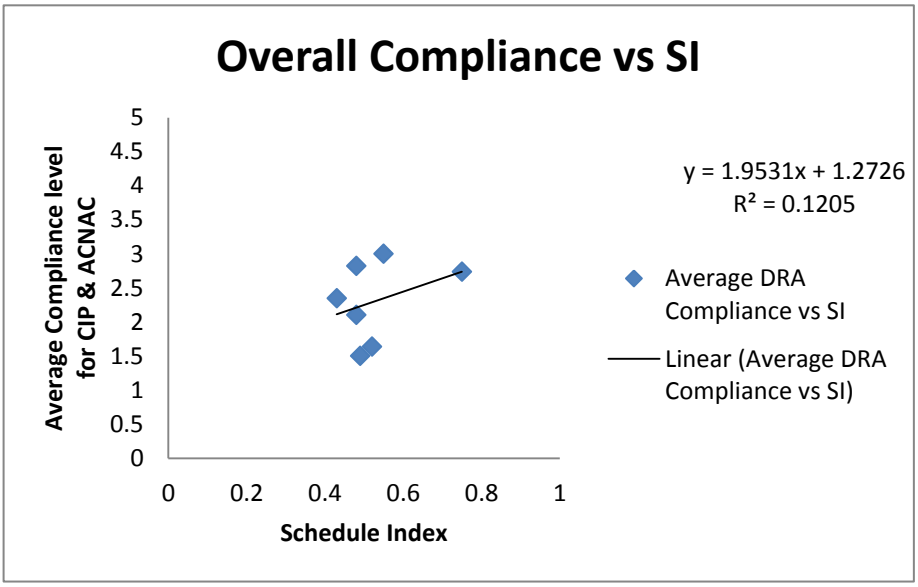

Figure 4-12:Average DRA Compliance level vs SI for CIP and ACNAC

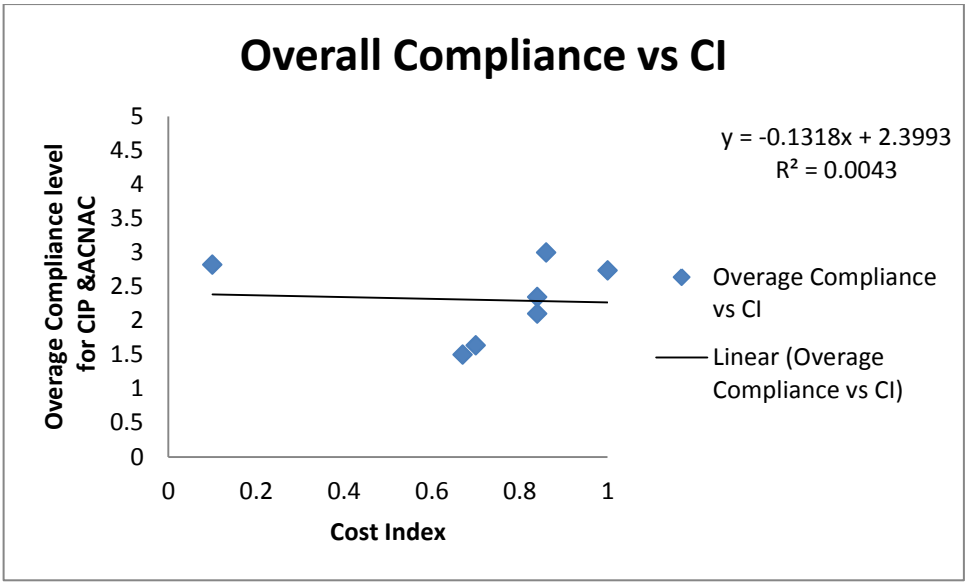

Figure 4-13: Average DRA Compliance level vs CI for CIP and ACNAC

4.1.6 Definition Phase (CIP)

Table 4.1-40 to Table 4.1-55 below indicates the number of PMs who scored certain scores, ranging from 1 to 5, with 1 indicating never and 5 indicating always. It also indicates the projects that the PMs were involved in by their corresponding project numbers. The average of the score is calculated and displayed in the table together with the corresponding SI and CI.

This phase of the questionnaire is only applicable to project managers.

4.1.6.1 Should there be a schedule available, do you follow a schedule?

A total of 10 project managers responded to this question.

Table 4.1-40: ERA CIP Definition Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	3										3	3	0.25	0.30
2					3						3	3	0.45	0.42
3				3							3	3	0.52	0.81
4		1									1	1	0.80	1.00
5							2				2	2	0.54	0.93
6			2								2	2	0.86	0.81
7					2						2	2	0.80	0.70
8					2						2	2	0.46	0.80
9										1	1	1	0.63	0.30
10								1			1	1	0.57	1.00
11						1			1		1	1		
Average compliance score for CIP at ERA defination phase												1.91	0.59	0.71

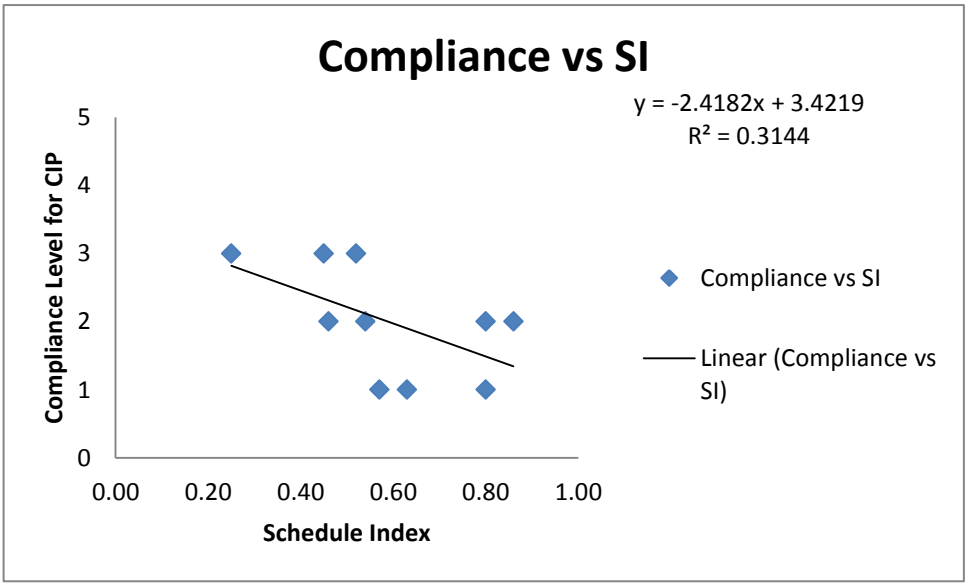

Figure 4-14: ERA Definition Compliance vs SI Source???

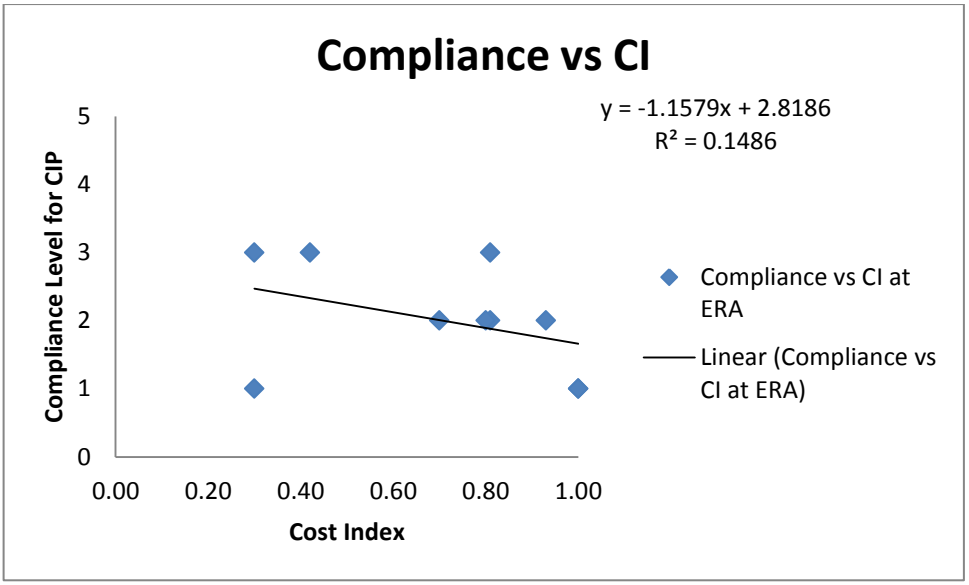

Figure 4-15: ERA Definition Compliance vs CI

The results from the definition phase CIP indicated an average score of 1.19 for compliance. Figure 4-15 indicates that the gradient of the SI graph is negative with an R-squared value of 0.31. This means that there is an inversely proportional relationship between compliance level and schedule performance. The CI graph in Figure 4-15 above also showed a negative gradient with an R-squared value of 0.14. This means that there is an inversely proportional relationship between compliance level and schedule performance. It can be concluded that there is a negative correlation between the compliance level at ERA definition and project performance (both schedule and cost). The relationship between the compliance level and schedule performance is stronger than the relationship between compliance level and cost performance.

4.1.1 Definition Phase (ACNAC)

4.1.1.1 Did you confirm scheduled dates with the project construction team before capturing onto the ERA form?

A total of 10 project managers responded to this question. (OWNSOURCES, 2016)

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	5										5	5	0.25	0.30
2					5						5	5	0.45	0.42
3				4							4	4	0.52	0.81
4		3									3	3	0.80	1.00
5							5				5	5	0.54	0.93
6			5								5	5	0.86	0.81
7					5						5	5	0.80	0.70
8					5						5	5	0.46	0.80
9										2	2	2	0.63	0.30
10								2			2	2	0.57	1.00
11						4			1		5	2.5		
Average compliance score for this question												3.95		

4.1.1.2 Do you understand the meaning of the dates you are required to populate on the ERA Form? (contracted job construction start date, previous contracted job completion date and job contracted completion date)

A total of 10 project managers responded to this question. It measures the knowledge level.

Table 4.1-41: ERA ACNAC Knowledge level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	5										5	5	0.25	0.30
2					5						5	5	0.45	0.42
3				5							5	5	0.52	0.81
4		5									5	5	0.80	1.00
5							2				2	2	0.54	0.93
6			2								2	2	0.86	0.81
7					5						5	5	0.80	0.70
8					5						5	5	0.46	0.80
9										5	5	5	0.63	0.30
10								5			5	5	0.57	1.00
11						5			5		10	5		
Average compliance score for this question												4.45		

4.1.1.3 Did you use the dates on the schedule to populate the contracted, job required completion and job contracted completion dates on the ERA Form?

A total of 10 project managers responded to this question.

Table 4.1-42: ERA ACNAC Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	1										1	1	0.25	0.30
2					1						1	1	0.45	0.42
3				1							1	1	0.52	0.81
4		1									1	1	0.80	1.00
5							1				1	1	0.54	0.93
6			1								1	1	0.86	0.81
7					1						1	1	0.80	0.70
8					1						1	1	0.46	0.80
9										1	1	1	0.63	0.30
10								1			1	1	0.57	1.00
11						1			1		2	1		
Average compliance score for this question												1.00		

4.1.1.4 Conclusion for the Definition phase ACNAC workflow.

The results from the definition phase ACNAC indicate an average score of 2.49 for compliance, while the average knowledge level of the project managers was 4.45. Figure 4-17 indicates that the gradient of the SI graph is negative with an R-squared value of 0.03. This means that there is an inversely proportional relationship between compliance level and schedule performance. The CI graph in Figure 4-17 showed a negative gradient with an R-squared value of 0.01. This means that there is an inversely proportional relationship between compliance level and cost performance. It can therefore be concluded that the there is a negative correlation between the ACNAC and project performance (both schedule and cost).The relationship between ACNAC workflow and schedule performance is stronger than the relationship between ACNAC workflow and cost performance.

Table 4.1-43: Average ERA ACNAC Compliance level results with ERA SI and CI

Projects	Q1	Q3	Average score	SI	CI
1	5	1	3.00	0.25	0.3
2	5	1	3.00	0.45	0.42
3	4	1	2.50	0.52	0.81
4	3	1	2.00	0.8	1
5	5	1	3.00	0.54	0.93
6	5	1	3.00	0.86	0.81
7	5	1	3.00	0.8	0.7
8	5	1	3.00	0.46	0.8
9	2	1	1.50	0.63	0.3
10	2	1	1.50	0.57	1

Average scores for the ACNAC in ERA	2.49

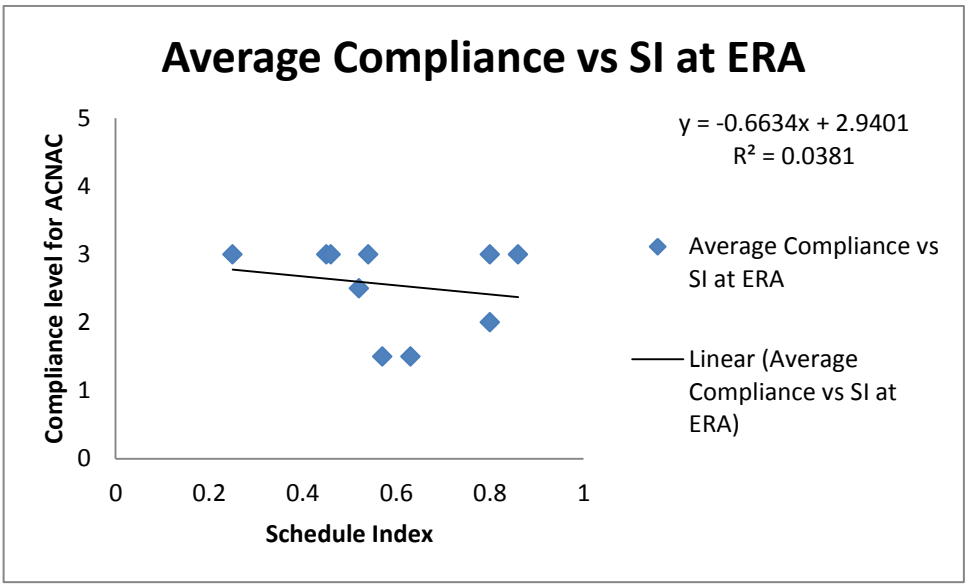

Figure 4-16: ERA Definition Compliance vs SI

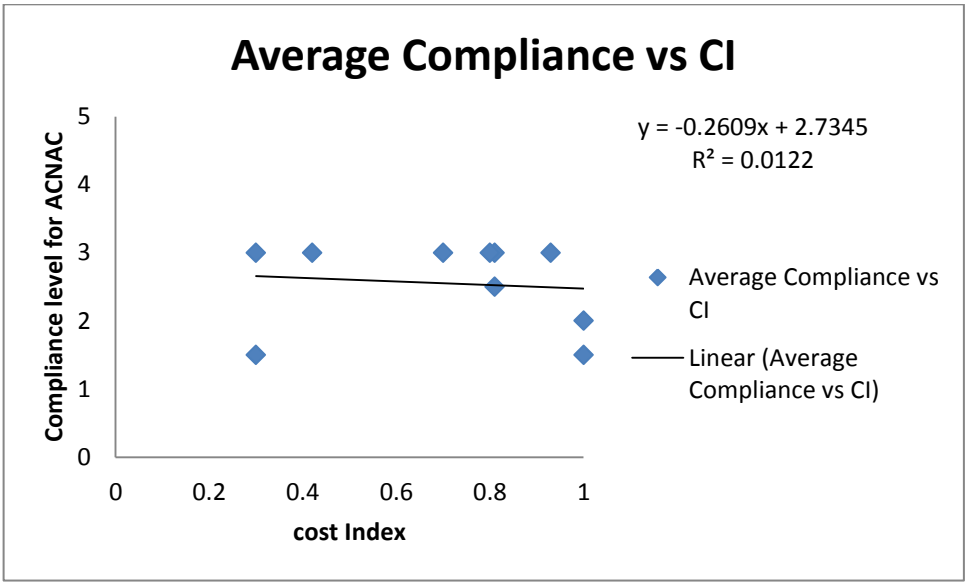

Figure 4-17: ERA Definition Compliance vs CI

4.1.1.5 Conclusion for the overall Definition phase

The results from the definition phase for CIP and ACNAC indicated an average score of 2.2, while the average knowledge level presented by Table 4.1-41 during this phase is 4.45. The average performance during this phase of the project life cycle is 0.58 for SI and 0.70 for CI. Figure 4-19 indicates that the average of the CIP and ACNAC with SI

graph showed a negative gradient with an R-squared value of 0.12. This indicates an inverse relationship between compliance level and schedule performance. Figure 4-19 indicated that the average of the CIP and ACNAC with CI graph showed a negative gradient with an R-squared value of 0.05. This means there is an inversely proportional relationship between the average of CIP and ACNAC with project performance (both SI and CI). Therefore a conclusion can be drawn that there is a negative correlation between ERA process (CIP and ACNAC) at definition phase and project performance (both schedule and cost).

Table 4.1-44: ERA Definition average Compliance results with ERA SI and CI

Projects	Q1	Q2	Q3	Average score	SI	CI
1	3	1	5	3.00	0.25	0.3
2	3	1	5	3.00	0.45	0.42
3	3	1	4	2.67	0.52	0.81
4	1	1	3	1.67	0.8	1
5	2	1	5	2.67	0.54	0.93
6	2	1	5	2.67	0.86	0.81
7	2	1	5	2.67	0.8	0.7
8	2	1	5	2.67	0.46	0.8
9	1	1	2	1.33	0.63	0.3
10	1	1	2	1.33	0.57	1
Average scores for the ACNAC in ERA				2.2	0.58	0.70

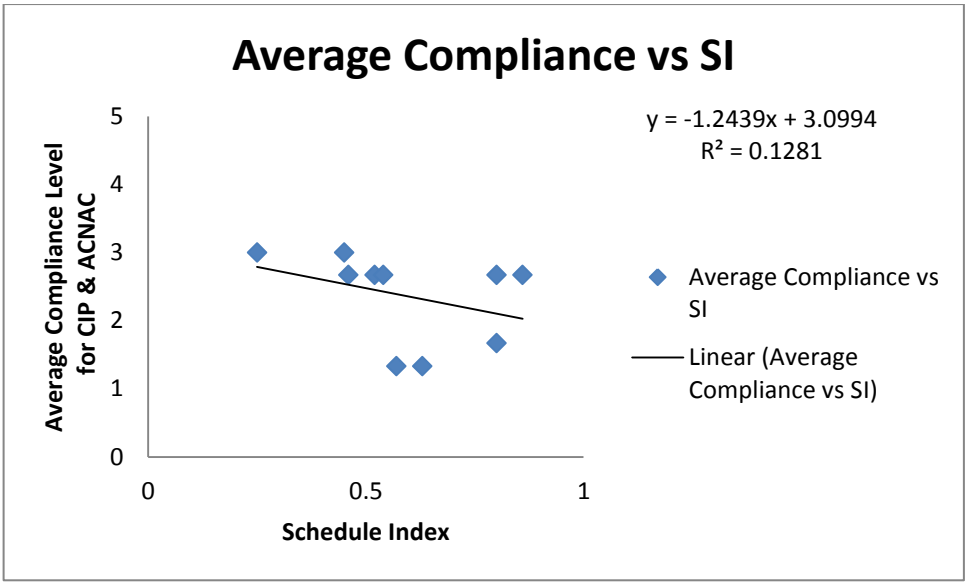

Figure 4-18: Average ERA Definition Compliance vs SI

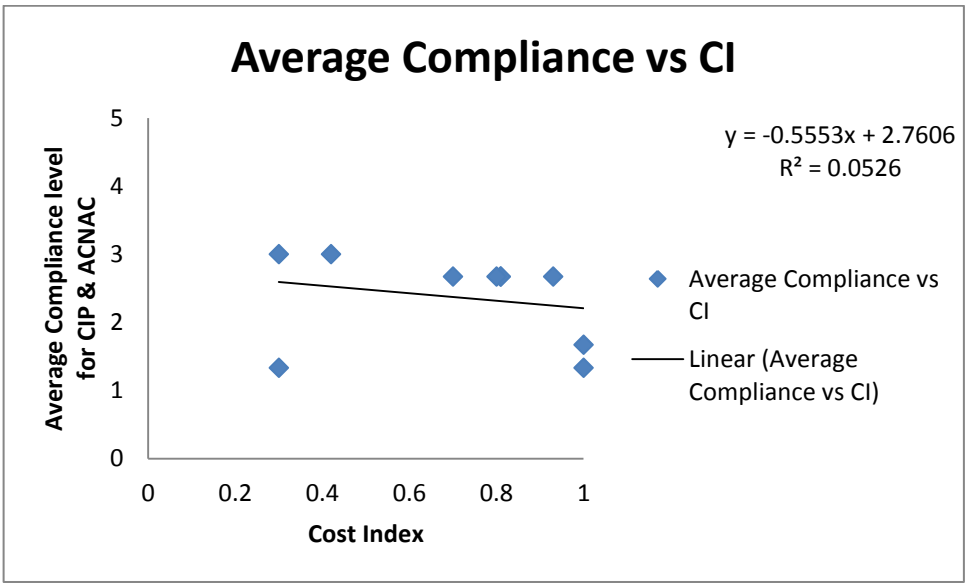

Figure 4-19: Average Definition Compliance vs CI

4.1.2 Execution Phase and Finalization (CIP)

This section of the questionnaire is applicable to project managers only.

4.1.2.1 Did you prepare any Form revisions should you have any Form variation in terms of cost and time above the required limit?

A total of 10 project managers responded to this question.

Table 4.1-45: ERA Execution CIP Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	5										5	5	0.25	0.30
2					5						5	5	0.45	0.42
3				5							5	5	0.52	0.81
4		5									5	5	0.80	1.00
5							5				5	5	0.54	0.93
6			4								4	4	0.86	0.81
7					5						5	5	0.80	0.70
8					5						5	5	0.46	0.80
9										5	5	5	0.63	0.30
10								5			5	5	0.57	1.00
11						5			5		10	5		
Average compliance score for this question												4.91		

4.1.2.2 Does the clerk of works test and perform quality Control of the constructed asset after construction?

A total of 10 project managers responded to this question.

Table 4.1-46: ERA Execution CIP Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	5										5	5	0.25	0.30
2					4						4	4	0.45	0.42
3				4							4	4	0.52	0.81
4		2									2	2	0.80	1.00
5							4				4	4	0.54	0.93
6			1								1	1	0.86	0.81
7					5						5	5	0.80	0.70
8					5						5	5	0.46	0.80
9										5	5	5	0.63	0.30
10								4			4	4	0.57	1.00
11						5			5		10	5		
Average compliance score for this question												4.00		

4.1.2.3 Did you have a project reconciliation report?

A total of 10 project managers responded to this question.

Table 4.1-47: ERA Execution CIP Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	4										4	4	0.25	0.30
2					4						4	4	0.45	0.42
3				5							5	5	0.52	0.81
4		4									4	4	0.80	1.00
5							3				3	3	0.54	0.93
6			3								3	3	0.86	0.81
7					5						5	5	0.80	0.70
8					5						5	5	0.46	0.80
9										4	4	4	0.63	0.30
10								4			4	4	0.57	1.00
11						3			4		7	3.5		
Average compliance score for this question												4.05		

4.1.2.4 Did you have a project performance evaluation report?

A total of 10 project managers responded to this question.

Table 4.1-48: ERA Execution CIP Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	1										1	1	0.25	0.30
2					3						3	3	0.45	0.42
3				2							3	2	0.52	0.81
4		1									1	1	0.80	1.00
5							3				3	3	0.54	0.93
6			3								3	3	0.86	0.81
7					5						5	5	0.80	0.70
8					5						5	5	0.46	0.80
9										2	2	2	0.63	0.30
10								2			2	2	0.57	1.00
11						3			3		6	3		
Average compliance score for this question												2.73		

4.1.2.5 Did you work on both the ACNAC and CIP Processes simultaneously when executing your work?

A total of 10 project managers responded to this question.

Table 4.1-49: ERA Execution CIP Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	2										2	2	0.25	0.30
2					3						3	3	0.45	0.42
3				1							1	1	0.52	0.81
4		2									2	2	0.80	1.00
5							3				1	1	0.54	0.93
6			3								1	1	0.86	0.81
7					2						2	2	0.80	0.70
8					3						3	3	0.46	0.80
9										1	1	1	0.63	0.30
10								2			2	2	0.57	1.00
11						2			2		4	2		
Average compliance score for this question												1.82		

4.1.2.6 Conclusion for Execution Phase CIP

The results from the execution phase CIP indicated an average score of 3.5 for compliance. Figure 4-21 indicates that the gradient of the SI graph is negative with an R-squared value of 0.11; this indicates that there is an inversely proportional relationship between compliance level and schedule performance. The CI graph in Figure 4-21 showed a negative gradient with an R-squared value of 0.04, indicating that there is an inversely proportional relationship between compliance level and cost performance. It can therefore be concluded that there is negative correlation between the CIP at ERA and project performance (both schedule and cost).

Table 4.1-50: Average ERA Execution CIP Compliance level results with ERA SI and CI

Projects	Q1	Q2	Q3	Q4	Q5	Average score	SI	CI
1	5	5	0.75	0.99	2	3.4	0.25	0.3
2	5	4	0.75	0.92	3	3.8	0.45	0.42
3	5	4	0.52	0.81	1	3.4	0.52	0.81
4	5	2	0.8	1	2	2.8	0.8	1
5	5	4	0.23	1	1	3.2	0.54	0.93
6	4	1	0.86	0.81	1	2.4	0.86	0.81
7	5	5	0.8	0.99	2	4.4	0.8	0.7
8	5	5	0.46	1	3	4.6	0.46	0.8
9	5	5	0.63	0.3	1	3.4	0.63	0.3
10	5	4	0.57	1	2	3.4	0.57	1
Average scores for the ACNAC in ERA						3.5		

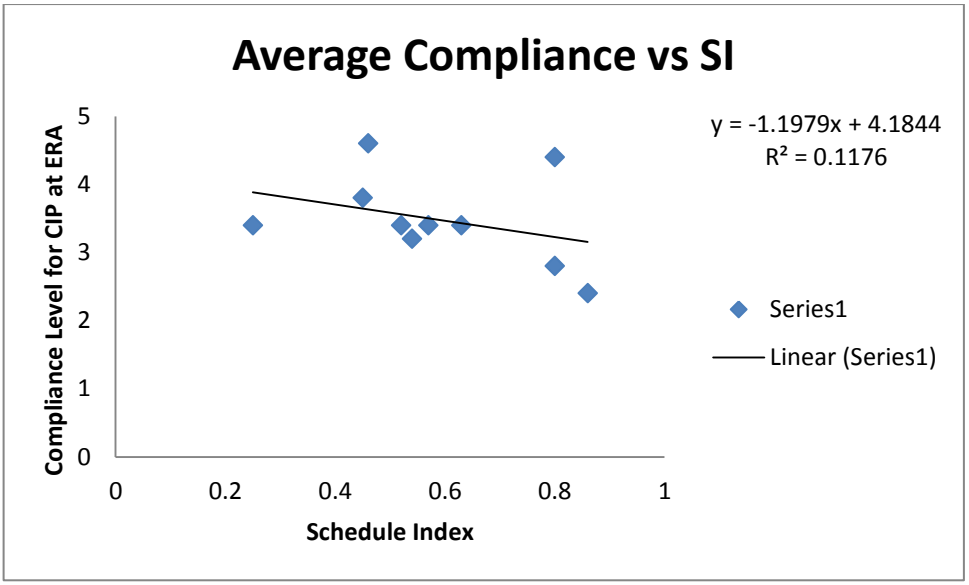

Figure 4-20: ERA Definition CIP Compliance vs SI

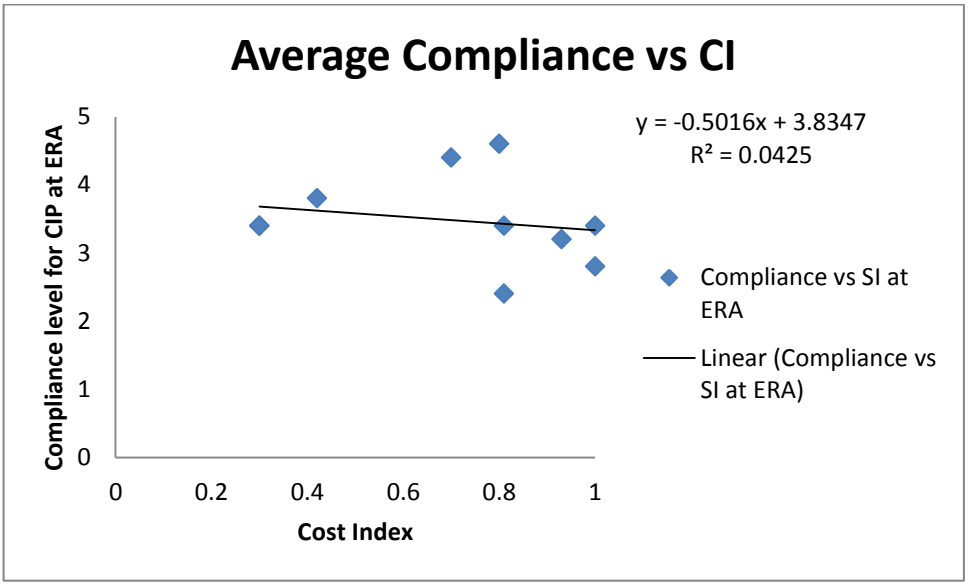

Figure 4-21: ERA Definition CIP Compliance vs CI

4.1.3 Execution and Finalization Phase (ACNAC)

4.1.3.1 Did you make sure that a post construction environmental audit has been completed before commissioning and energizing of the asset on the system?

A total of 10 project managers responded to this question.

Table 4.1-51: ERA Execution ACNAC Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	4										4	4	0.25	0.30
2					3						3	3	0.45	0.42
3				4							4	4	0.52	0.81
4		1									1	1	0.80	1.00
5							2				2	2	0.54	0.93
6			5								5	5	0.86	0.81
7					2						2	2	0.80	0.70
8					2						2	3	0.46	0.80
9										1	1	1	0.63	0.30
10								2			2	2	0.57	1.00
11						2			2		4	2		
Average compliance score for this question												2.64		

4.1.3.2 Did you conduct the appraisals for consultants and contractors after project completion?

A total of 10 project managers responded to this question.

Table 4.1-52: ERA Execution ACNAC Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	3										3	3	0.25	0.30
2					3						3	3	0.45	0.42
3				4							4	4	0.52	0.81
4		2									3	3	0.80	1.00
5							3				4	4	0.54	0.93
6			3								1	1	0.86	0.81
7					2						3	3	0.80	0.70
8					3						3	3	0.46	0.80
9										1	3	3	0.63	0.30
10								2			3	3	0.57	1.00
11						1			1		2	1		
Average compliance score for this question												2.82		

4.1.3.3 Did you manage the status of the EMP (that whether it is finalized or handed over to field services to complete)?

A total of 10 project managers responded to this question.

Table 4.1-53: ERA Execution ACNAC Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	3										3	3	0.25	0.30
2					3						3	3	0.45	0.42
3				3							3	3	0.52	0.81
4		1									1	1	0.80	1.00
5							1				1	1	0.54	0.93
6			1								1	1	0.86	0.81
7					5						5	5	0.80	0.70
8					5						5	5	0.46	0.80
9										3	3	3	0.63	0.30
10								3			3	3	0.57	1.00
11						2			2		4	2		
Average compliance score for this question												2.73		

4.1.3.4 Conclusion for the ACNAC work flow

The results from the execution phase ACNAC indicated an average score of 2.73. Figure 4-23 indicates that the gradient of the SI graph is negative with an R-squared value of 0.30. This indicates that there is an inversely proportional relationship between compliance level and schedule performance. The CI graph in Figure 4-23 showed a negative gradient with an R-squared value of 0.07. This indicates that there is an inversely proportional relationship between compliance level and cost performance. It can therefore be concluded that the there is a negative correlation between the ACNAC workflow at ERA and the performance (SI and CI) of a project.

Table 4.1-54: Average ERA Execution ACNAC Compliance level results with ERA SI and CI

Projects	Q1	Q2	Q3	Average score	SI	CI
1	4	3	3	3.33	0.25	0.3
2	3	3	3	3	0.45	0.42
3	4	4	3	3.67	0.52	0.81
4	1	3	1	1.67	0.8	1
5	2	4	1	2.33	0.54	0.93
6	5	1	1	2.33	0.86	0.81
7	2	3	5	3.33	0.8	0.7
8	3	3	5	3.67	0.46	0.8
9	1	3	3	2.33	0.63	0.3
10	2	3	3	2.67	0.57	1
Average scores for the ACNAC in ERA				2.73		

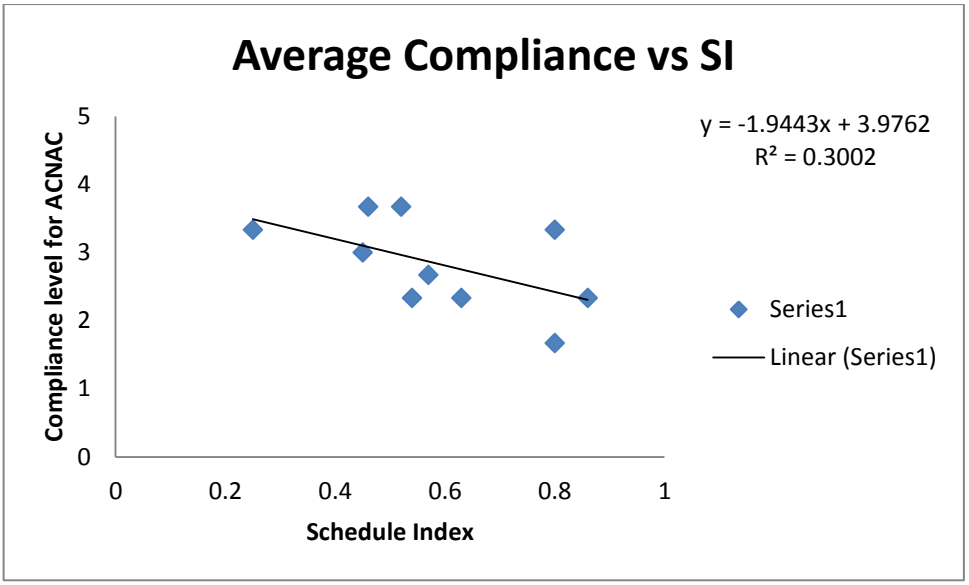

Figure 4-22: ERA Execution ACNAC Compliance vs SI

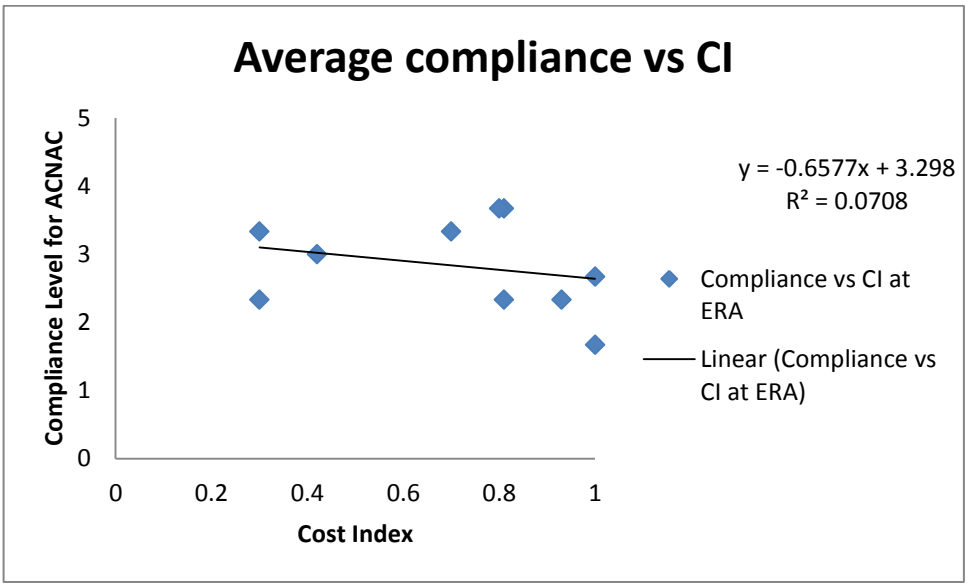

Figure 4-23: ERA Execution ACNAC Compliance vs CI

4.1.3.5 Conclusion for the Execution and Finalization phase.

The results from the execution phase for CIP and ACNAC indicated an average score of 3.11 for compliance. Figure 4-24 indicates that the gradient of the SI graph is negative with an R-squared value of 0.22. This indicates that there is an inversely proportional relationship between compliance level and schedule performance. The gradient of the CI graph is negative with an R-squared value of 0.06. This indicates that there is an inversely proportional relationship between compliance level for the ERA execution phase and schedule performance. It can therefore be concluded that there is a negative

correlation between compliance level at ERA execution and project performance (both schedule and cost).

Table 4.1-55: Average ERA Compliance level for CIP and ACNAC with SI and CI

Projects	CIP-Execution	ACNAC-Execution	Average Score	SI	CI
1	3.4	3.3	3.35	0.25	0.3
2	3.8	3	3.4	0.45	0.42
3	3.4	3.67	3.53	0.52	0.81
4	2.8	1.67	2.23	0.8	1
5	3.2	2.33	2.76	0.54	0.93
6	2.4	2.33	2.36	0.86	0.81
7	4.4	3.33	3.86	0.8	0.7
8	4.6	3.67	4.13	0.46	0.8
9	3.4	2.33	2.86	0.63	0.3
10	3.4	2.67	3.03	0.57	1
Average score at execution			3.11	0.58	0.70

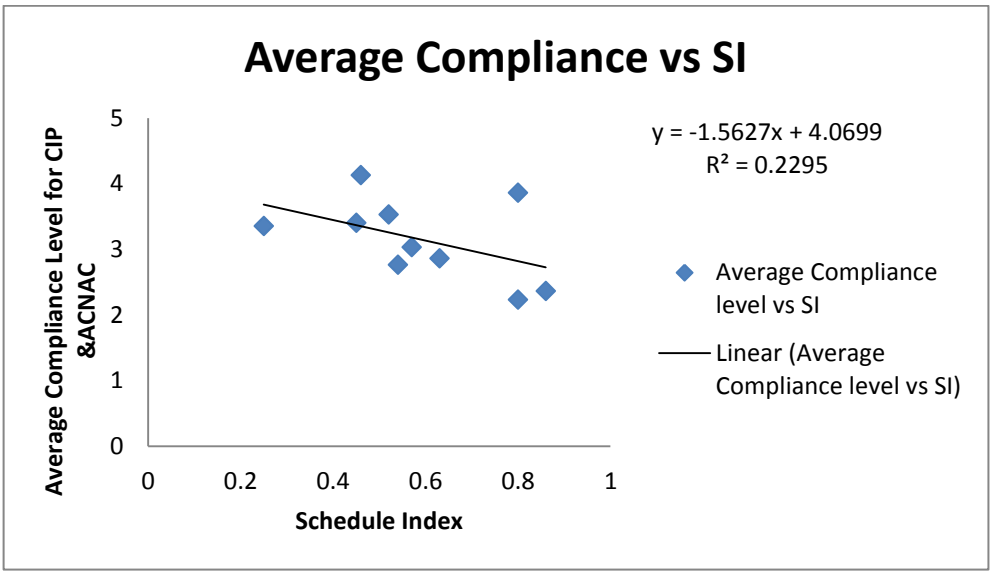

Figure 4-24:Average Execution phase Compliance vs SI

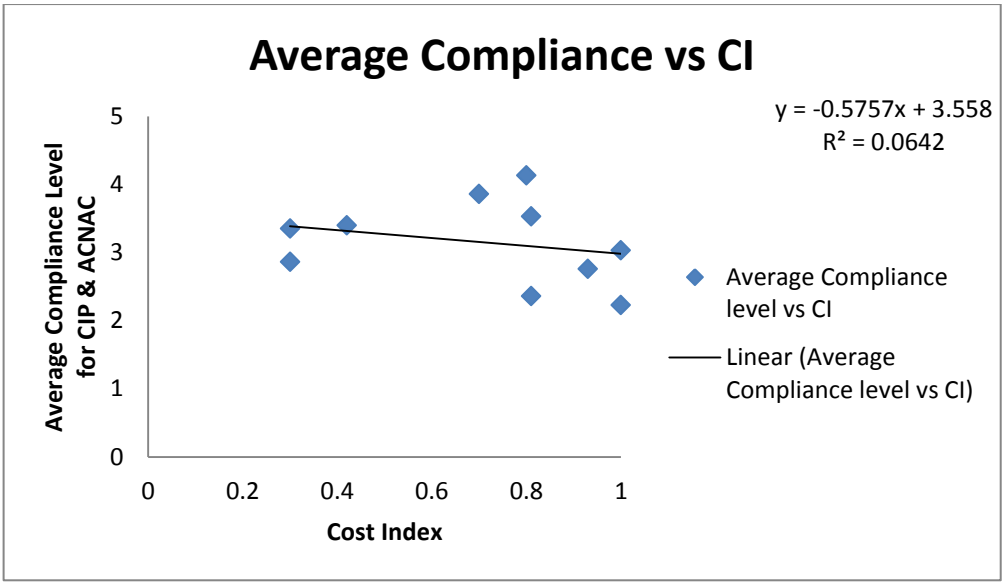

Figure 4-25: Average Execution phase Compliance vs CI

4.1.4 Post-project phase

This phase is applicable to project managers

4.1.4.1 Did you conduct project post-mortems?

A total of 10 project managers responded to this question.

Table 4.1-56: FRA Execution CIP Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	1										1	1	0.25	0.30
2					1						1	1	0.45	0.42
3				1							1	1	0.52	0.81
4		1									1	1	0.80	1.00
5							1				1	1	0.54	0.93
6			1								1	1	0.86	0.81
7					1						1	1	0.80	0.70
8					1						1	1	0.46	0.80
9										1	1	1	0.63	0.30
10								1			1	1	0.57	1.00
11						1			1		2	1		
Average compliance score for this question												1.00		

4.1.4.2 Did you have a business solution review on a sample of projects annually?

A total of 10 project managers responded to this question.

Table 4.1-57: FRA Execution CIP Compliance level results with ERA SI and CI

Projects	PM1	PM2	PM3	PM4	PM5	PM6	PM7	PM8	PM9	PM10	Total score	Average score	SI	CI
1	1										1	1	0.25	0.30
2					1						1	1	0.45	0.42
3				1							1	1	0.52	0.81
4		1									1	1	0.80	1.00
5							1				1	1	0.54	0.93
6			1								1	1	0.86	0.81
7					1						1	1	0.80	0.70
8					1						1	1	0.46	0.80
9										1	1	1	0.63	0.30
10								1			1	1	0.57	1.00
11						1			1		2	1		
Average compliance score for this question												1.00		

4.1.5 Conclusion for the post project phase

The average of the 2 questions is 1. Therefore no business review or projects post mortem were done on all 10 projects.

4.1.6 Overall compliance for the PLC

Table 4.1-58: Overall SI and CI during the whole PLC

SI ERA	SI DRA	SI CRA	Average SI	CI ERA	CI DRA	CI CRA	Average CI
0.25	0.48	0.85	0.526667	0.3	0.84	0.86	0.67
0.45			0.45	0.42			0.42
0.52	0.55	0.54	0.536667	0.81	0.86	0.41	0.69
0.8	0.49	0.2	0.496667	1	0.67	0.36	0.68
0.54			0.54	0.93			0.52
0.86	0.48	0.19	0.51	0.81	0.1	0.06	0.52
0.8	0.52	0.18	0.5	0.7	0.7	0.41	0.65
0.46	0.43	0.8	0.42	0.8	0.84	0.78	0.79
0.63		0.26	0.445	0.3		0.23	0.51
0.57	0.75	0.85	0.473333	1	1	0.88	0.94

Table 4.1-59: Overall Compliance results with average SI and CI

Projects	CRA	DRA	ERA	Average Compliance	Average SI	Average CI
1	1.6	2.1	3.18	2.29	0.53	0.67
2		2.75	3.2	2.98	0.45	0.42
3	3.2	3	3.1	3.10	0.54	0.69
4	3.9	1.5	1.95	2.45	0.50	0.68
5			2.72	2.72	0.51	0.52
6	1.6	2.82	2.52	2.31	0.52	0.52
7	2.07	1.64	3.27	2.33	0.47	0.65
8	1.6	2.35	3.4	2.45	0.63	0.79
9	2.4		2.1	2.25	0.55	0.51
10	1.5	2.73	2.18	2.14	0.71	0.94
Overall Compliance level				2.45		

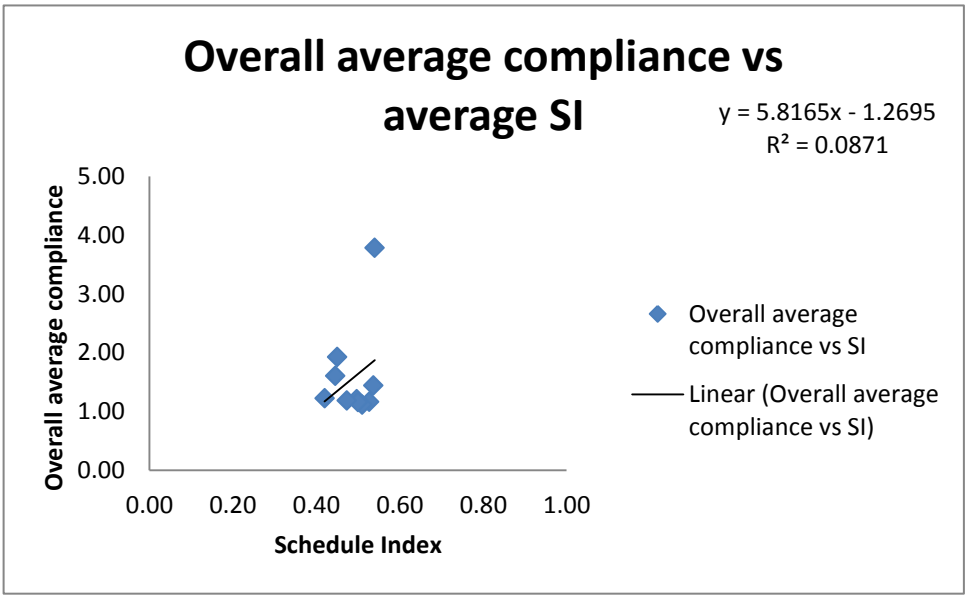

Figure 4-26: Overall Compliance vs overall SI

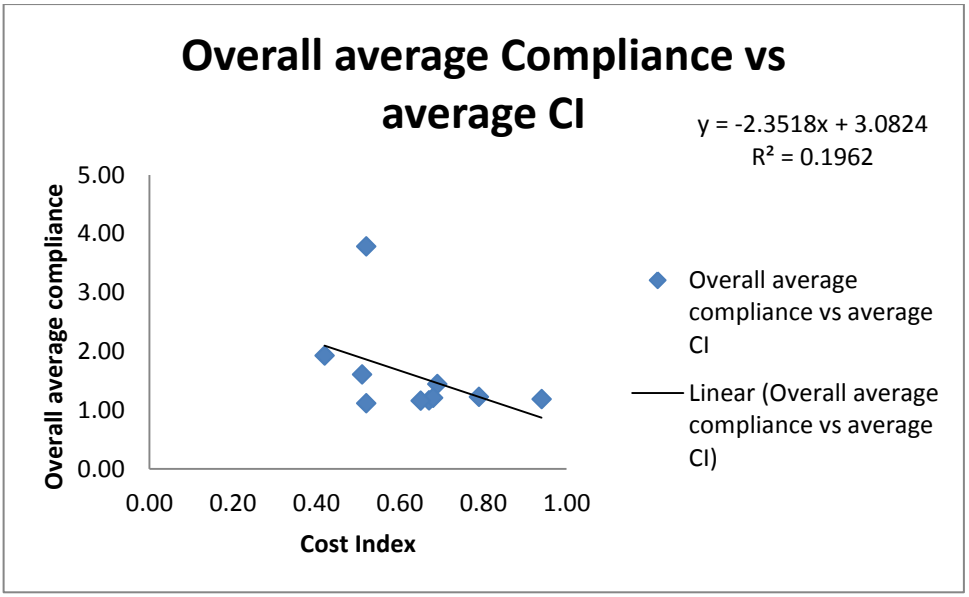

Figure 4-27: Overall Compliance vs overall CI

Referring to Table 4.1-59 above, the overall adherence level of the PLC is 2.45. The post project adherence level is 1.

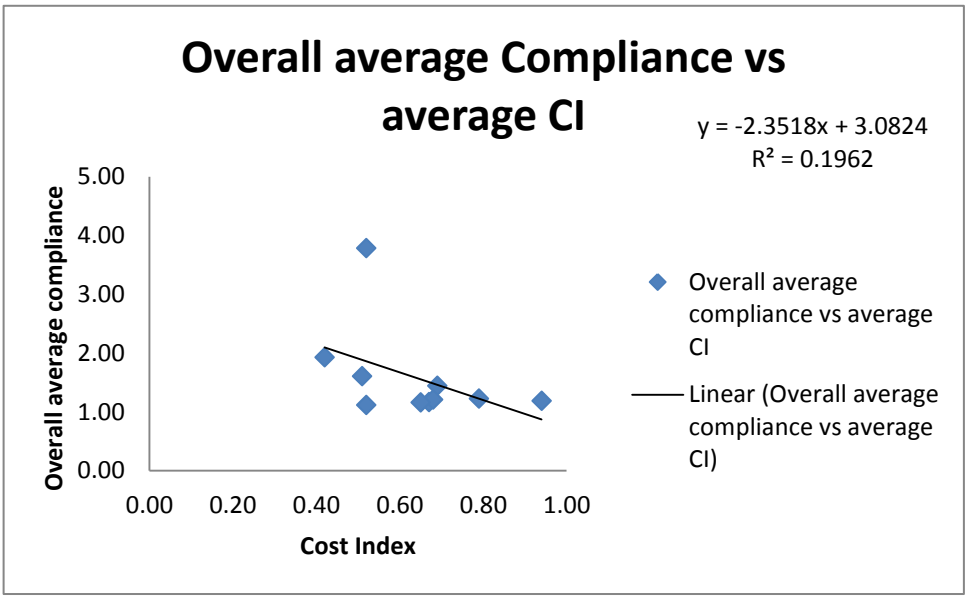

Figure 4-27 indicates that the gradient of the SI graph is negative with an R-squared value of 0.08. However the results are clustered on the same spot and not distributed on the straight line. There is only one point that is located away from the cluster and therefore makes the results look almost like a straight line. It can therefore be concluded that there is no correlation between the average schedule and overall average compliance level. Figure 4-27 indicates that the gradient of the CI graph is negative with an R-squared value of 0.19. This indicates that there is an inversely proportional relationship between the overall compliance level and average cost performance. It can therefore be concluded that there is a negative correlation between the overall process compliance level and average project performance in terms of cost.

4.1.7 Knowledge of Processes Documents

4.1.7.1 Have you ever heard of the Capital Investment Process document?

Table 4.1-60: knowledge of the CIP

Score	Number of designers	Number of Planners	Number of PM	Projects involved
Yes	17	4	10	05,06,08,09, 10
No	11	3	0	

From a total of 45 respondents who respondent to this question, 68% answered yes, 32% answered no. From a total of 28 designers who responded to this question, 60% answered yes and 40% answered no. From a total of 7 Planners who responded to this question, 53% answered yes and 47% answered no. From a total of 10 Project Managers who responded to this question, 100% answered yes. The projects that were done by respondents that had a high knowledge about the Capital Investment Process are: Khuma, Gopani Mine, Klerksdorp North and Zeerust Munic.

4.1.7.2 Do you know where to find the latest Capital Investment Process Document?

Table 4.1-61: knowledge regarding the location of CIP

Score	Number of designers	Number of Planners	Number of PM	Projects involved
Yes	10	1	6	03,04,05,06,08 ,10
No	18	6	4	

From a total of 45 respondents who respondent to this question, 37% answered yes, 63% answered no. From a total of 28 designers who responded to this question, 35% answered yes and 65% answered no. From a total of 7 Planners who responded to this question, 14% answered yes and 86% answered no. From a total of 10 Project Managers who responded to this question, 60% answered yes and 40% answered a no. The projects that were done by respondents that had knowledge about the location of the

Capital Investment Process are: Moffat, Delareyville Munic, Khuma, Gopani Mine, Klerksdorp North and Zeerust Munic.

4.1.7.3 Have you ever heard about the Project Life Cycle Governance Guideline?

Table 4.1-62: knowledge regarding the PLC

Score	Number of designers	Number of Planners	Number of PM	Projects involved
Yes	9	1	8	01,02,03,04,07,08
No	19	6	2	

From a total of 45 respondents who respondent to this question, 40% answered yes, 60% answered no. From a total of 28 designers who responded to this question, 32% answered yes and 68% answered no. From a total of 7 Planners who responded to this question, 14% answered yes and 86% answered no. From a total of 10 Project Managers who responded to this question, 80% answered yes and 20% answered a no. The projects that were done by respondents that had knowledge about the location of the Capital Investment Process are: Mmabatho Bulk, Fochville Kraalkop, Moffat, Delareyville Munic, Matlosana and Klerksdorp North.

4.1.7.4 Do you know where to find the latest Project Life Cycle Governance Guideline?

Table 4.1-63: knowledge regarding the location of PLC

Score	Number of designers	Number of Planners	Number of PM	Projects involved
Yes	8	1	1	01,03,02,05,06,07,08,09,10
No	20	6	9	

From a total of 45 respondents who respondent to this question, 22% answered yes, 78% answered no. From a total of 28 designers who responded to this question, 28% answered yes and 72% answered no. From a total of 7 Planners who responded to this question, 14% answered yes and 86% answered no. From a total of 10 Project Managers

who responded to this question, 10% answered yes and 90% answered a no. The project that was done by respondents that had no knowledge about the location of the Project Life Cycle Governance Guideline is Delareyville Munic.

4.1.7.5 Do you have access to ACNAC?

Table 4.1-64: Indication of the number of respondents regarding ACNAC access

Score	Number of designers	Number of Planners	Number of PM	Projects involved
Yes	28	7	10	All
No	0	0	0	

From a total of 45 respondents who respondent to this question, 100% answered yes.

Summary of the knowledge level

phases	General knowledge	Specific knowledge	Average knowledge
Planners-CRA	39.8%	83%	61.5%
Designers-DRA	52.6%	42.2%	46.5%
PM-ERA	70%	89%	79.5%

4.2 Summary of the analysis

The following is a summary of the responses received from different participants:
What is the level of knowledge and adherence to project systems?

Table 4.2-1: Summary of the analysis

Departmental measurements	% level of adherence	Knowledge level
The average level of adherence to project system	42%	62.5%

The level of adherence of Network Planning/Plant	42%	61.5%
The level of adherence of Network Engineering and Design	38%	46.5%
The level of adherence of Project Management	47.6%	79.5%

There is no correlation indicated between the project systems adherence level and knowledge level. The overall knowledge level of the respondents is 63.4%

General comments from most of the respondents in the questionnaires

- No control measures and monitoring for these processes. They are not updated nor checked for effectiveness. Lack of discipline is a culprit for noncompliance.
- The processes are followed when there are monitoring systems in place that enforce adherence, in this case the activities of the process is not necessarily carried in the correct way.
- If politics were to be minimal then project will move faster than predicted.
- The Clerk Of Works are not trained properly because quality is always an issue.
- The prioritization of projects in the prioritization register is not done correctly. Many processes are well documented but there is no guidance into accessing and applying them.
- The processes are in place and correct, but they are hindering progress of the project due to their lack of flexibility in terms of what the business need is at the specific time.
- The processes takes longer, therefore the projects need might shift by the time the project is executed. The duration of the processes makes it very difficult to compete in the corporate world.
- There are too many processes for every step that needs to be taken, there are processes within processes and this issue makes them unfriendly and difficult to understand. For everything that goes wrong a new process is introduced and this confuses people. At the end of the day people don't know which process is the latest and which one to adhere to.

- The employees are not well educated about processes, one only learns about a process when one needs to apply it.
- The project get delayed during the planning phase, this results in the other phases of the project not having enough time to complete their part as the total project life cycle gets shortened. The designers and project managers end up bypassing the processes in order to finish on time.

4.3 Hypothesis Testing

The hypotheses formulated in section 3.5 to 3.7, were investigated using correlation analysis techniques described in section 4.6. Below is the analysis of these hypotheses.

Chapter 5 will draw conclusions and recommendations on chapter 4's findings.

CHAPTER 5:CONCLUSIONS AND RECOMMENDATIONS

This chapter starts with the discussion about the findings of this research thesis. The findings are discussed against the research objectives envisaged at the start of the research. Subsequently the chapter discusses about the recommendations proposed by this research, followed by the contribution of knowledge and the limitations of this research. Lastly, the chapter proposes the recommendations for future research

5.1 Research objectives

The aim of this research was to investigate if there is a correlation between the degree of project manager's compliance to project systems and project performance in terms of cost and schedule. To determine the degree of project manager's compliance and the level of knowledge they have on the respective project systems in terms of locating, understanding and applying them. The level of knowledge might influence their ability to comply. In order to effectively address the above problem, the following hypotheses needed to be tested:

- Project systems are always applied by project manager's during the project life cycle
- Employees are familiar with the different project systems.
- The higher the level of compliance to project systems the better the project performance.

H1: The higher the level of adherence to project systems the better the project performance

Based on the observation from the result analysis, that for all phases except for concept phase that the compliance level to project systems is inversely proportional to both schedule performance and cost performance this hypothesis can be rejected for both schedule and cost performance.

H2: Project systems are always applied by employees during the project life cycle.

The overall level of adherence to project systems was 42% (2.1). It can be concluded that this hypothesis is rejected since the knowledge level falls below 80% (4). The second hypothesis highlighted that employees only apply project systems when it is enforced, or the penalty of non-compliance is too great, this statement was concluded from the questionnaire because the adherence level for ACNAC is higher than that of CIP. ACNAC is enforced and will give an error should one attempt to move to the next phase without completing the current phase. The activities in ACNAC are done, but not necessarily correct and by the right person.

H3: Employees are familiar with the different project systems.

The knowledge level of project systems was found to be 61.5% for the pre-project phase (planners), 46.5% for the concept phase (designers) and 79.5% for the definition and execution phase (PMs). The overall knowledge level of employees about project systems during the entire project life cycle was found to be 62.5% (3.1), therefore indicating that this hypothesis can also be rejected. Maryam et al (2012) statement that business processes are usually big and complex models which make them unreadable; he further says that they cannot be easily understood supports the rejection of this hypothesis.

Referring to Table 5.1 and Table 5.2, the results for CIP and ACNAC are very much the same (ACNAC workflow is based on CIP), only the concept phase showed a directly proportional relationship between compliance level and schedule performance, and no relationship between compliance level and cost performance. The rest of the results show an inversely proportional relationship between project systems and performance for both schedule and cost performance.

A conclusion based on the information can be drawn that there is a negative correlation between project systems compliance and project performance in terms of schedule and cost. However from the results in chapter 4, it was indicated that the relationship between compliance level and schedule performance is stronger than the relationship between compliance level and cost performance. According to the literature schedule delays are directly proportional to cost delay due to IDC, overheads, market movements and contractual obligations. The relationship between schedule delays and cost overruns for the CIP is as follows: a delay during the pre-planning phase and concept phase will affect the schedule performance throughout the project life cycle, but the delay will only affect the cost performance in terms of overheads and IDC, of which it is 9% of the actual expenditure. This will result in a lower impact of project system compliance on cost performance as compared to the impact on schedule performance. This supports the conclusion drawn. During the Execution phase (definition and construction) a delay will also have an impact on the schedule of a project, but during this phase the tender issues and the storage of the ordered materials that are not ready to be utilised will have an impact on the cost performance. The tender issues have an even greater impact on the cost performance than the material issues, should the project be late. These include the site re-establishment, site camp, and transportation. Due to the severity of cost impact of schedule delays on the execution phase PMs always makes sure that the schedule processes during this phase are handled adequately so that they do not have to do cost revision should the project delay. This also supports the conclusion that cost performance is not as affected as schedule performance by non-compliance. Additionally the gates for cost overruns revisions are tighter than the gates for schedule delays. Therefore during the project life cycle employees will let the schedule slip easier than they would let the cost.

Table 5-0-1: Conclusion for the relationship between CIP during different phases and performance (SI and CI) (OWNSOURCES, 2016)

Phase of the PLC	**SI per phase**	**CI per phase**
Pre-project phase Compliance level	Inversely proportional	Inversely proportional
Concept phase Compliance level	Directly proportional	No relationship
Definition phase Compliance level	Inversely proportional	Inversely proportional
Execution phase	Inversely proportional	Inversely proportional

Compliance level		

Table 5-0-2: Conclusion for the relationship between ACNAC during different phases and performance (SI and CI)

Phase of the PLC	SI per phase	CI per phase
Pre-project phase Compliance level	Inversely proportional	Inversely proportional
Concept phase Compliance level	Directly proportional	No relationship
Definition phase Compliance level	Inversely proportional	Inversely proportional
Execution phase Compliance level	Inversely proportional	Inversely proportional

The knowledge level and compliance level of project managers were found to be higher than the knowledge level of designer and planners. Therefore we can conclude that the knowledge level does influence the ability to comply.

The literature revealed a positive correlation between project systems and performance, but did not investigate the effect of the level of compliance on project performance. The literature also indicated that in spite of advancement in project managements processes, systems and tools, project success has not significantly improved. The first and main part of this research aimed to fill this gap in the literature which shall assist future research looking into this field. The study used correlational analyses and hypothesis testing to come to its conclusion. All the hypotheses were rejected.

The performance of 10 projects were studied and presented, the performance mainly looked at the cost and schedule of the project. The reason for this selection was because time delays are directly linked to cost overruns. (Aziz, 2013) indicated that the construction industry has a very poor reputation in coping with delays. Further saying that delay analysis is either ignored or done subjectively by simply adding a contingency. The level of adherence to project systems was measured using survey questionnaire. This factor was analysed for correlation and a conclusion was drawn.The hypotheses in the framework which were developed from the literature research were tested using the results in chapter 4, to determine their acceptance or rejection. A literature study was

done, to investigate the past literature on the correlation between the level of adherence to project systems and project performance.

If the knowledge level about project systems is not adequate, then employees might not fully understand or appreciate the importance of adhering to these project systems. (Bryde, 2008) claim that project (Ayesha, 2015) success is dependent on appreciation of the importance of PM. The impact of project systems to project performance needs to be boldly highlighted in order to increase the adherence level to project systems. This supports the conclusion drawn on the knowledge level influencing the ability to comply.

(Cheng, 2014) discussed the key cost influencing factors; he ranked them and indicated the level of severity for each group. (Cheng, 2014) indicated that cost control in terms of budgeting for higher costs for projects than actually needed have the second highest severity. Therefore the results indicating that as the compliance level increases, the project takes longer to complete and the cost overruns are not strongly affected as the schedule, could also be due to project cost contingencies that are added to mitigate addition costs often needed during the project life cycle, so to minimise cost revisions should there be delays.

The statistically negative correlation found between project systems compliance level and project performance in terms of schedule and cost is not consistent with previous research.

The project systems related training percentages in chronological order from highest to lowest are: Definition and Execution major stakeholders (Project managers), pre-project planning stakeholders (planners) and lastly concept phase stakeholders (designers). Referring to the respective adherence level which indicated that the compliance scores in chronological order from highest to lowest are as follows: Definition and Execution major stakeholders (Project managers), pre-project planning stakeholders (planners) and lastly concept phase stakeholders (designers), a conclusion can therefore be made based on this information that the ability to comply depends firstly on the knowledge or training on the project systems, because the order of training and knowledge follows the order of adherence levels. Secondly the PMs have a higher responsibility in the process throughout the project life cycle more than the designers and planners. Therefore the PMs Non-compliance will have a severe impact on project performance than the non-compliance of planners and designers. Thirdly the cost implications in terms of delays on

the project are higher in the ERA phase than in the CRA and DRA phases. This might have led to the higher compliance level of PMs as compared to planners and designers.

The following important outcomes were concluded from the investigation:

- All of the projects that had major scope changes were not presented at TEF for the second TEF approval.
- There were no project post mortems, section and departmental review meeting nor business solution reviews meeting on all projects. These will highlight the lesson learnt, and ensure that these lessons are fed back to the relevant resources to analyze, test, monitor and improve project systems.

The main recommendation arising from this study is that project based organization should invest time, effort and financial resources in the monitoring systems or tools of the adherence level to project systems by their employees in order to improve project performance.

5.2 Contribution of the study

The research will contribute towards knowledge of project manager's roles as a project leader and competencies required in Project Execution Department in LOU. There is a need to explore whether if there is a correlation between the degree of project manager's compliance to project systems and project performance in terms of cost and schedule. To determine the degree of project manager's compliance and the level of knowledge they have on the respective project systems in terms of locating, understanding and applying them. The level of knowledge might influence their ability to comply

5.3 Factors to consider as the limitation of the results

- The nature of the environment of the study only allows one planner or PM to be involved on a project, therefore resulting in one planner or PM evaluating a project which could have resulted in a biased evaluation and it is not statistically representative.
- There were no designers available for Khuma substation.
- There were no DRA performance figures for Charles Shaft.
- Most projects have a good representation in terms of the number of respondents received. Some projects are not well represented due to the unavailability of respondents since some have left the organization. Moffat has the least representation with only 3 respondents, Mmabatho Main, Fochville Kraalkop and

Khuma has 4 participants, Charles Shaft and Delareyville Munic has 5 respondents, Zeerust Munic and Gopani Mine has 6 respondents, Klerksdorp North has 7 representations and Matlosana has 8 respondents.

-

5.4 Conclusion

This research concluded on the correlation between the level of adherence to project systems and projects performance, found a negative correlation between them. However there is a need to look at the various factors that could be the underlying reason of the significantly low project manager's compliance level to project systems in Eskom Distribution LOU.

The research also recommends that the investigation be extended to the larger Distribution division in order to see if the results are consistent or differ in other environments

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Appendix A: Survey Questionnaire

Introduction

This questionnaire is part of a research project for my Master's Degree in Business Administration at the University of Limpopo. The research tittle is: "The degree of project manager's project system compliance and project performance in Eskom distribution asset creation project execution department in the Limpopo Operating Unit".

This questionnaire intends to measure the level of compliance to project systems in Eskom by project managers and engineers. The results will then be used to analyze if the measured level of compliance have an effect on project performance.

All information will be treated in the strictest confidence. Therefore feel free to be open and honest.

It should take you about 10-15 minutes to complete the questionnaire.

Please return the questionnaire as soon as possible to Maggy Tlakale Baloyi by email (BaloyiTM@eskom.co.za) or delivery to my office 92 Hans van Ransburg Room T117. If you have any questions about this project, feel free to contact Mrs TM Baloyi at 074 667 0102 or 015 230 1763.

I understand my right to choose whether to participate in completing the questionnaire and that the information will be handled confidentially.
I am aware that the results of the investigation may be used for purposes of publication.

☐	Agree
☐	Disagree

Demographics

1. Age

2. Gender

	Male
	Female

3. Qualification

	Matric
	N4-N6
	National Diploma
	B-Tech
	BSc/ BEng
	Honours
	MSc/MEng
	others

4. How many years of experience do you have with Eskom?

	Less than 5
	Between 5 and 10
	More than 10

5. Which department are you currently in?

	Project Management
	Network Engineering and Design
	Network Planning

	Plant Management
	Field Services

6. What is your current Position?

	Project Manager
	ACNAC Controller
	Scheduler
	Engineer
	Snr Engineer
	Technician
	Snr Technician
	Technologist
	Manager
	Middle Manager

7. How many years of experience do you have in your current position

	Less than 5
	Between 5 and 10
	More than 10

8. How many projects have you been fully involved in?

	Less than 5
	Between 5 and 10
	More than 10

9. How many projects have you been fully involved in simultaneously?

	None
	Less than 5
	Between 5 and 10
	More than 10

10. How many projects have you completed (from start to end)?

	Less than 5
	Between 5 and 10
	More than 10

11. Have you ever heard of the Capital Investment Process document?

	Yes
	No

12. Do you know where to find the latest Capital Investment Process Document?

	Yes
	No

13. Have you been trained for the Capital Investment Process?

	Yes
	No

14. If yes, what type of training did you receive?

	Formal
	Informal

15. Have you ever heard about the Project Life Cycle Governance Guideline?

	Yes
	No

16. Do you know where to find the latest Project Life Cycle Governance Guideline?

	Yes
	No

17. Have you been trained for Project Life Cycle Governance Guideline?

	Yes
	No

18. If yes, what type of training did you receive?

	Formal
	Informal

19. Do you have access to ACNAC?

	Yes
	No

20. Have you been trained for ACNAC?

	Yes
	No

21. If yes, what type of training did you receive?

	Formal
	Informal

Survey

Choose a project that you were involved in and answer the following questions based on the chosen project (indicate with an X)

If you were not involved in any of the mentioned projects, kindly proceed with the questions below based on projects you have worked on.

1	Mmabatho Main

2	Fochville Kraalkop
3	FJR1URR - Moffat
4	Delareyville Munic - Rapule Feeder
5	Khuma
6	Gopani Mine
7	Matlosana
8	Klerksdorp North (Direct Customer)
9	Charles Shaft
10	Zeerust munic
11	Other

Based on the selected project above and projects you have completed in the past, please read the questions below and indicate with an X in the appropriate block on the left which indicates the frequency in which you conducted the activity indicated in the question from a scale of 1 to 5 where 1 indicates Never and 5 indicates almost always. If the question is not applicable to you indicate as N/A. If you are not sure of the process or you do not know of it please indicate with an X on the unsure column.

The following questions are based on the Capital investment Process and the ACNAC workflow.

Pre-project planning phase CIP

Q. No.	*Question*	*Never*	*Rarely*	*Some times*	*Often*	*Always*	*Unsure*	*N/A*
1	Did you present the development plan and projects at the Regional Planning Review Forum (PRF)?	1	2	3	4	5		
2	When delivering a cost estimate letter to the customer, do you do this within 30 calendar days from the time you receive the application?	1	2	3	4	5		
3	Did you conduct section project review meetings before submitting the planning proposal to the designers?	1	2	3	4	5		
4	Did you conduct departmental project review meetings before submitting the planning proposal to the designers?	1	2	3	4	5		
5	Did you handover a project with CRA Form approved, schedule and planning proposal?	1	2	3	4	5		

Pre-project planning phase (ACNAC)

Q. No.	*Question*	*Never*	*Rarely*	*Sometimes*	*Often*	*Always*	*Unsure*	*N/A*
6	AS an ACNAC controller or planner do you initiate the work flow in ACNAC by registering the CRA	1	2	3	4	5		

Q. No.	*Question*	*Never*	*Rarely*	*Sometimes*	*Often*	*Always*	*Unsure*	*N/A*
	Form?							
7	Did you send a reminder to the customer after 21 days of receipt of the feasibility quote for the acceptance or rejection of the Feasibility Quote?	1	2	3	4	5		
8	Did you confirm that the fees allocated to the project are reasonable before approving the CRA on the system?	1	2	3	4	5		
9	Did you confirm the contracted CRA approval date on the system after the schedule is approved?	1	2	3	4	5		
10	Do you understand the meaning of the dates you are required to populate on the CRA Form? (contracted approval date, job required completion date and contracted completion date)	1	2	3	4	5		
11	Does the CRA Form get approved by the IC chairperson on the contracted CRA approval date indicated on the CRA Form?	1	2	3	4	5		

Concept Phase CIP

Q. No.	*Question*	*Never*	*Rarely*	*Sometimes*	*Often*	*Always*	*Unsure*	*N/A*
12	Did you present the CRA Form(s) to a Resource Planning Meeting (RPM)?	1	2	3	4	5		
13	Did you base the concept design on the site recommended in the Environmental Impact Assessment (EIA)?	1	2	3	4	5		
14	Did you schedule the project at the Concept phase (PPM)?	1	2	3	4	5		
15	Should there be a schedule, do you follow the dates on the schedule?	1	2	3	4	5		
16	When compiling the preliminary design, do you base it on the planning report?	1	2	3	4	5		
17	Did you do section project review meetings before submitting the design package to project management?	1	2	3	4	5		
18	Did you do departmental project review meetings before submitting the design package to project management?	1	2	3	4	5		
19	Did you (IC) make sure that that all land owners	1	2	3	4	5		

Q. No.	*Question*	*Never*	*Rarely*	*Sometimes*	*Often*	*Always*	*Unsure*	*N/A*
	have signed options for the servitudes required for the project before approval of the project?							
20	Did you present the project at TEF for approval after a major project scope change for projects that have been previously TEF approved?	1	2	3	4	5		

Concept Phase (ACNAC)

Q. No.	*Question*	*Never*	*Rarely*	*Sometimes*	*Often*	*Always*	*Unsure*	*N/A*
21	Did you as a manager verify project costs against the costs and schedule variances explanations?	1	2	3	4	5		
22	Did you understand the meaning of the dates you are required to populate on the DRA Form? (Contracted approval date, job required completion date and contracted completion date)?	1	2	3	4	5		
23	Did you use the dates on the schedule to populate the contracted, job	1	2	3	4	5		

Q. No.	*Question*	*Never*	*Rarely*	*Sometimes*	*Often*	*Always*	*Unsure*	*N/A*
	required completion and job contracted completion dates on the DRA Form?							
24	Did you understand the meaning of the dates you are required to populate on the DRA Form? (contracted approval date, job required completion date and contracted completion date)	1	2	3	4	5		
25	Did you use the dates on the schedule to populate the contracted, job required completion and job contracted completion dates on the DRA Form?	1	2	3	4	5		
26	Should there be a schedule, do you receive a copy of the schedule?	1	2	3	4	5		
27	Should the project be late, is the schedule updated?	1	2	3	4	5		

Definition Phase (CIP)

Q. No.	*Question*	*Never*	*Rarely*	*Sometimes*	*Often*	*Always*	*Unsure*	*N/A*
28	Should there be a	1	2	3	4	5		

Q. No.	*Question*	*Never*	*Rarely*	*Some times*	*Often*	*Always*	*Unsure*	*N/ A*
	schedule available, do you follow a schedule?							

Definition Phase (ACNAC)

Q. No.	*Question*	*Never*	*Rarely*	*Some times*	*Often*	*Always*	*Unsure*	*N/ A*
29	Did you confirm scheduled dates with the project construction team before capturing onto the ERA form?	1	2	3	4	5		
30	Do you understand the meaning of the dates you are required to populate on the ERA Form? (contracted job construction start date, previous contracted job completion date and job contracted completion date)	1	2	3	4	5		
31	Did you use the dates on the schedule to populate the contracted, job required completion and job contracted completion dates on the ERA Form?	1	2	3	4	5		

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Execution Phase and Finalization (CIP)

Q. No.	*Question*	*Never*	*Rarely*	*Some times*	*Often*	*Always*	*Unsure*	*N/A*
32	Did you prepare any Form revisions should you have any Form variation in terms of cost and time above the required limit?	1	2	3	4	5		
33	Does the clerk of works test and perform quality Control of the constructed asset after construction?	1	2	3	4	5		
34	Did you have a project reconciliation report?	1	2	3	4	5		
35	Do you have a project performance evaluation report?	1	2	3	4	5		
36	Did you work on both the ACNAC and CIP Processes simultaneously when executing your work?	1	2	3	4	5		

Execution and Finalisation Phase (ACNAC)

Q. No.	*Question*	*Never*	*Rarely*	*Some times*	*Often*	*Always*	*Unsure*	*N/A*
37	Did you make sure that a post construction environmental audit has been completed before commissioning and energizing of the	1	2	3	4	5		

Q. No.	*Question*	*Never*	*Rarely*	*Some times*	*Often*	*Always*	*Unsure*	*N/ A*
	asset on the system?							
38	Did you conduct the appraisals for consultants and contractors after project completion?	1	2	3	4	5		
39	Did you manage the status of the EMP (that whether it is finalized or handed over to field services to complete)?	1	2	3	4	5		

Post-project phase

Q. No.	*Question*	*Never*	*Rarely*	*Some times*	*Often*	*`Alway s*	*Unsure*	*N/ A*
40	Did you conduct project post-mortems?	1	2	3	4	5		
41	Did you have a business solution review on a sample of projects annually?							

If you have any comments please indicate the comments in the space provided below	
Q. No.	Comment
