Project portfolio management: Managing uncertainty in dynamic environments

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by

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SUMMARY

PROJECT PORTFOLIO MANAGEMENT: MANAGING UNCERTAINTY IN DYNAMIC ENVIRONMENTS

by

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Currently, many project dependent companies are facing a number of problems such as too many active projects, not enough resources to complete the projects and lack of ability to deal with changes in the project environments. These problems will lead to failure in the company's ability to fulfil its mandate and execute their strategic imperatives.

These problems were identified to lead to numerous complications that may threaten the company's business. The question that was asked was how can organisations use proper project portfolio management to deal with uncertainties in their environments. Hence, the purpose of this dissertation is to investigate the ability of project portfolio management in handling uncertainty, and the extent to which project portfolio management is used to circumvent the effects of uncertainty on the projects.

To this end, two project-driven companies were investigated. The choice of company was made by looking at the availability of information and the company structures. The author had access to resources within the company. It was found that there is an unclear understanding on the role of project portfolio management in both companies. One company claimed to have a fully functioning project portfolio management department, while the other is still in its infancy in this regard.

This is a qualitative study. The information was collected through scientific articles and books. This information was used to construct a case study, where the data was primarily gathered through a questionnaire. The responses to the questionnaire were analysed to determine the companies' ability to deal with uncertainty in their project management activities. The findings were then used to conclude that the businesses could improve their project success by implementing the proper project portfolio management principles.

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ABBREVIATIONS

APM	Association of Project Management
APMBOK	Association of Project Management Body of Knowledge
CAPEX	Capital Expenditure
Dx	Eskom Distribution
GOU	Gauteng Operating Unit
OPEX	Operational Expenditure
NERSA	National Energy Regulator of South Africa
NPV	Net Present Value
PMI	Project Management Institute
PMBOK	The Project Management Body of Knowledge
PPM	Project Portfolio Management
PMO	Project Management Office
ROI	Return On Investment

CHAPTER 1 Introduction

1.1 Problem statement

The economic downturn that occurred between 2008 and 2009 had a devastating impact on many industries [1]. Although there was a modest and uneven global recovery thereafter, many industries are still uncertain about their future prospects. Uncertainty exists in all areas of life, such as production costs, regulations from a government, political climate change, and innovation. Many organisations in the public and private sectors are gradually accepting market volatility and uncertainty as the new norm.

South Africa's power utility, Eskom, is facing enormous problems which are converging at the time when there is no straight forward solution for each one of them. In 2013, Eskom applied to the National Energy Regulator of South Africa (NERSA) for an annual tariff increase of 16% for the five year period ending in 2018, which would have translated into higher revenue for the utility. NERSA, however, only approved an 8% tariff hike [2]. In March 2016 NERSA further granted Eskom permission to raise tariff by an average of 9.4% in order for Eskom to recover unbudgeted expenses it incurred in 2014 to curb load shedding [3]. This increase, which came into effect on the first of April 2016, was set aside by a ruling of the High Court in Johannesburg in August 2016 [4] [5]. Eskom, therefore, continues to face uncertainty as a result of these and other setbacks.

In the United Kingdom (UK), and other developed countries, energy sustainability has moved up the political agenda since the early 2000s [6]. The energy trilemma[1] that is threatening modern energy sustainability is the subject of many energy discussions in governments. Uncertainty about how to balance carbon reduction and economic growth is a major risk to energy security. It is believed that such uncertainty could be alleviated if

[1] Energy Trilemma: The challenges associated with energy security, environmental sustainability, and affordability is termed by the World Energy Council as energy trilemma [82].

there is clear government policy on energy sustainability, and if the energy technological advancement needs are identified [7].

It is imperative for an organisation's strategic decision makers to find ways to ensure that strategic responses selected have validated economic foundation. In this era of high uncertainty, organisations' decision makers are also required to make or modify their strategic decisions according to the uncertainty levels they are exposed to, which may entail rebalancing their project portfolios. However, making effective decisions under uncertainty can be a daunting task.

Project portfolio management is a business strategy in which organisations group and manage projects and programs as a portfolio of investments that contribute to the entire organisation's success. Portfolio rebalancing is a common form of portfolio risk management. Periodic rebalancing controls the more volatile asset classes in a portfolio, thus improving the risk-adjusted returns over time [8].

There are many different approaches and models for qualitative and quantitative portfolio management – these can be numerical or non-numerical. Archer and Ghasemzadeh [9] found that, even though there are many of these models, "most of them are too complex, provide an inadequate treatment of risk and uncertainty, and fail to recognise interrelationships and interrelated criteria" [9]. These PPM models adopted by most organisations fail to appreciate that uncertainty in dynamic environments can be caused by new, terminated and deferred projects, as well as changing business conditions and priorities [9].

1.1.1 Context of the problem

Today organisations face highly dynamic, and competitive, environments that are characterised by rapid changes, uncertainty and increasing complexity [10]. It is important for these organisations to have a strategic plan to survive such circumstances and to guarantee their future. The strategic plan should outline the mission, vision, objectives, strategies and goals [10] [11]. To implement the strategic plan, organisations use projects and programs of work and apply project management principles to steer the plan. There are, therefore, two aspects that are vital to the success of a business: *doing the right projects and doing projects right* [12].

A project, as defined in The Project Management Body of Knowledge (PMBOK), is "*Any planned, temporary endeavour undertaken to create a unique product, service or result*" [13]. The uniqueness of a project and the goal it will fulfil are two important factors that separate project work from other forms of work within an organisation. In reality, organisations run multiple projects in parallel; it is acknowledged that up to 90% of all projects occur in a multi-project context [14]. In these multi-project organisations, multiple projects are managed concurrently at an organisational level and this dynamic decision-making process is referred to as project portfolio management (PPM) [15].

Project portfolio management (PPM) provides structures and necessities to integrate projects and to create synergies. PPM is about balancing priorities, project selection, resource allocation and alignment, and overall bandwidth management to avoid overruns of time and money, and overutilization of human resources. The founding theory of PPM is portfolio optimisation and is done by placing priority on maximising the financial return while minimising the risk of the portfolio. This theory should be kept in mind when making decisions and selecting projects for a portfolio [16].

For over three decades, scholars have noted that the need to use projects to accomplish an organisation's important tasks could lead to more projects raised than required [11]. Some of these projects may fall outside the organisation's stated mission, some might be completely unrelated to the strategy and goals of the organisation and some might even

yield less return on investment (ROI) than expected for the capital invested. The scholars' forethought is true still today. There are usually more projects available for selection than there are resources [9]. In addition to the intricacies of time, budgetary and human resource constraints; are the volatility of the economies and risks. These intricacies validate the importance of selecting and implementing projects that are in line with the organisation's mission and strategic goals.

A key problem within the project management discipline is the limited amount of literature and research available about Project Portfolio Management (PPM) [17]. One might then argue that PPM is relatively a new concept. However, there is literature that presents the evidence that PPM was examined as far back as the nineteen-fifties [18]. In his 1999 publication, Markowitz dates the concept of portfolio diversification, which is an important part of PPM, back to the 17th century [19].

Research done by Lorie et al [20], who in 1955 looked at the PPM problem in the context of capital budgeting, and Petersen's development of an algorithm to find an optimal solution to the PPM problem he was facing in 1965 [21], are among the most trusted contributions made to the PPM literature. Given this evidence, it could be expected that PPM would be a mature and implementable concept in organisations and within the project management discipline however, this is not the case. Projects are meant to be the means of implementing organisational strategy, yet it rarely happens in practice as "*there is little literature on how business strategy is translated into project terms* [17]."

The Project Management Institution (PMI) Standard for Portfolio Management highlights the fact that project execution methodologies and lessons are not incorporated early enough into the phases of the portfolio management process [22]. Another difficulty with the management of projects and the overall portfolio is that company decision-makers frequently select the projects which cannot be completed [23]. Some researchers suggest that projects are not completed because resource limitations are often left out of the portfolio planning and overall project portfolio process [9]. Generally, there is an inconsistency in selecting projects and the management of the project portfolio within organisations.

1.1.2 Research gap

Any portfolio management problem consists of two crucial inputs: returns (expected profits) and risks (possible losses). The focus in PPM research has been on the selection and prioritisation of projects to ensure that risks, potential returns, and resource allocations are balanced and aligned to the organisational strategy in order to obtain best returns. This focus, however, needs to widen to enable and encourage finding ways to ensure that the right decisions are taken during the management of a portfolio.

The common practice for most organisations is to evaluate the projects after they have been executed. The problem with that approach is that, at that stage, there is little that can be done to improve or prevent failure. A small percentage of portfolio managers and decision-makers do make efforts to monitor and review projects regularly during execution; nevertheless many problems remain unresolved.

There is insufficient literature available, even in the PPM body of knowledge, addressing potential disturbances to the portfolio in dynamic environments. The prevalent portfolio disturbance, in these recent times, is the increased volatility and risk of financial markets. Other potential disturbances that might impact the successful implementation of the portfolio include the addition of new projects, termination of some projects, lack of resources, changing business conditions, and new threats and opportunities between portfolio planning cycles.

According to the PMI, portfolio re-alignments may occur when there are changes in the business strategy. The impromptu disturbances to an active portfolio, such as those mentioned here before, have not been addressed in PPM literature. This lack of research gives the notion that projects occur in stable, predictable, and strategy-inclined environments; the opposite is actually true.

This dissertation is, therefore, motivated by the observations that project portfolios beyond their selection and prioritisation are rarely investigated; and the inadequate research on the impact of uncertainty on portfolio management.

1.2 Research objective and questions

This dissertation addresses the following question:

How do organisations manage uncertainty affecting portfolios in a dynamic environment?

To get to the solution of this question, the research will answer these two questions:

RQ1: How should risks, unexpected events, and deviations (uncertainty) affecting project portfolios be managed?

RQ2: How do organisations manage uncertainty resulting from a changed project portfolios environment?

The objective of this dissertation is to:

- Study project portfolio management in practice in organisations; and
- Identify potentially useful practices in the project portfolio management field that can effectively manage uncertainty affecting a portfolio in a dynamic environment.

1.3 Research process

Qualitative study was undertaken to answer the research questions posed in section 1.2 [24]. Of the main research philosophies found in research literature, this dissertation subscribes to positivist and interprevist categories [25] [26]. More precisely, considering the five paradigms (positivism, post-positivism, critical theories, constructivism, and participatory), this research is a post-positivist inquiry of carefully selected cases [27]. The minimum literature and consequently limited understanding of the effects of uncertainty on portfolios in dynamic environments warrant for a descriptive study rather than to investigate causality.

1.4 Overview of study

Chapter 1 of this dissertation aimed to introduce Project Portfolio Management (PPM) as a subject matter. The problem was then identified and research questions were posed. In Chapter 2 the observed and theoretical foundations of PPM are presented. Also presented in this literature review chapter are the concepts related to uncertainty and dynamic environments, as well as their relation to project portfolios.

In Chapter 3 the alternative research methods are briefly evaluated. The author then presents the research methodology used in this dissertation, and describes the rationale for the use of case studies. Being the research design chapter, Chapter 3 details what question the research answers, identifies the data relevant to fulfil the research question, and how that data was collected and analysed [28].

Chapter 4 gives the background for the organisations and the project portfolios chosen for this research. It describes how the case study evidence was collected and analysed to fulfil the research design. Data patterns therefore are derived from each case study, and a cross-case study analysis is done. The dissertation is concluded in Chapter 5 when the author discusses the implications the results obtained would have on the theory and practice of PPM. The author furthermore, provides the answers to the research questions in a logical manner and synthesizes the research.

CHAPTER 2 Literature study

2.1 Chapter objectives

This chapter presents only the most relevant information to the study synthesised from existing body of knowledge. It then discusses the concept of uncertainty and investigates its relationship to similar concepts such as unexpected events, deviations and risks. The different project management approaches that have been developed to cope with dynamic environments are presented, and their application to PPM in dynamic environments with high uncertainty is checked.

2.2 Project portfolio management

2.2.1 Project, program, and portfolio

There is often confusion about the concepts Project Management, Project Program management, and Project Portfolio Management. It is however, important to first distinguish between a *project*, a *program* and a *portfolio* before the management thereof is explored. We established in the introduction to this dissertation that a project is a transient, unique endeavour undertaken to create a unique product or service or archive the desired result [13] [29]. The Association of Project Management Body of Knowledge (APM) has defined a programme[2] as "a collection of projects related to some extent to a common objective" [29]. PMI's definition also has a similar notion that a program[3] is a "group of related projects managed in a coordinated way to obtain benefits and control not available from managing then individually" [22].

When it comes to the definitions of project portfolio, different researchers focus their definition on a variety of aspects such as strategic alignment, management and resources management. Some of the different definitions of project portfolio, including the definitions from the APM and PMI, are contained in Table 1. The summary of this table is shown in Figure 1.

[2] APM uses the British spelling of programme.

[3] PMI uses American spelling of program; this is the spelling used in this dissertation.

Table 1: The definition of a project portfolio from different literature sources

Reference	Definition
APM [29]	A grouping of an organisation's projects, or programmes. Portfolios can be managed at an organisational or functional level.
PMI [22]	A portfolio is a collection of programs, projects and/or operations managed as a group. The components of a portfolio may not necessarily be interdependent or even related – but they are managed together as a group to achieve strategic objectives.
Archer and Ghasemzadeh [9, p. 208]	A group of projects that are carried out under the sponsorship and/or management of a particular organisation.
Dye and Pennypacker [30, p. 421]	A collection of projects that, in aggregate, make up an organisation's investment strategy.
Githens [31, p. 84]	A collection of projects or programs that fit into an organisational strategy. Portfolios include the dimensions of market newness and technical innovativeness.

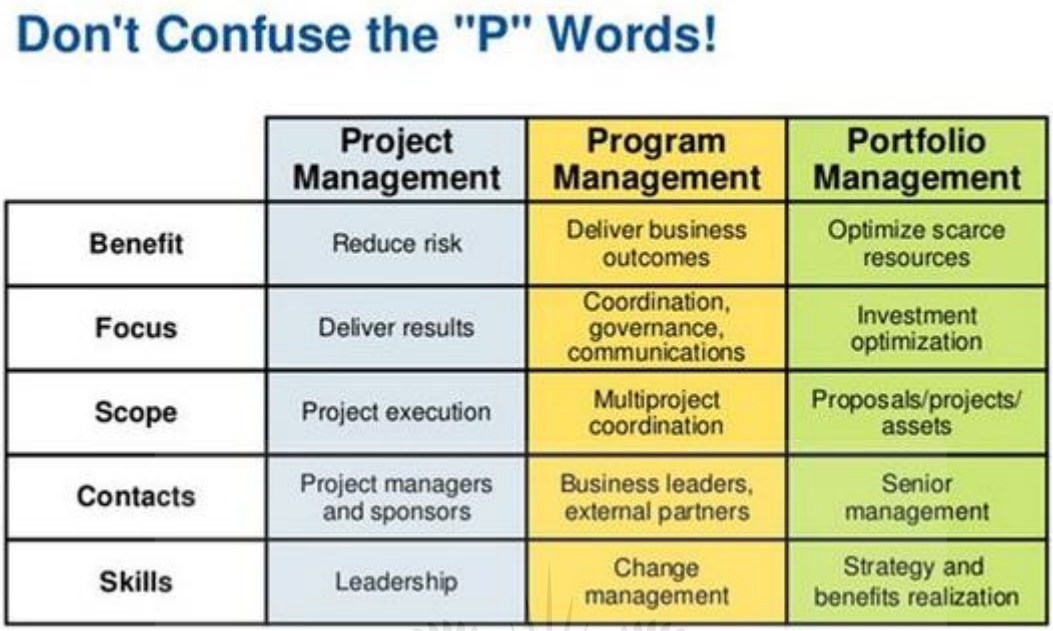

Figure 1: Summary of Projects, Programs and Portfolios [32].

2.2.2 Project management, program management and portfolio management

Project, programs and portfolios can all be used to manage an organisation's output. Each one has its own focus and unique management approach. Project Management is a discipline concerned with managing discrete packages of work, guided by a set of standards contained in the Project Management Body of Knowledge (PMBOK[4]), to achieve the set objectives. It enables organisations to deliver projects and programs on time, within budgets, and in accordance with the scope. Project management involves developing and implementing plans to achieve specific deliverables that are driven by the objectives of its program and organisational strategy [23].

[4]PMBOK is a body of knowledge from the Project Management Institute (PMI) that is commonly used across the world. In Europe Project Management is largely guided by the body of knowledge from the Association of Project Management Body of Knowledge (APM BoK).

The definitions of project portfolio management found in the literature are similar to the definitions found for project program management. There are scholars, such as Turner [33] and Poskela *et al* [34], who believe that there is little difference between program and portfolio management. These authors deduct their designations from their understanding that a program is a coherent group of projects that are managed in a coordinated way and contribute to a common, higher order objective. This school of thought is found again in Murray-Webster and Thiry definition that states that a program is "a collection of change actions purposefully grouped together to realize strategic benefits" [35]. The difference between a program and a portfolio, according to Turner, is that a program has common outputs whilst a portfolio involves grouping projects together that share common resources (common inputs) [33].

Dye et al. [30] focus on management when defining PPM as "the art and science of applying a set of knowledge, skills, tools, and techniques to a collection of projects in order to meet or exceed the needs and expectations of an organisation's investment strategy". Cooper et al. [36], who have researched the subjects of product innovation and new product portfolio management extensively, have incorporated the concepts found in the PMBOK into their definition of project portfolio management. Cooper et al. define in their many publications project portfolio management as follows:

"Project Portfolio Management (PPM) is a dynamic process where new projects are evaluated, selected and prioritized; and existing projects may be accelerated, killed or de-prioritized; and resources are allocated and re-allocated to active projects. The portfolio decision process is characterized by uncertain and changing information, dynamic opportunities, multiple goals and strategic considerations, interdependency among projects, and multiple decision-makers and locations." [36, p. 3] [37]

The PMI have identified that the difference between program or multi-project management and portfolio management lies in their approach to change, control and evaluation processes [38]. The difference between the program and portfolio management is also identified in the roles and responsibilities given to each discipline's manager. Portfolio managers need to ensure portfolio coordination and that stakeholders have access to reliable information, in the effort to optimise the organisation's outcomes. Program

managers are required to have the ability to improvise, deal with uncertainty and change, and align with the on-going business.

It should be noted that the components of a portfolio may not necessarily be interdependent or even related, however they have to be managed together to achieve the strategic objectives. Figure 2 shows the translation of corporate strategy into the business via portfolios, sub-portfolios, programs and multiple projects.

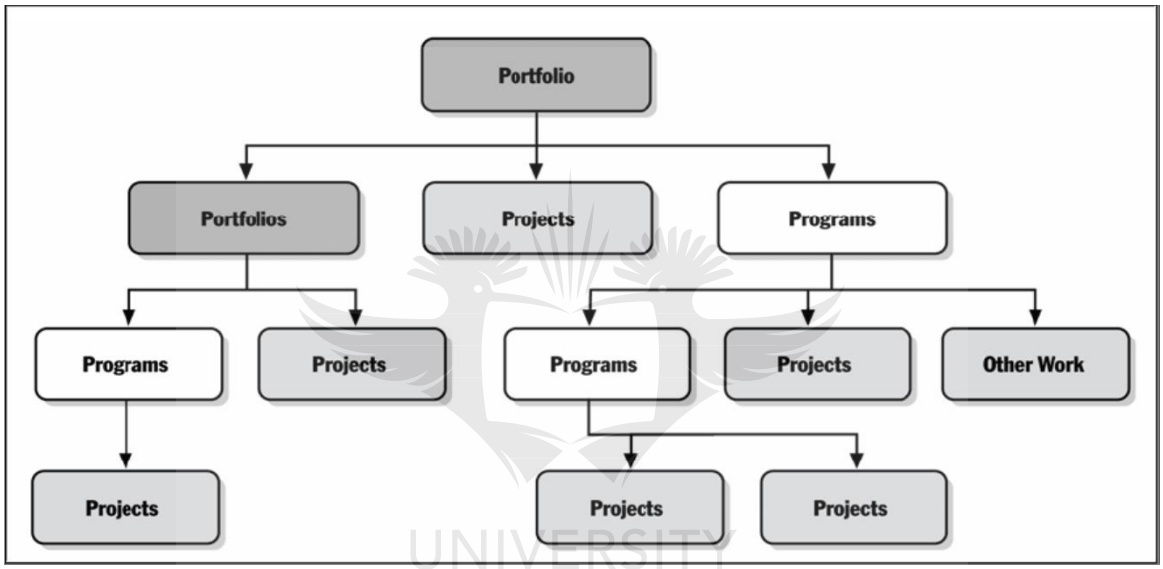

Figure 2: High Level View – How strategy is translated into the business [39, p. 5].

Projects portfolios provide organisations with information on individual projects, as well as the performance of the entire portfolio. Project Portfolio Management balances conflicting demands between programs and projects, allocates resources based on organisational priorities and capacity, and manages so as to achieve the benefits identified [23].

For organisations involved in the execution of projects, it is important that the right mix (balance) of projects is implemented. The key, therefore, is for multi-project organisations to focus on ensuring that different projects that are simultaneously undertaken are compatible, and have the same strategic approach [40]. A project portfolio should consist of projects that enable new product development and technology investment, and overall support the business strategy.

2.2.3 Strengths and weaknesses of PPM

In the recent past, portfolio management has gained attention amongst many organisations' senior management. Senior managers have realised that implementing portfolio management can enable their organisations to [36] [40]:

- Achieve maximum value of the portfolio thus improving the financial standing of the organisation;
- Maintain the business's competitive position;
- Focus the business and achieve a balanced portfolio by choosing and allocating the right resources for the long and short term and the high and low risks projects that are consistent with business goals;
- Provide greater objectivity in project selection. The aim is to pick the right number of projects for the limited resources available;
- Build strategy into the portfolio. The objective being to reflect organisational strategic priorities in the portfolio. This goal is attained by making explicit connection between shared strategic goals, investment decisions and the allocation of resources; and
- Communicate project priorities both vertically and horizontally within the organisation.

The lack of the project portfolio management (PPM) and prioritisation systems in an organisation can result in an implementation gap. This gap occurs when only top management understand the organisation's strategy while the middle management is not conversant with it. Middle management will pursue projects they perceive important and urgent to the organisation, which could be contradicting the strategy developed by top management. The conflicting interests between top and middle management result in strained relationships between the parties, and can lead to an inefficient use of valuable resources. Also, what happens frequently is that strategically relevant projects with low risk profile are viewed less urgent and hence are given low priority.

Another consequence of a poor PPM system is the selection of projects that have strong political and psychological pressures, but lack the ability to fulfil any of the goals of a project portfolio. In situations where resources are limited, unclear projects priorities can cause conflicts when each project requires resources for implementation. In most project environments, multitasking is common practice. In resource limited organisations, however, multitasking adds to project delays, costs and worker inefficiency [10]. The lack of effective project portfolio management and project selection criteria in an organisation is best illustrated in Figure 3 below:

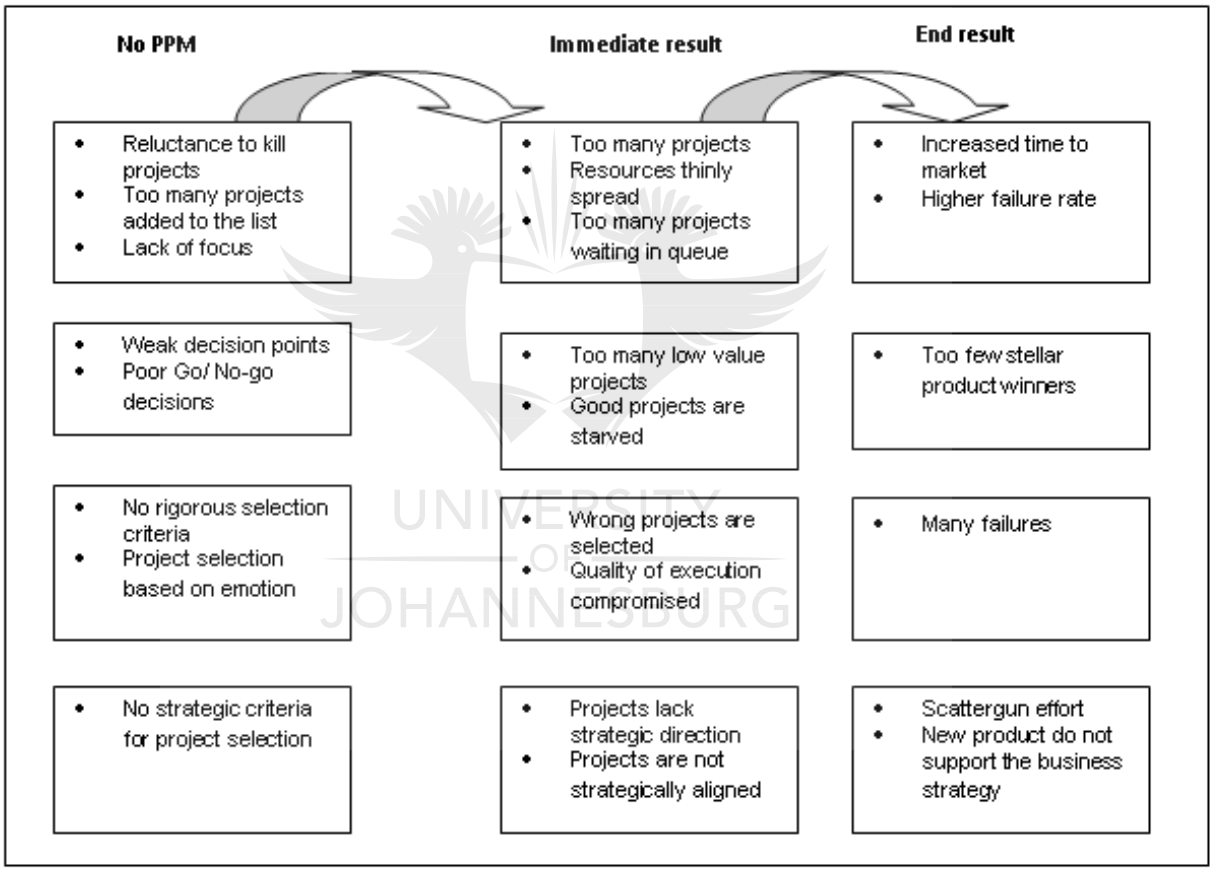

Figure 3: Consequences of no PPM in organisation [36, p. 5].

2.2.4 The PPM process

Project portfolios are usually managed by an organisation's steering committee. These steering committees typically comprise of senior managers, line managers, project portfolio managers, and project managers - who represent project teams and the customer at project portfolio level. The committee reviews the projects proposed, by internal and external stakeholders, and decide which ones to pursue. The projects selected are those that meet the most criteria set out by the steering committee; in most instances this criterion is established to fulfil a mix of organisational objectives.

The scope of PPM activities that the committee embarks on can be structured along three main and recursive phases; which are portfolio structuring, resource management and portfolio governance. Portfolio structuring entails the identification and categorisation of new and ongoing initiatives. These initiatives are then evaluated; using qualitative and quantitative methods, selected based on the set criteria, and prioritised.

The resource management phase entails the balancing of the key components of the portfolio. These components could be the desired risk profile, specific objectives, ROI, investment diversification and other components that the organisation has deemed important.

The portfolio governing phase should include timely reporting of relevant and reliable information to stakeholders. The long-term nature of a portfolio may require frequent portfolio rebalancing until a terminal date is reached. At each rebalancing period, new information is available to stakeholders. The stakeholder must react consistently to this new information, such that the objectives and constraints of the portfolio are matched. All these stages are shown in Figure 4.

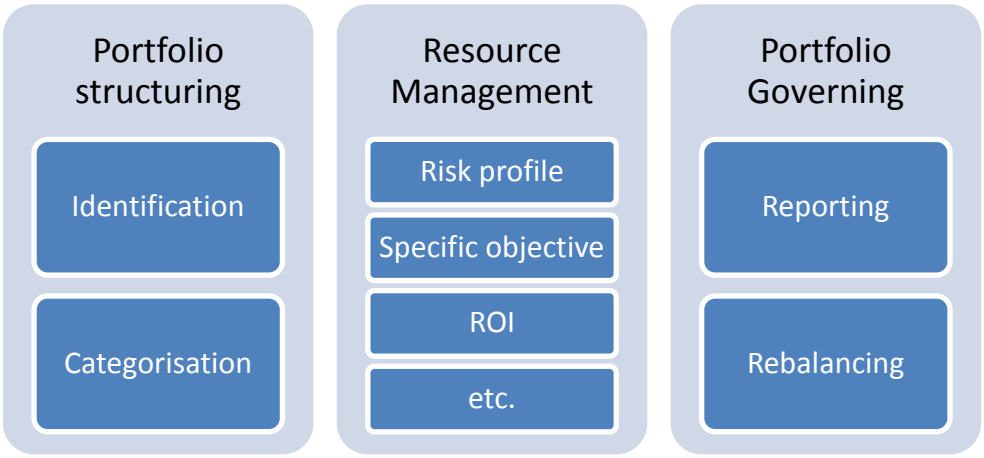

Figure 4: Project Portfolio Management Process.

2.2.5 Implementing PPM effectively

A structured approach is required for organisations to effectively implement PPM [22] [37]. Expanding on the process presented in 2.2.4 PPM can be presented as a funnel-shaped process; this is illustrated in Figure 5. Starting from an organisation's strategy, which needs to be translated into clear goals and objectives, a link must be established between the organisation's current portfolio of projects, programs and ideas and the strategy and objectives [41]. At this stage, it is also useful to capture and understand the current status of the running projects.

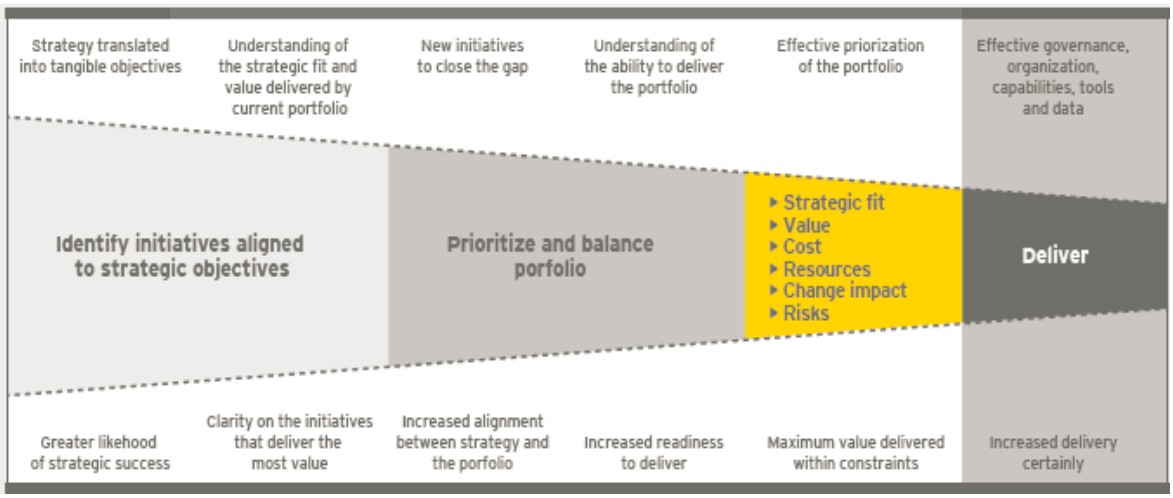

Figure 5: Funnel-shaped PPM process for effective PPM implementation [42].

The next step is to ensure the availability of the right resources to deliver the portfolio of change. This requires a detailed understanding of the human, financial, knowledge and physical resource constraints within the organisation. The availability of these constraints is company dependent and has no single formula, but it is clear that resource constraint is one of the major reasons for project overruns [41].

The final step is to establish the portfolio structures and governance framework. A single portfolio for all projects might ease the management and governance initiatives of the projects but most organisations divide projects and programmes into aligned clusters or portfolios to enable prioritisation and balancing of resource constraints across a portfolio that shares a common theme [20]. An organisation may implement portfolios to separate revenue-generating projects from initiatives that tackle any mandatory statutory or regulatory requirements.

2.2.6 PPM Methods

Various methods are available to organisations for project selection. These methods range from highly qualitative approaches to quantitative approaches. Most organisations rely on a combination of methods for selection and prioritisation of projects. Organisation utilise numerous decision models and have to establish a baseline model that will help them make the best decision considering the triple constraints. The popular and most frequently used PPM methods are discussed here below:

2.2.6.1 Financial methods

Common financial methods used for project selection approaches are the Net Present Value (NPV), Return on Investment (ROI), Internal Rate of Return (IRR), Discounted Payback period, and cash flow analysis. Cooper et al. [26] discovered that 77.3% of businesses surveyed use financial methods as the overall approach for project selection and prioritisation; and that 40.4% of businesses rely predominantly on financial methods to make project and portfolio selection decisions.

Financial models are based on the time value of money (TVM) principle. TVM principle states that provided 'a money' can earn interest; money is worth more now than the same amount received in the future. TVM principle simply states that when two almost identical projects A and B that earn the same x amount in two and in five years respectively are evaluated, project A would be the best choice as it will be worth more in two years than project B in five years' time.

There are businesses that use financial methods to rank projects against each other. The project's economic value is compared to an alternative's economic value, and the result is used to rank the projects on the selection list. Other businesses, although a small percentage, base their investment decision on a comparison of the internal rate of return (IRR) against the hurdle rate or minimum acceptable rate of return (MARR).

The hurdle rate is derived from the cost of capital, which takes into account the business's average cost of its debt, equity and a combination of the two. Research found that organisations that use both financial value ranking, and compare project value against the hurdle rate, achieve a slightly higher portfolio performance as compared to organisations that use one or the other approach or do not use any financial methods at all [37].

2.2.6.2 Scoring models

One of the most widely used methods for prioritising projects is using scoring models. Washington [43] has identified five uses of using scoring model in PPM, which are:

i) Project prioritisation - the most common use of scoring models. Projects are scored to establish their rank in the importance list, and consequently resources will be allocated to priority projects as per their rank.

ii) Project selection – projects are scored and ranked. Project ranked at the top are selected for the portfolio first, and the selection of projects continues through the subsequent ranks while considering the availability of resources.

iii) Portfolio optimisation – project scores can be used as inputs in optimisation calculation.

iv) Gate keepers – at project review meetings, projects' prioritisation scores can be evaluated against scoring hurdle to determine if they (projects) should be included in a portfolio, deferred or cancelled.

v) Scoring models can be used to build risk-value bubble charts. The total value scores and total risk scores are used as input data to plot the bubbles on the chart. Bubble charts provide visual presentation of data and if more data is available it can be displayed simultaneously on the chart.

2.3 Limitation to the existing PPM literature

The PPM body of knowledge highlights the importance of proper PPM methods to an organisation success as well as the consequences of ignoring it. This literature presents good practices for prioritising and selecting projects for a portfolio, mathematical models and techniques that will ensure the right mix of projects for a portfolio, and portfolio governance procedures. The research, however, falls short of showing practical application of these practices and techniques. These shortcomings are mostly evident when the application is in dynamic environments.

2.4 Risk and uncertainty in dynamic project environments

2.4.1 Dynamic environments

Organisations have to remain in cognisance of their relationships with their environment. Organisational theorists emphasise the importance for organisations to adapt to their environment for them to remain relevant and viable [44] [45]. In his 1972 paper, Duncan [45, p. 314] defines an environment as "*the totality of physical and social factors that are taken directly into consideration in the decision-making behaviour of individuals in the organisation*". By this definition, an organisation is affected by both the internal and external environment.

The internal environment consists of relevant physical and social factors within the boundaries of the organisations that influence decision-making behaviours [45]. The external environment consists of social and physical factors outside the boundaries of the organisation. Organisations tend to have no control on their external environments but they need to be able to respond and adapt to these external changes as early as possible.

External environments also present an organisation with opportunities and threats that can strengthen or weaken the organisation, respectively. Fitzroy and Hulbert [46] classify external environments into three levels; namely the remote environment, the industry environment, and the competitive environment. These external environments are also called operating environment. Pearce and Robinson [47] see competition as another subtype under the operating environment umbrella.

The operating environment does not only relate to competitors, but also the direct and indirect relationship with suppliers and business partners. Remote environments are the economic, social political, technological, and ecological factors in which organisations exist. This environment affects a majority of organisations. It is typically characterised by slow-moving trends such as maternity, mortality and culture.

The industry environment refers to factors affecting all competitors within a specific industry [46]. Common themes include barriers to entry, availability of common resources, and specific market regulations. The final type of external environment is the competitive

environment which covers the relationships with direct or indirect competitors and collaborators (such as suppliers and partners), distribution channels and the customers themselves.

Organisational theorists have well-established that many organisations face increasingly dynamic environments. Management within these organisations is concerned with finding ways to become agile in their response to evolving technological, political, and/or economic environments. Collyer et al. [48] recognised dynamism in the project environment as an increasing threat across all industries. This literature is of the view that:

- The dynamic, and uncertain, environments present projects with challenges that are yet to be addressed within the project management discipline [48], and
- Dynamism is a dimension of a project that represents the extent to which a project is influenced by changes in the environment in which it is conducted [49].

Given these notions, it can be concluded that a project is neither 'dynamic' nor 'static', but operates in environments characterised by constant change [49]. Some organisations have embraced change to be normal and relentless. Nevertheless, this punctuated equilibrium sometimes experiences a radical change lasting short durations [50]. Dynamic environments, combined with high complexities of an organisation, lead to increased uncertainty [45].

2.4.2 Risk versus uncertainty

Risk and uncertainty are ubiquitous and intrinsic in decision-making and hence receive considerable attention in the decision-making literature [51] [49] [52]. Some classical Project Management scholars of, and contributors to, capital investment decision-making literature use the terms risk and uncertainty interchangeably; however, it is important to differentiate between the two concepts. In Table 2, some of the definitions of risk and uncertainty are presented.

Table 2: Risk versus Uncertainty

AUTHORS	TERM	CONCEPTUALISATION
Anderson et al. (1981)	Uncertainty	A situation in which one has no knowledge about which of several states of nature has occurred or will occur.
	Uncertainty	A situation in which one knows only the probability of which several possible states of nature has occurred or will occur.
	Risk	Same as (1) and (2)
Harrison (1995)	Uncertainty	An uncommon state of nature characterised by the absence of any information related to a desired outcome.
	Risk	A common state or condition in decision-making characterised by the possession of incomplete information regarding a probabilistic outcome.
Holmes (1998)	Uncertainty	A situation where the decision-maker can identify each possible outcome, but does not have the information necessary to determine the probabilities of each of the possibilities.
	Risk	A situation which refers to a state where the decision-maker has sufficient information to determine the probability of each outcome occurring.

As much as risk and uncertainty differ at a fundamental level, risk is a consequence of uncertainty. Risk can be defined as a measurable uncertainty in contrast with non-measurable uncertainty. Risk can be identified and/or modelled; each outcome, or potential consequence, can be forecasted using probabilities. Therefore, risk is a product of two dimensions, which are *probability* and *consequence*. The basic mathematical expression of *risk* is therefore:

$$Risk = Probability \times Consequence$$

Uncertainty is a state of incomplete knowledge about a proposition. Garner [53], who is credited with making significant contributions to psychophysics, presents the notion that uncertainty has statistical nature. In his book called "*Uncertainty and Structure as Psychological Concept*", Garner estimates that the average amount of uncertainty, in an array of events with different probability of occurrence(p), can be determined by the expression:

$$\sum p \log_2 \frac{1}{p}.$$

Duncan [45] found three components that are common in the many definitions presented in Uncertainty literature. According to Duncan, uncertainty can be identified as:

i. The lack of information regarding environmental factors associated with a given decision-making situation;
ii. Not knowing the outcome of a specific decision and the impact it would have on the organisation; and
iii. The inability to assign probabilities with any degree of confidence with regards to how environmental factors are going to affect the success or failure of the decision unit in performing its function.

There are, therefore, two elements that are consistent with uncertainty, which are the *ambiguity* and *volatility* of dynamic environment.

Uncertainty and structural complexity are major contributors to the complexity of a project; thus, uncertainty can be considered as a dimension of a project [54]. In projects, uncertainty is about volatility (aleatory uncertainty) and ambiguity (epistemic uncertainty) [55]. Aleatory uncertainty is presumed to be a phenomenon of intrinsic randomness, characterised by a probability distribution function. An epistemic uncertainty is presumably caused by lack of crucial knowledge (or data), relevant to a project. The source of this knowledge deficiency could be the lack of understanding of a process or an

imprecise evaluation of the related characteristics; nonetheless this type of uncertainty is reducible [55] [56].

2.4.3 Uncertainty management in project management

Dynamic environments lead to uncertainty. Uncertainty management can be regarded as an extension of risk management that deviates from the concept of managing possible events towards the management of more general sources of uncertainty [19] [57]. Furthermore, Ward and Chapman [57] also state that "*Uncertainty management is not just about managing perceived threats, opportunities and their implications. […] It implies exploring and understanding the origins of project uncertainty before seeking to manage it, with no preconceptions about what is desirable or undesirable*". This statement can be disintegrated into multiple focus areas of project related uncertainty. These areas include the:

- Uncertainty due to the variability associated with estimates of project parameters such as time, funding and quality;
- Uncertainty about the basis of estimates of project parameters;
- Uncertainty in the process and logistics;
- Uncertainty about scope, objectives and priorities; and
- Uncertainty about fundamental relationships between project resources and stakeholders.

Similar to the sources of risk, sources of uncertainties can generally be classified under the following four broad categories [58]:

- **Technical uncertainties:** This includes issues that are related to the correctness and completeness of the underlying scientific knowledge or the technical specifications.
- **Market uncertainties:** This includes issues related to customer needs and wants in relation to the customers' interactions with the product, method of sales and distributions, the relationship to competitors' product, etc.

- **Organisational uncertainties:** It refers to the capabilities required to form the project team, the team's relationship with the rest of the organisation, and the levels of support from management.
- **Financial uncertainties:** It refers to access to funding for the projects including partnerships.

Some researchers have proposed a project management based typology for uncertainty [59], as follows:

- **Variations:** variations come from many small influences that yield a range of values on a particular activity. Project managers can still plan a complete project based on the sequence of tasks but the durations estimates might still vary. They are easily compensated using scheduling techniques like PERT [60]. Typically, these uncertainties fall under the umbrella of risk management.
- **Foreseen Uncertainty:** These are uncertainties that are identifiable and understood. This is analogous to risk.
- **Unforeseen Uncertainty:** These uncertainties are commonly known as unknown-unknowns. But often a consequence of the occurrence of many events, which might all be foreseeable.
- **Chaos:** Contrary to unforeseen uncertainty, which can start with reasonably stable assumptions, chaos projects do not. These projects could even have the basic structure of the project plan being uncertain, like when research (and not development) is the main goal. This is typical of projects that focus on disruptive technologies. These projects often end up with final results that are completely different from the original objective.

2.4.4 Uncertainty management

The presence of this uncertainty motivates the transition from the overly static conception that has dominated classical literature, towards a more dynamic approach. The execution of such a dynamic approach is no small feat as what seems to be a correct action at a given time may become a completely wrong action at the next because of the changing environment. It is therefore necessary to prepare the organisation to cope with the stress of

managing unexpected events [61] [57]. The work of Geraldi, Lee-Kelley and Kutsch provides three ways in which organisations can adapt to handle uncertainty, i.e. [57]:

- **At an organisational level:** organisations must take time to confirm decisions,
- **At group level:** stakeholders should negotiate with each other regarding different solutions,
- **At individual level:** organisations should have well-defined leadership, good teamwork, the necessary resources and expertise available at the right time.

Ward and Chapman define uncertainty as not only the *lack of certainty* but also the *ambiguity* associated with a lack of clarity, lack of data, lack of detail, lack of structure, known and unknown sources of bias, and ignorance about how much effort it is worth spending to clarify the situation [57]. Therefore, uncertainty management is not only a management of perceived threats or opportunities and their implications, but also the understanding of the possible cause and source of these uncertainties. Their conclusion is that project managers should emphasise uncertainty management more than just risk management.

Petit presents a conceptual framework that emphasises the operational processes needed in the management of project portfolios in dynamic environments [19]. The processes are labelled *sensing*, *seizing*, and *reconfiguring*. Sensing is the structures, tools and processes needed for the sensing, filtering and interpreting of changes and uncertainties [19]. Seizing comprises of the structures, tools and procedures for identifying the fact that changes are required once uncertainty has been sensed. Finally, reconfiguring is defined as the actions taken to ensure project alignment and resources with the changes identified by the sensing mechanisms and decided upon in seizing [19].

By acknowledging the frequent occurrence of unexpected events in project work, the organisation builds processes for adaptation to change in their corporate culture and strengthens the alignment of strategy and the external environment.

CHAPTER 3 Research methodology

3.1 Chapter objectives

Research is a systematic inquiry into a specific problem using scientific methods [62, p. 2] [63, p. 4] [64, p. 532] [65, p. 600]. It is defined by the research philosophy it subscribes to, the research strategy employed, and the research instruments utilised to achieve the objectives set and to find a solution to the problem. This chapter therefore, aims to:

- Discuss the philosophy this research subscribes to with respect to the other philosophies;
- Explain the research strategy employed; and
- Introduce the research instruments chosen for the study.

3.2 Research philosophy

Research philosophy describes the basis on which data should be gathered, analysed and used to achieve the research objectives and provides additional rationale for the selection of the methodology. Philosophies are analogous to different lenses which can be used to observe the same phenomenon. The main research philosophies found in literature are [66] [26]:

- **Positivism:** This method is the view that the world is ordered and regular. The main characteristic of positivism research is objectivity. This type of research aims to quantitatively measure, directly observe and envisage relationships between variables from an objective point of view [66].
- **Critical/Realist:** This method identifies and eliminates conflicts and power relations by postulating that the social world external to individual cognition is a real world consisting of hard, tangible and relatively immutable structures [66]. The aim of critical research is to emancipate research from conflicts.
- **Interpretivism:** The philosophy employed in this method is that the subject of interest should be studied in its natural environment [67] [68]. This research methodology focuses on work that has multiple interpretations. Even though there may be many interpretations of reality, the researcher acknowledges that those interpretations are in themselves part of the scientific knowledge there are in

pursuit of. Interprevist researchers believe that there is no single version of the truth regardless of whether or not the world is viewed as ordered and regular [66].

This research is therefore, placed in the positivist and interprevist categories. More precisely, considering the five paradigms (positivism, post-positivism, critical theories, constructivism, and participatory) proposed by Guba and Lincoln [14], this research would fall into the post-positivist category. This paradigm adds an important nuance to positivism by abandoning the dualism of positivism and focusing on finding correlations between phenomena and pre-existing knowledge. The interpretivism research philosophy on the hand accommodates multiple interpretations, which is required for this research as company project portfolio management methods are varied.

3.3 Research strategy

3.3.1 Research approach

Research approaches can be classified into two main categories, i.e. quantitative and qualitative. Quantitative research is used to quantify the problem by way of generating numerical data or data that can be transformed into useable statistics [26]. It is used to quantify attitudes, opinions, behaviours and other defined variables. These results are often generalised to a larger sample population.

Qualitative research is primarily exploratory research. It is used to gain an understanding of underlying reasons, opinions and motivations. It provides insights into the problem or helps to develop ideas or hypotheses for potential quantitative research [66]. This work uses qualitative research to uncover trends in project portfolio management and evaluate the effects of uncertainty on the management of project portfolios.

3.3.2 Research instruments

There are various types of instruments such as experiments, surveys, archival analysis, history and case studies [66] that can be used to conduct research. These options are based on similar principles which include, collecting and analysing data to obtain a specific result. According to Yin [25], the three main factors that require consideration for research

instrument selection are the type of research question to be investigated; the amount of control wielded by the researcher to manipulate the behavioural events to be investigated; and the degree of focus on contemporary versus historical events. The information presented in Table 3 can be utilised to select the appropriate instrument for the research.

Table 3: Viability of research methods for different situations [69]

Method	**Form Research Question**	**Method requiring control of behavioural events?**	**Method focuses on contemporary events?**
Experiment	How, why?	Yes	Yes
Survey	Who, what, where, how many, how much?	No	Yes
Archival Analysis	Who, what, where, how many, how much?	No	Yes/No
History	How, why?	No	No
Case Study	How, why?	No	Yes

The research questions are of explanatory nature and favour case study, history and experiment methods. The experiment method requires control of the environment and history method is used when there aren't any persons to provide a first-hand account of events. The researcher cannot manipulate the actual behaviour of the investigated events. Taking the research question and objectives stated in CHAPTER 1 of this dissertation the logical choice is to use the case study research method. An introduction into case study research and case study design are presented in the next sections.

3.4 Case study research methodology

Yin [25, p. 23] defines the case study method as "an empirical inquiry that investigates a contemporary phenomenon within its real-life context; when the boundaries between the phenomenon and context are not clearly evident; and in which multiple sources of evidence are used." The case study research method enables the researcher to closely examine the data within a specific context [70]. There are various categories of case study research, which include exploratory, descriptive, causal and explanatory [71] [70].

The exploratory research is considered to be the important part of any business strategy. This research design focuses on discovering ideas and insights instead of collecting statistically accurate data. The exploratory research design is used when there is uncertainty about or little research available on the subject matter [72] [73]. The descriptive research aims to better define an opinion or behaviour on a given subject. In this research design statistically accurate data is collected, from which a conclusion can be drawn [72] [73].

Casual research attempts to explain the cause and effect relationship between variables. It aims to understand 1) which variables are the cause, and which variables are the effect; and 2) the relationship of the two variables (i.e. cause and effect). The explanatory research is sometimes referred to as the analytical study. It examines the data closely, from which the researcher may form a theory that could be tested [74]. The most suitable and selected case study design chosen for this dissertation is the exploratory case study.

3.5 Case study research design

Case study research can be mistaken for preliminary research unless the research is well designed and scientific [75]. Conducting case study research should follow a logical and structured process. Yin [75] identified the steps that are to follow and illustrated in Figure 6, to be vital to the achievement of the case study objective:

- **Case study definition:** where the research plan is outlined and objectives defined.

- **Case study design:** the selection of one or more cases and protocol definition for data collection.
- **Data collection:** the collection of the actual evidence from the case or cases using all available sources.
- **Data evaluation:** evaluation and analysis of collected data.
- **Conclusion:** reporting and deriving conclusions from the data.

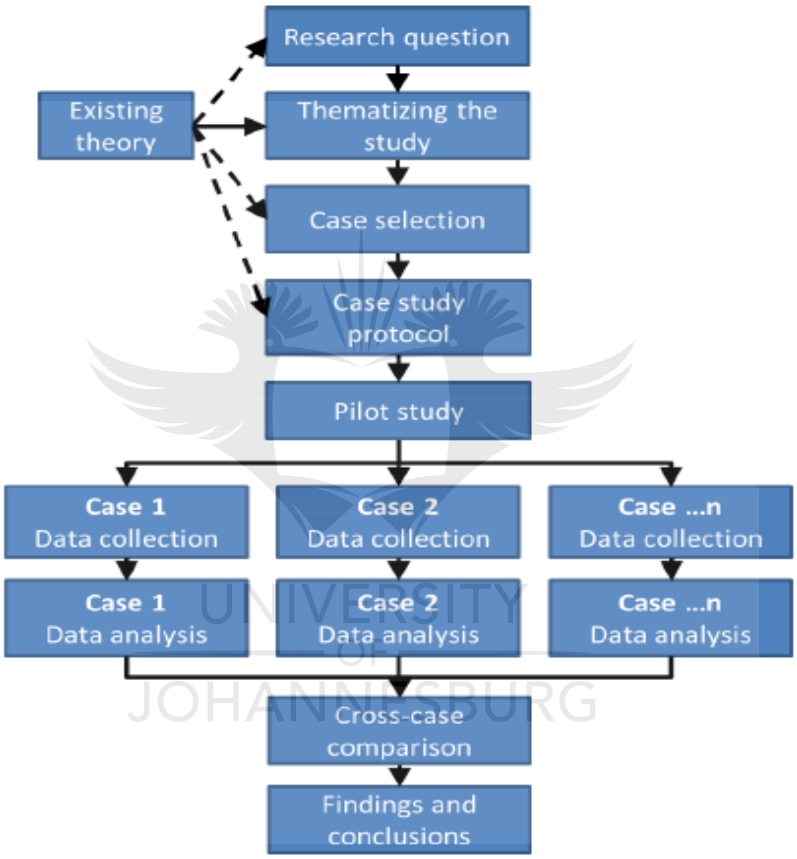

Figure 6: Case study research process for a multiple case design (adapted from [69] and [76]).

3.5.1 Case study definition

CHAPTER 3 RESEARCH METHODOLOGY

The process to define the case study entails posing the study question, making a proposition (if any), setting the unit of analysis, logically linking the data to the propositions, and setting the criteria for interpreting the findings [69].

i) Study Question

It is important to identify the question the case study aims to answer. The question will direct the researcher towards the '*case*' that should be studied. This dissertation sets out to answer the question:

How do organisations manage uncertainty affecting portfolios in a dynamic environment?

ii) Proposition

A proposition is a statement that helps direct the attention to specific aspects that should be examined in the case study [69]. For this research the proposition that is made is that:

Organisations do not apply project portfolio management best practices. If organisations applied project portfolio management best practices they would be in better positions to handle uncertainty. The best PPM practices include:

- *Using strategic methods that result in better alignment of projects in a portfolio with business strategy, and better spending of CAPEX in alignment with the strategy;*
- *Using financial methods to select high value projects for the portfolio; and*
- *Using scoring methods to prioritise projects and balance the portfolio*

iii) The unit of analysis

According to Yin [69] the unit of analysis defines what a "case" is in a case study. It is the major entity that you are analysing in your study. The unit of analysis for this research is *an organisation facing uncertainty.*

iv) Logically linking the data to the proposition

It is important to identify a method to best link the data to the proposition. This step is the least developed component of the case study. The methods that can be employed to perform this logic linking include pattern matching, explanations building, time-series analysis, and cross-case synthesis [69] [77]. The methods that have been identified as most suitable for this dissertation are pattern matching and the cross-case synthesis. These methods will also deal with the fifth component, which set the criteria for interpreting a study's finding.

3.5.2 Case study selection

When using the case study research approach the important question that always arises is the number of cases that will be studied [77]. A quantitative research requires a large number of cases to do an effective and valid statistical analysis. Although satisfactory qualitative study can be done using single case, multi-case studies presents many benefits to the qualitative research. Some of the benefits of using multiple cases in case study research are that a) multiple case study research is considered to yield more robustness to the conclusions of the study; b) they allow for cross-case comparison; and c) offer the possibility to directly replicate the study in another context [77] [25].

For a multi-case study Yin [66] suggests the use of three to four cases for literal replication; and four to six cases for theoretical replications. The use of Patton's [26, pp. 182-183] sixteen purposeful sampling strategies aids the process of replication, thus providing methodological framework in multi-case studies. This dissertation however, was limited to studying the portfolios of two organisations with different business objectives and strategies. The similarities with the two organisations lie in the fact that they are both capital-intensive businesses and are state-owned enterprises. The objective was to select two information-rich cases which satisfied the following criteria:

- The case study information is reliable and is from credible sources;
- The case should have adequate data so that a cross-case comparison can be made, thus maximising the potential of answering the research question;
- The organisation should exist in a dynamic environment with a moderate to high level of uncertainty;

- The organisation should have an established project portfolio management processes;
- The organisation should have matured level of project management.

Of the two cases to be studied, one was selected from the researcher's organisational environment. As recommended by Yin [69] [77], the researcher conducted an interview as a form of a pilot study to determine if the second organisation of interest presented a case suitable for the study. The second organisation chosen for this study satisfy the above criteria.

3.5.3 Designing data collection protocol

There are six possible sources of evidence for case studies, which are documents, archival records, interviews, questionnaires, direct observation, participant-observation, and physical objects [25, pp. 83; 85-96]. Data collection in case study research can be done using qualitative, quantitative or both methods [77] [69] [75]. It has been observed, however, that while quantitative data appears in case studies, qualitative data predominates [71, p. 60].

This dissertation was compiled through structured interviews, organisation's documentation, direct observation and a questionnaire. The questionnaire consisted of both quantitative and qualitative questions. The questionnaire is designed in such a way that in additions to the options given to the questions posed (closed-ended questions) the participants would have the freedom to express their views (open-ended questions). Purposive sampling, which is a non-probability sampling technique, was used for this study. Expert sampling of the population was selected in the interest of this qualitative study [70] [78].

3.5.4 Data evaluation and analysis

De Vos et al. [24, p. 397] define qualitative data analysis as *'the process of bringing order, structure and meaning to the mass of data'*. The order and structure can be achieved by reducing, organising, examining, categorising, tabulating, interpreting and substituting the collected data [25, p. 109] [79, p. 232]. The data collected for this research was analysed using the techniques mentioned here before.

3.6 Summary

This chapter presented the research philosophy, strategy and methodology that shall be used to conduct this study. This research was placed in the post-positivist and interpretivist categories. The case study methodology will be used as the instrument of the qualitative research that will be carried out to uncover trends in project portfolio management and evaluate the effects of uncertainty on the management of project portfolios. Two cases have been selected for the study. An open-ended questionnaire has been developed targeting an expert population. In the chapter that is to follow, the cases that have been selected for the study will be presented, and the results of the study will be analysed.

CHAPTER 4 Study findings and analysis

4.1 Chapter objectives

This chapter first describes the organisational context of the companies whose portfolios have been selected for the study; and thereafter the case identified in each portfolio is presented. The case descriptions aim to show why each case have been selected for this study. The main objective of the chapter is to present the findings for each investigation conducted, and to summarise the main findings by doing a cross-case synthesis.

4.2 Case study 1: Eskom Distribution – GOU Asset creation department

4.2.1 Brief background

Eskom is a state-owned South African national electricity providing enterprise with a mandate to provide this electricity in an efficient reliable and sustainable manner. The utility generates approximately 95% of the electricity used in South Africa (RSA) and approximately 45% of the electricity used in Africa [80]. Eskom also is involved in the commercial trading of electricity with neighbouring countries in the Southern African Development Community (SADC) [80].

Eskom contributes immensely to the South Africa's economic growth. The utility is seen as an economic enabler because through its capital investment programmes, it provides major stimuli for industrial development [81]. Eskom generates, transmits and distributes electricity to its customers. The organisation is therefore committed to acting in the national interest by actively partnering with the wider industry in resolving industry issues. Eskom has divisions that play significant and specific line functions to ensure that the strategic imperatives are fulfilled. The organisation spends its resources on operations and maintenance of the existing infrastructure (OPEX). The resources are also used for the creation of, and long-term investment in new assets (CAPEX).

The business unit of interest for this study is Eskom Distribution - Gauteng Operating Unit (Dx - GOU). This business unit has an established and functional Asset Creation department that uses projects and programs of work, and apply project and portfolio

management principles to implement the strategic plan of the division and consequently of the organisation. This Asset Creation department is responsible for:

- Providing a supervisory function, transparency, and control over the division's capital investments;
- Planning, development and execution of capital projects; and
- Ensuring that capital expansion programmes exist and are continuous.

The Asset Creation department is a matrix structure where functional managers are responsible for allocation of resources and the processes used to fulfil their respective roles in the projects. The projects that Asset Creation executes can be categorised as listed here below:

a) Direct Customer;
b) Land and Rights;
c) Reliability;
d) Refurbishment;
e) Strengthening; and
f) Split metering.

Each business category signifies a program in the portfolio. Gauteng Operating Unit is divided into four zones. Each zone has a project portfolio management office (PPMO) which, is managed by a portfolio manager at a middle management position. Program and project managers are assigned to the respective programs and projects from the feasibility study phase until the project has been handed over, finalised and close-out.

The project managers are responsible for planning, monitoring and controlling the projects under the supervision of the program manager. The program manager is equally responsible for the different projects' documentation, liaising with the functional line managers to allocate proper resources, reporting progress, and escalating project issues or risks to the portfolio manager.

The PPMO is a strategic project office responsible for mapping strategy to projects and monitoring project portfolios to ensure that they continue to address strategic initiatives of

the business unit and the organisation at large. The portfolio managers represent the project management community on the executive-level steering committee when decisions are taken on the opportunities the GOU would pursue. The business that Eskom and its divisions undertake is capital-intensive; hence project prioritisation and portfolio balancing are crucial to the sustenance of the business.

4.2.2 The case

Eskom and its divisions including Distribution - GOU have been using projects and programs of work to execute the strategic plan for a long time. Project selection, prioritisation, planning and execution methods have been repetitive in such a way that portfolio management is turned into a routine endeavour rather than a robust activity it ought to be drawn from the projects.

There are well-documented processes and procedures on managing portfolios and projects however, these processes and procedure are not followed to the fullest. Poor portfolio planning resulted in too many projects and less capacity and resources to execute them. This lack of capacity to execute the portfolio plan is evidence that there is a gap between the divisional executive management and the project management community.

Eskom is facing substantial financial sustainability challenges. The organisation applied to The National Energy Regulation of South Africa's (NERSA) for the approval of a tariff increase of 16% per annum; this application is referred to as Multi-Year Price Determination (MYPD3). NERSA however only approved an 8% tariff increase per annum instead of 16% per annum increase Eskom applied for. NERSA's decision created a financial gap of R225bn in the Eskom business. The CAPEX budget for MYPD3 is R251bn, which is less than the required capital to execute the total CAPEX portfolio.

This unforeseen funding set back impacted the entire organisation including the line divisions. The financial constraints highlighted the importance of spending the CAPEX budget on priority projects, necessitated a well-functioning PPMO, and the implementation

of the project life-cycle model in all departments of the organisation that are concerned with capital expenditure.

4.3 Case study 2: Company Y

4.3.1 Brief background of Company Y

Company Y is a state-owned company in the transport sector that has the mandate to provide a reliable service to the South Africa and surrounding countries. Its services are specialised and regulated by an international organisation that is part of the United Nations. This organisation has divisions that play significant and specific line functions to ensure that the strategic imperatives are fulfilled.

Company Y spends its resources on operations and maintenance of the existing infrastructure (OPEX), and the creation of new assets (CAPEX). The company's regulated business relies on mostly radio frequency technology infrastructure to fulfil the mandated services. These systems are key to increase capacity, efficiency and availability, and enhance safety to meet the requirements of every operator.

4.3.2 Asset creation in Company Y

Asset creation is done by a combination of departments as shown in the chart in Figure 7. The Procurement and PPM department plays a support and oversight role. The PPM department is still developing the processes that will allow it to correctly execute its role.

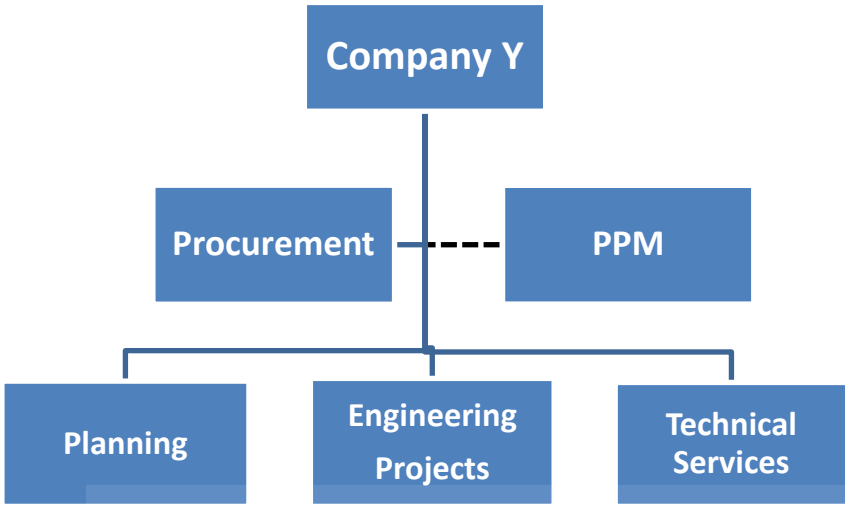

Figure 7: Company Y's Asset Creation Organogram.

The Planning department recommends projects for approval to be included in the portfolio. Once the portfolio is approved, the Planning department confirms the requirements with the user and begin the design. The output of the planning process is:

- The final user requirement statement document;
- The functional specification document that includes the technical feasibility analysis;
- Risk Analysis and environmental requirements; and
- Business case (including estimated cost breakdown, return on investment and business motivation).

The Project Engineering department is responsible for the:

- Driving of the tender process until the contract awarding (this is done together with Planning and Procurement departments);
- Systems Engineering lifecycle;
- Derivation and enforcement of the Project Management Plan;
- Factory acceptance test;
- Site acceptance test; and
- Handing over of the accepted asset to technical services.

The Technical Services department ensures that maintainability is considered throughout the project life and accepts the asset from the Engineering Project department. After project hand over the Technical Services department maintains the systems throughout its product life.

4.3.3 The case

Similar to Eskom, Company Y and its divisions use projects and programs to implement their strategic objectives. Their project selection process has a rigid structure. The Planning department is responsible for proposing projects that should be planned for a fixed five-year period (rolling plan). This plan is negotiated with the shareholder and the regulatory committee. The approved plan is officially reviewed in the third year of implementation to check the progress of the commitment and implementation; and the planning of the next five years period starts in the fourth year of the current plan.

At the beginning of each financial year, the projects that will be committed by the end of the financial year are confirmed and work begins. Commitment means that the planning and the tendering process has been completed and the contract has been signed with the selected supplier. Once the contract is signed, the Project Engineering department executes the project as agreed upon in the contract.

Changes to the current project portfolio (5-year rolling plan) occurred because of the addition of new strategic projects, legislative projects, projects caused by technology changes and risks. These projects added to the portfolio were approved up to board-level of the company but did not go through a formal portfolio re-prioritisation process. The company has well-documented processes and procedures for managing portfolios and projects however, these processes and procedure are rarely followed to the fullest. Poor portfolio planning resulted in too many projects and less capacity and resources to execute them. The many projects in a portfolio, while there was less capacity to execute them showed that there was a gap between the executive management and the rest of the project community.

The projects that are in the portfolio are negotiated with the shareholder and the regulator. The regulatory committee is made up of stakeholders from all over the industry. A large contingent is made up of the customers that use the services of Company Y. During the negotiation, the company also proposes the service level agreements, human resource requirements and tariff increase requirements. The tariff increase is dependent on a multitude of factors but a largely it is based on the projects that are commissioned or those that are arrayed in the portfolio.

Failure to implement projects has a negative influence in the company's standing with the customers, shareholder and regulator. Customers can go as far as to request rebates on tariffs and even a percentage decrease in tariffs, which has occurred in the current financial year and is forecasted to affect the subsequent fiscal year. Such requests have negative effects on the company's bottom line and consequently impede the company's ability to execute their business plan. The failure to implement the portfolio plan in full, which resulted in financial constraints, therefore, highlights the importance of spending the CAPEX budget on priority projects, compels for a well-functioning PPMO, and the implementation of the project life-cycle model in all departments of the organisation that are concerned with capital expenditure.

The company has recognised the importance of a well-functioning and resourced PPM office. Currently, the company's PPM process can be viewed as a bottom-up approach. The company is in the process of improving the PPM department to ensure that all projects follow a cyclic approach that is shown in Figure 8. In this approach, the PPM office will have a continuous portfolio analysis and prioritisation that allows it to react to any environmental changes that might occur. This structure allows projects in the risk register to be actively prioritised depending on the strategy, availability of resources, company image, and any other influence that comes up.

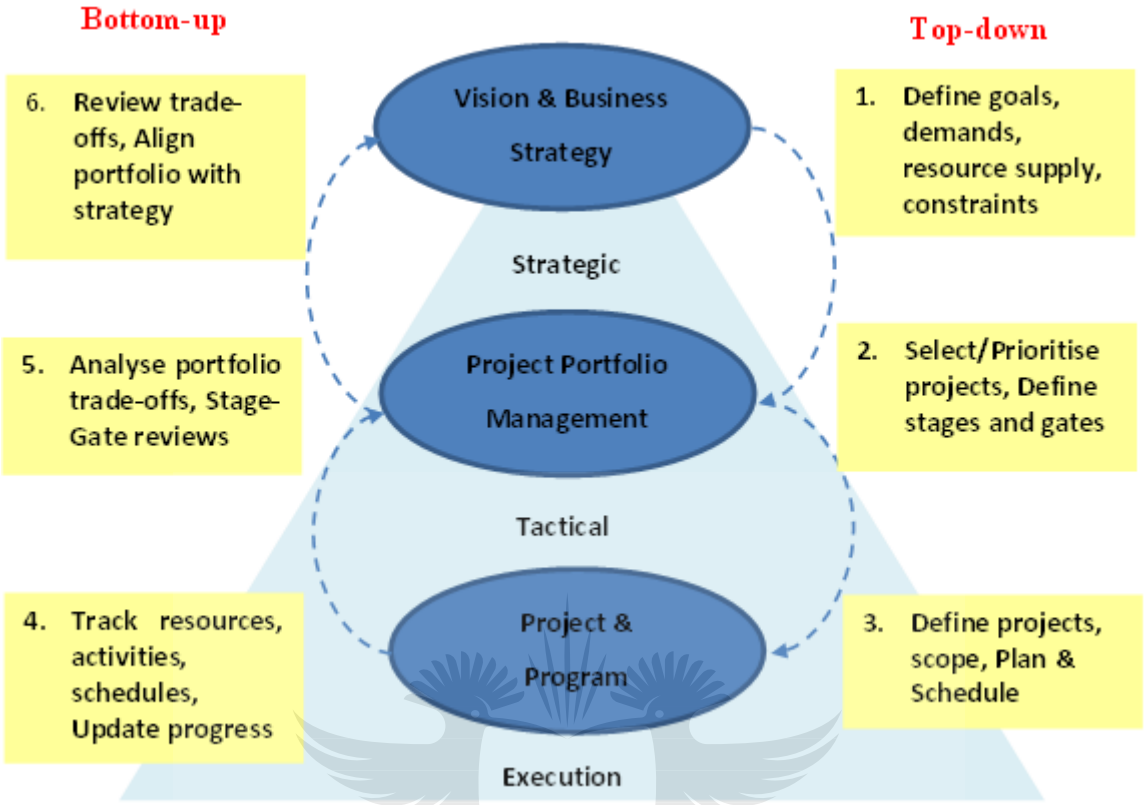

Figure 8: The proposed cyclic approach to PPM (obtained from Company Y strategic plan document).

4.4 Findings

The investigation focused on two main topics which are:

- The Effectiveness of Project Prioritisation Process in Uncertain Dynamic Environments; and
- Project Portfolio Management in Uncertain Dynamic Environments.

The analysis of the findings for each case will be presented with some citations from respondents in some instances. Even though all responses from the respondents are important, the determinant factor of citations and researcher's focus was on the quality of the answers, and not the quantity.

4.4.1 The effectiveness of project prioritisation process in uncertain dynamic environments

Project prioritisation is an important step in the project portfolio management process. It has become a focus area for many organisations which seek to optimise resources and maintain their competitive advantage [30]. Respondents were asked the following questions relating to project prioritisation in their work environments:

a) The use of prioritisation process to select capital projects?

The respondents from Eskom are familiar with the prioritisation process used in their organisation and their department; and they have participated in this process on many occasions. These respondents believe that prioritisation system employed is well-defined, serves the purpose it was created for, and should still be used in the department.

At Company Y, the respondents have participated in the prioritisation process. The respondents, however, disagree that the process was implemented as per process control manual prescribed for PPM. The prioritisation process is deemed important for the business and should be used; nevertheless, the process needs to be well-defined and structured to serve the purpose it is created for.

b) How effective is the prioritisation process to ensure organisation resources are spent in projects that support strategic plans?

The prioritisation process employed at Eskom is aligned to the corporate strategy. The process is effective to support the project and organisational objectives. Some respondents, however, are of the feeling that the process could be improved with regards to allocation of resources to projects. One respondent was concerned that:

Eskom, PM: *"The business and the prioritisation process have not taken into account that there is less skilled manpower in the division; some critical vacant positions have not been filled such as in Land Development department."*

The respondents at Eskom believe that senior management has the same understanding of, and is well-informed about the organisation's strategies as the rest of the Project

Management community. Senior management, middle management and the rest of the project management community have the same understanding that the projects that are selected and prioritised should support the organisation's strategies.

The prioritisation process at Company Y is aligned to the corporate strategy. According to the respondents, however, the implementation of the process does not support the allocation of limited resources where they are most needed. Some of the respondents believe that the prioritisation process is not effective to support the organisational strategies.

Respondents from Company Y have also identified an implementation gap that occurs when the senior management and the rest of the project management community have different knowledge and understanding of the organisation's strategies. There is no mutual understanding of the importance of the projects selected and prioritised in relation to the organisation's strategies.

c) Is the prioritisation process consistent to all capital projects?

The respondents from Eskom and from Company Y are aware and agree that some projects are not subjected to the prioritisation process. Projects such as those concerned with safety go to the top of the priority list and remain there until they are executed. In the case of Eskom other such projects that are prioritised higher than other projects are those projects that fulfil the strategic imperative of meeting an external customer's request.

At Company Y, although there would be a priority list for the five-year plan the balancing done at the beginning of each fiscal year determines the projects that will be committed by the end of the financial year, which disturb the priority list. There is, therefore, no consistency in the prioritisation of capital projects at Eskom and at Company Y.

d) In your opinion, how well is the prioritisation results communicated?

The respondents from both Eskom and Company Y indicated that prioritisation results are not adequately communicated to stakeholders. The respondents are familiar with the media through which results should come, which should be used to report these results timeously.

e) What is the main challenge with current capital project prioritisation process?

The respondents from Company Y find that there is a misalignment between prioritisation objectives and organisation investment strategy. The Eskom respondents, on the other hand, have identified different challenges with the current capital project prioritisation projects. Some respondents just like at Company Y find that there is a misalignment between prioritisation objectives and organisation investment strategy.

There are respondents that believe that the area of concern is in capital project planning and development that is often put on hold and which might lead to wasteful expenditure. There are those that have identified the challenge to be the inconsistency in the allocation of funding and resources to capital projects; those that found that decision-makers often delay in making capital investment decision; while other respondents believe the problem is that the priority list is not up to date. A summary of the responses from the respondents from the two organisations are tabled in Table 4.

Table 4: Summary of the main challenge with current project prioritisation process

Main Challenge with prioritisation process	Respondents from Eskom	Respondents from Company Y
Project Priority list and database not up to date.	X	
Delay in making capital projects investment decisions.	X	
Misalignment between prioritisation objectives and organisation investment strategy.	X	X
Capital project development and planning put on hold, which may result in wasteful expenditure.	X	
Allocation of funding and resources to capital projects initiative is not consistent.	X	

4.4.2 Project portfolio management in uncertain dynamic environments

a) Are you aware of any uncertainty that your organisation or business unit is facing? Has uncertainty impacted the business and the portfolio's project priority list?

Respondents from both organisations have acknowledged that their organisations and business units are facing uncertainty. All respondents were in a consensus that the funding shortfall was the major source of uncertainty, which resulted in budget cuts and initiatives to save and reduce wasteful expenditure. This uncertainty has had a great impact on project portfolios and priority lists. Projects were re-prioritised, and as a result some projects were deferred to later rolling plans while others were cancelled.

In addition to substantial financial sustainability challenges, one of the respondents recognised other sources of uncertainty at Eskom Distribution's Asset Creation to be:

- Acquisition of Servitudes;
- Environmental Authorisation;
- Resources to complete projects; and
- Poor execution of projects.

The responded explained that:

Eskom Planner: *"Prioritisation in a portfolio should be influence by 2 factors. The first factor (which is done by the project initiator) should quantify the business need based on the corporate strategy and the second factor (which should be done by the project executioner) should define the readiness to implement.*

When the portfolio is defined, the prioritisation should be influenced by both factors, i.e. the first will indicate highest priority in terms of need and the second will indicate the easiest to implement – i.e. Prioritisation = Need Priority × Implementation priority. The first factor is well defined as there is a defined methodology.

The second factor, which constitute of constraints like servitude availability, environmental authorisations, availability of material, contractors etc., is what is missing. Once the methodology for the second factor is defined and the means to combine the 2 factors is defined, it will make it much easier to manage portfolios in uncertain environments."

b) Does the prioritisation process need some adjustment in order to be efficient under current uncertain environment/conditions you identified

Half of Eskom's respondents believe there is no need to make any adjustment to the prioritisation process even under the uncertain conditions that the organisation is facing. The other half of the respondents believe that the uncertainty the organisation is facing advocates for an adjustment to the prioritisation process. The consensus at Company Y is that the prioritisation and the management of project portfolios need to be modified. The proposed cyclic approach to PPM can be seen in 4.3.3 of this dissertation.

c) How often is the portfolio rebalanced under normal conditions and under uncertain condition?

At Eskom the project portfolio is balanced quarterly. This frequency of re-balancing has not changed even under the uncertain conditions. At Company Y the project portfolio is re-balanced at the beginning of each financial year where a decision is made on the projects to pursue in that fiscal year within the 5-year priority plan. Just as it is a case at Eskom, the frequency of balancing the portfolio has not changed even under uncertainty.

d) What other aspects have changed in the management of project portfolios under uncertain environment

At Eskom some respondents have noticed that the re-prioritisation of projects due to uncertainty in the business have resulted in a delay in meeting the project objectives and executing the strategic plan. The business has put various methods in place to close financial gap that was created by the regulator's decision. Projects that have been prioritised have to undergo the processes of scrubbing and optimisation.

Company Y has embarked on a mission to set up a fully-functional project portfolio management office, and also change the PPM process controls (PCM). The unexpected funding constraints and the risks that resulted from the unexpected events highlighted to the organisation the need to change the management of the portfolio.

4.5 Summary of findings

The findings presented in Section 4.4 of this dissertation enabled the researcher to conduct a cross-case analysis to determine if a pattern could be deduced from the two cases studied. There is a difference in PPM maturity between Eskom and Company Y. Eskom asset creation department has a more mature PPM system as compared to that of Company Y. At Eskom, there is an established project/portfolio management office (PMO) that has been providing governance and other roles, although not adequately.

Eskom has been using financial methods to select high-value projects for the portfolio; however, the prioritisation of projects and balancing of the portfolio needs improvement. When Eskom was faced with uncertainty, decision makers saw the need to re-prioritise the projects in the portfolio and some projects were deferred and others were cancelled. The re-planning of the portfolio highlighted that strategy had not been used to drive a top-down allocation of resources and other deficiencies of the used prioritisation method.

Company Y requires a total review and improvement of the PPM practices employed in the organisation. There is an established methodology to select relevant and high value projects for a portfolio. The CAPEX spend of Company Y does not adequately align to the project priority list and portfolio plan. It would benefit the organisation if portfolio balancing is done more often than it is done currently. An increase in the portfolio balancing frequency may mitigate some of the uncertainty that results from the inclusion of projects that were not originally planned for during portfolio planning and project prioritisation.

There is a need for Company Y to use PPM methods to drive a top-down allocation of resources, which will result in a better alignment of a project portfolio to the business strategy. It is equally necessary for Company Y to establish a functional PMO office to provide governance and a central point for relevant and reliable project information, which will enable the organisation to fully benefit from the tools and resources at their employ, and close an implementation gap that occurs when the senior management and the rest of the project management community have different knowledge and understanding of the

organisation's strategies. The above fact emphases that the best PPM practices had not been employed at the two organisations that were selected for this study, thus they were not equipped to handle uncertainty.

CHAPTER 5 Conclusion and recommendations

5.1 Introduction

Organisations have acknowledged that project portfolio management is an essential business management tool that can enable their organisations to stand out and maintain their competitive edge, thus contribute to the entire organisation's success. Project portfolio management is the bridge between strategic development and strategic implementation [41]. The best project portfolio management strategies and process have been identified and documented in literature, however, for the benefits to be realised these documented processes and procedure should be efficiently implemented, monitored and controlled. The literature also shows that the Project Management ("to do things right") has to be complemented by Project Portfolio Management ("to do the right things") to ensure that organisations meet their strategic imperatives.

In Chapter 1 of this dissertation, the research problem was clearly defined and the research questions were posed. The research questions were then used to derive the research objectives. The research questions and objectives will be restated in this chapter.

Chapter 2 of this dissertation focused on providing a foundation of PPM and the best practices for implementation. The literature review chapter also introduced the concepts of uncertainty and dynamic environments, as well as their relation to project portfolios. The focus was to show the difference between risks and uncertainties and discuss their impact on effective project portfolio management. As discussed in Chapter 1, there is very limited literature on the management of uncertainty in Project and Portfolio management, which re-emphasises the requirement for this study.

Chapter 3 provides details on the common research methods used by project management researchers and a guide for selecting the correct method for this dissertation. The author then presented the selected research methodology and described the rationale for the use of case studies. Chapter 3 also revisited the research questions, identified the data relevant to

response to the research question, and discussed how the data was collected and analysed [28].

Chapter 4 introduced the case study research and gave the background of the organisations and the project portfolios chosen for this research. It described the collection of case study evidence and analysed the data discussed in the research design. Data patterns were derived from each case study, from which a cross-case study analysis was done.

The conclusion of the research, limitations of the study, and recommendations for future research will be presented in this final chapter. The relevance of the research questions in response to the purpose of the study will also be provided. The conclusion also shows the possibilities of testing the theory in practice and makes recommendations for future improvements.

5.2 Conclusions and recommendations

5.2.1 Conclusions

This dissertation aimed to answer the following question:

5.2.1.1 How do organisations manage uncertainty affecting portfolios in a dynamic environment?

The answer to this question required the problem statement to be broken down to research questions that will assist in responding to the questions.

(a) How should risks, unexpected events, and deviations (uncertainty) affecting project portfolios be managed?

Organisations cannot plan for uncertainty in the same manner as they would plan for risk. Based on the literature presented in Chapter 2, the case study findings and the analysis done in Chapter 4 of this mini dissertation, it is evident that a formal application of project portfolio management that incorporates best practices is imperative for project success and organisations' successful implementation of strategy. Organisations that have

a mature and optimised PPM system and are implementing the best PPM practices, are in a better position to manage uncertainty that they might face. To be able to continue to successfully implement the strategic plan, even in the presence of uncertainty, an optimal PPM system will regularly question if the right projects are being executed; if the organisation is investing in the right projects; and if the organisation has the right resources to be competitive.

(b) How do organisations manage uncertainty resulting from a changed project portfolios environment?

The two case studies, cross-case synthesis and pattern matching presented in Chapter 4 of this mini dissertation revealed that the absence of a mature PPM system, where best practices for portfolio management are implemented, results in the chaotic management of project portfolios facing uncertainty. The capital-intensive nature of the two organisations selected for this study and the dynamic environments they operate in demand for these organisations to have organised and mature PPM systems. The two organisations could also avoid technical, and procedural, uncertainty by devising a methodology to identify and manage this type of uncertainty before it has a negative impact on the project portfolios and their businesses.

5.2.2 Recommendations

The investigation looked at two organisations, which are both parastatals, which use CAPEX for asset creation. The study suggests a deeper investigation through the research of companies belonging to other states to increase and diversify the statistical sample size. It is recommended that a continuation of the study be done, 2-3 years from now, when the PPM office in Company Y is functioning accordingly to verify the findings. A decision for doing new research has to be supported by the management of Company Y to allow the researcher access to more information that was deemed private in this study.

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ANNEXTURE A Questionnaire

Evaluation of Project Portfolio Management in Uncertain Environments

1 Biographical Information and General Information

1.1 Biographical Information (Please indicate by making an **X** in the relevant column)

Gender	Male			Female				
Age (years)	Under 20		20 - 29		30 - 39			
	40 - 59		60+					
Highest Qualification	Diploma		Degree		Post Graduate		Other	

1.2 Type of Organisation

Private	1
Public	2
Parastatal	3
Non - Profit	4
Other (Please specify)	5

1.3 Position / Role / Job title (Please indicate by making an **X** in the relevant column)

Planning Engineer	1
Portfolio Manager	2
Project Coordinator	3
Project Engineer	4
Project Engineering Manager	5
Program Manager	6
Senior Manager	7
Consultant	8
Other (Please specify)	9

1.4 In which domain is your position? (Please mark only one with **X**)

Senior / Executive Management	1
Middle Management	2
Project Engineering Management	3
Project / Program Management	4
Planning / Business Development	5
Program Manager	6
Senior Manager	7
Consulting	8
Other (Please specify)	9

2 The Effectiveness of Project Prioritization Process in Uncertain Dynamic Environments

2.1 Considering the explanation given below have you participated in prioritization of (capital) projects in the last five years?

- **Project Prioritization:** It is a structured and consistent activity for defining which projects within a portfolio to initiate, which on-going projects to continue to fund, which projects to revamp, which projects to kill, and in what sequence. The aim of the prioritization process is to analyse the current operational environment, develop a scoring model, and apply that model to develop the execution order that ensures the highest efficiency of the overall portfolio. Ideally to manage the project pipeline optimal choices should be made at each stage of the project lifecycle.

Participation in Prioritization Process (number of times)	

2.2 How familiar are you with the prioritization process in your organisation or business unit?

	Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
I am familiar with my organisation's prioritization process and the related process control manual (PCM).	❑ 1	❑ 2	❑ 3	❑ 4

2.3 The use of prioritization process to select capital projects (Please answer the questions in the table below by selecting the most accurate option)

		Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
2.3.1	Does the prioritization system serve the purpose it was created for?	❑ 1	❑ 2	❑ 3	❑ 4
2.3.2	Should the prioritization system continue to be used?	❑ 1	❑ 2	❑ 3	❑ 4
2.3.3	The prioritization process is well defined and supports the selection of capital projects.	❑ 1	❑ 2	❑ 3	❑ 4

2.4 Are you familiar with the corporate strategy of your organisation?

Yes	1
No	2

2.5 How effective is the prioritization process to ensure organisation resources are spent in projects that support strategic plans?

		Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
2.5.1	The prioritization process is aligned to the corporate strategy	❑ 1	❑ 2	❑ 3	❑ 4

		Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
2.5.2	The prioritization process supports the allocation of limited resources needed to accomplish projects goals and objectives.	❑ 1	❑ 2	❑ 3	❑ 4
2.5.3	The prioritization process is effective to support organisational strategies.	❑ 1	❑ 2	❑ 3	❑ 4

2.6 Considering the difference between risk and uncertainty given below;

Risk: Risk is defined as unknowns that have measurable probabilities. It can be identified or modelled; each outcome or potential consequence can be forecasted using probability. If risk occurs, it will have a positive or negative effect on at least one of the objectives. Risk is a product of two dimensions, which are probability and consequence.

Example: If the project material is procured from an overseas supplier, there is a probability that the material might arrive later than expect. The potential consequence on the project can be forecasted, and therefore the response to the risk can be planned for.

Uncertainty: Uncertainty involves unknowns with no measurable probability of outcome. It is a state of incomplete knowledge about a proposition. There are two elements that are consistent with uncertainty, which are the ambiguity and volatility of dynamic environment. Uncertainty can be identified by:

i. The lack of information regarding the environmental factors associated with a given decision-making situation;
ii. Not knowing the outcome of a specific decision and the impact it would have on the organisation; and
iii. The inability to assign probabilities with any degree of confidence with regards to how environmental factors are going to affect the success or failure of the decision unit in performing its function.

Example: If the main project sponsor withdraws 50% of their funding to the project, the project might be cancelled because it could not have been predicted that 50% funding would be required while project is under way.

2.6.1 Are you aware of any uncertainty that your organisation or business unit is facing?

Yes (Please specify)	1
No	2

2.6.2 Has uncertainty impacted the business and the portfolio's project priority list?

Yes, uncertainty impacted the portfolio and priority list immensely. Projects were re-prioritised, some deferred and others cancelled.	1
Yes, however only minor adjustment were made to the portfolio and project priority list.	2
No, uncertainty has not impacted the portfolio and/or project priority list.	3
Project priority list was adjusted as a risk mitigation measure, not due to uncertainty.	4

2.6.3 Does the prioritization process need some adjustment in order to be efficient under current uncertain environment/conditions you identified in 2.6.1?

	Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
The prioritization process needs some adjustment under current uncertain conditions.	❑ 1	❑ 2	❑ 3	❑ 4

2.7 According to you is the prioritization process consistent to all capital projects?

	Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
The prioritization process is consistent to all capital projects.	❑ 1	❑ 2	❑ 3	❑ 4

2.8 What is the main challenge with current capital project prioritization process? (Please choose only one challenge)

Project Priority list and database not up to date.	1
Delay in making capital projects investment decisions.	2
Misalignment between prioritization objectives and organisation investment strategy.	3
Capital project development and planning put on hold, which may result in wasteful expenditure.	4
Allocation of funding and resources to capital projects initiative not consistent	5
Other (Please specify)	6

2.9 In your opinion, how well is the prioritization results communicated?

	Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
The prioritization results are well communicated to me.	❑ 1	❑ 2	❑ 3	❑ 4
I am familiar with the media used to communicate the prioritization results.	❑ 1	❑ 2	❑ 3	❑ 4

3 Project Portfolio Management in Uncertain Dynamic Environments

3.1 Do you think the senior management have the same understanding of, and are conversant with the organisation's strategies as the rest of the Project Management community particularly middle management?

Yes, senior management, middle management and project management community understand that the projects that are selected should support the organisations strategies.	1
No, senior management and middle management have different knowledge and understanding of the organisation's strategies, which result in an implementation gap.	2

3.2 Under normal conditions how often is the portfolio rebalanced?

At the beginning of each financial year	1
Once every 5 years	2
Quarterly	3
Other (Please specify)	4

3.3 Under current uncertain conditions how often has the portfolio been rebalanced?

Portfolio balancing frequency has not changed	1
Portfolio balancing has changed as follows: (Please specify)	2

3.4 What other aspects have changed in the management of project portfolios under uncertain environment?