An evaluation of project integration management practice at Hillside Aluminium Smelter

by

Zintle Ndandani

A Minor Dissertation Submitted in Partial Fulfilment of the Degree
MAGISTER INGENERIAE / MAGISTER PHILOSOPHIAE

in

ENGINEERING MANAGEMENT

at the
FACULTY OF ENGINEERING AND THE BUILT ENVIRONMENT

of the
University of Johannesburg

February 2020

SUPERVISOR: Prof. JHC Pretorius
CO-SUPERVISOR: Dr A Malan

Abstract

The purpose of the study on which this dissertation reports, aimed to evaluate project integration management methods applied at Hillside Aluminium Smelter as the strategy tool for effective project management. The study further identified other successful strategic methods that sought to improve current methods where necessary. The chosen improvement methods from the strategy tools were applied for the case company, a metal manufacturing company in South Africa, to recommend strategy alternatives to enhance project integration management for effective project management. The first approach sought feasible strategic tools to create viable project integration management advantage for a metal manufacturing company. Secondary data from project files was used to analyse project integration methods applied in the smelter. A second approach was to utilise literature regarding areas of project integration management. The strategy deployed provided an inclusive methodology for systematically studying and describing project integration capability within a real-life context. Applying the developed strategic conceptual project integration management framework, which combines company strategy tools with more recognised successful and focused tools led to enhance project success through project integration management for the metal manufacturing company. Analysis of project integration management in the metal manufacturing industry was mainly used in other industries based on research papers, articles and books. The gathering of information depended on the provision of accessible data. Through this dissertation, the author contributes to the debate of creating success in projects through integration management. Moreover, guidance for project practitioners is offered by exploring the benefits of applying other proven project integration management tactical tools.

Acknowledgements

My sincere thanks and gratitude to

- My supervisors, Prof. JHC Pretorius and Dr Andre Malan, for guidance and support throughout the pebbly journey travelled in order to learn and grow positive in life.
- To my loving husband, Siyabonga (Ndoda), and three daughters, Azuke, Olothando and Amila,
- Everyone who had supported me throughout this journey,

and above all to God, Almighty, for He has been kind to me against all odds.

Table of contents

List of figures

List of tables

List of Acronyms

AC	actual cost
BAC	budget at completion
CEO	chief executive officers
CM	configuration management
CLM	configuration lifecycle model
CPI	cost performance index
CRM	customer relationship management
CV	cost variance
EAC	estimate at completion
ERP	enterprise resource planning
EV	earned value
EVM	earn value management
ISO	International Standard Organisation
MBE	management by exception
NIH	National Institutes of Health
OPM	organisational project management
PM	project management
PMB	performance measurement baseline
PMBoK	project management body of knowledge
PMI	Project Management Institute
PMO	project management office
PV	planned value
SV	schedule variance
SPI	schedule performance index
TCPI	to complete cost index

VAC	variance at completion

1 INTRODUCTION

1.1 Background

This chapter introduces the research for evaluating project integration management practice at the Hillside Aluminium Smelter, by initially framing the background and context of the research. After this, we will provide an overview of the research by articulating the problem statement, purpose of the study, research question and objectives. Next, we will define the scope and aim of the research, the author's research objectives and targets, including the organisation of the research and how the study will contribute to the body of knowledge. We will end with a brief overview of the chapters that follow.

1.2 Overview of the challenge

The Project Management Institute (PMI) says “the success of a project largely depends on the ‘integration’ of stakeholders to satisfy the outcomes of a project”. It is expected that each project input be inclusive by “getting stakeholders involved, collecting the correct requirements and managing expectations for stakeholders, sponsors and clients” (PMI, 2017). PMI also believes that projects run into trouble during the execution phase because project managers are more concerned with pleasing clients and sponsors and making sure the project stays on track. The result is that they forget to take care of the project team. Project managers “cannot manage people in the same way as individuals manage personal cash, schedules and resources”. The success of a project can be ensured by effectively integrating the project within the project team (Klaus, 2013; PMI, 2017).

Cioffi (2002) sees the word ‘integration’ as having meaning outside the sphere of Mathematics. He explains ‘integration’ as adding or joining separate parts to form a whole. Cioffi suggests integration is incomplete if the project manager only integrates certain factors like budget, schedule and scope in a project. It is only complete if stakeholders and the project team are integrated too (Cioffi, 2002).

Data and information in a project are shared and integrated among members of the project team. By sharing knowledge from many projects across programmes and throughout the company, project managers can ensure that all projects are suitably aligned to the company's strategic objectives and can effect meaningful 'integration'. A project review will ensure that the goals and projects of the company are integrated in terms of cost, schedule, and scope of an individual project. The current research expands on the project review concept to consider integration management as meeting project objectives by bringing together data, information, knowledge and people. Project integration can be extended to take into account the roles of a project in the parent organisation. Figure 1.1 below illustrates the knowledge management cycle for project integration management.

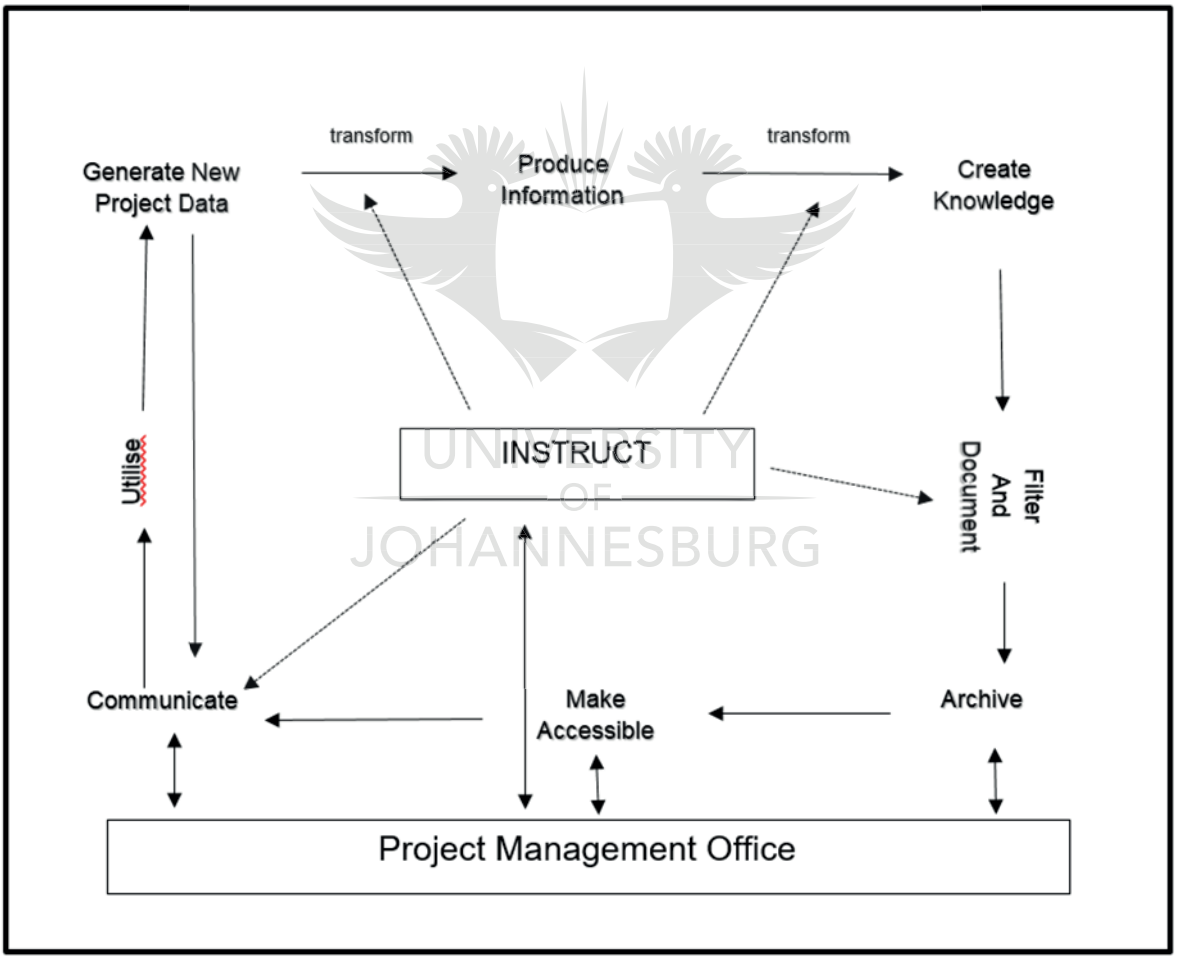


Figure 1.1: Knowledge management cycle for integration management

Source: Cioffi (2002)

According to Charan and Colvin (1999), effective business executives must embrace projects that are profitable in order to ensure their company remains financially effective. The majority of executives understand the need to create the best vision, strategy and marketing plans for business projects and any business venture. However, few executives use a mathematical analysis that involves evaluating the success of a project, the performance of the project manager, identifying problems, and taking corrective action (Charan & Colvin, 1999). Often executives, senior managers and senior project managers cannot understand why their teams are unable to resolve operational problems, which would leave the executive more time to deal with the important strategic issues. (Charan & Colvin, 1999).

Steyn (2004) recommends that these managers should be asking themselves "if, when and how they get into the operational details". Charan and Colvin (1999) say it is "desirable for an executive or senior manager to think of himself or herself as a strategic proactive leader". However, it is often the case that successful executives must deal with daily operational issues, grappling with the details in order to be of value in the future (Charan & Colvin, 1999). So, executives and managers must adequately balance the operational and strategic concerns of a company with little in the way of rule-book assistance. In many cases, this kind of balance is only learnt by managers through on-the-job experience. Charan and Colvin propose an informational integrated approach to capturing the experience of others as this "may enhance business executives' overall effectiveness, thus, reducing the trial and error learning process". Senior managers' knowledge of operational details is important and just how much they know of these details is a thought-provoking question when thinking about projects.

In terms of projects, "success" is an ambiguous concept. This ambiguity arises because the success of a project may be measured against one of many different objectives. Brun (2008) identifies the following objectives:

- Project objectives: what the project organisation is expected to deliver at the close of the project (scope, cost, quality, time);

- Business objectives: what the project sponsor expects to obtain from using the project results after the project has been completed and handed over to operations from the project organisation; and
- Political, social and environmental objectives: which benefits the local municipalities expect from the project during project execution as well as during the use of the project results (Brun, 2008).

Cooke-Davies (2002) agreed with this and further distinguished between project success (measured against the business objective) and project management success (measured against the project objectives). Belassi and Tukel (2007) approach ambiguity by proposing a framework to classify success factors into four groups: "related to the project, related to the project manager and team members, related to the organisation, and related to the external environment" (Belassi, 2007). Shenhar (2001) describes four success dimensions: "project efficiency, effect on the customer, direct business and organisational success, and preparing for the future". In terms of the above approaches the dimension of project efficiency is related to fulfilling project objectives (or project management success). The other three dimensions are related to meeting the business objectives of different stakeholders (Shenhar, Dvir, Levy, & Maltz, 2001). Cooke-Davies (2002) further suggests that in order to understand which factors are critical to successful project integration, we need to ask these questions:

- Which factors are critical to project integration success?
- Which factors are critical to success on an individual project? and
- Which factors lead to consistently successful projects (Cooke-Davies, 2002)?

The results of a project may be unsuccessful even when it is managed successfully. And the reverse may also be true – while a project may be managed to perfection, it may not be successful. For example, changing markets could lead to a business disaster even though a project has been managed meticulously. Project results can also be successful even though the project might have been managed unsuccessfully (PMI, 2013). In this research, I evaluate the project integration management in Hillside Aluminium Smelter to identify opportunities to enhance project success.

1.3 Research problem statement

Company leadership, such as chief executive officers (CEOs) and executive management at reputable companies, sometimes fail while having good business vision, strategies and work principles. It is estimated that 70% of executives fail due to poor performance (Charan & Colvin, 1999).

A metal manufacturing industry, such as Hillside Aluminium Smelter, requires effective project integration management to execute engineering projects in its operations. In other words, the smelter requires the numerous engineering management processes to be used in a project to ensure that project activities are effectively coordinated in a manner that ensures continuity of operations, safety of employees and visitors, productivity and acceptable returns, while not endangering the environment. Below is a list of departments in an aluminium smelter:

- Reduction;
- Maintenance;
- Carbon;
- Casthouse;
- Treatment and logistics;
- Engineering;
- Business and process improvement; and
- Support departments

Project managers are faced with the task of maximising integration management with all stakeholders, particularly production teams. In a production plant such as Hillside, project execution requires trade-offs with multiple production departments to get the project completed on time and within budget. Developing strategies to enhance project integration management will support project managers in executing projects at the smelter effectively.

1.4 Purpose of the study

By following the research approach, as well as project integration management methodologies discussed in the literature review, the fundamental objective of this study is to evaluate project integration management of capital projects at Hillside Aluminium Smelter.

The smelter is equipped with multiple engineering and production areas for managing different knowledge areas of the project. The research identified project integration management as one of the tools to manage time, costs and quality. This study will further benefit the smelter by improving the applied project integration methods to maximise the efficiency of project teams and to maximise a return on investment.

1.5 Research questions

The research questions for the study were as follows:

- What integration methods are utilised in the smelter?
- Who is included as stakeholders of integration management?
- Do current project integration methods support effective execution of projects?
- What are areas to improve project integration management on capital projects?

1.6 Research objectives

The current research had the following objectives:

- To identify project integration management methodologies in the smelter;
- To identify stakeholders to effect project integration management in Hillside Aluminium Smelter;
- To review models to determine the best and most effective project integration methodologies;
- To establish and recommend areas of improvement to enhance project integration methodologies applicable to the problem statement.

1.7 Focus study area

The scope of this research was guided by the following key principles:

- focused on engineering projects executed at Hillside Aluminium Smelter in Richards Bay;
- focused only on the projects led by internal project teams; and
- focused on projects executed during the period of one to two years.

1.8 Significance of the challenge

The research focuses on project integration management methods and their effectiveness to execute projects in Hillside Aluminium Smelter. The research further identified potential improvement methodologies for the execution of projects. The research included process improvement of current training and development measures available. Most project professionals were measured against project delivery key performance indicators and assessed on whether these indicators assisted management of project integration.

1.9 Chapter outline

The research report is structured into six chapters or sections as follows:

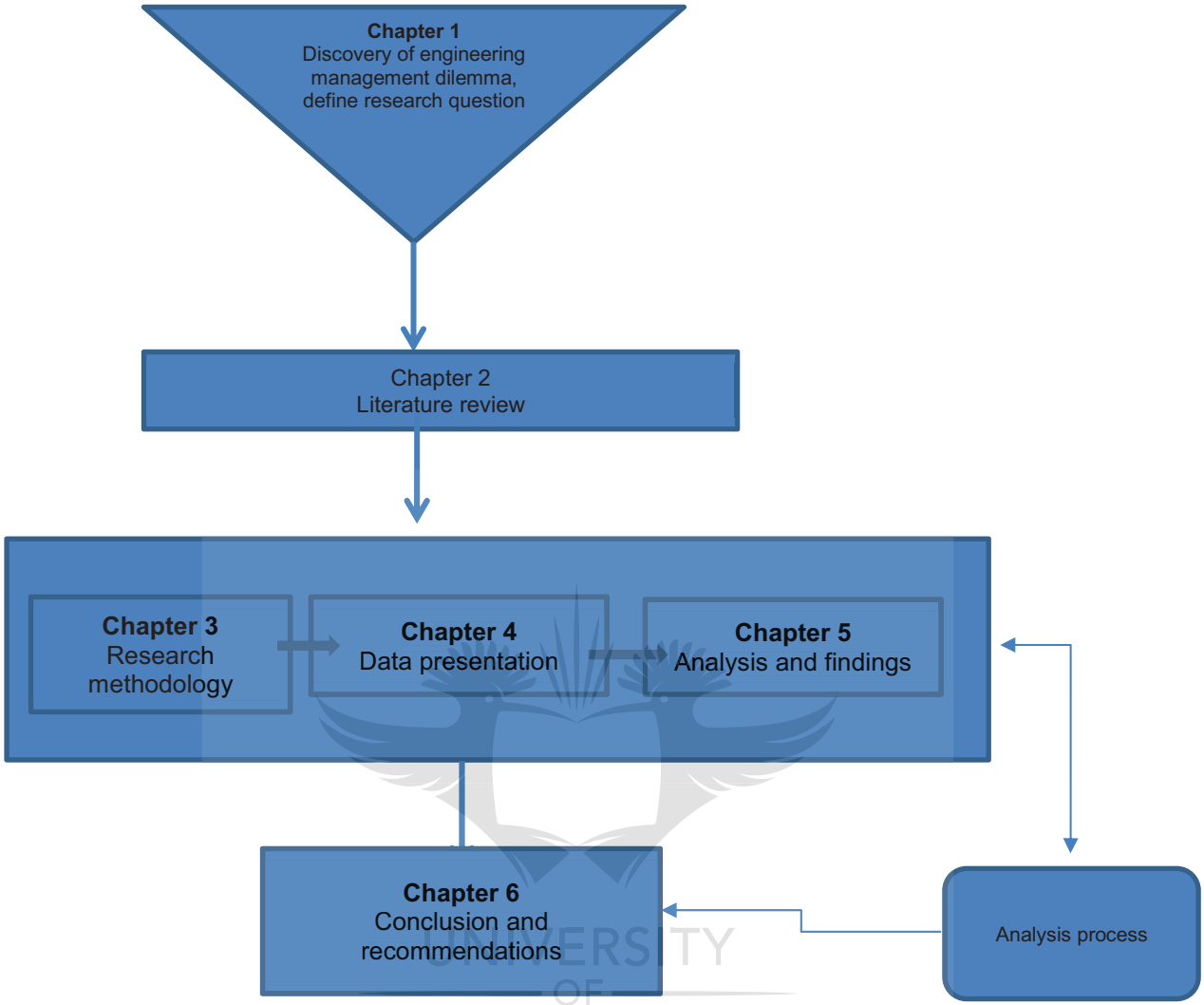


Figure 1.2: Research process

Source: Yin (2014)

The chapters presented in this dissertation illustrate an understanding of effective project integration management processes when executing projects in an organisation.

Chapter 1 sets the research by discussing the background, research methodology and the objectives of the research project.

Chapter 2 introduces the literature review and represents theory and past research efforts on project integration management.

Chapter 3 provides research methods used in this research.

Chapter 4 is the presentation of results and findings gathered when conducting the research.

Chapter 5 is the analysis and discussion of the research results.

Chapter 6 provides the conclusion and recommendations for the research.

1.10 Conclusion

When executing projects, integration management is an integral part of ensuring success in the execution of projects. This first chapter sets the research background and the objective of the research project. In Chapter 2, a theoretical perspective towards project integration management in general is provided with the aim to evaluate success and shortcomings experienced by Hillside Aluminium Smelter as determined by this research project.

2 LITERATURE REVIEW

2.1 Introduction

Project integration management literature study is presented in this chapter by means of a relevant literature review that characterises the concept and some historical determinations on project integration management practices. Various hypothetical methodologies endeavour to elucidate the landscape of project integration management and some propositions are made for the applied execution of the project integration management process.

This chapter provides an amalgamation of existing project integration management processes and acts as a structure against which project integration management initiatives are analysed in this report.

The chapter ends with a brief introduction or overview of the chapters that follow.

2.2 Project management body of knowledge

Gholamreza (2016) describe project management body of knowledge (PMBoK) as a guide that reflects the purpose and provide the set of themes, relationships, and definitions of project management (Gholamreza, 2016). PMBoK provide a group of methods and knowledge fields which are regarded as best practice within the project management discipline (Gholamreza, 2016). PMI (2017) in the guide to PMBoK defined ten areas, forty-nine processes and five project groups of the body of knowledge (PMI, 2017).

Dionisio (2018) states that PMBoK is a vital resource for project management students and working professionals (Dionisio, 2018). The PMBoK guide is also an internationally recognized standard which provides the fundamentals of project management as they apply to a wide range of projects. PMBoK concepts and theory are applicable to real world practices of effective project management practices throughout all project phases (Dionisio et al., 2018). PMBoK provides detailed

illustration of real time project management implementation to provide expert guidance to all levels of project professionals (Dionisio et al., 2018).

Milosevic (2003) states that when project professionals are required to select project management tools or designing toolbox with selecting individual project management select PMBoK as their main guide for successful project management knowledge. PMBoK is regarded as a proven project management guide that widely accepted and successful project management standard (Milosevic, 2003).
Dionisio (2018) states that PMBoK is a vital resource for project management students and working professionals (Dionisio, 2018). PMBoK concept and theory are applicable to real world practices of effective project management practices throughout all project phases (Dionisio, 2018). PMBoK provides detailed illustration of real time project management implementation to provide expert guidance to all levels of project professionals (Dionisio, 2018).

2.3 What is project integration management?

Project integration management is the integration of projects in context It is the integration of costs, schedules, and scopes of the individual project and can be expanded further to integrate the roles of a project within the parent organisation (PMI, 2017).

Project integration management is highly recommended in construction projects to present considerations for originating, planning, implementing, monitoring and controlling, and finalising construction projects. Key activities during this knowledge area include classify, describe, combine, combine, organise, and make a project compatible on various processes (PMI, 2016).

The project integration management role is performed by project managers. The other knowledge areas (such as cost analysis, scheduling, risk management etc) in projects may be managed by experts in those fields. But the project manager is fully responsible for project integration management thus making it impossible to transfer or delegate accountability. It is the responsibility of the project manager to collate the results from all the other knowledge areas in order to have an overall understanding

of the project. In the end it is the project manager who is responsible for delivering on the project as a whole. (Cioffi, 2002).

2.4 Organisational project management

PMI (2018) defines organisational project management (OPM) as an integrated approach between people, knowledge, and processes, utilising functional organisational tools. Utilisation of OPM in organisation advances performance and linking portfolio, program, and project management values and approach. The key enablers of OPM in an organisation are people, technology, culture and infrastructure supported by business processes (Project Management Institute, 2018).

2.4.1 OPM maturity model

Kerzner (2015) describes OPM maturity model is when organisations evaluate factors that promote effective project management. Having organisational project management methods, policies and procedures does not lead to maturity of the OPM model. Critical components to the success of OPM are identified as the following: -

- Effective communication;
- Effective support;
- Effective project team; and
- Trustworthy. (Kerzner, 2015)

PMI (2017) further developed a standard of enhancing OPM through best practices. Key functional areas that organisations can measure their capabilities in preparation for improvement include the following elements: -

- knowledge of best project management methods;
- assessment of current project management capabilities and identify improvement opportunities; and
- continuous improvement of practices based on results attained (Kerzner & Frank, 2017).

2.5 Review of some project management processes

The PMI describes the project management processes to be deployed when carrying out project work. These processes are organised into five groups as listed below (PMI, 2017):

- initiating processes: determining the nature and scope of the work to authorise a project;
- planning processes: defining and refining the project scope and selecting the strategic plans to maximise project production;
- executing processes: coordinating teams and other resources effectively while organising project timeline expectations and attainment of goals;
- monitoring and controlling processes: managing project alteration, addressing budget issues, and justifying unexpected situations that may affect project progress to meet client expectations; and
- closing processes: sanction approval of the project or phase and conveying it to a logical end (Nokes, 2007; PMI, 2017).

Meredith, Samuel, and Mantel (1995) go on to suggest that the project management process establishes a standard project life cycle, which goes through a start-up phase, a building phase, a maturing phase and a closing-out phase (Meredith et al., 1995).

Project management process groups are related by the outputs they produce. The outcome of one process often becomes an input for another process. The project management process groups are not separated or defined as prompt actions. However, they are intersecting actions that occur at movable periods or levels throughout each period of the project (Meredith et al., 1995).

The project management processes defined above meet the assessment of general acceptance, as they are applicable to most projects (Steyn, 2004). It must also be noted that not all processes will be needed on all projects. Project management processes are also evident in projects that result in no tangible results, like national events such as the World Cup and a census. However, building the stadium for the

World Cup required all project management processes to be implemented (Steyn, 2004).

The project management body of knowledge identifies ten knowledge areas that must be managed in the above specified project management processes (PMI, 2017). Project integration management, which is one of the project management knowledge areas, is discussed in the sections below.

2.6 Review of some project integration management theories

Project integration management involves identifying, outlining, combining, customising and organising processes and project management events in the project management process groups (Cioffi, 2002). Within the project management framework, integration would include features of unification, association, communication and connecting with project teams. These activities are applied from the beginning to the end of the project. Cioffi (2002) further states that project integration management includes a selection that may include the following:

- allocating resources;
- balancing challenging demands;
- examining alternative approaches;
- tailoring processes to meet the project objectives; and
- managing interdependencies among project management knowledge areas.

By doing this, a project manager will ensure:

- project deliverables throughout the project life cycle are met and aligned to benefit management;
- the continuous alignment of a project management plan so that project objectives are achieved;
- the appropriate expertise will be attracted and used as and when required;
- project performance is managed and changes in the activities of the project management plan are controlled;
- the development of the project is measured and monitored, and appropriate action is taken to meet project deliverables;

- data on the outcomes achieved are gathered and analysed to acquire information, which is then communicated to relevant project stakeholders;
- that each phase of the project is closed properly and the scope of the project of the whole is completed; and
- that project phase evolutions are managed when necessary (Project Management Institute, 2017; Project Management Network, 2016).

2.7 Product integration management

Cagley and Thomas (2010) describe product integration management as execution of products that are defect-free is the responsibility of the entire project team but integrating all of product elements into a fully functional, defect-free product is the responsibility of a project manager. A product manager uses product integration ensuring that all product fragments come together at the right place and at the right time (Cagley & Thomas, 2010).

Below are steps that encompasses product integration management:

i. Identify integration approach;
ii. Develop all common components first, examine them, and make them available to the part integrators;
iii. Top down integration approach includes the following: -
    - Assign responsible person to integrate each part;
    - Ensure that the component(s) that form part of framework for other components to conclude a product are developed tested;
    - As product components are concluded they are integrated to the assembly and verification and validation of assembly activities is completed; and
    - Integrate the remainder of other components according to their priorities until integration is complete;
iv. Bottom up integration approach includes the following: -
    - Collect all required components into the assigned functional location as their construction and testing activities are completed;
    - When all modules are completed, a responsible person is assigned to integrate parts into a required product; and

- When integrated product is complete verification and validation process will be conducted then fixing all relevant defects realised;

v. Plan and execute integration of verification and validation of all modules;

vi. Assign responsible person or lead to prepare the product construction and hand over all integrated modules;

vii. Once the product is built, arrange for quality assurance activities to be carried out;

viii. Arrange defect ratification process for all relevant defects revealed during quality assurance activities to be fixed and complete the product build;

ix. Co-ordinate system testing and arrange for all relevant defects uncovered in system testing to be fixed; and

x. Formulate product for acceptance testing and delivery process.

2.8 The project integration management process

A project integration management literature study is presented based on a relevant literature review that characterises the concept and some historical determinations regarding project management practices. Various hypothetical methodologies endeavour to elucidate the landscape of project management and suggestions are made for the applied execution of the project integration management process (PMI, 2017).

2.8.1 Develop a project charter

This is the process of developing a document that legitimises a project and permits the project manager to use organisational resources for project activities. The project charter provides a link between the project and the business's strategic objectives. It also confirms the business's commitment to the project and creates a formal record of the project (PMI, 2017).

The inputs, approach, and results of the process are illustrated in Figure 2.1 below

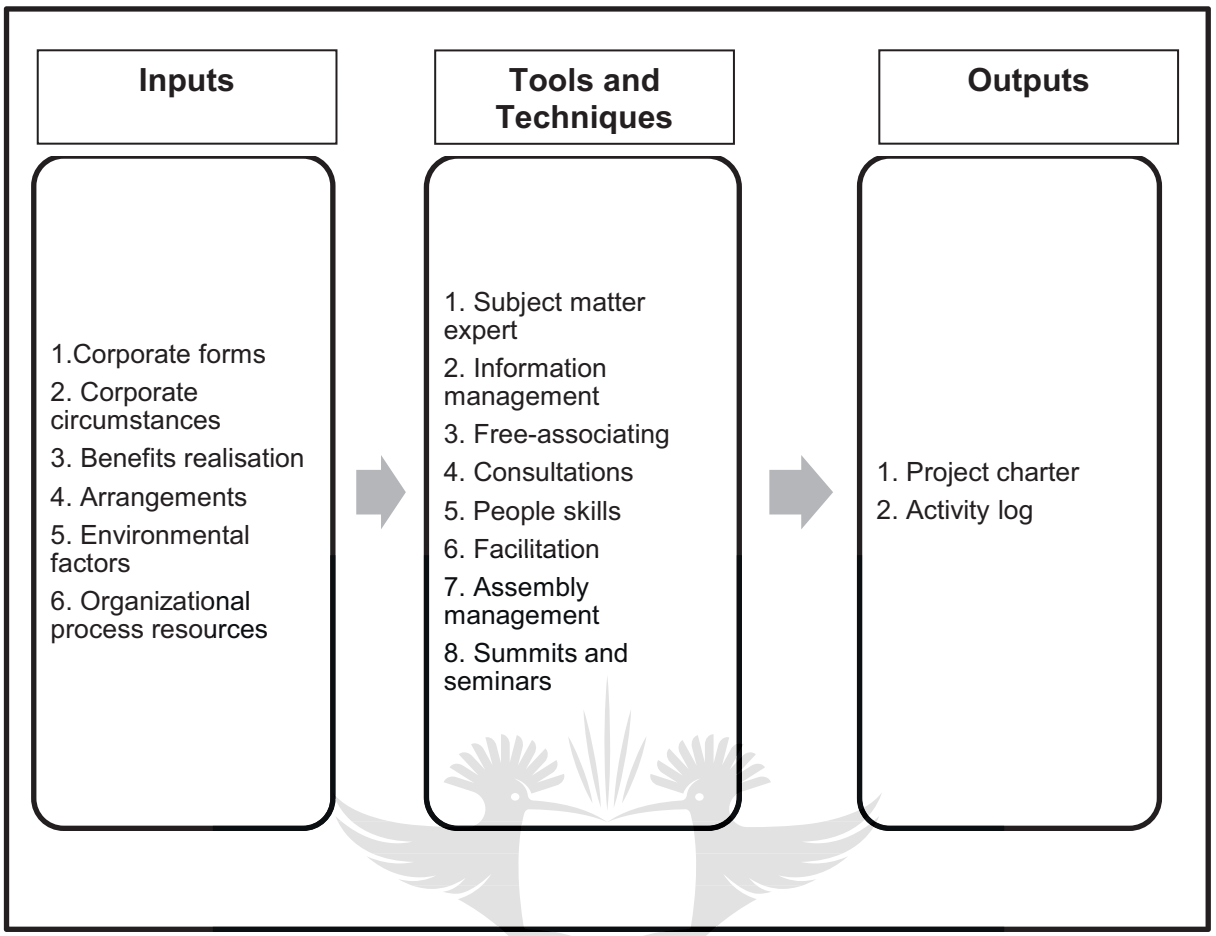


Figure 2.1: Develop a project charter process

Source: PMI (2017)

Ramu (2017) further describes a charter as a project contract document that states the purpose of a project and guides the project team towards the project goals. A charter should contain the following points:

- problem statement – outlines the needs of the project;
- purpose – develops team goals and objectives;
- benefits – states how the organisation will benefit from the project;
- scope – provides project limitations in terms of budget, time, and other resources; and
- results – defines the criteria and key performance areas for the success of the project, including the baseline measures and improvement expectations (Ramu, 2017).

2.8.2 Develop a project management plan

This is the process of defining, formulating, and organising all the plan details and combining them to form a consolidated integrated project management plan. The project management plan provides a strategy for how the project is to be carried out, monitored and controlled, and closed. Project management plans vary from one project to another and depend on the application area and how complex the project is (PMI, 2017).

PMI (2011) further says the integration by the team of the project plan includes analysis, consolidation, and integration of project information from the scope, schedule, and cost baselines. An integrated project management plan includes information from risk registers and risk response plans as baseline information (Project Management Institute, 2011).

PMI (2017) illustrates inputs, approach, and results of the process in Figure 2.2 below.

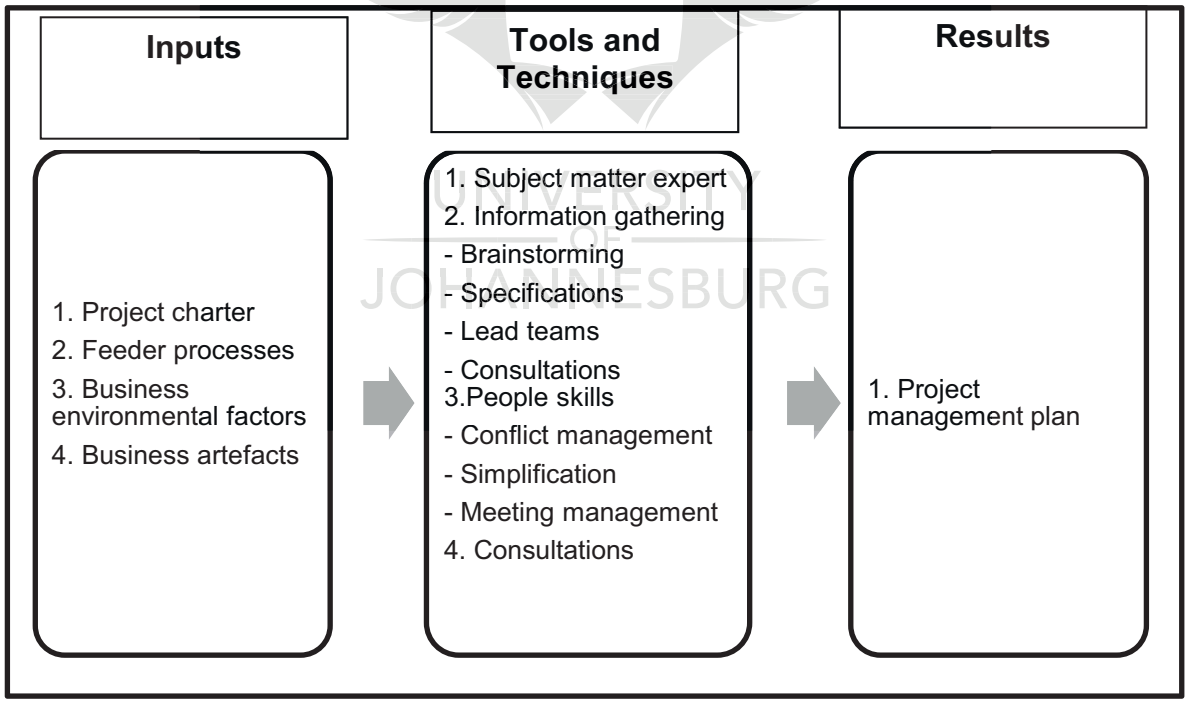


Figure 2.2: Develop a project management plan
Source: PMI (2017)

Project planning therefore is a systematic approach of monitoring the execution of a project to achieve the desired outcomes.

Munro (2015) says effective project planning requires skills in the following areas:

- Data processing;
- Communication;
- Resource discussions;
- Securing commitments;
- Incremental and modular planning;
- Assuring quantifiable milestones; and
- Facilitating executive involvement.

Using the problem statement, subject matter experts, and tools like free-associating charts, the scope of the project can be planned through systematic activities (Munro, Ramu, & Daniel, 2015).

2.8.3 Direct and manage project work

This is the process of guiding and executing the work defined in the project management plan and applying approved changes to reach the desired outcomes for the project. This process ensures the overall management of project work and deliverables and is performed throughout the project phases. The inputs, approach, and results of the process are illustrated in Figure 2.3 below.

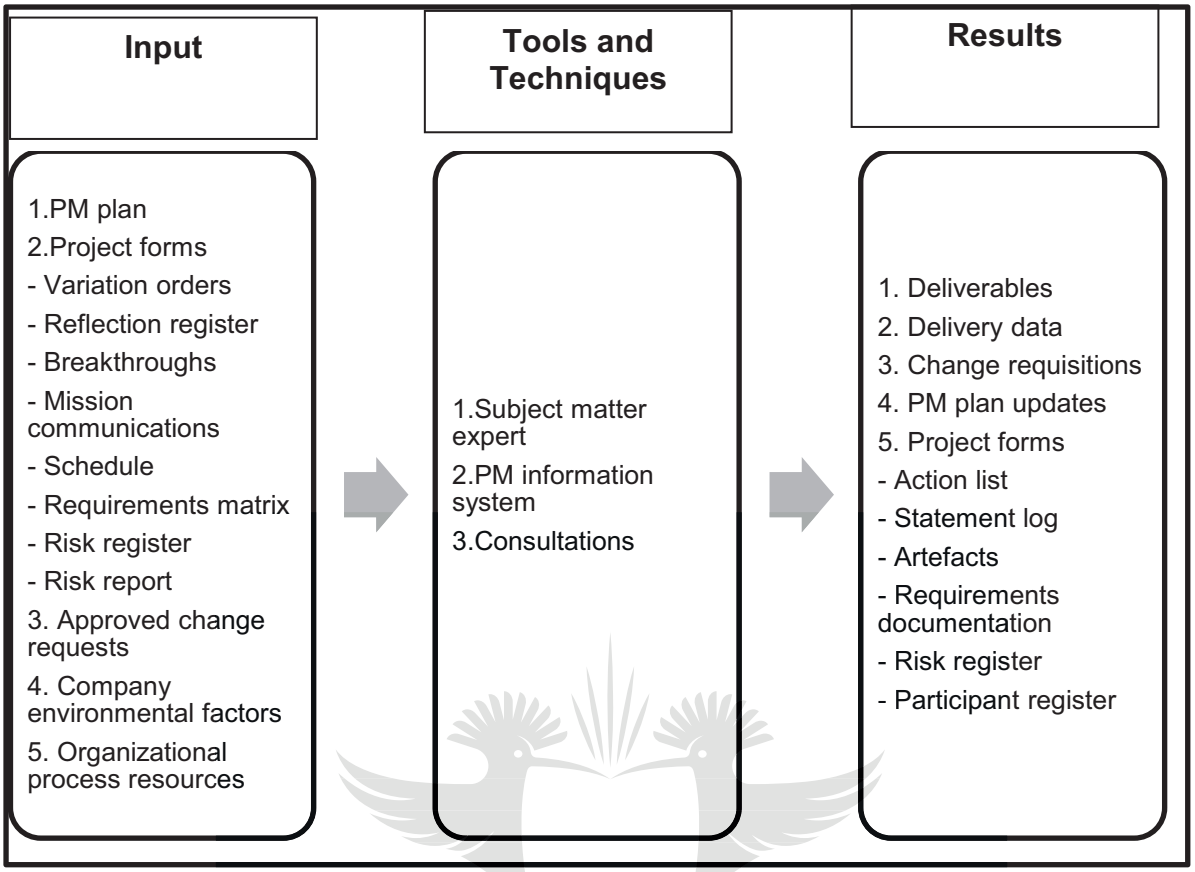


Figure 2.3: Direct and manage project work

Source: PMI (2017)

When project work is performed as prescribed by the project management plan, the outputs are achieved through directing and managing project work processes. The delivery of project milestones, work performance data, issue logs, change requests, project management plan updates, project document updates, and organisational process asset updates are then attained. Directing and managing project work also includes quality control and quality assurance of the project outputs (Kerzner & Frank, Project Management Workbook and PMP®/CAPM® Exam Study Guide, 2017).

Altwies (2019) says the execution of the project is driven by primary processes where the project management plan is put into action. This requires the high utilisation of project resources and funds. Key drivers of this process are the project management plan, the environmental factors at the organisation, and process assets. These inputs all influence project team performance (Altwies, 2019).

2.8.4 Manage project data

To monitor the evolution of a project, controlling the project, and facilitating good communication, the effective management of data is crucial. Managing data impact communication addresses the following kinds of questions: -

- How will project data and information be gathered, organised, processed, and updated? and
- How will project information be communicated among project stakeholders i.e. by frequent meetings, written memos, reports? (Kendrick, 2014)

Since projects have unique feature and resources are allocated in a matrix manner, effective communication is crucial for the success of a project. A significant number of problems in a project may result from ineffective communications. Communication challenges come in the form of overlapping responsibilities, regular scope changes and constraints, intricate departmental or discipline integration that require intense interface requirements and decentralised decision-making processes, and a potential for conflict. Communication is the biggest influencer of quality, effectiveness, satisfaction and productivity of a project team (Kendrick, 2014).

PMI (2017) identify the inputs, approach, and results of the process as illustrated in Figure 2.4 below.

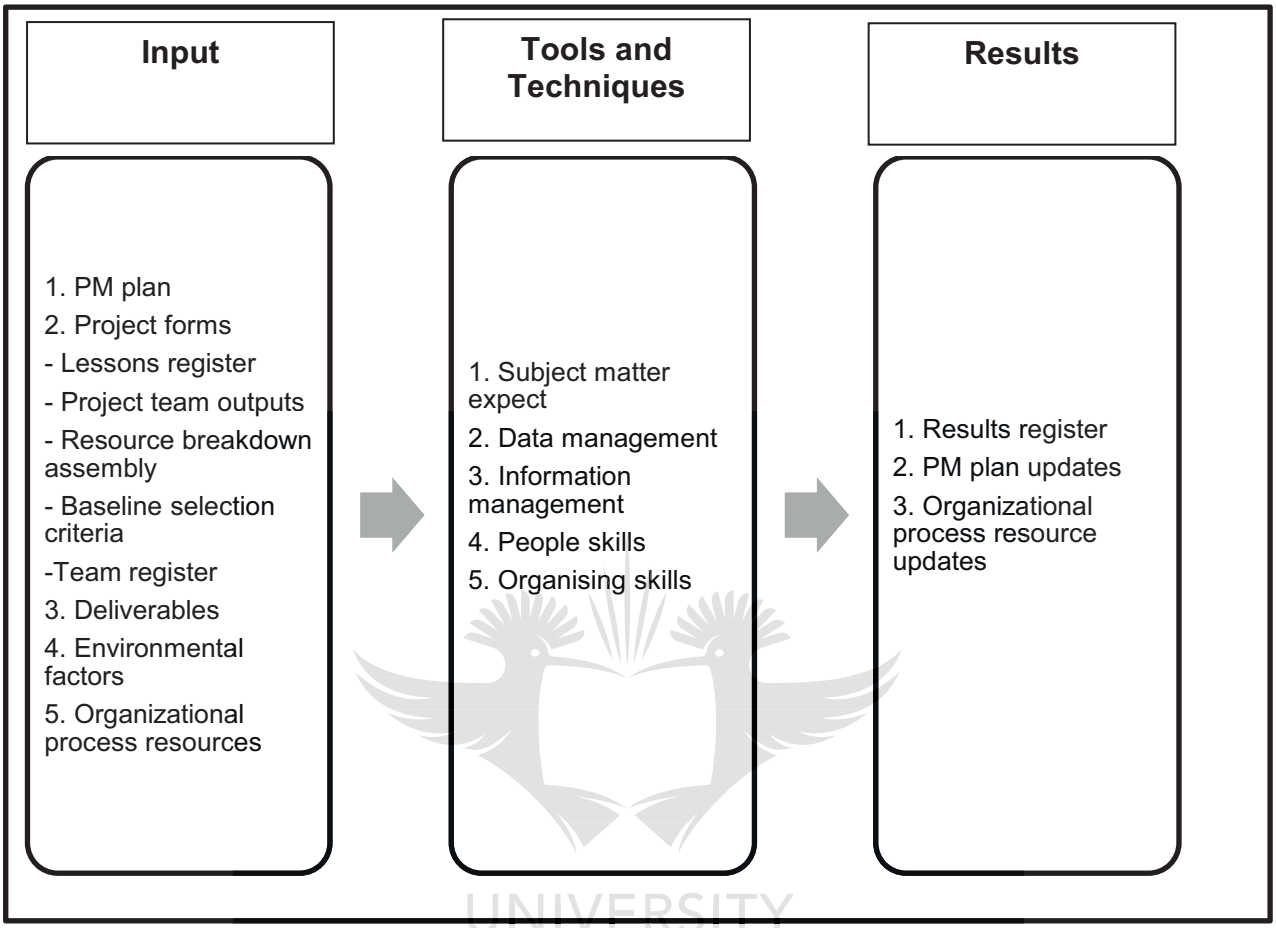


Figure 2.4: Manage project data

Source: PMI (2017)

2.8.5 Monitor and control the project effort

Monitoring and controlling the project effort process is achieved by examining project information, monitoring discrepancies to the plan, and responding to discrepancies appropriately, promotes the achievement of project goals. This establishes the quality and deliverables of the existing project management plan (Dinsmore & Cabanis-Brewin, 2014).

Monitor and control the project effort process is implemented throughout the project life cycle. It consists of following, revising, and reporting on the overall progress of the project plan in order to meet the objectives defined in the project management plan. The key benefits of this process are that stakeholders may understand where the plan stands at any current time, to identify the actions taken to address performance issues, and to be able to forecast the project status in terms of cost and schedule. The inputs, approach, and results of the process are illustrated in Figure 2.5 below.

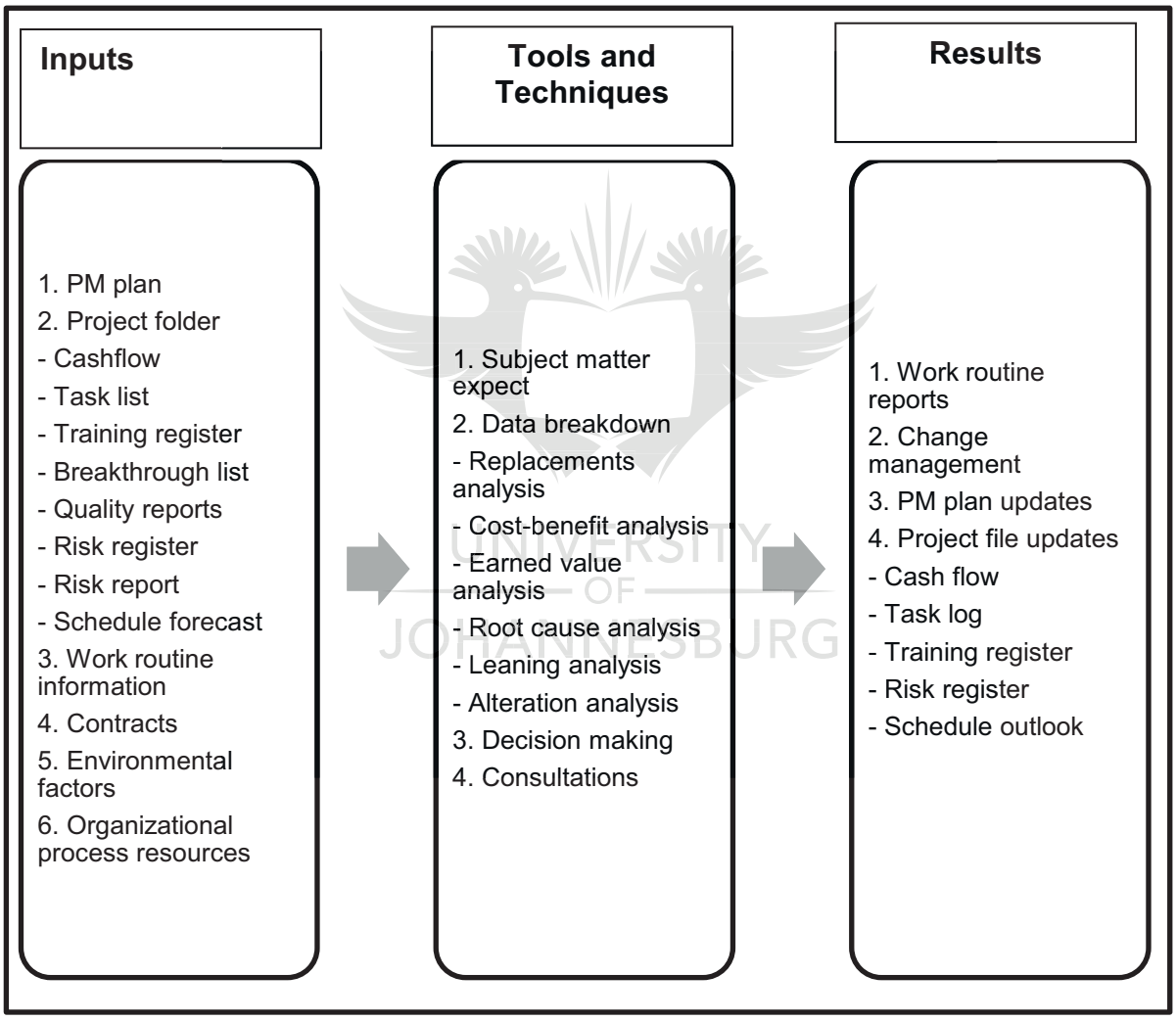


Figure 2.5: Monitor and control the project effort

Source: PMI (2017)

In order for the project manager to execute proper monitoring and control, that project manager must possess good project management skills as well as the proper tools to

work with from the inception of a project. Poor initiation and planning phases can compromise the success and effectiveness of a project manager. Monitoring and control is crucial in order for a project manager to control a project consistently and with vigour. (Dinsmore & Cabanis-Brewin, 2014).

2.8.6 Execute integrated change control

The integrated change control process includes monitoring project performance results, managing change requests, and reviewing and approving configuration changes. An integrated change control process is used to minimise risks when the scope of a project changes and to reduce or eliminate scope creep. Approved project changes require the project manager to update project plans, schedule and implement the change, validate that the change has been successfully implemented, and record the lessons learned (Kerzner & Frank, Project Management Workbook and PMP®/CAPM® Exam Study Guide, 2017).

This process includes the following activities:

- assessing requests for changes;
- approving changes;
- managing changes to outputs;
- managing organisational process resources;
- managing project data;
- managing project management plan baseline; and
- communicating decisions to project stakeholders.

The inputs, approach and results of the process are illustrated in Figure 2.6 below.

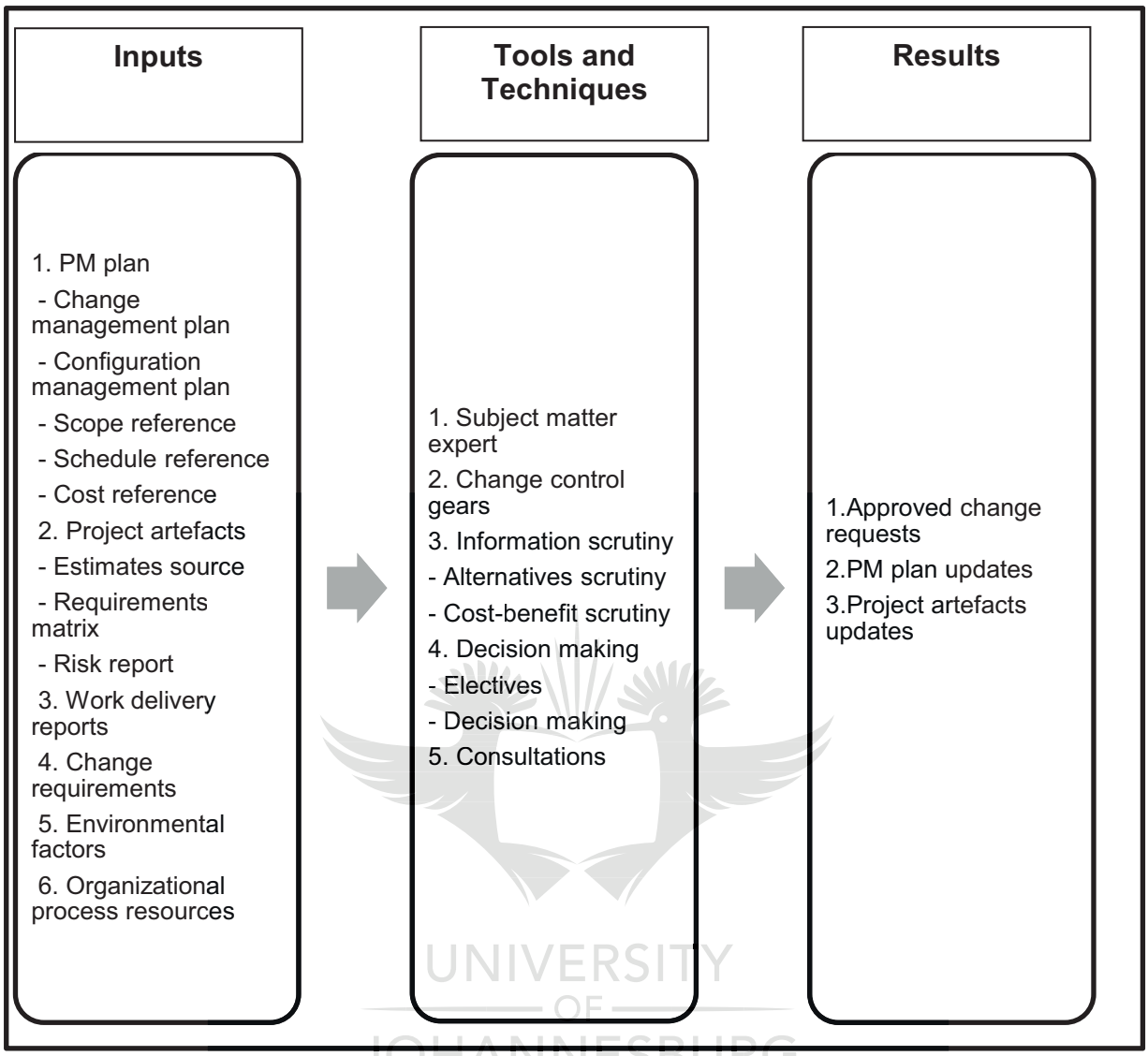


Figure 2.6: Execute integrated change control

Source: PMI (2017)

Change is an aspect of every project and may be beneficial. However, scope creep may not be. It can occur in many ways. In construction projects some common examples of scope change are design errors, unclear measuring limits, and unrecognised/uncontrolled accumulation of changes by the owner. Scope creep in a project may come from project stakeholders (such as additional recognised needs, incomplete design work, incomplete project documentation, contractor's change requests, etc.), from project conditions (materials quantities, manpower issues, new legislation, regulations, etc.), and from project constraints (financing issues, societal issues, environmental issues, etc.). It is, therefore, vital that projects require an

effective change management process in order to deal with scope creep. (Project Management Institute, 2016).

2.8.7 Close project or phase

When a project is complete or comes to an end it must be closed. This process ensures that all contracted project deliverables have been accomplished and that the client is satisfied. Project resources are then transferred to their appropriate destinations or to a new project, closing contracts or procurement actions, and the necessary handover documentation is done and archived. The closing process also includes the process of recording the lessons learned from the project (Dobson, 2015).

This is the process of concluding all project activities for each phase in the project. PMI (2017) outline the inputs, approach, and results of the process in Figure 2.7 below.

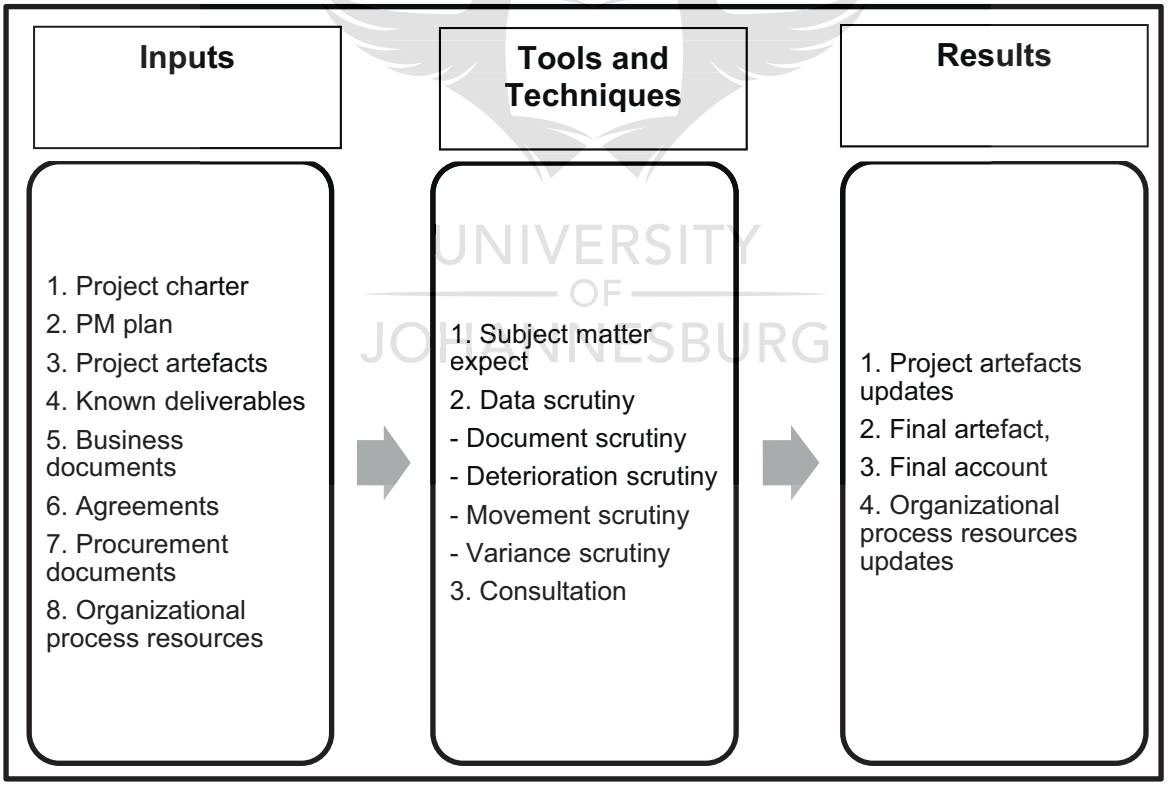


Figure 2.7: Project close-out
Source: PMI (2017)

The key leadership connection on this process is as follows: -

- close project and communicate status to stakeholders;
- arrange project review to seek improvements;
- acknowledge the project team for their good work;

The closing performance indicators include the following: -

- project objectives are met;
- deliverables are complete and signed off;
- project documentation is archived; and
- project success is celebrated (Rowe, 2015).

2.9 Project crew integration

Nardone (2009) says integrating service providers (such as contractors) can be challenging. Contractors are often unfamiliar with one another as well as the integration routines of the facility, and it can take some time for personnel to fit in with the routine of the project. This should be taken into account when allocating the time for contractors to prepare for and execute their work. The project team and a dedicated resource can help service providers to settle in by using inductions, holding routine meetings, and getting involved with the issues that the service providers face when they set up for project work. Integration during construction can also include holding briefings with the contractors and project team in order to prepare for and perform the job at hand (Nardone, 2009).

2.10 Effective project management and project success factors

According to Knutson (2001) effective project management relies on five components.

- **Awareness**

  Project management will be successful if there is awareness of:

  - the basics in project management;
  - how project management can benefit a business; and
  - management's expectations of the project as it relates to other disciplines operating within the business.

- **Organisation**

  Organisational support structures for a project are not the same as support structures for day-to-day operational work. Project management is driven by teams that require a clear definition of the organisational structure within which they are expected to work.

- **Processes**

  Processes map out how project work must be performed. Project management is directed and facilitated by these processes. Knutson identifies two major processes that support project management:

  - the product development process or life cycle (how to create the deliverable from the project); and
  - the project management process or life cycle (how to plan and control the product development process).

- **Tools**

  These are usually automated software tools that can be used to integrate processes, including forms, guidelines, and the archiving of historical metrics (Knutson, 2007).

- **Education**

  Project management requires that people involved in a project are competent and possess skills learnt either in an educational setting or outside of this setting. Education is about teaching people the correct skills at the correct time (Knutson, 2007).

Belassi (2007) advocates that an organisation that wants to develop successful new projects must operate in an enabling work environment and with strong leadership. He also stresses that an organisation must enable a culture that encourages employees to perform optimally but still feel comfortable when they deal with unfamiliar situations and have to express their opinions (Belassi, 2007).

Bryde and Wright (2007) illustrate that because traditional project performance (project cost, time and quality) has such a narrow definition it has a negative effect in the organisation because it encourages project managers to value short-term measures.

This is particularly the case when these measures are linked to reward and recognition. From a tactical, short-term perspective project management performance could be optimised. But from a strategic, long-term perspective sub-optimisation may be the result (Bryde, 2007). In order to combat this scenario, Bryde and Wright (2007) identify five distinct project management priorities for effective project performance, which are:

- managing for efficiency;
- customer and project team orientation;
- stakeholder orientation;
- control; and
- flexibility

To accomplish the above, a project manager is needed (Knutson, 2007). For Steyn (2004), the project manager assumes accountability for project output, cost and schedule. This individual head up a team of people from different departments and works mostly independently from the usual command chain. The project manager also uses project management methodologies to meet the project objective (Steyn, 2004). By virtue of working with a cross-functional team, the project manager controls a host of different functions, but has little power in terms of position. A project manager has to influence rather than instruct the people in the team. (Steyn, 2004; Peterson, 2007).

According to Peterson (2007), a project manager must understand that individuality is important. To keep team members motivated, the project manager must understand how each individual team member is inspired. Knowing what inspires each team member will help the project manager understand their needs and what drives them. This in turn will help the project manager nurture individual motivation and unite team members to work optimally in different environments, assignments, responsibilities and objectives (Peterson, 2007).

2.11 Project management office

Project management practitioners say that establishing a project management office (PMO) would engender better project control (Martin, Pearson, & Furumo, 2005). A PMO is a buffer between senior management and project management. It is a formal, centralised layer of control between the two. In the past, project offices usually dealt with a single project. However, today a PMO can simultaneously provide managerial, administrative, training, consulting and technical services for a variety of projects or project portfolios in an organisation (Martin et al., 2005).

A PMO can ensure the approach to all projects are consistent. It can "establish project management methods and procedures, define and implement project structures, implement automated project management systems and tools, and institute project management training" (Martin et al., 2005).

According to Martin (2005), a consistent approach to projects will improve project performance. There are other benefits too: "formalised and consistent project selection, efficient coordination of multiple projects, improvement in project performance in terms of cost, schedule, scope and people, and improvement in organisational profitability" (Martin, 2005).

Steyn (2004) sums up a PMO as essentially a project support office that contributes to establishing sound project management practices and that acts as a knowledge or expertise centre in project management (Steyn, 2004).

Section 2.8 below provides processes and systems of managing and controlling project artefacts.

2.12 Configuration management

2.12.1 What is configuration management?

What is configuration management?

Configuration management (CM) is "a system engineering process for establishing and maintaining consistency" (TechAmerica, 2011; ISO,2003). It involves a number of processes, tools and activities to manage phases of the project life cycle.

TechAmerica describes CM functions as follows:

- It enables logical identification of plant characteristics;
- It provides control of plant information;
- It manages plant alterations that improve proficiencies, correct insufficiencies, increase performance, increase trustworthiness and maintainability, co-ordinate interface control, or increase product life span; and
- It manages differences from product requirements (TechAmerica, 2011; ISO, 2003).

2.12.2 The configuration management process

Figure 2.8 below illustrates the process of configuration management (CM).

Figure 2.8: The configuration management process

Source: ISO (2003)

2.12.2.1 Configuration management planning

CM planning involves establishing and documenting the requirements, standards, practices, and procedures for utility configuration management (ISO, 2003; Mette & Jonassen, 2003).

2.12.2.2 Configuration identification

Configuration identification determines metadata for the configuration items and relationships. Identification is one of the crucial factors of configuration management to initiate effect controls of configuration items (ISO, 2003; Mette & Jonassen, 2003).

2.12.2.3 Change control

Controlling configuration change is a process whereby the approved configuration changes are controlled (Mette & Jonassen, 2003). Changing a configuration item can be affected by a customer or a change in baseline (ISO, 2003).

The process for controlling the alterations should be standardised and should include the following:

- description change;
- category change;
- evaluation of change consequences;
- position of the change; and
- change implementation.

2.12.2.4 Configuration status accounting

Configuration status accounting reports on the progress of the development in particular ways. Configuration status accounting is carried out to record and report meta-data that is significant for the configuration process. The configuration accounting system may include tracing through documents and the records management process to find status change (ISO, 2003; Menendez, 1986).

2.12.2.5 Configuration auditing

Configuration audits are accomplished according to recognised standards and procedures to ensure the product conforms to specified requirements (ISO, 2003).

There are two types of configuration audits:

- A functional audit – this is a formal inspection to authenticate whether the configuration item conforms to its purposeful and performance features specified for the product procedure;
- A physical audit – this is a formal inspection to authenticate if the configuration item has met physical features specified in the product procedure (ISO, 2003).

Configuration audits are required before formal acceptance of the configuration item. These audits do not replace any other forms of verification such as tests, reviews and inspections (Brouse, 2001; ISO, 2003; Menendez, 1986).

2.12.3 Benefits of the configuration management process

Configuration management is applied in many enterprises, no matter how small or complex projects are. Early application of CM in the life cycle phases of the project will provide less stringent change control (Brouse & Peggy, 2001; ISO, 2003).

According to Albright and Bradley (2005) the benefits of CM are:

- expedited fault finding and troubleshooting;
- more accurate and information planning activities;
- finance management; and
- ensuring safety of the plant or facilities (Albright & Bradley, 2005).

2.12.4 Application of configuration management

Configuration management is applied in many enterprises no matter how small or complex projects are. Early application of CM in the life cycle phases of the project will provide less stringent change control (Brouse & Peggy et al., 2001; ISO, 2003).

2.13 Configuration management within the system life cycle

Baseline procedures are developed within the system development life cycle from the beginning of the life cycle. To ensure effective control change in systems, a CM process should be put in place. Organisations should develop a standard process used for all system development and maintenance. The CM tasks associated with the life cycle are illustrated in Figure 2.9 below (Brouse & Peggy et., 2001).

Project initiation	Requirements definition	System design	Development	Integration and test	Development and maintenance
• Develop CM plan for the project • Select CM tool • Inform change board of the project	• Identify items • Establish functional baseline • Conduct configuration audit on proposed baseline • Initiate change control procedures • Establish cross-reference to system concept documents	• Establish allocated baseline • Conduct configuration audit on proposed allocated baseline • Cross reference to requirements documents	• Establish test libraries • Cross reference to design documentation	• Conduct configuration audit on proposed product baseline • Establish product baseline • Cross reference to development and requirements	Conduct functional configuration audit Conduct physical configuration audit

Figure 2.9: System life cycle

Source: Brouse and Peggy (2001)

The configuration lifecycle management (CLM) system is the directing technique of recording configuration logic and items. Figure 2.10 below demonstrates how a CLM system integrates customary initiative systems such as enterprise resource planning, customer relationship management and project lifecycle model (Brouse & Peggy et., 2001; Confit, 2012).

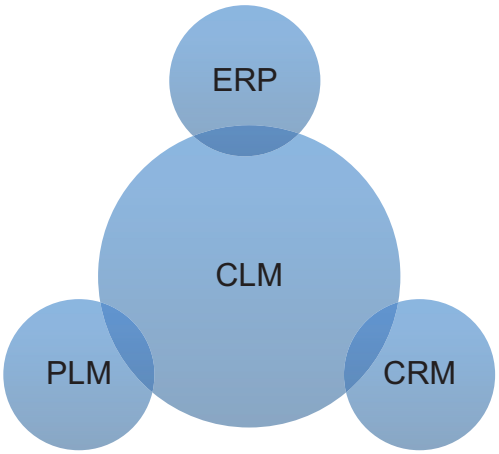


Figure 2.10: Configuration lifecycle management integrated system

Source: Brouse and Peggy (2001)

Table 2.1 below illustrates integrated systems and functions in an enterprise to ensure successful delivery of a product (Configit, 2012); (Brouse & Peggy, 2001)

Table 2.1: Integrated system applications

	PLM	CLM	ERP
Purpose	Supports product knowledge management	Supports configuration lifecycle management	Supports operational business requirements
Approach	Project - based	Utilised for both project and operational meta-data	Transaction-based
Time cycles	Supports time to market	Supports both time to the market and to consumers	Supports time to client or consumer
Engineering artefacts	Defines engineering artefacts	Generation of item relationships	Execution of manufacturing artefacts
Solve performance	Artefacts expansion	Perform many types of solutions	Artefacts expanded to finer details
Type of constraints	Technical constraints	Technical and commercial	Commercial
Change of product configuration	By model year	Linking model years and executed changes	Running
Configuration space	Partially defined configuration space biased towards technical features	Fully defined configuration platform linking technical and commercial features	Partially defined configuration space biased towards commercial features

Source: Brouse and Peggy (2001) and Configit (2012)

2.14 Earned value management

The earned value management (EVM) technique is used to understand and manage project performance. It is recommended that project managers use earn value (EV) with the management expectation to improve project results (Fleming, 2010).

Fleming's recommendations to establish value management science are as follows:

- Use a single management control system that will provide precise, consistent, reliable and timely data management throughout the project. This will make it possible for the project manager to oversee and control the performance of all project activities and production work;
- An integrated management approach that includes the scope of work, the schedule assurance, as well as an approved budget that allows for the accurate reference of integrated performance throughout the project;
- Scientifically documented project information for lessons that were learnt from previous projects that used EVM. This information must show a pattern of consistent and predictable performance records;
- Development of a cost performance index (CPI), a key metric that reflects the important link between the actual project work accomplished and its equivalent budget, versus the actual expenditure to do the work. CPI will allow management continuously to monitor cost performance;
- Development of a schedule performance index (SPI) that reflects the relationship between the actual physical work accomplished and the approved project baseline schedule. This will allow management to focus on and manage their schedule obligations right up to the end of the project; Development of a to-complete performance index (TCPI) where the remaining scope is monitored against specific management financial goals. This will assist management to authorise budget at completion (BAC), or the project manager's provisional budget to complete the scope of work. This budget is also referred to as estimate at completion (EAC);
- A weekly or periodic industrial engineering CPI to monitor performance results for production or repetitive work;

- Embark on a management by exception (MBE) approach, allowing executives to focus on project key performance indicators (KPI) earned through value metrics i.e. (CPI, SPI, TCPI, EAC. This will allow executives to effectively control project success within the organisation (Fleming, 2010).

Figure 2.11 below illustrates EVM curve in projects.

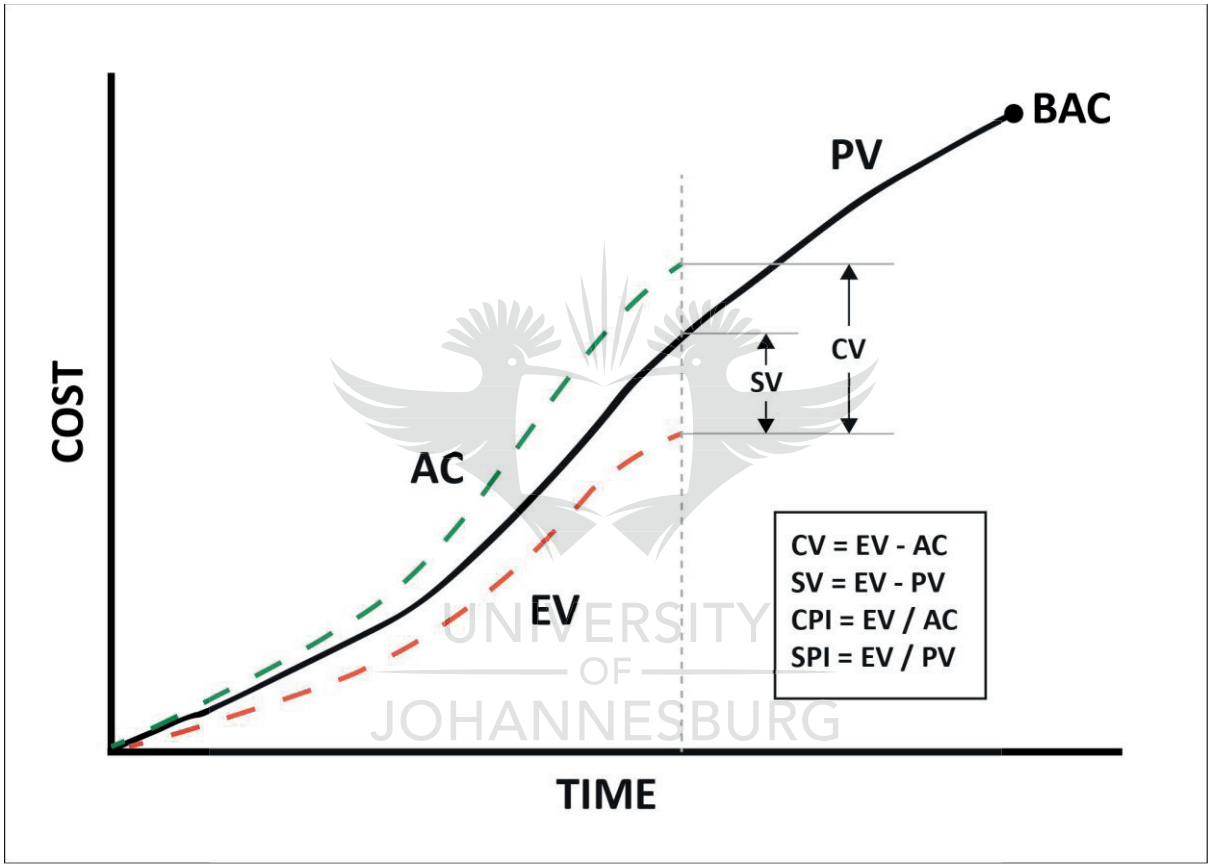


Figure 2.11: Earned value management summary

Source: Fleming (2010)

Table 2.2 below illustrates earned value calculation at different point in time when executing a project.

Table 2.2: Earn value management calculations

	Description	Formula
BAC – Budget at completion	Planned project budget	
PV – Planned value	Cost of planned work to be completed	
AC – Actual cost	Actual cost of the work to date	
EV – Earned value	Estimate of the value of work completed to date	
CV – Cost variance	Variance between the actual cost spent and the planned budget	**CV = EV – AC**
SV – Schedule variance	Variance between the value of the work completed at a point in time versus what was planned to be completed at this point	**SV = EV – PV**
CPI – Cost performance index	Above 1 = under budget (Good), Below 1 = over budget (Bad)	**CPI = EV / AC**
SPI–Schedule performance index	Greater than 1 = ahead of schedule (Good), Below 1 = behind schedule (Bad)	**SPI = EV / PV**
EAC – Estimate at completion	Estimate of the final project cost based on the budget performance to date	**EAC = BAC / CPI**
EAC – Estimate to complete	Estimate of the remaining costs to complete the project	**ETC = EAC – AC**
VAC – Variance at completion	Difference between the original planned budget and the estimated cost at completion	**VAC = BAC – EAC**
PV – Planned value	Value of the work that was originally planned to be completed	

AC – Actual cost	Actual cost of the work that has been performed to date	
EV – Earned value	Estimate of the value of work completed to date	

Source: Charles (2009)

The above earn value analysis is a quantitative and progress technique to measure project progress.

2.15 Performance Measurement Baseline

PMI (2011) describes the performance measurement baseline (PMB) as the comparison of the budget against which schedule project performance is measured. PMB is formed by budgets and is assigned to control accounts, instant level planning funds and undistributed funds. It is the performance base budget minus the management reserve. The PMB is maintained by project management, and all changes within the PMB are approved by the project manager (Project Management Institute, 2011).

2.16 Conclusion

In Chapter 2, PMBoK was identified as a preferred project management tool when executing projects. Project integration management was further discussed in conjunction with system engineering configuration management. Earned value management and performance base management theories were also reviewed. Effective project management benefit to the organisation and the importance of the project management office were also reviewed.

Chapter 3 will review research methodology aligned to propositions that were highlighted in Chapter 1.

3 RESEARCH METHODOLOGY

3.1 Introduction

This chapter provides an overview of the research methodology for the research. Section 3.1 introduces the chapter, while section 3.2 develops the study design and approach. Section 3.3 outlines the research approach. Sections 3.4, 3.5, 3.6 and 3.7 identify the research method, tool, population and sample of this study, respectively. Thereafter section 3.8 explains data analyses procedures. Thereafter, section 3.9 outlines the reliability and validity of the sampling and section 3.10 states ethical considerations taken into account. Finally, section 3.11 identifies the strengths and limitations of the study and section 3.12 concludes the chapter.

3.2 Research design

Figure 3.1 below illustrates the systematic process the researcher followed to design the field study:

Figure 3.1: Research process

Source: Yin, (2014)

Sekaran and Bougie (2013) define research design as a “blueprint” for the actions involved in the study. This includes collection of data, measurement, and data analysis directed by the research questions (Bougie, 2013).

The chosen design for the study was empirical with the aim to investigate organisational project integration management effectiveness to improve project execution delivery at the smelter. This was done by collecting and utilising primary data from projects executed.

3.3 Research approach

The research approach undertaken was qualitative. Key to this approach is the premise that this research is centred from a set of principles that project integration management can be best executed through appropriate methods. Therefore, the researcher's aim is to ensure that the research purpose can be answered as unambiguously as possible (Yin, 2003).

Yin (2003) says a qualitative research design is a logic that "links the data to be collected (and the conclusions to be drawn) to the initial questions of a study with consistency". A qualitative research design involves mapping out the parts of the investigation – this includes research questions and propositions, working out how to establish validity and reliability, and choosing a case study design (Baxter, 2008).

3.4 Research method

The case study research methodology was selected to investigate the activities conducted by the project team members when executing plant capital projects. This strategy provides an inclusive methodology for systematically studying and describing project integration management capability within a real-life context (Yin et al., 2003).

The case study method also provides a practical framework for collecting, analysing and triangulating quantitative and qualitative evidence. Triangulating was deployed by using a systematic approach between literature review, project integration management evidence and intuition. Evidence is derived from sources such as project documents, meeting minutes, and governance files. The case study method was the best choice because the researcher's goal is to expand and generalise on theoretical propositions of process acceptance by investigating an innovative process application within a unique context (Yin, 2014). Figure 3.2 below illustrates a case study research logic that the researcher had undertaken through thought processes of other aspects involved in the decision-making process, and the sequence of events i.e. plan, design, preparation, collection, analysis and sharing that occurred during the research process.

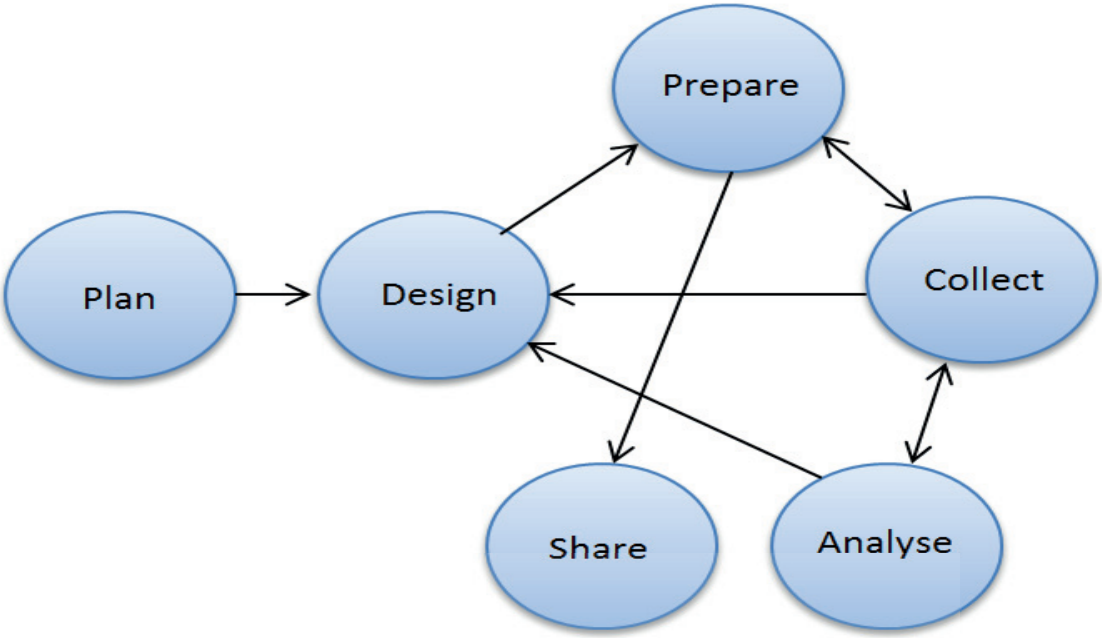


Figure 3.2: Case study illustration

Source: Yin (2014)

Yin (2014) says the goal of the case study report is to describe the study as a comprehensive report so that readers feel as if they have been an active participant in the research. It would also help readers determine whether the study findings can apply in their own situations. The researcher describes the context within which the phenomenon occurs as well as the phenomenon itself.

A chronological story-telling report addresses each proposition to ensure that the report remains focused and deals with the research question (Yin et al., 2003). Yin (2003) also suggests that the researcher avoid unintended errors in report writing. This can come about then researchers become distracted by unnecessary but interesting data. The research report is to provide a full appreciation of findings that are analysed against what can be found in published literature. This is done to place the new data baseline within pre-existing data. Yin (2014) suggests six methods for reporting a case study: linear, comparative, chronological, theory building, suspense, and un-sequenced (Yin et al.,2014).

3.5 Research tool

This is the tool used to conduct the case study on several projects executed as per the framework in Figure 3.2. Case study sources of evidence discussed here include the following: project files, project archival records and physical artefacts. Collecting case study evidence tools includes the following:

- letters, memorandums, e-mail correspondence, calendars, and notes;
- agendas, announcements and minutes of meetings, and other written reports of events;
- administrative documents-proposals, progress reports, and other internal records, system files; and
- formal studies.

The researcher draws implications about particular artefacts in the project sample based on these (Leedy, 2013). Figure 3.3 below illustrates this research tool.

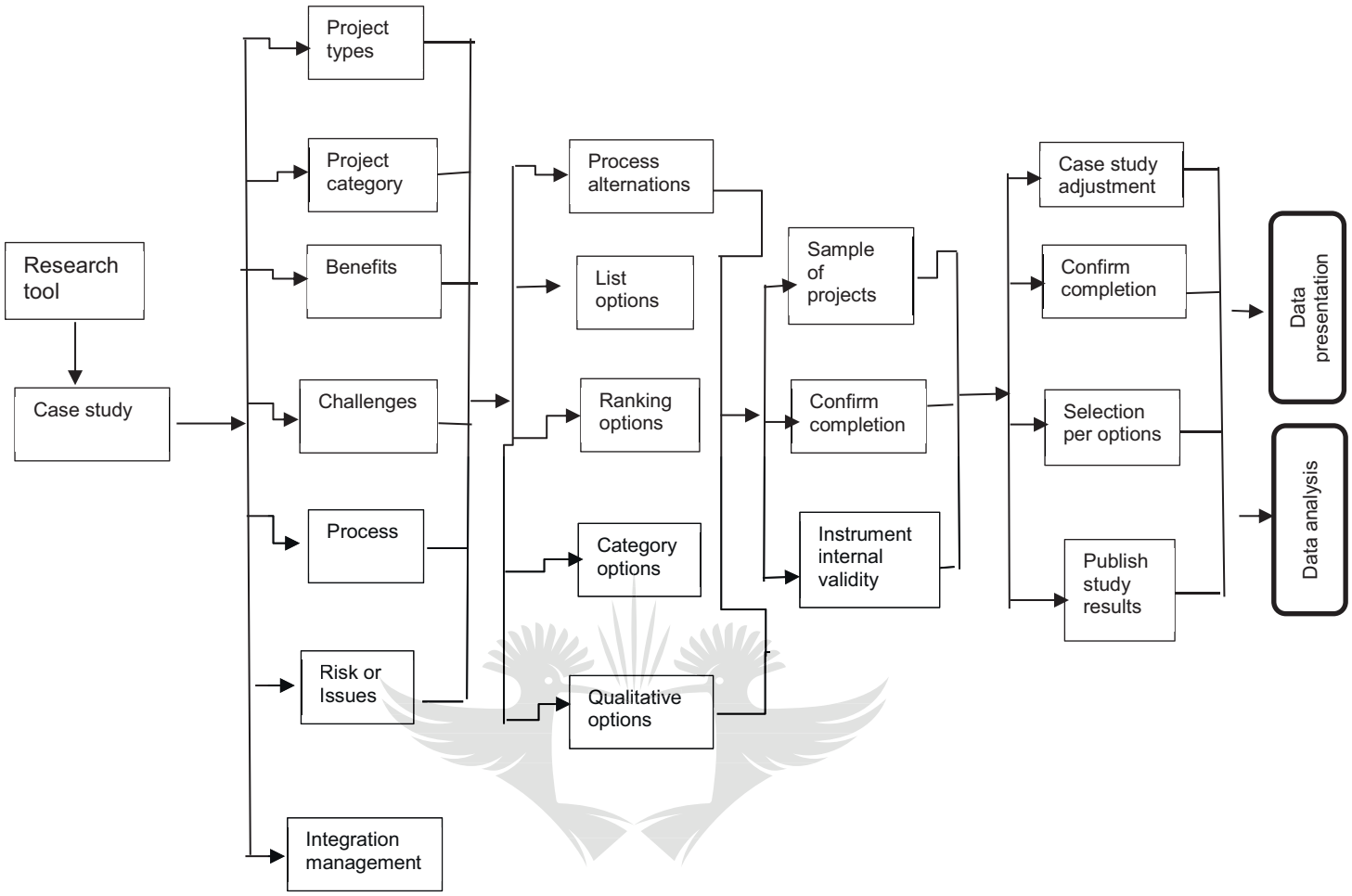


Figure 3.3: Research tool framework

Source: Leedy (2013)

The case study tool comprised the project list, project type, category and the project integration process review used to collect qualitative data from a selected smelter project. The case study used classified selection under one of the following categories:

- process alternations;
- list options;
- ranking options;
- category options;
- qualitative options and
- Integration management.

According to Leedy and Ormrod (2014), measurement tools are the foundation upon which the entire study is built. Hence data collection must be accurate and systematic as this is critical for conducting scientific research (Ormrod & Leedy, 2014). Table 3.1 below presents a tool guide when conducting case study research.

Table 3.1: Checking case study tool guide

Case study tool guide		
Tests	**Case study tactic**	**Phase of research in which approach occurs**
Construct validity	- Use multiple sources of evidence - Establish chain of evidence - Have key sources review draft case study report	Data collection Data collection Data collection
Internal validity	- Do pattern matching - Do explanation building - Do time series analysis	Data analysis Data analysis Data analysis
External validity	- Use replication logic in multiple case studies - Use case study protocol	Research design Data collection
Reliability	- Develop case study database	Data collection

Source: Yin (2003)

3.6 Research population

The research population in this research consists of the following:

- capital plan of the project has been used as a research population;
- projects scheduled with starting and ending date;
- project allocated to a project team for the duration of the project;
- projects that ended when the goals were or were not accomplished;
- interdependent activities involved in projects;
- service or product because of a project; and
- activities of the project are connected. Some sequence or order is also necessary in these activities. Activities are connected, and the outputs of some activities become inputs of others.

3.7 Research sampling

Research sampling is defined by Sekaran and Bougie (2013) as a group within the population. It is made up of members who are selected from the population (Bougie, 2013). The sampling design used for this study is the probability technique. This is where the projects in the population have some known, non-zero chance or probability of being selected as sample subjects (Bougie, 2013)

The following process in Figure 3.5 illustrates the selection process when selecting project samples:

Figure 3.4: Sampling process

Source: Sekaran and Bougie (2013)

The researcher used a stratified random sampling technique to ensure that a specific project category within the capital plan and business are sampled and categorised below:

- external compliance
- material risk
- sustained production
- sustained cost
- non-material risk
- internal compliance; and
- improve production

This sampling technique has a high success probability amongst designs with a good choice when diverse information is required within the population for the same number of sample subjects. This technique also offers precise and detailed information (Bougie, 2013).

Barry and Zikmund (2007) further say the following factors determine a research sample:

a) the level of precision (closeness to the proximity population) or,
b) confidence level (how sure the researcher can be) and
c) degree of variability (margin of error)".

The sample size therefore needs to be big enough to ensure all crucial insights are included (Zikmund & Barry, 2007).

3.8 Data analysis

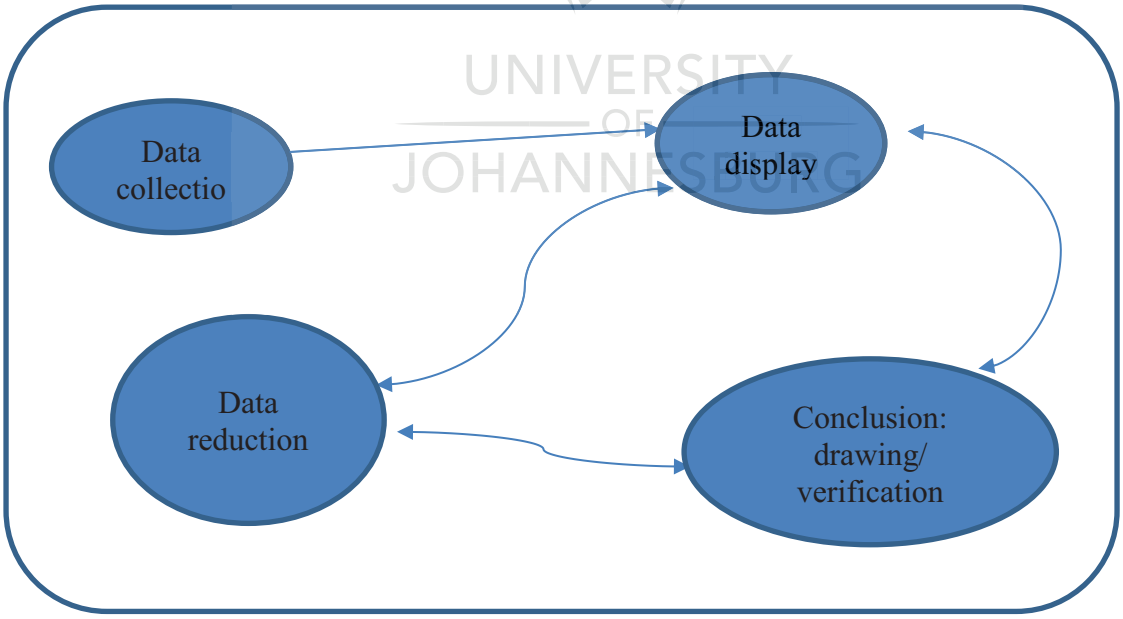
The researcher will utilise different stages of data analysis in the study approach as per Watson (1998). These stages are:

- **Familiarisation**: reviewing current project data by reading company processes, reading minutes and studying notes to identify key ideas and themes.
- **Identifying a systematic framework**: identifying all key issues, concepts, and themes by which the data can be examined and referenced. This is carried out by drawing on likely issues and questions perceived from the aims and

objectives of the study as well as issues raised by the respondents. The researcher also draws on the views or experiences that come up persistently in the data. The final artefact of this stage is to index in detail the data into manageable sections so that it may be retrieved and investigated further.

- **Indexing**: applying the systematic framework or index to all the data in a documented form supported by short text descriptors to elaborate the index heading.
- **Charting**: rearranging the data according to the appropriate part of the systematic framework to which they relate and forming charts. This process involves a considerable amount of conceptualisation and synthesis.
- **Mapping and interpretation**: using charts to define concepts, map the range and nature of issues, create typologies and identify theme links in order to clarify the findings. This process is influenced by the research objectives as well as by what themes emerge from the data (Skovdal, 2015; Watson, 1998).

Data analysis represents the central step within the research process. Qualitative data analysis has four major components: data reduction, data display, drawing and verifying conclusions. Figure 3.6 below shows how these three activities interact in an active relationship during the analysis.



Source: Miles (2014)

Figure 3.5: Components of qualitative data analysis: Interactive model

3.9 Reliability and validity

Reliability is dependent on the consistency and stability of the measurement process, while validity depends on how well the research model investigates what it intends to investigate, and to what extent the researcher has access to the subject's knowledge and meaning (Lee, 1999).

The researcher utilised an approved capital project plan from the project management office and triangulated the data to achieve reliability and validity. This also increases research credibility in this study. A capital plan in the smelter is validated through multi-governance committee's prior to being executed by the project management office.

Research validity was maintained through appropriate structural alignment of primary data against the research framework and objectives. A pilot case study was conducted to ensure that the research questions were not ambiguous. After the pilot project was executed and necessary adjustments were made, the researcher then conducted the research study on other selected sample projects.

3.10 Ethical considerations

Research ethics, according to Saunders (2007), is the appropriate conduct of a researcher with regards to the rights of those who are the subject of the researcher's work or those who are affected by it (Saunders, 2007). The National Institutes of Health (NIH) (1979) also articulates principles that form part of universally accepted research ethics as follows (NIH, 1979).

Permission to access information was requested from the Departmental Managers and Vice-President Operations (see Appendix A1). Before the case study was conducted, the researcher offered confidentiality for the case study research. The confidentiality included a clause that the data collected would be analysed, presented and used anonymously without mentioning names and would focus on the project integration management process. The researcher also signed the plagiarism declaration form confirming that the researcher acknowledged other researchers' work used in the study where applicable.

Furthermore, the researcher will not put participants or company information in a situation where they might be at risk of harm or reputational damage.

3.11 Strengths and limitations

The following strengths were applicable to this research:

- detailed information was easily obtained;
- within the case study, scientific experiments can be conducted;
- case study novel hypotheses can be used for later application.

The following limitations were applicable to this research:

- this study focused only on Hillside Aluminium Smelter situated in Richards Bay, South Africa, and the results cannot be generalised;
- the study only focused on project integration management and excluded other project management knowledge areas.

3.12 Conclusion

In concluding this chapter, a research method and approach was discussed. Section 3.1 introduced the chapter. Section 3.2 developed the study design, followed by section 3.3, which outlined the research approach. Sections 3.4, 3.5, 3.6 and 3.7 identified the research technique, method, tool, population and sample of this study, respectively. Thereafter section 3.8 explained the data analysis framework. Section 3.9 discussed the validity and reliability of the data. After that, section 3.10 gave the ethical considerations taken and section 3.11 identified the strengths and limitations. Section 3.12 concluded the chapter. Chapter 4 will provide the data presentation from the projects evaluated.

4 PRESENTATION OF RESULTS AND FINDINGS

4.1 Introduction

This chapter presents five sampled projects from the smelter and utilises project integration management literature and project information using the triangulation method. Projects A, B, C, D and E were evaluated on a microscopic level to fulfil the research objectives. Each project was evaluated in five processes: develop a project charter, develop a project management plan, direct and manage project work, manage project data, monitor and control project effort and the close of the project or phase. In each process, inputs and techniques are articulated to get the required process outputs. Each project sampled has been evaluated regarding process inputs and techniques to evaluate the project integration management deployed. Process outputs further provide the current state of the integration process of each project.

4.2 Data presentation

This section provides organises the data collected from project and finance files per sampled project so that logical conclusions can be derived from the collected measurements.

4.2.1 Data presentation: Project A – sustain production

Section 4.2.1 presents the data gathered in project A, the results of data analysis done and an interpretation of the findings.

i. **Develop project charter**

The development of the project charter evaluation provides for how the project is formally authorised as a project and its initiation purpose that will describe high level goals and deliverables. The project charter further identifies the project lead and gives him or her authority to request and manage resources for the project. This process is the foundation for a project manager to execute his or her project. Table 4.1 below is the evaluation of project charter process for project A.

Table 4.1: Project charter evaluation A

Process tools/ technique / Process Inputs	Subject matter expert	Information management	Free-associating	Consultations	People skills	Facilitation	Assembly management	Summits and seminars	Meeting management
Corporate forms	x	x							
Corporate circumstances		x							
Benefits realisation		x							
Arrangements							x		x
Environmental factors		x							
Organizational process resources		x		x					

With the above inputs that were implemented in Project A, process outputs were identified. Table 4.2 below is the evaluation of the project charter process outputs for project A according to current practices.

Table 4.2: Project charter outputs evaluation A

Develop project charter outputs	Availability Y/N	Comments
Project charter	Y	Organisation templates were utilised to develop a project charter
Activity log	N	Not available on project file

ii. Develop project management plan evaluation

The evaluation of the development of the project management plan outlines how the master plan of the project was developed. Development of a project management plan further provides a baseline so that any change that is required after the approved baseline is subjected to change management. The inputs and techniques of development of a project management plan will provide a desired project management plan for effective project integration management.

Table 4.3 below is the evaluation of development of the project management plan process for project A.

Table 4.3: Develop project management plan evaluation A

Process tools/ approach / Process inputs	Subject matter expert	Information gathering	Brainstorming	Specifications	Lead teams	Consultations	People skills	Meeting management
Project charter		x						
Feeder processes		x		x	x			x
Business environmental factors	x							
Business artefacts	x	x						

With the above inputs and techniques that were implemented in Project A, process outputs were identified. Table 4.4 below is the evaluation of the development of the project management plan process outputs for project A according to current practices.

Table 4.4: Develop Project Management Plan Output Evaluation A

Develop project management plan outputs	Availability Y/N	Comments
Project management plan	Y	Organisation templates were utilised to develop an integrated project plan

iii. Direct and manage project work

During the life cycle of a project, the process of directing and managing the project work process is used to manage actions needed for project success. Execution of this process is determined by the project management plan, and changes required are approved through a change management process. Information utilised to evaluate this process includes an electronic project file, communication including meeting minutes and emails and standards and change control office files. Further assessment of project processes includes the scope, schedule, budget, and quality management records. Table 4.5 below is the evaluation of direct and managed project work process for project A.

Table 4.5: Direct and manage project work evaluation A

Process tools/ techniques / Process inputs	Subject matter expert	PM information system	Consultations and meetings
PM plan	x	x	
Project forms			
- Variation orders			
- Reflection register			
- Breakthroughs			
- Mission communications			
- Schedule		x	
- Requirements matrix			
- Risk register			
- Risk report		x	
Approved change requests			
Company environmental factors	x		
Organisational process resources		x	

With the above inputs and techniques that were identified in project A, process outputs were identified. Table 4.6 below is the evaluation of output analysis for direct and managed project work process identified for project A.

Table 4.6: Direct and manage project work process output A

Direct and manage project work outputs	Availability Y/N	Comments
Deliverables	Y	Project deliverables were outlined on the project initiation phase and close-out. Change requisition template was available on the project file with no input of changes during the project execution.
Delivery data	Y	
Change requisitions	Y	
PM plan updates	N	
Project forms - Action list - Statement log - Artefacts - Requirements documentation - Risk register - Participant register	N	

iv. Manage project data

Management of project data by maintaining and organising project information throughout the project life cycle equips the project and business managers with a better view of project information and key trends for decision-making. Aspects of evaluating the management of project data include data governance, data quality, documents and record management. Table 4.7 below is the evaluation of the data management process for project A.

Table 4.7: Data management process Evaluation A

Process tools/ techniques / Process inputs	Subject matter expert	Information management	Data management	People skills	Organising skills	Facilitation
PM plan	x	x				
Project forms						
- Lessons register						
- Project team outputs	x			x		
- Resource breakdown assembly						
- Baseline selection criteria						
- Team register						
Deliverables		x				
Environmental factors		x				
Organisational process resources						

With the above inputs and techniques that were identified for project A, process outputs were identified. Table 4.8 below is the evaluation of data management process outputs identified for project A.

Table 4.8: Evaluate data management process outputs A

Manage project data	Availability Y/N	Comments
Results register	Y	Identified as part of handover file and punch list
PM plan	Y	Only initial project plan available
Organisational process resource updates	N	Not available

v. Monitor and control project effort

Directing and controlling of project work concerned evaluating processes, tools and techniques used to manage change and development in a project. Changes can be requested throughout the life cycle of a project, but these requests must be monitored and controlled to ensure that project quality is not negatively affected. Another area of evaluation was project progress and reporting among the project team interfaces to ensure effective integration for project success. Table 4.9 below is the evaluation of monitoring and controlling the project effort process for project A.

Table 4.9: Evaluation of monitor and control project effort A

Tools/ technique / Process inputs	Subject matter expert	Data breakdown	Replacements analysis	Cost/benefit analysis	Earned value analysis	Root cause analysis	Leaning analysis	Decision-making	Consultations
PM plan	x	x							
Project folder									
- Cashflow		x							x
- Task list									
- Training register									
- Breakthrough list									
- Quality reports									
- Risk register									
- Risk report		x							
- Schedule forecast	x								
Work routine information									
Contracts	x	x							
Environmental factors		x							
Organisational process resources	x	x							

With the above inputs and techniques that were identified in project A, process outputs were identified. Table 4.10 below is the evaluation of monitoring and controlling project effort process outputs identified for project A.

Table 4.10: Monitor and control project effort output analysis

Monitor and control project effort outputs	**Availability Y/N**	**Comments**
Work routine reports	N	Improvements identified
Change management	Y	
PM plan updates	N	Improvements identified
Project file updates: - Cash flow - Task log - Training register - Risk register - Schedule outlook	 Y Y N N Y	Improvements identified. Note Earned value analysis and root cause analysis

vi. Execute Integrated Change Control

Integrated change control is the organised and systematic coordination of information, tools and resources of change, which provides a project manager with a key process to achieve project objectives. The availability of tools and techniques of integrated change control were evaluated when change was identified in a project. Table 4.11 below is the evaluation of execution of the integrated change control process for project A.

Table 4.11: Execute integrated change control evaluation A

Process Tool/ Techniques / Process Inputs	Subject matter expert	Change control gears	Information scrutiny	Decision-making	Deterioration scrutiny	Consultations
PM plan			x			x
Project artefacts	x	x	x	x		
Work delivery reports	x	x				
Change requirements	x	x				
Environmental factors	x			x		x
Organisational process resources	x	x		x		x

With the above inputs and techniques that were identified for project A, process outputs were identified. Table 4.12 below is the evaluation of execution of integrated change control process outputs identified for project A.

Table 4.12: Monitor and control project effort outputs A

Execute integrated change control	**Availability Y/N**	**Comments**
Approved change requests	Y	Signed approval forms available
PM plan updates	Y	
Project artefacts updates	Y	

vii. Close Project or Phase

When the project is done, it must close. The process of closing a project includes reviewing various processes used and rating them on whether they were successful or not. The evaluation of processes includes documenting and archiving so that future projects have reference points on how to implement their plans and processes. Each phase of the project delivers important artefacts that outline what lessons were learned over this period.

Project integration management occurs from the start to the finish of a project and the close project process evaluation provides a view of properly closing a project. Table 4.12 below is the evaluation of execution of project close-out process for project A.

Table 4.13: Project close-out evaluation A

Process tool/ techniques / Process inputs	Subject matter expert	Data scrutiny	Document scrutiny	Movement scrutiny	Deterioration scrutiny	Variance scrutiny	Consultation
Project charter	x						x
PM plan	x						
Project artefacts							
Known deliverables	x	x					
Business documents	x	x	x				x
Agreements							x
Procurement documents	x						
Organisational process resources	x						

With the above inputs and techniques that were identified in project A, process outputs were identified. Table 4.13 below is the evaluation of the project close-out process for project A. Table 4.14 below is the evaluation of the project close-out process outputs identified for project A.

Table 4.14: Project close-out process outputs

Close project or phase outputs	**Availability Y/N**	**Comments**
Project artefacts updates	Y	Improvements identified
Final artefact	Y	Improvements identified
Final account	Y	
Resources updates	N	

4.2.2 Data presentation: Project B – external compliance

Section 4.2.2 presents the data gathered in project B, the results of data analysis done and an interpretation of the findings

i. Develop project charter

The development of the project charter evaluation identifies how the project is formally authorised as a project and its initiation purpose that will describe high level goals and deliverables. The project charter further identifies the project lead and gives him or her authority to request and manage resources for the project. This process is the foundation for a project manager to execute his or her project. Table 4.15 below is the evaluation of the project charter process for project B.

Table 4.15: Project charter process evaluation B

Process tools/ technique / Process inputs	Subject matter expert	Information management	Free-associating	Consultations	People skills	Facilitation	Assembly management	Summits and seminars	Meeting management
Corporate forms		x							
Corporate circumstances		x							
Benefits realisation		x	x		x				
Arrangements		x							
Environmental factors		x							
Organisational process resources	x	x							

With the above inputs that were implemented in project B, process outputs were identified. Table 4.16 below is the evaluation of project charter process outputs for project B according current practices.

Table 4.16: Project charter process outputs evaluation B

Develop project charter outputs	Availability Y/N	Comments
Project charter	Y	
Activity log	Y	

ii. Develop project management plan

The evaluation of the development of the project management plan outlines how the master plan of the project was developed. The development of a project management plan further provides a baseline from which any change is subjected to change management. The inputs and techniques of the development of a project management plan will provide a desired project management plan for effective project integration management. Table 4.17 below is the evaluation of the development of the project management plan process for project B.

Table 4.17: Development of project management plan evaluation B

Process tools/ approach / Process inputs	Subject matter expert	Information management	Consultations and meetings	Specifications	Lead teams	Consultations	People skills	Meeting management
Project charter		x				x		
Feeder processes	x	x			x			
Business environmental factors		x						
Business artefacts		x						

With the above inputs that were implemented in project B, process outputs were identified. Table 4.18 below is the evaluation of development of project management plan process outputs for project B according to current practices.

Table 4.18: Develop project management plan process outputs evaluation B

Develop project management plan outputs	**Availability Y/N**	**Comments**
Project management plan	Y	Plan articulated well and is comprehensive to ensure that project plan is informed.

iii. Direct and manage project work

During the life cycle of a project the process of directing and managing the project work process is used to manage work and actions needed to attain project success. Execution of this process is determined by the project management plan and changes required are approved through a change management process. Information utilised to evaluate this process includes an electronic project file, communication including meeting minutes and emails, standards and change control office files. Further assessment of these project processes includes the scope, schedule, budget, and quality management records. Table 4.19 below is the evaluation of directing and managing the project work process for project B.

Table 4.19: evaluation of direct and manage project work process output B

Process tools/ techniques / Process inputs	Subject matter expert	PM Information system	Consultations and meetings
PM plan	x	x	
Project forms			
- Variation orders			
- Reflection register			
- Breakthroughs			
- Mission communications		x	
- Schedule		x	
- Requirements matrix			
- Risk register			
- Risk report		x	
Approved change requests			
Company environmental factors		x	
Organisational process resources			

With the above inputs that were implemented in project B, process outputs were identified. Table 4.20 below is the evaluation of directing and managing project work processes for project B according to current practices.

Table 4.20: Direct and manage project work process outputs evaluation B

Direct & manage project work outputs	**Availability Y/N**	**Comments**
Deliverables	Y	
Delivery data	Y	
Change requisitions	N	Organisation templates available
PM plan updates	N	Improvements identified
Project forms -Action list -Statement log -Artefacts -Requirements documentation -Risk register -Participant register	 N Y Y Y Y Y	

iv. Manage project data

Management of project data by maintaining and organising project information throughout the project life cycle, and equipping project and business managers with a better view of project information and key trends for decision-making. Aspects of evaluating management of project data include data governance, data quality, and document and record management. Table 4.21 below is the evaluation of the data management process for project B.

Table 4.21: Data management process evaluation B

Process tools/ techniques / Process inputs	Subject matter expert	Information management	Data management	People skills	Organising skills
PM plan		x			
Project forms					
- Lessons register					
- Project team outputs		x			
- Resource breakdown assembly					
- Baseline selection criteria					
- Team register					
Deliverables		x			
Environmental factors		x			
Organisational process resources		x			

With the above inputs that were implemented in project B, process outputs were identified. Table 4.22 below is the evaluation of data management process outputs for project B according to current practices.

Table 4.22: Data management process outputs B

Manage project data	Availability Y/N	Comments
Results register	Y	Process improvements identified
PM plan	Y	
Organisational process resource updates	Y	

v. Monitor and control project effort

Directing and controlling of project work was evaluating processes, tools and techniques used to manage the change and development in a project. Changes in a project can be requested at any time and throughout the life cycle of a project, but these requests must be monitored and controlled to ensure the quality of the project is not affected negatively. Project progress and reporting among the project team interfaces to ensure effective integration for the success of the project, was also evaluated. Table 4.23 below is the evaluation of monitoring and controlling project effort process for project B.

Table 4.23: Monitor and control project effort evaluation B

Process Tools technique / Process inputs	Subject matter expert	Data breakdown	Replacements analysis	Cost benefit analysis	Earned value analysis	Root cause analysis	Learning analysis	Alteration analysis	Decision-making	Consultations
PM plan	x	x	x						x	x
Project folder										
- Cashflow	x	x								
-Task list	x	x								
- Training register										
- Breakthrough list										
- Quality reports	x									
- Risk register										
- Risk report		x								
- Schedule forecast		x								
Work routine information	x									
Contracts	x	x								
Environmental factors		x								
Organizational process resources		x								

With the above inputs that were implemented in project B, process outputs were identified. Table 4.24 below is the evaluation of monitoring and controlling project effort process outputs for project B according to current practices.

Table 4.24: Monitor and control project effort process outputs evaluation B

Monitor and control project effort outputs	**Availability Y/N**	**Comments**
Work routine reports	Y	
Change management	N	Organisation template available
PM plan updates	N	
Project file updates: - Cash flow - Task log - Training register - Risk register - Schedule outlook	 Y N Y Y Y	Improvements identified. Note earned value analysis and root cause analysis

vi. Execute integrated change control

Integrated change control is an organised, systematic action that coordinates information, tools and resources of change. This provides a project manager with a key process to achieve project objectives. The availability of tools and techniques for integrated change control were evaluated when change was identified in a project. Table 4.25 below is the evaluation of the execution of the integrated change control process for Project B.

Table 4.25: Execution of the integrated change control process evaluation B

Process tool/ techniques / Process inputs	Subject matter expert	Change control gears	Information scrutiny	Decision-making	Deterioration scrutiny	Consultations
PM plan			x			x
Project artefacts	x	x	x	x		
Work delivery reports	x	x				
Change requirements	x	x				
Environmental factors	x			x		x
Organisational process resources	x	x		x		x

With the above inputs that were implemented in project B, process outputs were identified. Table 4.26 below is the evaluation of execution of the integrated change control process outputs for project B according to current practices.

Table 4.26: Execution of integrated change control process outputs evaluation B

Execute integrated change control	**Availability Y/N**	**Comments**
Approved change requests	Y	
PM plan updates	Y	
Project artefacts updates	Y	

vii. Close project or phase

When the project is done, it must close. The process of closing a project includes reviewing various processes used and rating them on whether they were successful or not. Evaluation of this process includes documentation to create an archive that future project managers can reference for decisions on how to implement their plans and processes. Each phase of the project delivers important artefacts that outline what lessons were learned over this period.

Project integration management occurs from start to finish of a project and close project process evaluation provides a view of properly closing a project. Table 4.27 below is the evaluation of the project close-out process for project B.

Table 4.27: Project close-out evaluation B

Process tool/ techniques / Process Inputs	Subject matter expert	Data scrutiny	Document scrutiny	Movement scrutiny	Deterioration scrutiny	Variance scrutiny	Consultation
Project charter		x					
PM plan		x					
Project artefacts	x	x					x
Known deliverables	x	x					x
Business documents	x	x					x
Agreements		x					
Procurement documents		x					
Organisational process resources		x					x

With the above inputs that were implemented in project B, process outputs were identified. Table 4.28 below is the evaluation of the project close-out process outputs for project B according to current practices.

Table 4.28: Project close-out process outputs evaluation B

Close project or phase outputs	**Availability Y/N**	**Comments**
Project artefacts updates	Y	Project closeout outputs acceptable with significant opportunities
Final artefact,	Y	
Final account	Y	
Resources updates	Y	

4.2.3 Data presentation: Project C – material risk

Section 4.2.3 presents project C data gathered, the results of data analysis done and an interpretation of the findings.

i. Develop project charter

The development of the project charter evaluation shows how the project is formally authorised as a project and its initiation purpose, which will describe high level goals and deliverables. The project charter further identifies the project lead and gives him or her authority to request and manage resources for the project. This process is a foundation for a project manager to execute his or her project. Table 4.29 below is the evaluation of project charter process for project C.

Table 4.29: Project charter process evaluation C

Process tools/ technique / Process inputs	Subject matter expert	Information management	Free-associating	Consultations	People skills	Facilitation	Assembly management	Summits and seminars	Meeting management
Corporate forms	x	x		x	x				
Corporate circumstances		x							
Benefits realisation	x	x		x					
Arrangements		x							
Environmental factors	x	x							
Organisational process resources		x		x					

With the above inputs that were implemented in project C, process outputs were identified. Table 4.30 below is the evaluation of project charter process outputs for project C according to current practices.

Table 4.30: Project charter process outputs evaluation C

Develop project charter outputs	Availability Y/N	Comments
Project charter	Y	Project charter clearly articulated to inform effective project integration
Activity log	Y	

ii. Develop project management plan

The evaluation of the development of the project management plan outlines how the master plan of the project was developed. Development of a project management plan further provides a baseline, after which any required change is subjected to change management. The inputs and techniques of development of a project management plan will provide a desired project management plan for effective project integration management. Table 4.31 below is the evaluation of the development of a project management plan process outputs for project C.

Table 4.31: Development of project management plan process evaluation C

Process tools/ approach / Process inputs	Subject matter expert	Information gathering	Brainstorming	Specifications	Lead teams	Consultations	People skills	Meeting management
Project charter	x	x						
Feeder processes		x			x			
Business environmental factors		x		x	x			
Business artefacts		x						

With the above inputs that were implemented in Project C, process outputs were identified. Table 4.32 below is the evaluation of the development of the project management plan process outputs for Project C according to current practices.

Table 4.32: Development of project management plan process outputs C

Develop project management plan outputs	**Availability Y/N**	**Comments**
Project management plan	Y	Organisation template was utilised however, integration improvement identified

iii. Direct and manage project work

During the life cycle of a project the process of directing and managing the project work process is utilised to manage work and actions needed to accomplish project success. Execution of this process is determined by the project management plan and changes required are approved through a change management process. Information utilised to evaluate this process includes an electronic project file, communication, including meeting minutes and emails, standards and change control office files. Further assessment of this project processes includes the scope, schedule, budget, and quality management records. Table 4.33 below is the evaluation of directing and managing the project work process for project C.

Table 4.33: Directing and managing project work process evaluation C

Process tools/ techniques / Process inputs	Subject matter expert	PM information system	Consultations and meetings
PM plan		x	
Project forms			
▪Variation orders			
▪Reflection register			
▪Breakthroughs	x		
▪Mission communications		x	
▪Schedule	x		x
▪Requirements matrix	x		
▪Risk register			
▪Risk report	x	x	x
Approved change requests			
Company environmental factors	x		
Organisational process resources		x	

With the above inputs that were implemented in project C, process outputs were identified. Table 4.34 below is the evaluation of directing and managing project work process for project C according to current practices.

Table 4.34: Directing and managing project work process outputs C

Direct and manage project work outputs	Availability Y/N	Comments
Deliverables	Y	Integration opportunities identified
Delivery data	Y	
Change requisitions	N	
PM plan updates	N	
Project forms -Action list -Statement log -Artefacts -Requirements documentation -Risk register -Participant register	 N N Y Y Y N	

iv. Manage project data

Management of project data by maintaining and organising project information throughout the project lifecycle equips project and business managers with a better view of project information and key trends for decision-making. Aspects of evaluating management of project data include data governance, data quality, and document and record management. Table 4.35 below is the evaluation of data management process for project C.

Table 4.35: Data management process evaluation C

Tools/ techniques / Inputs	Subject matter expert	Information management	Data management	People skills	Organising skills
PM plan	x	x	x		
Project forms					
▪Lessons register					
▪Project team outputs					
▪Resource breakdown assembly					
▪Baseline selection criteria	x				
▪Team register					
Deliverables		x	x		
Environmental factors		x			
Organisational process resources		x			

With the above inputs that were implemented in Project C, process outputs were identified. Table 4.35 below is the evaluation of data management process outputs for project C on current practices.

Table 4.36: Data management process outputs evaluation C

Manage project data	Availability Y/N	Comments
Results register	Y	Data management process improvements identified
PM plan	Y	
Organisational process resource updates	Y	

v. Monitor and control project effort

Directing and controlling of project work were evaluating processes, tools and techniques used to manage the change and development in a project. Changes in a project can be requested throughout the project life cycle, but these requests must be monitored and controlled to make sure that the quality of the project is not negatively affected. Project progress and reporting among the project team interfaces to ensure effective integration for the success of the project was also evaluated. Table 4.37 below is the evaluation of monitoring and controlling project effort for project C.

Table 4.37: Evaluation of monitoring and controlling of project effort C

Process tools/ techniques / Process inputs	Subject matter expert	Data breakdown	Replacements analysis	Cost benefit analysis	Earned value analysis	Root cause analysis	Leaning analysis	Alteration analysis	Decision making	Consultations
PM plan		x							x	x
Project folder										
▪Cashflow	x	x								
▪Task list										
▪Training register										
▪Breakthrough list										
▪Quality reports										
▪Risk register										
▪Risk report		x								
▪Schedule forecast		x								
Work routine information										
Contracts	x	x								
Environmental factors	x	x								
Organisational process resources	x	x								

With the above inputs that were implemented in project C, process outputs were identified. Table 4.38 below is the evaluation of the monitoring and controlling of the project effort outputs for project C according to current practices.

Table 4.38: Monitoring and controlling of the project effort outputs evaluation C

Monitoring and controlling of project effort outputs	**Availability Y/N**	**Comments**
Work routine reports	N	Process improvements identified
Change management	Y	
PM plan updates	N	
Project file updates: - Cash flow - Task log - Training register - Risk register - Schedule outlook	 Y N N Y Y	

vi. Execute integrated change control

Integrated change control is an organised, systematic coordination of the information, tools, and resources of change that provide a project manager with a key process to achieve project objectives. Availability of tools and techniques of integrated change control were evaluated when change was identified in a project. Table 4.39 below is the evaluation of execute integrated change control for project C.

Table 4.39: Execute integrated change control evaluation C

Process tool/ techniques / Process inputs	Subject matter expert	Data scrutiny	Document scrutiny	Movement scrutiny	Deterioration scrutiny	Variance scrutiny	Consultation
Project charter		x					
PM plan	x	x					
Project artefacts	x	x					
Known deliverables		x					
Business documents	x	x					
Agreements	x						x
Procurement documents	x	x					x
Organisational process resources	x	x	x				

With the above inputs that were implemented in project C, process outputs were identified. Table 4.40 below is the evaluation of execute integrated change control outputs for project C according to current practices.

Table 4.40: Execute integrated change control outputs evaluation C

Execute integrated change control	Availability Y/N	Comments
Approved change requests	Y	
PM plan updates	Y	
Project artefacts updates	Y	

vii. Close project or phase

When the project is done, it must be closed. The process of closing a project includes reviewing various processes used and rating them on whether they were successful or not. Evaluation of this process includes documentation to create an archive that future project managers can reference for decisions on how to implement their plans and processes. Each phase of the project delivers important artefacts that outline what lessons were learned over this period. Project integration management occurs from start to finish of a project and closed project process evaluation provides a view of properly closing a project. Table 4.41 below is the evaluation of the project close-out process for project C.

Table 4.41: Project close-out evaluation C

Process tool/ techniques / Process inputs	Subject matter expert	Change control gears	Information scrutiny	Decision-making	Deterioration scrutiny	Consultations
PM plan			x			x
Project artefacts	x	x	x	x		
Work delivery reports	x	x				
Change requirements	x	x				
Environmental factors	x			x		x
Organisational process resources	x	x		x		x

With the above inputs that were implemented in project C, process outputs were identified. Table 4.42 below is the evaluation of project close-out process outputs for project C according to current practices.

Table 4.42: Evaluation of project close-out process outputs C

Close project or phase outputs	**Availability Y/N**	**Comments**
Project artefacts updates	N	Only final artefacts available. Process improvements identified.
Final artefact,	Y	
Final account	Y	
Resources updates	N	

4.2.4 Data presentation: Project D – improve production

Section 4.2.4 presents gathered data for project D, the results of data analysis done and an interpretation of the findings.

i. Develop project charter

The development of the project charter evaluation provides how the project is formally authorised as a project and its initiation purpose that will describe high level goals and deliverables. The project charter further identifies the project lead and gives him or her authority to request and manage resources for the project. This process is a foundation for a project manager to execute his or her project. Table 4.43 below is the evaluation of the project charter process for project D.

Table 4.43: Project charter process outputs evaluation D

Process tools/ technique / Process inputs	Subject matter expert	Information management	Free-associating	Consultations	People skills	Facilitation	Assembly management	Summits and seminars	Meeting management
Corporate forms	x	x		x					
Corporate circumstances	x	x							
Benefits realisation		x							
Arrangements		x							
Environmental factors	x	x							
Organisational process resources	x	x							x

With the above inputs that were implemented in project D, process outputs were identified. Table 4.44 below is the evaluation of the project charter process outputs for project D according to current practices.

Table 4.44: Project charter process outputs evaluation D

Develop project charter outputs	Availability Y/N	Comments
Project charter	Y	
Activity log	Y	

ii. Develop project management plan

The evaluation of the development of the project management plan outlines how the master plan of the project was developed. Development of a project management plan further provides a baseline so that any change that is required is subjected to change management. The inputs and techniques of the development of a project management plan will provide a desired project management plan for effective project integration management.

Table 4.45 below is the evaluation of development of project management plan process for project D.

Table 4.45: evaluation of development of project management plan process D

Process tools/ approach / Process Inputs	Subject matter expert	Information gathering	Brainstorming	Specifications	Lead teams	Consultations	People skills	Meeting management
Project charter		x		x				
Feeder processes	x				x		x	
Business environmental factors		x		x				
Business artefacts				x			x	

With the above inputs that were implemented in project D, process outputs were identified. Table 4.46 below is the evaluation of the development of the project management plan process outputs for project D according to current practices.

Table 4.46: Develop project management plan process outputs evaluation D

Develop project management plan outputs	**Availability Y/N**	**Comments**
Project management plan	Y	Template utilised to conclude a project management plan

iii. Directing and management of project work

During the life cycle of a project directing and managing the project effort process is utilised to manage work and actions needed for project success. Execution of this process is determined by the project management plan and changes required are approved through a change management process. Information utilised to evaluate this process includes an electronic project file, communication including meeting minutes and emails, standards and change control office files. Further assessment of this project processes includes the scope, schedule, budget, and quality management records. Table 4.47 below is the evaluation of directing and management of the project work process for project D.

Table 4.47: Direct and management of project work process evaluation D

Process tools/ techniques / Process Inputs	Subject matter expert	PM Information system	Consultations and meetings
PM plan		x	
Project forms			
▪Variation orders			
▪Reflection register			
▪Breakthroughs			
▪Mission communications		x	x
▪Schedule		x	
▪Requirements matrix			
▪Risk register			
▪Risk report		x	
Approved change requests	x	x	
Company environmental factors	x	x	
Organisational process resources	x	x	

With the above inputs that were implemented in project D, process outputs were identified. Table 4.48 below is the evaluation of directing and management of project work process outputs for project D according to current practices.

Table 4.48: Direct and management of project work process outputs evaluation D

Direct and manage project work outputs	**Availability Y/N**	**Comments**
Deliverables	Y	Opportunities identified
Delivery data	Y	
Change requisitions	N	
PM plan updates	N	
Project forms -Action list -Statement log -Artefacts -Requirements documentation -Risk register -Participant register	 Y N Y Y Y N	

iv. Manage project data

Management of project data by maintaining and organising project information throughout the project life cycle equips the project and business managers with a better view of project information and key trends for decision-making. Aspects of evaluating the management of project data include data governance, data quality, and document and record management. Table 4.49 below is the evaluation of the data management process for project D.

Table 4.49: Data management process evaluation D

Process tools/ techniques / Process inputs	Subject matter expert	Information management	Data management	People skills	Organising skills
PM plan		x	x		
Project forms					
▪Lessons register					
▪Project team outputs		x	x		
▪Resource breakdown assembly					
▪Baseline selection criteria	x				
▪Team register		x			
Deliverables	x	x			x
Environmental factors	x	x		x	x
Organisational process resources	x	x			

With the above inputs that were implemented in project D, process outputs were identified. Table 4.50 below is the evaluation of data management process outputs for project D according to current practices.

Table 4.50: Data management process outputs evaluation D

Manage project data	Availability Y/N	Comments
Results register	Y	
PM plan	Y	
Organisational process resource updates	Y	

v. Monitor and control project effort

Directing and controlling of project work were evaluating processes, tools and techniques used to manage change and development in a project. Changes in a project can be requested throughout the project life cycle, but these requests must be monitored and controlled to make sure that the quality of the project is not negatively affected. Project progress and reporting among the project team interfaces to ensure effective integration for the success of the project was also evaluated. Table 4.51 below is the evaluation of monitoring and controlling project effort for project D.

Table 4.51: Monitor and control project effort evaluation D

Tools/ technique / Process inputs	Subject matter expert	Data breakdown	Replacements analysis	Cost benefit analysis	Earned value analysis	Root cause analysis	Leaning analysis	Alteration analysis	Decision making	Consultations
PM plan	x	x							x	x
Project folder										
▪Cashflow	x	x								x
▪Task list		x								
▪Training register										
▪Breakthrough list	x									
▪Quality reports		x								x
▪Risk register										
▪Risk report		x								
▪Schedule forecast	x	x								
Work routine information	x	x							x	x
Contracts	x	x								x
Environmental factors	x	x								x
Organisational process resources	x	x								x

With the above inputs that were implemented in project D, process outputs were identified. Table 4.52 below is the evaluation of the monitoring and controlling of project effort outputs for project D according to current practices.

Table 4.52: Monitor and control project effort outputs evaluation D

Monitor and control project effort outputs	**Availability Y/N**	**Comments**
Work routine reports	Y	Improvements Identified
Change management	N	
PM plan updates	N	Improvements Identified
Project file updates: - Cash flow - Task log - Training register - Risk register - Schedule outlook	 Y N N N Y	Improvements identified. Note earned value analysis and root cause analysis

vi. Execute integrated change control

Integrated change control is an organised, systematic coordination of the information, tools, and resources of change that provide a project manager with a key process to achieve the project objectives. Availability of tools and techniques of integrated change control were evaluated when change was identified in a project. Table 4.53 below is the evaluation of the execution of integrated change control process for project D.

Table 4.53: Execute integrated change control evaluation D

Process tool/ techniques / Process inputs	Subject matter expert	Data scrutiny	Document scrutiny	Movement scrutiny	Deterioration scrutiny	Variance scrutiny	Consultation
Project charter		x					
PM plan	x	x					
Project artefacts	x	x					
Known deliverables		x					
Business documents	x	x					
Agreements	x						x
Procurement documents	x	x					x
Organisational process resources	x	x	x				

With the above inputs that were implemented in project D, process outputs were identified. Table 4.54 below is the evaluation of the execution of integrated change control process outputs for project D according current practices.

Table 4.54: Execute integrated change control process outputs evaluation D

Execute integrated change control	**Availability Y/N**	**Comments**
Approved change requests	Y	
PM plan updates	Y	
Project artefacts updates	Y	

vii. Close project or phase

When the project is done, it must close. The process of closing a project includes reviewing various processes used and rating them on whether they were successful or not. Evaluation of this process includes documentation to create an archive that future project managers can reference for decisions on how to implement their plans and processes. Each phase of the project delivers important artefacts that outline what lessons were learned over this period.

Project integration management occurs from start to finish of a project and the close project process evaluation provides a view of properly closing a project. Table 4.55 below is the evaluation of project close-out process for project D

Table 4.55: Project close-out process evaluation D

Process tool/ techniques / Process inputs	Subject matter expert	Data scrutiny	Document scrutiny	Movement scrutiny	Deterioration scrutiny	Variance scrutiny	Consultation
Project charter	x	x					x
PM plan		x					
Project artefacts		x					
Known deliverables							
Business documents		x					
Agreements							
Procurement documents							
Organisational process resources		x					
Project charter		x					

With the above inputs that were implemented in project D, process outputs were identified. Table 4.56 below is the evaluation of project close-out process outputs for project D according to current practices.

Table 4.56: Project close-out process outputs evaluation D

Close project or phase outputs	**Availability Y/N**	**Comments**
Project artefacts updates	N	Opportunities identified
Final artefact,	Y	Opportunities identified
Final account	Y	
Resources updates	N	Opportunities identified

4.2.5 Data presentation: Project E – Internal compliance

Section 4.2.5 presents data gathered for project E, the results of data analysis done and an interpretation of the findings.

i. Develop project charter

The development of the project charter evaluation shows how the project is formally authorised as a project and how its initiation purpose that will describe high level goals and deliverables. A project charter further identifies the project lead and gives him or her authority to request and manage resources for the project. This process is a foundation for a project manager to execute his or her project. Table 4.57 below is the evaluation of the project charter process for project E.

Table 4.57: Project charter process evaluation E

Process tools/ technique / Process inputs	Subject matter expert	Information management	Free-associating	Consultations	People skills	Facilitation	Assembly management	Summits and seminars	Meeting management
Corporate forms	x	x							
Corporate circumstances	x	x							
Benefits realisation	x	x		x		x			x
Arrangements	x	x							
Environmental factors	x	x		x					x
Organisational process resources	x	x		x					

With the above inputs that were implemented in project E, process outputs were identified. Table 4.58 below is the evaluation of project charter process outputs for project E according to current practices.

Table 4.58: Evaluation of project charter process outputs E

Develop project charter outputs	Availability Y/N	Comments
Project charter	Y	None
Activity log	Y	

ii. Develop project management plan

The evaluation of the development of the project management plan outlines how the master plan of the project was developed. Development of a project management plan further provides a baseline so that any change that is required is subjected to change management. The inputs and techniques of the development of a project management plan will provide a desired project management plan for effective project integration management.

Table 4.59 below is the evaluation of the development of a project management plan process for project E.

Table 4.59: Development of project management plan evaluation E

Process tools/ approach / Process inputs	Subject matter expert	Information gathering	Brainstorming	Specifications	Lead teams	Consultations	People skills	Meeting management
Project charter	x	x						
Feeder processes	x	x		x	x	x		
Business environmental factors	x	x				x	x	
Business artefacts	x	x			x			

With the above inputs that were implemented in project E, process outputs were identified. Table 4.60 below is the evaluation of development of project management plan process outputs for Project E according to current practices.

Table 4.60: Development of project management plan process outputs evaluation E

Develop project management plan outputs	Availability Y/N	Comments
Project management plan	Y	Company template utilised for a comprehensive project management plan

iii. Direct and manage project work

During the life cycle of a project, the process of directing and managing the project work process is utilised to manage work and actions needed for project success. Execution of this process is determined by the project management plan, and changes

required are approved through a change management process. Information utilised to evaluate this process includes an electronic project file, communication including meeting minutes and emails, standards and change control office files. Further assessment of this project processes includes the scope, schedule, budget, and quality management records. Table 4.61 below is the evaluation of directing and management process for project E.

Table 4.61: Direct and management process evaluation "E"

Process tools/ techniques / Process inputs	Subject matter expert	PM information system	Consultations and meetings
PM plan		x	x
Project forms			
▪Variation orders			
▪Reflection register			
▪Breakthroughs			
▪Mission communications	x	x	x
▪Schedule	x	x	
▪Requirements matrix			
▪Risk register			
▪Risk report		x	
Approved change requests	x		
Company environmental factors	x	x	x
Organisational process resources		x	x

With the above inputs that were implemented in project E, process outputs were identified. Table 4.62 below is the evaluation of directing and management of process outputs for project E according current practices.

Table 4.62: Directing and management process outputs evaluation E

Direct and manage project work outputs	Availability Y/N	Comments
Deliverables	Y	Process opportunities identified
Delivery data	Y	
Change requisitions	N	
PM plan updates	N	
Project forms -Action list -Statement log -Artefacts -Requirements documentation -Risk register -Participant register	 Y Y Y Y Y Y	

iv. Manage project data

Management of project data by maintaining and organising project information throughout the project lifecycle equips project and business managers with a better view of project information and key trends for decision-making. Aspects of evaluating management of project data include data governance, data quality, and document and record management. Table 4.63 below is the evaluation of data management process for project E.

Table 4.63: Data management process evaluation E

Process tools/ techniques / Process Inputs	Subject matter expert	Information management	Data Management	People skills	Organising skills
PM plan		x	x		x
Project forms					
▪Lessons register					
▪Project team outputs		x			
▪Resource breakdown assembly					
▪Baseline selection criteria					
▪Team register	x				
Deliverables	x	x			
Environmental factors	x	x			
Organisational process resources	x	x			

With the above inputs that were implemented in project E, process outputs were identified. Table 4.64 below is the evaluation of the data management process outputs for project E on current practices.

Table 4.64: Evaluation of data management process outputs E

Manage project data	Availability Y/N	Comments
Results register	Y	None
PM plan	Y	None
Organisational process resource updates	N	Initial project resources were available, no indication of additional or updated resources

v. Monitor and control project effort

Directing and controlling of project work consisted of evaluating processes, tools and techniques used to manage the change and development in a project. Changes in a project can be requested throughout the project life cycle, but these requests must be monitored and controlled to make sure that the project quality is not negatively affected. Project progress and reporting among the project team interfaces to ensure effective integration for the success of the project, was also evaluated. Table 4.65 below is the evaluation of monitoring and controlling of the project effort process for project E.

Table 4.65: Evaluation of monitoring and control of project effort process E

Process tools/ technique / Process inputs	Subject matter expert	Data breakdown	Replacements analysis	Cost benefit analysis	Earned value analysis	Root cause analysis	Leaning analysis	Alteration analysis	Decision-making	Consultations
PM plan	x	x							x	x
Project folder										
▪Cashflow	x	x								
▪Task list	x	x								
▪Training register										
▪Breakthrough list										
▪Quality reports	x	x								
▪Risk register										
▪Risk report	x	x							x	x
▪Schedule forecast		x								
Work routine information										
Contracts		x								
Environmental factors		x								
Organisational process resources		x								

With the above inputs that were implemented in project E, process outputs were identified. Table 4.66 below is the evaluation of the monitoring and controlling of project effort process outputs for project E according to current practices.

Table 4.66: Monitoring and control of project effort process outputs evaluation E

Monitor and control project effort outputs	**Availability Y/N**	**Comments**
Work routine reports	N	No routine reports on the file and project management system
Change management	N	Template available
PM plan updates	Y	No updates on the file and project management system
Project file updates: - Cash flow - Task log - Training register - Risk register - Schedule outlook	 Y N N N Y	Opportunities identified

vi. Execute integrated change control

Integrated change control is an organised, systematic coordination of the information, tools, and resources of change that provide a project manager with a key process to achieve project objectives. Availability of tools and techniques of integrated change control were evaluated when change was identified in a project. Table 4.67 below is the evaluation of execution of the integrated change control process for project E.

Table 4.67: Execute integrated change control process evaluation E

Process tool/ techniques / Process inputs	Subject matter expert	Data scrutiny	Document scrutiny	Movement scrutiny	Deterioration scrutiny	Variance scrutiny	Consultation
Project charter		x					
PM plan	x	x					
Project artefacts	x	x					
Known deliverables		x					
Business documents	x	x					
Agreements	x						x
Procurement documents	x	x					x
Organisational process resources	x	x	x				

With the above inputs that were implemented in project E, process outputs were identified. Table 4.68 below is the evaluation of the execution of integrated change control process outputs for project E according to current practices.

Table 4.68: Execute integrated change control process outputs evaluation E

Execute integrated change control	**Availability Y/N**	**Comments**
Approved change requests	Y	
PM plan updates	Y	
Project artefacts updates	Y	

vii. Close project or phase

When the project is done, it has to close. The process of closing a project includes reviewing various processes used and rating them on whether they were successful or not. Evaluation of this process includes documentation to create an archive so that future project managers can reference for decisions on how to implement their plans and processes. Each phase of the project delivers important artefacts that outline what lessons were learned over this period. Project integration management occurs from start to finish of a project, and closed project process evaluation provides a view of properly closing a project. Table 4.69 below is the evaluation of project close-out process for project E.

Table 4.69: Evaluation of project close-out process E

Process tool/ techniques / Process inputs	Subject matter expert	Data scrutiny	Document scrutiny	Movement scrutiny	Deterioration scrutiny	Variance scrutiny	Consultation
Project charter	x	x					x
PM plan	x	x					
Project artefacts	x	x	x				
Known deliverables	x	x					
Business documents	x	x	x				
Agreements	x	x	x				
Procurement documents	x	x	x				x
Organisational process resources	x	x	x				x
Project charter	x	x					x

With the above inputs that were implemented in project E, process outputs were identified. Table 4.70 below is the evaluation of project close-out process outputs for project E according current practices.

Table 4.70: Project close-out process outputs evaluation E

Close project or phase outputs	Availability Y/N	Comments
Project artefacts updates	N	Process opportunities identified
Final artefact,	Y	
Final account	Y	
Resources updates	Y	

4.3 Conclusion

The chapter concluded with project integration management evaluation of five sampled projects from the smelter. Each project was evaluated in five processes as per the literature. Each process had inputs, techniques and outputs evaluated to realise opportunities and recommendations. Chapter 5 will provide an overall analysis of and recommendation for the project integration process identified according to current practices.

5 DATA ANALYSIS AND RECOMMENDATIONS

5.1 Introduction

This chapter presents an analysis and discussion of case studies of the smelter projects by demonstrating the application of project integration management literature. The aim of the present study was to demonstrate the application of project integration management principles and identify opportunities to improve project integration management in the execution of projects. The names of the projects will not be disclosed due to a company non-disclosure agreement. For this study, multiple projects were selected for the purpose of the research. The project names were projects A, B, C, D and E.

5.2 Analysis and discussion of the results

Below is a discussion of the analysis and recommendations for the integration processes.

5.2.1 Develop project charter analysis

McKeever (2006) refers to the project charter as the blueprint for the success of the project (McKeever, 2006). Many projects fail because projects can be tricky. But a good project charter is an effective way to ensure that the project team and organisation is equipped to deliver projects successfully (McKeever, 2006).

All projects that have been evaluated consisted of an approved project charter which was signed off by the project client and sponsor as part of project initiation. The smelter has a template that guides minimum requirements of a project charter and stakeholders that support a project charter. The smelter's project charters comprise business needs, client needs, stakeholder understanding, assumptions, constraints and high-level requirements of the project intent with results that it intended to satisfy. With the above analysis, there is a comprehensive project charter that provides a road map that will guide and act as a foundation for a project, and contracts to with project stakeholders.

5.2.2 Develop project management plan analysis

Strategic planning is critical for the success of any project. Good project planning methodology can close gaps in time, cost and the quality of a project (Kerzner, 2001). A projects manager's key responsibility is the development of a project management plan to fulfil effective project integration (PM Network, 2016).

The analysis of the projects includes various inputs from maintenance, process governance, production, engineering and support services for the successful development of a project management plan. With techniques that have been utilised to conclude a project management plan process, opportunities have been identified to improve development of a project plan. These opportunities include baselines for schedules, cost performance, and scope management. In project integration management, the use of these factors helps monitor how closely the work aligns with the approved plan, schedule and cost. It is recommended that a configuration management plan be included in the development of a project management plan to manage changes to project deliverables. When a configuration management plan is developed as part of project plan, it will provide a guide to document, control, implement and account for all configuration items of various components of the project.

The analysis further identified that none of the projects was supported by a review of past projects. Historical documents about past projects could include final reports about other projects, contracts, and scope of work that other teams used in previous projects, or informal discussions with those involved in past projects.
The recommendation therefore is to include historical documentation from similar closed projects to assist the project manager in planning and executing a better and more efficient current project.

5.2.3 Direct and manage project work analysis

Sokowski (2015) indicates that when project work is performed, a number of strategic initiatives that incorporate ad-hoc planning, tasks and steps are executed. It is therefore important that various tools and techniques be used by those who execute the work and by those who direct and manage the project work (Sokowski, 2015). A

project manager is identified as a lead in directing and managing of project work with support from production, maintenance, process governance, engineering management and support services. The evaluation of this process identified minimal utilisation of tools and techniques to direct and manage project work. This process has integration opportunities that can contribute to more effective project management. The recommendation for the smelter is to consider alternative tools and techniques that can be used to implement a proactive search for scope management in the project plan and quickly identify any corrective and preventative actions. These techniques could include the following:

- utilising reflection registers and breakthroughs as inputs to the process;
- utilising project management information systems as tools to support the process.

5.2.4 Manage project data analysis

Management of project data includes tools and techniques employed to gather, integrate and disseminate the artefacts of projects. Management of project data is therefore performed throughout the project life cycle (Transportation Research Board - National Research Council, 2000). The analysis of the evaluation of the projects identified the following:

- project forms are available as organisational documents to execute different phases of a project;
- documentation centre is available store plant information after project has been completed;
- documentation centre does not include filing of project progress information;
- a shared folder for information repository is available, however there is no guide for effective utilisation of this folder;
- a project manager is responsible to store and manage project data;
- project information is stored on multiple platforms at the discretion of a project manager; and
- minimal process inputs and techniques have been utilised to execute this process.

Recommendations for consideration to manage project data in projects are the following:

- the introduction of a project data management plan for the smelter to detail actions and responsibilities to manage project information;
- increasing the effort to manage information throughout the project in order to improve performance on the current project. The knowledge gleaned from the current project should be available for future project participants to look at;
- capturing project knowledge by managing both explicit and unspoken knowledge. However, it is important that the project manager allows for an environment of collaboration and trust so that people are motivated to share their knowledge with their colleagues; and
- platforms for data management are available. However, storage, archiving and retrieving project data remains a challenge to be explored for improvement.

5.2.5 Monitor and control project effort analysis

Monitoring and control of project effort is done throughout the project phases. Monitoring includes gathering information from project activities and comparing it to the project management plan. Then variances and forecasts of future performance of the scope, schedule and cost allocation for a project is identified (Billows, 2011).

During this evaluation the following findings were identified.

- Project scheduler and planner supports the project manager with scheduling and planning.
- Maintenance and production provide plant access to execute some project scope.
- Earned value management techniques are not utilised to provide more efficiency to monitor project performance.

Recommendations to be considered to improve monitoring and control of project effort include application of earned value management techniques discussed below.

- The introduction of CPI to monitor and control project costs. CPI provides a critical connection between the actual project work accomplished and its equivalent budget vs the actual expenditure to accomplish the work.

- The introduction of SPI as a project performance management tool. SPI reflects the relationship between actual work accomplished and the approved project baseline schedule, which allows management to focus on and manage their schedule obligations.

- TCPI to monitor the scope of work to be completed against management's specific financial goals. This will assist management in authorising BAC.
- Variance at completion is the difference between the original budget and the estimated cost once the project is completed.

Earned value management is to be utilised as management support to scrutinise project performance.

5.2.6 Execute integrated change control analysis

The first step in bringing about change is creating awareness around the need for change (Hiatt, 2006). Executing change control involves assessing project change requests, approving the changes and managing the deliverables, organisational process resources, project artefacts, and the project management plan. Integrated change control also involves communicating the current position. It evaluates all requests for changes or adjustments and approves or rejects the requests. The existence of this process allows and integrates structured management of changes within the project (PMI, 2017).

The evaluation identifies a project change control committee as a governance tool utilised to manage and control the project charter and project scope.

Recommendations for this process includes the following:

- as part of any change during the execution of a project earned value management techniques are to be utilised as part of change control and key performance areas of a project; and
- configuration management support to be utilised as a consideration for verification and validation of any change implemented.

5.2.7 Close project analysis

The project is closed when it achieved its agreed purpose with the client and further accepted by the client. The project manager ensures that any further expenditure is closed. However, closing is carried out when remaining activities have been completed and associated invoices are paid. The project manager further facilitates all actions to correct design faults prior to closing of a project (Lawson, 1999).

Below are the findings of the close project process:

- the evaluation identified that closing project process is fulfilled by handing over artefacts and closing finance reports only; and
- there is no capturing, nor sharing lessons learnt from a completed project.

Recommendations for effective project integration management on close project process include the following:

- the introduction of a project close-out committee as an improvement process;
- the effective storage, archive and retrieval of all project contracts, files, change documents and other files produced during the project;
- gathering a formal or informal group/protect team to review the project and identify what worked and what didn't. This group would also identify the lessons learned from changes and mistakes.
- producing lessons learned report to the project governance committee to identify the what they learnt and how they can use the lessons in the next project. Not only will the project manager be more effective in the future, but it will also help to build teamwork by getting other team members to share their opinions and insights. Sharing team insights may be the biggest benefit for improving integration in future projects.

5.3 Conclusion

Chapter 5 presented an analysis of and recommendations from five projects used for the case study from the smelter projects to evaluate and analyse the application of project integration management. Seven integration management processes have been evaluated and analysed to identify opportunities in the execution of each process. Chapter 6 will provide a conclusion and describe the success of this study.

6 CONCLUSION

6.1 Introduction

This chapter provides a case study success assessment for an evaluation of project integration management practice at the Hillside Aluminium Smelter. The study provides four objectives that should be achieved to fulfil solutions to the research problem statement.

6.2 Conclusion pertaining to each objective

Below is a review of the research objectives.

Objective 1: Identify project integration management methodologies in the smelter.
This objective has been met.
Project integration methods at the smelter have been identified and analysed. Understanding the methods and techniques currently being utilised at the smelter has enabled the researcher to identify opportunities for effective project integration management as a key contributing factor in delivering projects.

Objective 2: Identify the stakeholders to effect project integration management at Hillside Aluminium Smelter.
This objective has been met. Stakeholders that effect project integration management at the smelter have been identified. Processes that have been evaluated to accomplish effective project integration management provided stakeholder categories that contribute towards the success of each process.

Objective 3: Review models to determine the best and effective project integration management methods.
This objective has been met. The PMBoK was a preferred project management tool utilised to determine best and effective project integration management methods. Matrices supported by PMBoK were developed to identify inputs and approach of execution of project integration management processes. The matrices further identified project integration models and results attained when executing projects. Using developed matrices and literature, models to determine best and effective project integration management methods in the smelter were identified.

Objective 4: Applicable to the problem statement; establish and recommend areas of improvement to enhance project integration management.

This objective has been met. The research problem statement to identify and recommend areas of improvement to enhance project integration management has been archived. Opportunities and recommendations have been attained for each project integration management process.

6.3 Scope for future research

The following points can be researched in future:

- An effective project management office;
- Research of effectiveness in other knowledge areas;
- Effectiveness of construction management on the brown field's platform.

BIBLIOGRAPHY

Albright, P., & Bradley, M. (2005). *Implementing Service and Support Management processes: A practical guide.* Nertherlands: Van Haren Publishing. doi:10.1002/pmj.20014

Altwies, D. (2019). *A concise study guide for new project manager.* J. Ross Publishing. Retrieved from http://www.scribd.com

Baxter, P. (2008). Qualitative Case Study Methodology: Study Design and Implementation for Novice Researchers. *CAHSS Journal*, 544-559. doi:10.4236/health.2013.58A3010

Belassi, W. (2007). New product development projects:The effects of organizational culture. *Project Management Journal*, Vol.38, No.4, 12-24. doi:10.1002/pmj.20017

Billows, R. (2011). *Monitor & Control Project Work.* Colorado: The Hampton Group. Retrieved from http://www.scribd.com

Bougie, S. &. (2013). *Research Methods for business.* New York: John Wiley & Sons. Retrieved from http://www.scribd.com

Brouse, & Peggy. (2001). System Engineering and Management for Sustainable Development. *Configuration Management*. Retrieved from http://books.google.co.za

Brun, E. (2008). Ambiguity reduction in new product. *International Journal of Innovation Management*, 573-596. doi:10.1142/S1363919608002126

Bryde, W. (2007). Project management priorities and the link with performance management systems. *Project Management Journal*, 5-11. doi:10.1002/pmj.20014

Cagley, M., & Thomas, M. (2010). *Best Practices, Tools and Techniques.* Fort Lauderdale: J. Ross Publishing. Retrieved from http://www.scibd.com

Charan, R., & Colvin, G. (1999). Why CEOs fail. *Fortune*, 68-78. Retrieved from http://money. cnn. com

Cioffi, D. (2002). *Managing project integration.* Vienna: Management Concepts. Retrieved from http://www.scribd.com

Configit. (2012). *Configuration lifecycle management.* Retrieved from Configit: http://configit.com/

Cooke-Davies, T. (2002). The real success factors on projects. *International Journal of Project Management*, 185-190. doi:10.1016/S0263-7863(01)00067-9

Dinsmore, P. C., & Cabanis-Brewin, J. (2014). *AMA Handbook of Project Management.* New York: Division of American Management Association. Retrieved from http://scribd.com

Dionisio, C. S. (2018). *Project Manager's Book of Tools and Techniques - A Companion to the PMBOK® Guide (6th Edition).* John Wiley & Sons. Retrieved from https://app.knovel.com

Dobson, M. (2015). *Successful project management - How to complete projects on time, on budget, and on target.* Chicago: American Management Association. Retrieved from http://app.knovel.com

Fleming, Q. (2010). *Earn value project management.* Newton Square: Project Management Institute. Retrieved from http://app.knovel.com

Gholamreza, J. (2016). A Study on Project Management Based on PMBOK and PRINCE2. *Modern Applied Science, 10*, 146. doi:10.5539/146

Hiatt, J. (2006). *A Model for Change in business, government, and our community.* Colorado: Prosci learning center publications. Retrieved from http://books.google.com

ISO. (2003). *Guidelines for configuration management* (2nd Edition ed.). Geneva: International Organisation for Standards. Retrieved from http://schoolar.google.com

Kendrick, T. (2014). *Project Management Tool Kit.* New York: Division of American Management Association. Retrieved from http://app.knovel.com

Kerzner, H. (2015). *Project Management 2.0 - Leveraging tools, distributed collaboration and metrics for project success.* New Jersey: John Wiley and Sons. Retrieved from https://app.knovel.com

Kerzner, H., & Frank, P. (2017). *Project management workbook.* Pennsylvania: John Wiley & Sons. Retrieved from https://app.knovel.com

Kerzner, H., & Frank, P. (2017). *Project Management Workbook and PMP®/CAPM® Exam Study Guide.* New Jersey: John Wiley & Sons. Retrieved from https://app.knovel.com

Knutson, J. (2007). *Succeeding in project driven organisation.* New York: John Wiley & Sons. Retrieved from http://www.scribd.com

Lawson, G. (1999). *Project management for the process industries.* Warwickshire: Institute of Chemical Engineers. Retrieved from http://app.knovel.com

Lee, T. (1999). *Using qualitative methods in organisational research.* New Delhi: Sage .

Leedy, P. D. (2013). *Practical Research: Planning and design.* Colorado: Pearson.

Martin, L., Pearson, M., & Furumo, A. (2005). IS project management: Size, complexity, practices and the project management office. *Proceedings of 38th Hawaii International Conference on System Sciences* (pp. 1-10). Hawaii: IEEE. Retrieved from http://app.knovel.com

McKeever, C. (2006). The project charter - Blueprint success. *Journal of Management in Engineering*, 6-9. doi:10.1.1.641.9513

Menendez, J. (1986). *Configuration management in trusted systems.* Maryland: Diane .

Mette, A., & Jonassen, H. (2003). *Configuration management principles and practice.* Boston: Addison-Wesley.

Milosevic, D. Z. (2003). *Project Management Toolbox - Tools and Techniques for the Practicing Project Manager.* John Wiley & Sons. Retrieved from https://app.knovel.com

Munro, R., Ramu, G., & Daniel, J. (2015). *Six sigma green belt handbook.* Villanova: American society for quality. Retrieved from http://app.knovel.com

Nardone, P. (2009). *Well testing project management - Onshore and oofshore.* New York: Gulf Professional Publishing. Retrieved from https://app.knovel.com

Nokes, S., & Kelly, S. (2007). *The definitive guide to project management.* London: Pearson .

Ormrod, E., & Leedy, P. (2014). *Practical research: Planning and design.* Colorado: Pearson.

PM Network. (2016). *Getting it done.* Newtown Square, Pennsylvania: PA: Project Management Institute.

PMI. (2013). Organizational Project Management Maturity Model. In *Organisational Project Management Maturity Model* (p. 22). Pennsylvania: PMI Publications.

PMI. (2016). *Construction Extension to the PMBOK® Guide.* Pennsylvania: Project management institute. Retrieved from https://app.knovel.com

PMI. (2017). *A guide to the project management body of knowledge.* Pennsylvania: Project Management Institute. Retrieved from http://www.scribd.com

Project Management Institute. (2011). *Practice standard for earned value management.* Project Management Institute.

Project Management Institute. (2016). *Construction extension to the PMBOK® guide .* Pennsylvania: Project Management Institute.

Project Management Institute. (2018). *Standard for organizational project management.* Pennsylvania: Project Management Institute, Inc. Retrieved from https://app.knovel.com

Ramu, G. (2017). *Certified six sigma-yellow belt.* Villanova: American Society for Quality. Retrieved from http://www.app.knovel.com

Rowe, S. (2015). *Project management for small projects - Keys for closing success.* Washington: Management Concepts.

Saunders, L. (2007). *Research methods for business students.* Havard: Prentice Hall.

Shenhar, A., Dvir, D., Levy, O., & Maltz, A. (2001). Project success: a multidimensional strategic concept. *Long Range Planning Journal*, 699-725.

Skovdal, M. (2015). *Qualitative research for development.* Warwickshire: Practical Action. Retrieved from http://www.scribd.com

Sokowski, D. (2015). *Mastering project management integration and scope.* New Jersey: Pearson Education. Retrieved from http://app.knovel.com

Steyn, H. (2004). *Project Management a multi-disciplary approach.* Pretoria: FPM Publishing. Retrieved from http://www.scribd.com

Transportation Research Board - National Research Council. (2000). *Project management information systems.* Washington: National Academy. Retrieved from http://www.trb.org

Watson, E. (1998). Quality in qualitative research in health care: Assessing quality in qualitative research. *Journal of Health Services Research & Policy*, 167-172. Retrieved from http://www.scribd.com

Yetton, L. a. (2007). The Contingent Effects on Project Performance of Conducting Project Reviews and Deploying Project Management Offices. *IEEE*, 789-799. doi:10.1108/14637150910987928

Yin. (2003). *Case study research: Design and methods.* Los Angeles: Sage. Retrieved from http://www.scribd.com

Yin. (2014). *Case study research, design and methods.* Los Angeles: Sage. Retrieved from http://www.scribd.com

Zikmund, W., & Barry, B. (2007). *Essential of market research.* Boston: Thomson South-Western. Retrieved from http://www.scribd.com

7 APPENDIX

A.1 Request for permission to conduct a research

From:	To:
Zintle Ndandani - Engineering Manager Hillside Aluminium	Lead Human Resources The Vice President Operations

24 July 2019

Request for Permission to Research on Project Integration Management at Hillside Aluminium

I am at the final stage of my studies towards a Master's in Engineering Management (MEM) with University of Johannesburg.

For my dissertation I have elected to conduct a case study to evaluate project integration management of capital projects at Hillside Aluminium. This study will focus on project management activities in Engineering.

The research utilises random sampling of project files to investigate the activities conducted by project team members when executing plant capital projects. The evaluation benchmark for the evaluation is the Project Management Body of Knowledge.

A comparison will be drawn to identify opportunities to improve project integration in the smelter.

For purposes of non-disclosure agreement of company information, none of the project content either by name, department, scope, cost will be disclosed when conducting this research.

The research will be conducted purely for the academic purpose of obtaining my MEM. No information will be made available for public scrutiny nor risk to compromise the image of the company. The final research will be available for verification of content prior submission.

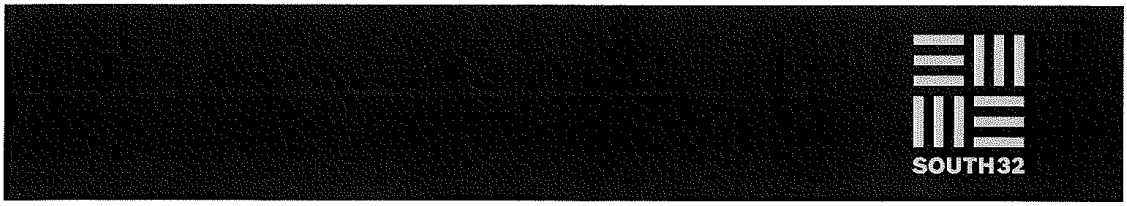
Regards

Zintle Ndandani

Approval Signatures

Title	Name	Signature	Date
Lead of HR	Mark Patrick		04/07/2019.
The Vice President Hillside Operations	Calvin Mkhabela		4/7/19

A.2 Authorisation letter



Hillside Aluminium Proprietary Limited
9 West Central Arterial
Richards Bay, 3900
South Africa

P O Box 897
Richards Bay, 3900
South Africa

T +27 35 908 8111
south32.net

4 July 2019

From:
Hillside HRD Department

Re : Approval to conduct research for Masters in Engineering Management (MEM)

Dear Zintle Ndandani

Further to your request for permission to conduct research on "Project Integration Management at Hillside Aluminum", for your Master's in Engineering Management (MEM) with University of Johannesburg, you are hereby granted permission to conduct the requested research.

Please ensure that Hillside's code of ethics and confidentiality is not breached in any way. All material must be submitted to the Hillside HRD department for screening prior to submission to the University of Johannesburg.

Approval Signatures

Title	Name	Signature	Date
Lead L&D PGI	Mrs. A Kleinhans		04/07/2019
Lead Human Resources	Mr. Mark Patrick		04/07/2019.

A.3 Consent letter

SOUTH32

Hillside Aluminium Proprietary Limited
9 West Central Arterial
Richards Bay, 3900
South Africa

P O Box 897
Richards Bay, 3900
South Africa

T +27 35 908 8111
south32.net

4 July 2019

From:
Hillside HRD Department

Re : Approval to conduct research for Masters in Engineering Management (MEM)

Dear Zintle Ndandani

Further to your request for permission to conduct research on "Project Integration Management at Hillside Aluminum", for your Master's in Engineering Management (MEM) with University of Johannesburg, you are hereby granted permission to conduct the requested research.

Please ensure that Hillside's code of ethics and confidentiality is not breached in any way. All material must be submitted to the Hillside HRD department for screening prior to submission to the University of Johannesburg.

Approval Signatures

Title	Name	Signature	Date
Lead L&D PGI	Mrs. A Kleinhans		04/07/2019
Lead Human Resources	Mr. Mark Patrick		04/07/2019.

A3. Editing certificate

Jackie Viljoen
Language Editor and Translator
16 Bergzicht Gardens
Fijnbos Close
STRAND 7140

Accredited member of the South African Translators' Institute
No APSTrans No. 1000017
Member of the Professional Editors' Group (PEG) No. VIL003
Member of Safrea No. SAF03316

☎ +27+21-854 5095 082 783 0263 086 585 3740
Postal address: 16 Bergzicht Gardens, Fijnbos Close, STRAND 7140 South Africa

DECLARATION

I hereby certify that the thesis by **ZINTLE NDANDANI** was properly language edited but without viewing the final version.

The track changes function was used and the author was responsible for accepting the editor's changes and for finalising the reference list.

Title of thesis:

AN EVALUATION OF PROJECT INTEGRATION MANAGEMENT PRACTICE AT THE HILLSIDE ALUMINIUM SMELTER

The editor did not write or rewrite any part of the thesis on behalf of the client, including passages that may have been plagiarised. The academic content is the sole responsibility of the client as author of the work. The editor could not and did not test definitively for plagiarism, nor is there any explicit or implicit guarantee that the content that was edited contained no material used without consent. The editor accepts no responsibility for any failure on examination of the thesis by the university.

JACKIE VILJOEN
Strand
South Africa
19 October 2019

A4. Turnitin