Improved risk management processes for South African industrial ESCos

HPR Joubert
12611239

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Promoter: Dr JF van Rensburg

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ABSTRACT

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Author: Mr HPR Joubert
Supervisor: Dr JF van Rensburg

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In the past, South African energy service companies (ESCos) primarily implemented demand side management (DSM) projects, which were supported by Eskom Integrated Demand Management (IDM) funding models. With the introduction of new Eskom IDM performance-based funding models, more risk involved with implementing and sustaining DSM projects is moved to the ESCos.

Established and new ESCos need to adapt to manage the risk involved with the new funding models. Alternatively, ESCos can directly pursue DSM projects with funding from clients. Funding can be realised by using performance-based funding models, which are used successfully by ESCos in other countries. In both cases, South African ESCos (especially new ESCos) have limited experience with the processes required to implement and sustain DSM projects under a performance-based funding model.

In this study, a business model was developed for ESCos aspiring to implement DSM projects. The business model encapsulates improved processes that ESCos require to implement and sustain DSM projects, while managing the risk involved. To evaluate improvements made to risk management processes, a risk evaluation tool was also developed as part of the study.

As a case study, a South African ESCo was involved with the implementation and evaluation of the improved processes. This ESCo has implemented 129 projects over the past 12 years and has maintained a constant overperformance of 14% on promised savings. The ESCo has also implemented DSM projects on average 18% faster than their contracted deadlines. Where involved to revive and maintain neglected DSM projects, an average of 280% improvement in achieved cost savings was recorded.

By utilising risk management processes, the ESCo managed the increasing risk involved with DSM projects and maintained constant and successful performance. Senior project managers from the ESCo were asked to evaluate the improved processes using the newly developed risk evaluation tool. The interviewees perceived a 69% improvement in the risk management capabilities of the improved processes.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ABBREVIATIONS

Abbreviation	Description
B-BBEE	Broad-Based Black Economic Empowerment
BOQ	Bill of Quantities
CPr	Communication Process
DM	Decision Maker
DSM	Demand Side Management
EMS	Energy Management System
ESCo	Energy Service Company
IDM	Integrated Demand Management
IP	Intellectual Property
ISO	International Organization for Standardization
M&V	Measurement and Verification
M&V Pr	Measurement and Verification Process
MAD	Measurement and Acceptance Date
MPr	Meeting Process
NDA	Non-Disclosure Agreement
PDCA	Plan-Do-Check-Act
PE	Project Engineer
PM	Project Manager
PPr	Payment Process
QA	Quality Auditor
RFQ	Request for Quotation
ROI	Return on Investment
SANS	South African National Standards
SD&L	Skills Development and Localisation
SE	Simulation Expert
TOU	Time of Use

1

INTRODUCTION

Chapter 1: An introduction to the study, which discusses the problems that initiated the research and the contributions that resulted from the study.

CHAPTER 1: INTRODUCTION

1.1 Preamble

Energy service companies (ESCos) provide energy efficiency services and products that are used by clients in other industries to optimise energy indicators such as energy use, intensities and cost [1]. ESCos operate in countries across the world and in each country ESCos experience risks and challenges that need to be managed in order to be successful at managing energy use, intensities and cost [2].

Five of the leading risks that result in ESCos failing as businesses are [3]:

- The difference between estimated project paybacks and actual return on investment (ROI) – the result of being inexperienced in a new industry.
- ROI for investors is not proportionate to the risk involved with the project – profit margins on energy savings projects are small.
- An energy efficiency project has a long project development cycle and a high financing cost – new technologies in a new industry still need to be refined.
- Achieving proposed project savings has an extremely narrow margin of error – the number of risks involved when implementing energy savings projects increases the probability of something going wrong that will affect the proposed project savings negatively.
- Most countries do not have policies and laws that promote energy efficiency – unless law and regulations force other industries to be energy efficient, there is no reason to spend money on energy efficiency.

The US Department of Energy suggests that risk management is a key improvement area for ESCos [4]. Considering the nature of the challenges that ESCos face, improvements in cost, time, resource and quality management will result in less risk [2].

The nature and severity of the risks ESCos face are unique to each country's industries [2]. The challenges that South African ESCos face are mainly financing; lack of awareness and trust; low profit margins; and business and technical risk [2]. This study investigates the current processes that South African ESCos use to manage these and other issues. The goal of this study is to improve these processes to manage the risk to ESCos.

Eskom's Integrated Demand Management (IDM) division is the largest financier of demand side management (DSM) projects in South Africa. The South African industrial sector is the largest consumer of electricity in the country [5]. For this reason, the focus will be on the processes used to implement Eskom IDM-funded DSM projects in the industrial sector of South Africa. These processes will form a framework for the processes required to implement DSM projects.

In addition, Eskom announced that R1.7 billion is available to achieve 975 MW DSM savings in the 2015–2017 term [6], [7]. They are also motivating new and smaller ESCos to participate in DSM projects [7]. New ESCos are inexperienced with DSM and unfamiliar with the risks involved. It is clear that there is also a need for an ESCo business model to guide new ESCos when implementing DSM projects.

1.2 Demand side management

DSM is exactly what the term suggests – the management of energy on the demand side of the electric grid. The aim of the process is twofold:

- Energy efficiency reduces the load on the electric grid, which directly results in a decrease in electrical generation on the supply side. This has environmental and operational benefits where the electrical utility has supply limitations.
- A reduction in electrical usage directly results in a reduced electrical bill, which means that DSM projects have cost benefits to clients implementing these projects.

South Africa's power utility, Eskom, has been the main instigator of DSM and ESCo financing since 2004 [5]. As a result of inadequate planning, the country's growing electricity demand exceeded the utility's supply capacity. Eskom's total net maximum capacity in 2014 was 41 995 MW [8]. This is a mere 8% more than the normal high demand for the country [8]. Eskom admits that this is 7% lower than the international industry standard [9].

In an attempt to mitigate the issue, Eskom IDM started the DSM funding scheme for South African ESCos [5]. Eskom funds ESCos to achieve guaranteed energy savings on client sites. Eskom requires these savings so that its supply capability remains adequate until new electricity generation units go online.

Internationally, ESCos deal directly with clients when implementing DSM projects. If third-party investors are involved, they only benefit from the financing arrangement [10]. International power utilities do not finance DSM initiatives. The resulting energy savings from DSM projects are only for the client's benefit. The fact that Eskom as a power utility funds DSM is unique to South Africa.

1.3 Industrial electricity users

Recent tariff increases and new laws are forcing South African industries to become energy efficient [11]. This is good news for the ESCo industry, because larger industrial electricity users are becoming more aware of ESCos and their services.

Industrial users use 49% of all electricity that is generated in South Africa. As a group, they are the largest electrical consumer in the country [5]. It is thus clear that a significant impact on this sector will decrease the electrical demand noticeably. Figure 1 shows a breakdown of the country's electrical distribution [5].

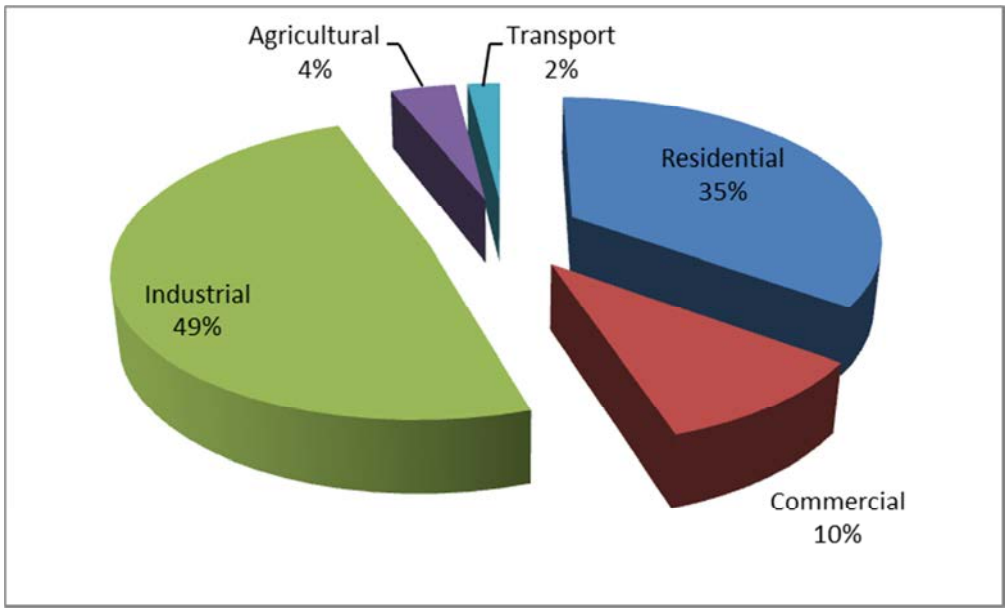

Figure 1: South Africa's electrical distribution

The Eskom IDM DSM programme has achieved 47 000 GWh savings from 2004–2014. Eskom says that 80% of this figure was contributed by industrial consumers [6]. The majority of DSM projects in the South African industrial sector are implemented on mines, process-line industries and pumping schemes [5].

1.4 ESCos in South Africa

The first ESCo in South Africa was founded in 1998. After the introduction of the Eskom IDM DSM fund, the South African ESCo industry was established in 2002 [5]. Although still growing, it is one of the smallest ESCo industries in the world [5], [12].

Since 2004 (when Eskom IDM officially launched DSM), Eskom IDM became the largest funder of DSM in South Africa [5]. The ESCo model for implementing an Eskom IDM-funded DSM project consist of project investigation and implementation [2], [13], [14]. Project maintenance was the responsibility of the clients who received the benefit of the project [15].

During middle 2015, Eskom introduced a new performance-based DSM model. While performance contracting was not new to South African ESCos, the new model adopted some of the aspects from the international standard for performance contracting, but with no benefit to the ESCos [16], [17]. This new model increased the risk to ESCos and in doing so, the need to be able to manage that risk.

The new Eskom IDM DSM model may inspire more ESCos to do projects with client funding instead of Eskom IDM funding. This is obviously an ideal situation for Eskom as they are currently paying clients to use less of their product, which is a bizarre business strategy. Eskom IDM is still the largest funder of DSM projects in South Africa. Thus, it stands to reason that their drastic change of the Eskom IDM DSM model may hurt a lot of ESCos and the ESCo industry in South Africa [5].

Of the more than 500 ESCos that are registered with Eskom, only 50 are still active. Considering that only three of the active ESCo received contracts for industrial projects during the contract placement round in September 2015, it is clear that there is a need to help ESCos develop [2]. Risk management forms part of developing ESCos to do Eskom IDM DSM projects or even traditional DSM projects in line with international methods.

1.5 ESCo risk management

The risk ESCos face can be classified in five categories [4], [18]:

- Economic risk;
- Contextual risk;
- Technology risk;
- Operation risk; and
- Measurement and verification (M&V) risk.

Independent studies confirmed that the risks that South African ESCos experience align with these categories [5], [12].

Upon investigation, it was found that South African ESCos do not use formal risk management guidelines to manage risk. Instead, a trial-and-error format is used to improve on risk management through lessons learned. This approach worked for previous Eskom IDM DSM models and valuable lessons were learned – these lessons are applied in this study. However, as the Eskom IDM DSM model is changing and the risks for South African ESCos are increasing, a trial-and-error approach cannot be followed any longer.

There is no formal guideline that new and upcoming ESCos, who do not have experience in the industry, can use to manage risk while implementing DSM projects.

1.6 Risk management in other industries

There are various risk management standards that are used in other industries – all with their own merits depending on the industry [19]. Risk management is thus industry-dependent. In addition, risk is perceived to be the perception of the risk-taker [20]. Thus, the risk-taker's perception classifies the risk and the severity thereof.

This is why risk management is not a set of rules, but rather a guideline. Risk management guidelines, such as the International Organization for Standardization (ISO) 31000 guideline, are used to assist when formulating processes that can be used to manage risk [21]. These processes ultimately form part of an industry's business model [22]. Thus, managing the risk of an industry or business requires processes that are designed for risk management.

1.7 Contributions of this study

A unique ESCo business model to implement DSM projects

South African ESCos usually implement existing technologies to achieve energy savings. As a result, these ESCos also do business as suppliers, consultants, contractors and/or metering services. This leads to business models being employed that are designed for those industries and not specifically for ESCos. Resource allocation within these business models is not always aligned with efficient ESCo processes. There are no published ESCo-specific business models available for South African ESCos.

This study contributes a unique business model for South African ESCos. It focuses on the required processes to implement Eskom IDM DSM projects and the resources required to do so. The skills and responsibilities required by the resources are listed for each of the improved processes. The general structure of these processes forms a business model that can be tailored to ESCos implementing DSM projects outside of the Eskom IDM framework.

Formulating a new internal process to manage DSM project M&V

It was found that M&V requirements coincide with DSM project steps. If M&V requests and milestones are delayed, the entire DSM project is delayed. ESCos, especially new ESCos, are unfamiliar with the M&V process and have no procedures in place to manage it. A “wait-and-see” approach is usually implemented that leads to random results.

In this study, an internal M&V process is formulated to manage M&V requirements and key milestones proactively. The internal ESCo M&V process focuses on streamlining M&V outcomes by preparing for M&V requests as project milestones are reached.

Improved risk management processes for implementation of DSM projects

There is a need to define processes that enable South African ESCos to manage their risks when implementing DSM projects. Setbacks such as unexpected financial overheads, irregular contract placement and inexperience when working with various industrial clients cause setbacks from which some ESCos cannot recover.

Variations of the processes are applied, but these processes have not been designed specifically for ESCos to implement DSM projects in the industrial sector. It was found that previous research did not focus on risk management, but it did lay a foundation from where a risk analysis approach could be formulated.

As part of this study, risk management processes for the following project requirements are developed/improved:

- Conducting investigations during the project investigation phase.
- Managing a project proposal.
- Managing contracts and role players involved during contract placement.
- Procuring the project scope.
- Placing sub-contractor orders.
- Managing the project implementation.
- Managing client and contractor payments.
- Managing commissioning, training and project handover.
- Optimising project savings during the project performance assessment phase.

A new process to maintain the sustainability of an implemented DSM project

Some of the Eskom IDM project savings decrease after the ESCos withdraw at the end of their contracts. A lack of interest from the client and improper training by ESCos lead to implemented technologies being underutilised. This results in neglected projects and project savings. Senior managers at the client are not always aware of missed opportunities resulting from neglected projects.

In this study, a process is formulated that manages the sustainability of implemented DSM projects. It focuses on post-implementation reporting and project monitoring.

A new quality management process to ensure process compliance

There are variations of project quality processes, but these are not followed. Eskom IDM contractual requirements stipulate that ESCos must be ISO 9001 compliant. Being compliant – as opposed to being certified – means that the quality process is not optimised to govern the project implementation processes efficiently.

In this study, a quality management process, which is based on ISO 9001, is developed to ensure quality compliance of the project management processes.

Formulating a new risk quantification tool to evaluate ESCo processes

It is difficult to identify the effectiveness of a process in terms of risk mitigation. In most cases, the potential of a new process can only be evaluated after the implementation thereof.

During this study, a risk quantification tool is developed to measure the perceived risks of the improved processes. The tool generates a score that is calculated using process components as variables. This is a unique method for achieving measurable improvement in risk mitigation processes.

1.8 Overview of chapters

Chapter 2 and **Chapter 3** describe literature pertaining respectively to information about the ESCos' environments and the technical requirements that ESCos face. As mentioned, the focus of the study is on South African ESCos implementing Eskom IDM-funded DSM projects on industrial client sites. The literature considers both old and new DSM models and the risks faced by ESCos at present.

Chapter 4 lists the methodology of the study in the form of improved processes to manage the risks that ESCos face. The process details and improvements are listed with each process.

Chapter 5 is a compilation and discussion of the results obtained from interviewing experts in the ESCo industry. The old and improved processes were presented to the experts who used the newly developed quantification tool to score the improved process. The success of the ESCo processes were tested – these are also discussed and analysed.

Chapter 6 is the conclusion of the study where the final results and success of the study are discussed. This chapter concludes with recommendations for future work.

2

THE INDUSTRIAL ESCO ENVIRONMENT

Chapter 2: This chapter discusses the business and management aspects of DSM projects that an ESCo may encounter.

CHAPTER 2: THE INDUSTRIAL ESCO ENVIRONMENT

2.1 Introduction

The focus of this study is managing an ESCo's risk when implementing industrial-type DSM projects. Since Eskom IDM is the largest funder of DSM projects in South Africa, the project phases and processes required to do these DSM projects were investigated [5]. The lessons learned through experience form the groundwork to improve the processes for DSM projects.

Of the 500 registered ESCos with Eskom, only 50 are still active [2]. This is largely due to the risk involved when implementing DSM projects. Some of the challenges experienced by ESCos include [2]:

- Client distrust, which complicates investigations;
- Complex procurement rules, which complicates proposal approval;
- Lack of energy awareness by the client, which complicates implementation and savings sustainability;
- Perceived business and technical risks, which are the result of financing and experience issues; and
- Small projects versus high implementation costs, which result in small profit margins.

All of these issues have the potential to terminate a project or even result in the liquidation of an ESCo who does not have the experience to mitigate these issues. These issues are investigated as part of the literature survey.

2.2 Project funding options

Funding is the most crucial aspect of a project. Without funding, an ESCo cannot participate in any phase of the project process. Internationally, the two most popular performance-based DSM funding models are [10], [23], [24]:

- The shared savings model, and
- The guaranteed savings model.

Figure 2 shows a graphical representation of the shared savings model [25]. The norm is for an ESCo to finance a project and then claim an agreed percentage from the resulting cost savings for an agreed period after implementation of the project. Thus, an ESCo is rewarded for overperformance.

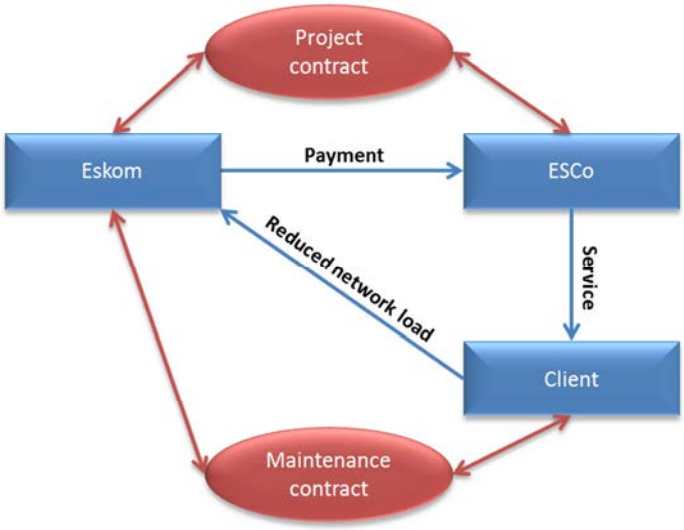

Figure 2: Shared savings model

Figure 3 shows a graphical representation of the guaranteed savings model [25]. With this model, the ESCo guarantees a proposed saving and the client pays for the saving. In some cases, savings achieved from overperformance are shared between the client and the ESCo. Again, ESCos are rewarded for overperformance.

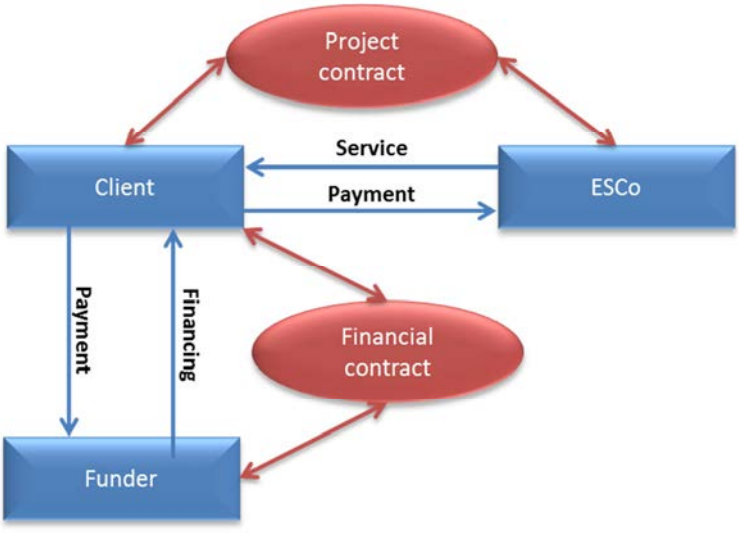

Figure 3: Guaranteed savings model

For more than a decade, Eskom IDM used a project-based model that contractually bound the ESCos to projects until performance assessment was completed. Eskom IDM labelled this funding model the “ESCo-funding model” [26]. The focus of this study is on

industrial-type projects with savings exceeding 1 MW. For this purpose, the Eskom IDM ESCo-funding model is relevant [27], [28].

Once a project was implemented and assessed, it was handed over to the client for maintenance. This uniquely South African model worked well for two reasons [13], [29]:

- Eskom needed to reduce the load on the national grid, and
- The clients needed relief from increasing energy tariffs.

Figure 4 shows a graphical representation of this of this Eskom ESCo-funding model, which is a project-based model.

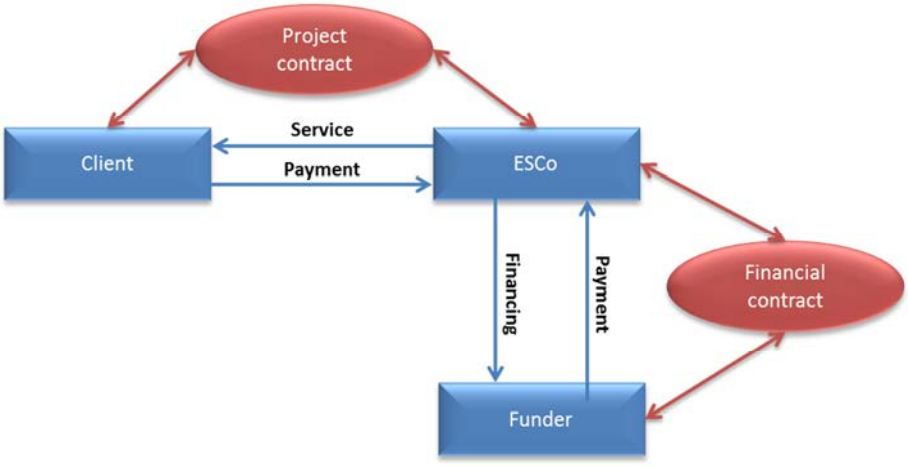

Figure 4: Eskom ESCo-funding model

Table 1 compares an ESCo's advantages and risks for each model. Although ESCos were not compensated for overperformance with the Eskom IDM ESCo-funding model, an ESCo's exposure to risk was limited to the implementation and assessment periods of the project.

Table 1: Comparison of funding models

Funding model	ESCo risk	ESCo advantage	Maintenance
Shared savings	ESCo finances the project.	ESCo receives an agreed percentage of cost saving realised. Overperformance is rewarded.	Yes. For a predetermined period.
Guaranteed savings	ESCo assumes performance risk.	ESCo receives an agreed percentage of cost saving realised above target saving. Overperformance rewarded.	Yes. For a predetermined period.

Funding model	ESCo risk	ESCo advantage	Maintenance
Eskom ESCo-funding model (2003–2014)	ESCo assumes performance risk.	No financial risk as long as performance during assessment is above 90% of the target savings.	No.

2.3 Eskom DSM role players

The four main role players involved with Eskom-funded DSM in South Africa are [17], [30]:

- Eskom IDM;
- ESCos;
- Clients; and
- M&V teams.

A fifth role player could be third-party sub-contractors whose expertise an ESCo may require. Each of the role players are discussed in the following sections.

2.3.1 Eskom IDM

Eskom IDM is responsible for evaluating and awarding ESCo project contracts [17]. As mentioned, Eskom IDM has been the largest funder of DSM projects in South Africa over the past decade to mitigate the stress on their supply capacity resulting from the country's growing demand. In addition, Eskom used DSM to reduce the average cost of generating electricity and utilise their resources better [31].

2.3.2 South African ESCos

South African ESCos must be registered with the Southern African Association of Energy Engineers (SAEE) and the South African National Energy Development Institute (SANEDI) to conduct work as an ESCo outside of the Eskom environment [2], [32]. However, ESCos only need to be registered with Eskom IDM to participate in the Eskom IDM DSM programme [2].

In South Africa, 25% of all ESCo work is conducted in the industrial sector [12]. This figure is only topped by the 35% ESCo involvement with municipalities. However, municipalities include an array of sectors that cannot be defined individually. Thus, it

can be assumed that the industrial sector is the largest single market for DSM project implementation. Figure 5 shows the market distribution of ESCos in South Africa.

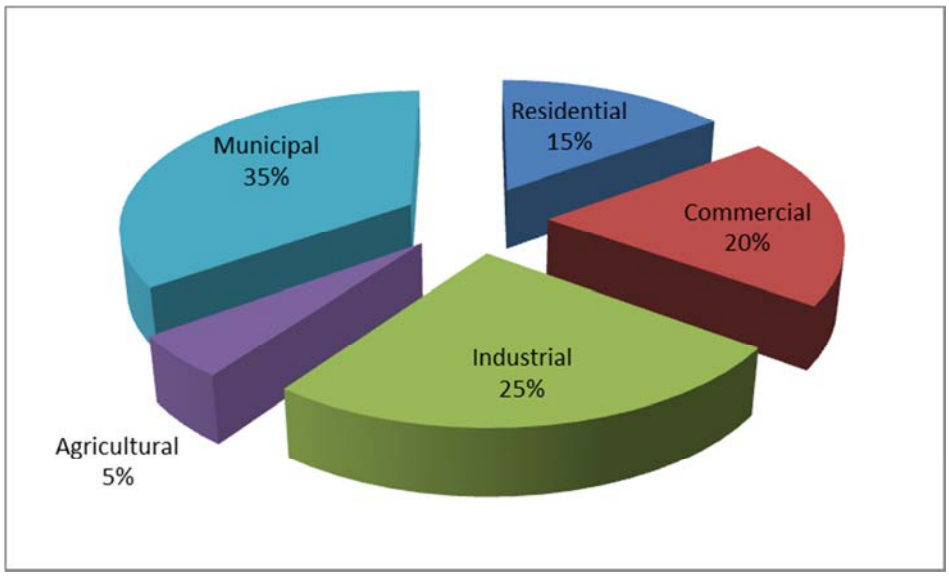

Figure 5: ESCo market distribution

South African ESCos usually implement existing technologies to achieve energy savings. As a result, these ESCos also do business as suppliers, consultants, contractors and/or metering services [2]. Ultimately, ESCos are responsible for the investigation, implementation, performance and maintenance of DSM projects [17].

2.3.3 Clients

In South Africa, industrial clients are mainly:

- Mines;
- Process-line industries; and
- Water utilities.

These clients have the most potential for load management and efficiency opportunities. Experience showed that pumping systems in particular have been targeted for load management opportunities. Work conducted on compressed air systems and industrial cooling systems has been successful with efficiency solutions. Process lines in the gold and cement industries have also been successfully load managed. Experience shows that projects with these clients have a minimum target saving of 1 MW.

There are opportunities to improve efficiency because inefficient equipment was installed in earlier years when electricity was cheap. In addition, opportunities were also found where clients are understaffed. A common problem across the world is that energy

management is not the top priority when the primary focus is on optimising production outputs. However, creating awareness among these clients resulted in savings [33], [34].

2.3.4 M&V teams

For DSM projects, it is the responsibility of M&V teams to do independent measurement and reporting. In short, the M&V teams audit and report the claims and performances of ESCos [35].

2.3.5 Third-party contractors

Third-party contractors usually assist with hardware installations and supply where ESCos lack skills, knowledge, resources and/or time. Typically, these contractors have the mechanical, electrical and/or instrumentation skills and knowledge that are required.

2.4 Regulatory compliance

Eskom is a government-owned entity and as a result, government initiatives are forced onto contractors who wish to do work for the utility. Skills development and localisation (SD&L) and broad-based black economic empowerment (B-BBEE) form a standard part of the regulatory compliance that Eskom includes in their project contracts.

The compliance requirements may not be compulsory with other client/funders. However, it is considered and discussed since the Eskom model is used as a framework for this study.

2.4.1 Skills development and localisation

SD&L is unique to South Africa. Introduced in 2012, it forces ESCos to develop the skills of South African individuals by training and employing them [36]. Localisation requires companies to use locally developed equipment, instruments, experience etc. to support South African companies [36].

As a standard, SD&L requirements form part of Eskom contracts. The requirements are unique to each contract and are negotiated with the ESCo. Retentions on an ESCo's funding motivate the ESCO to complete the SD&L commitments successfully. The influence SD&L requirements have on an ESCo's cash flow is a risk that needs to be managed.

2.4.2 Broad-based black economic empowerment

The B-BBEE Act was first published in 2003. The objective of the Act was to advance and enhance economic transformation and participation of black people in the South African economy [37]. Government-owned institutions such as Eskom enforce B-BBEE [38]. Eskom requires ESCos to have valid B-BBEE certificates before projects will be considered [39]. This will be the case with any government-owned entity.

Recent studies and articles showed that B-BBEE negatively affects the key aspects of South African businesses [40], [41], [42]. Some of the business aspects that are affected included financial performance, product quality, productivity and service excellence. These are all key features in the business of ESCos [40]. The risk management process that was improved in this study also manages the adverse effects that B-BBEE has on an ESCo's business.

2.5 Old DSM model phases

This study investigates the processes and business model used by an ESCo, who successfully implemented over a 100 Eskom IDM DSM projects. Lessons learned by this ESCo are considered during the investigation.

ESCos perceived the previous Eskom IDM DSM model as a project-based approach due to the project-type phases of the model. Since the start of the Eskom IDM DSM programme up to middle 2015, the project phases for a DSM project were [2], [13], [14]:

a) Investigation phase;
b) Proposal phase;
c) Implementation phase; and
d) Performance assessment phase.

Project maintenance was the responsibility of the clients and they were obligated to maintain projects according to their Eskom IDM DSM contracts. The processes used during the period from 2003–2014 are referred to as the old processes and models.

2.5.1 Investigation phase

Experience showed that the old investigation phase had two goals:

- Find potential clients; and
- Find new project opportunities.

The requirements for marketing, and the content of the meetings with potential clients were defined through experience. Clients were introduced to DSM and all of the ESCo's technologies and services at first contact. Unfortunately, due to poor documentation, in a few cases this approach led to clients stealing the ESCo's intellectual property (IP) and implementing the initiative themselves. This resulted in the ESCo receiving no ROI during the development of a product and/or service required to achieve energy savings.

As part of the investigation, it was found that initial DSM projects that were implemented either grossly overperformed or that they underperformed. This was due to the ESCo being inexperienced in project simulation and project validation. The ESCo either lost potential funding, because Eskom IDM does not reward overperformance, or it faced penalties as a result of the underperformance.

Time was also wasted by revisits because the initial investigations were incomplete. Improper documentation resulted in work that required redoing due to inadequate or lost information. This also complicated the drafting of the findings reports and project proposal documents.

Project validation and quality improvements to documentation are required. The old project investigation phase is shown in Figure 6. The processes in red indicate where risk management is required.

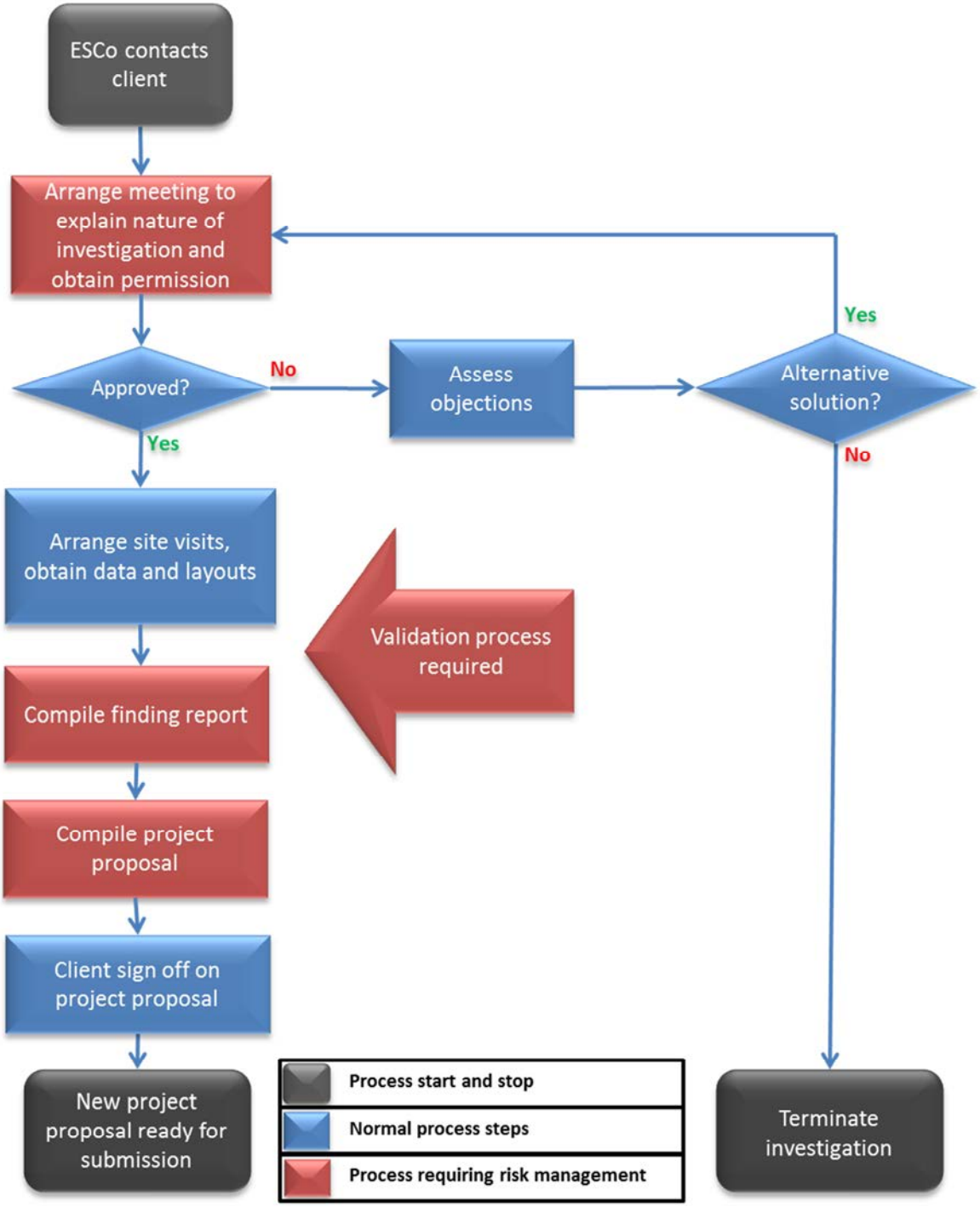

Figure 6: Project investigation phase

Risks:

- IP is unprotected when marketing DSM projects.
- Inadequate validation of proposed project savings.
- Poor documentation resulting in inadequate or lost information.

2.5.2 Project approval phase

ESCos submit project proposals to clients and financiers for approval and funding. Project approval requires that a project proposal be submitted and evaluated against technical, financial, legal and commercial criteria [29]. A comprehensive project approval process will be similar to the Eskom IDM proposal approval process. Thus, this process is again used as a framework to construct a general process.

Project proposals submitted to Eskom IDM pass through the following steps [43]:

- Technical evaluation;
- Project evaluation;
- Finance approval; and
- Procurement (contract negotiations and contract placement).

Once all of these criteria have been satisfied, a project is approved for funding and contract placement [2].

During the proposal phase, the client/funder made decisions. The ESCo was only involved during contract negotiations and sign-off. The project funder (in this case Eskom IDM) investigated and decided whether the proposed project was a sound investment. If a proposal was disqualified at any stage for whatever reason, the ESCo could correct the issue and resubmit the proposal.

Eskom IDM received proposals from numerous ESCos. Thus, a resubmitted proposal would return to the back of the submission queue. Eskom only accepted a predetermined number of proposals per contract placement round. This could result in disqualified proposals being too far back in the queue to be considered for evaluation again. The proposal would then have to stand over for a next round [29]. A big concern during project approval was the Eskom delay in contract placement [18], [29]. Thus, it was not ideal for a proposal to be disqualified and removed from the proposal queue.

In a more general sense, any work that needs redoing is a waste of time. Thus, a proposal that is disqualified by any client wastes time, money and resources. Quality proposal documents that adhere to all requirements are necessary. Figure 7 shows the flow diagram for the proposal phase. The processes in red indicate where risk management is required.

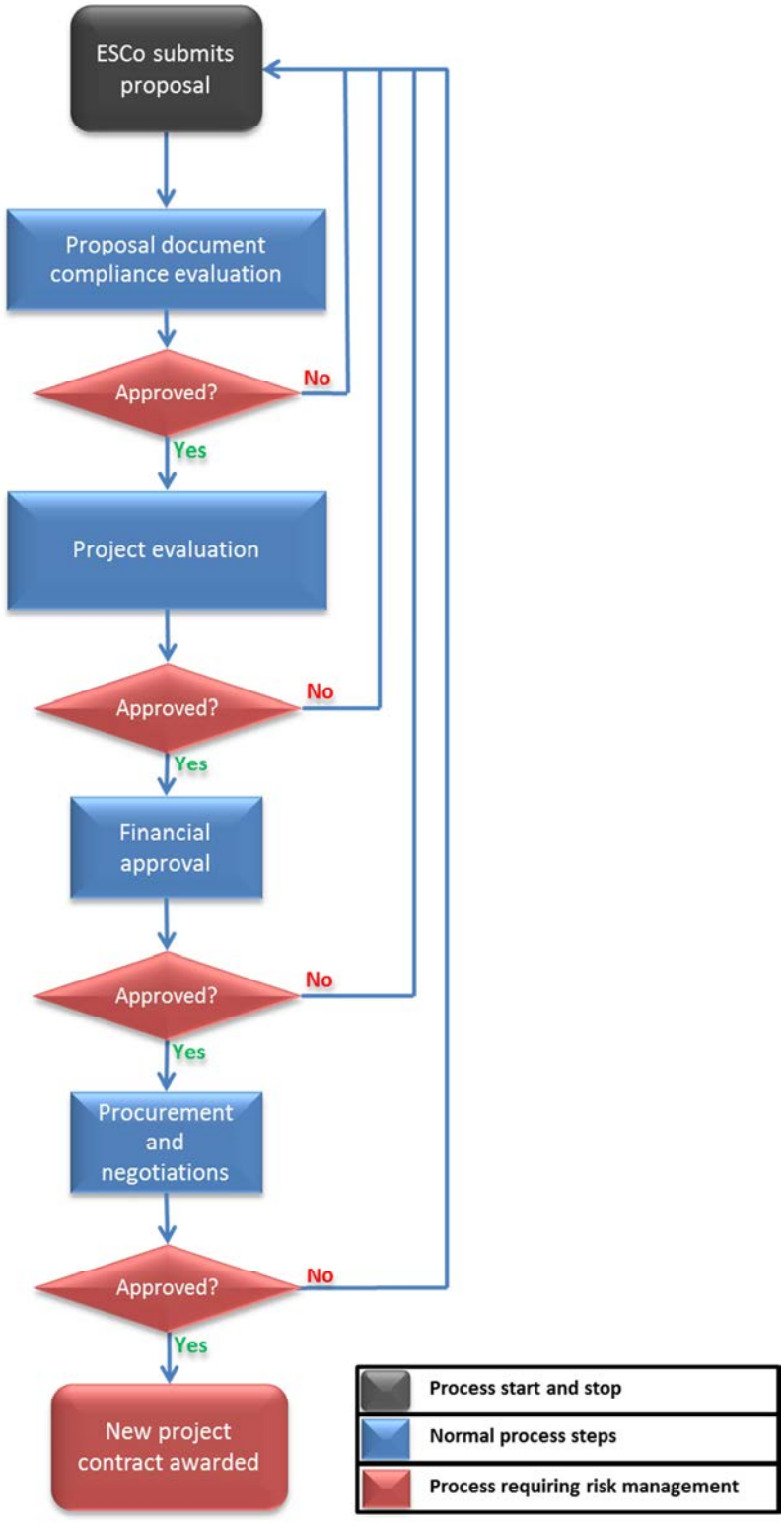

Figure 7: Project proposal phase

Risk:

- Proposal is disqualified due to inadequate or incomplete proposals.

2.5.3 Implementation phase

DSM project implementation initiated after a project contract was signed. With a project contract in effect, the options to terminate the project were limited and would likely result in losses to the ESCo. The project had to be implemented and the proposed saving achieved for the ESCo to fulfil the contract requirements.

A common challenge experienced with all the processes in the implementation phase was the quality of documentation and communication. Figure 8 shows the flow diagram for the implementation phase. The processes in red indicate where risk management is required. Experience with these processes once again indicated that improvements are required to manage the increasing risk imposed on the ESCo by the continuously changing DSM models.

The changes include introducing a quality management process; processes to manage contract regulatory compliance; efficient resource management; and product and service management.

Figure 8: Project implementation phase

Risks:

- Poor communication and documentation.
- Quality management is required.
- Contract regularity compliance.
- Inefficient resource management.
- Inefficient product and service management.

2.5.4 Performance assessment phase

In the Eskom IDM framework, performance assessment consisted of a three-month period [35]. During this period, the ESCo monitored and maintained the project to prove that the proposed savings were achievable. The savings achieved (as reported on in the performance certificate) were used on the Measurement and Acceptance Date (MAD) certificate, which is the Eskom term for a handover certificate. ESCos managed the project savings until the MAD certificate was signed. Thereafter, the project was handed over to the client.

Misperceptions about the M&V processes and requirements resulted in delayed performance assessment and project handovers. Improvements in managing an ESCo's internal M&V are required. Figure 9 shows the flow diagram for the performance assessment phase. The processes in red indicate where risk mitigation is required.

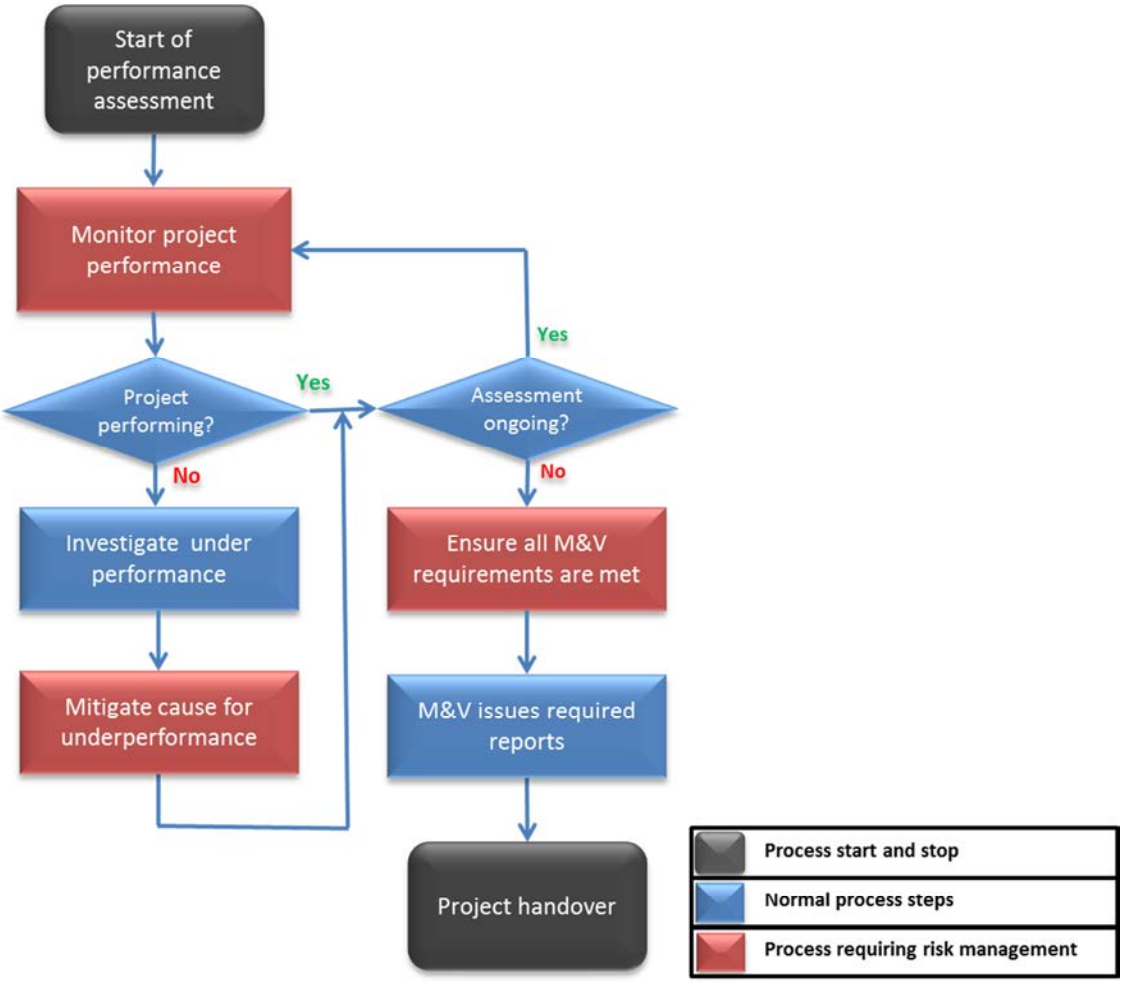

Figure 9: Performance assessment phase

Risks:

- Improved turnaround time for M&V requests is required.
- Improved performance monitoring is required.
- Faster response to performance issues is required.

2.6 New Eskom ESCo DSM model

In the middle of 2015, Eskom IDM announced a new DSM funding model that they claimed to be performance-based [16]. This is not entirely the case, since the new model still has a project component that was adapted from the previous model. The most significant differences between the previous and new models are:

- The new model is predominantly a performance-based model; and
- A mandatory maintenance period was introduced with the new model.

Due to Eskom's financial and cash flow issues, the new model has been designed to shift all of the risk involved with the project to the ESCo [8].

Under the previous project-based DSM model, ESCos received funding upfront, which was used to implement projects [26]. After project implementation, the performance was evaluated for three months during the performance assessment phase. Upon completion of performance assessment, the project was handed over to the client for maintenance.

With the new model, ESCos must fund project implementation as is the case with the shared savings model, but the ESCos do not share in the savings achieved. Instead Eskom only pays an ESCo 30% of the agreed project cost if the target saving is achieved during the three-month assessment period [17]. The ESCo must maintain the project for three years during which funding is received in three-month intervals based on the performance of the project [17].

During the project proposal phase, Eskom IDM determines the maximum available funds per project. The project type and proposed target savings are considered when calculating this value. This value is also known as the "capped value" for the project.

During procurement negotiations, the capped value can be reduced to less than the maximum calculated value. The final maximum value will be the total shown in the project contract. This is referred to as the "contract value".

As part of Eskom IDM DSM contracts, there are SD&L outcomes that need to be fulfilled. These outcomes are linked to a 10% retention of the contract value. The 10% SD&L retention is deducted from each invoice until all SD&L commitments have been documented and audited. At that point, all accumulated SD&L retention deductions will be paid to the ESCo and no further deductions will be made for the remainder of the contract payments.

ESCo payments occur at the end of a series of 12 payment periods spread out over 36 months. These periods are defined as follows:

- When the MAD certificate is signed, 30% of the contract value is payable. The MAD certificate can be issued no sooner than three months after performance assessment has ended.

- The remaining 70% of the contract value will be paid in quarterly intervals over the three years following MAD sign-off. Thus, 5.83% of the contracted value is the maximum value that can be paid for each period.

Achieved savings are verified by an M&V team. The payment due at each payment period can never exceed the maximum value for that period. Thus, overperformance does not yield additional payment. Underperformance on a target will lead to a deduction on the period's maximum payment. The deduction is calculated linearly for each period as shown in Equation 1.

$$PP = PP_{max} \times \frac{PT}{CT} \qquad \textit{Equation 1}$$

PP – Payment for specific period
PP_{max} – Capped value (maximum payment for the project)
PT – Target achieved in the period
CT – Contract target

The achieved saving is not accumulated or averaged over the three-year period. Each three-month payment period is measured independently. Figure 10 illustrates the cash flow of the new model from an ESCo's perspective.

To graphically represent this scenario, the example values shown on Table 2 are used.

Table 2: New funding model example values

Variable	Value
Project implementation cost (paid in month 3 of implementation)	R100 000
Total project funding	R1 000 000
Performance assessment payment (30%)	R300 000
Maintenance period payments (12 in total)	R58 333
Underperformance (50%) experienced in maintenance periods 3, 7 and 11	R29 167

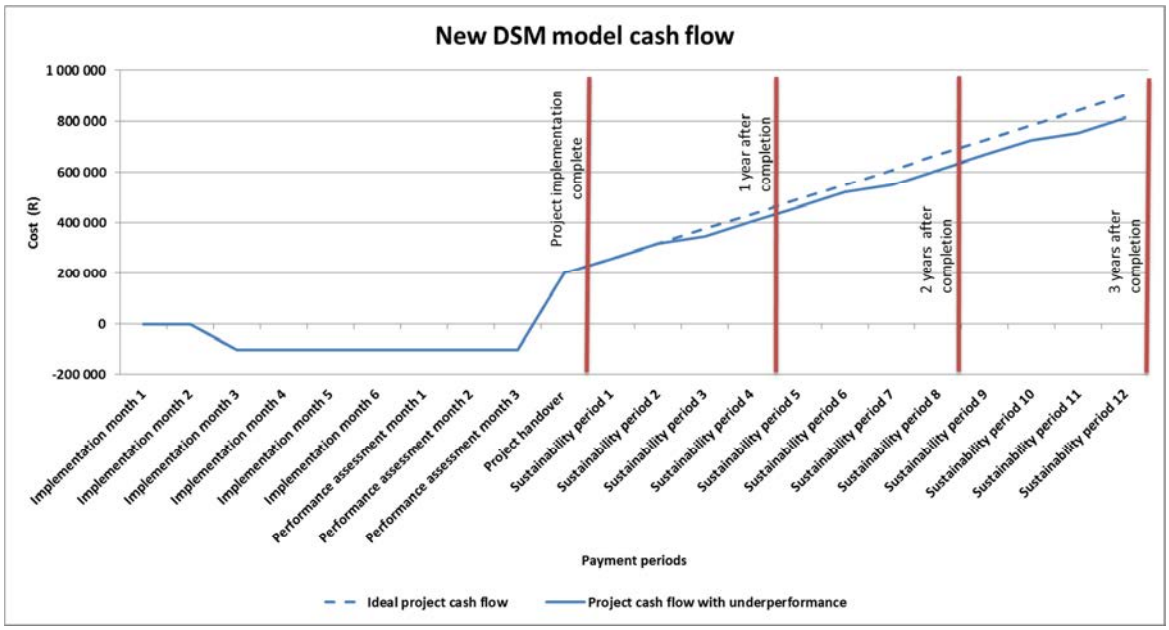

Figure 10: Cash flow expected from new DSM model

This model is designed to shift all the risk involved with a DSM project to the ESCo. The result is that ESCos need to be able to manage risk to implement these DSM projects successfully. Alternatively, ESCos may want to investigate other DSM project possibilities. This study will consider lessons learned from Eskom IDM DSM models to generate process guidelines that manage risk when used to implement other DSM projects.

Risk:

- Proper cash-flow planning is required.

2.7 New Eskom DSM model phases

The old and new Eskom IDM DSM models are similar with the exception of two differences [8]:

- A mandatory maintenance phase was added to the new model.
- The funding scheme for the new model is no longer project-based. It was replaced with a modified shared savings model.

Thus, apart from these exceptions, all the existing processes from the previous DSM model are applicable to the new model. This also allows for lessons learned and experience gained from the old model to be used with the new model.

The old Eskom IDM DSM model did not make provision for ESCos to remain involved with project maintenance after performance assessment. The previous DSM agreement between Eskom IDM and clients stipulated that clients had to maintain the projects savings themselves [44]. The ESCo's involvement thus ended with the signing of the handover certificate.

Due to several reasons, clients could not always maintain their DSM projects and it led to project savings deteriorating [44]. To help clients revive and maintain old projects, the ESCo investigated and entered into maintenance agreements with clients. In exchange for a service fee, the ESCo offered expertise and resources to assist clients with DSM project maintenance. This resulted in the first processes that a South African ESCo used to maintain implemented DSM projects [44].

Under the new Eskom IDM DSM model, ESCos are required to maintain a project for three years after implementation [17]. The experience gained from the maintenance contracts will assist in creating an ESCo maintenance process.

Under the new model, an ESCo remains responsible for the DSM project savings while either an Eskom three-year contract or a client maintenance agreement is in place. Termination of ESCo involvement will occur when either one of these contracts expires, or when the client or the ESCo does not wish to continue with the project.

ESCos face risks with cash flow and project performance due to their prolonged exposure to the projects. There is no direct contract between Eskom and the client who

committed to energy savings. The client's only incentive is the savings resulting from the ESCo's work. ESCos need to manage this risk to ensure that projects are successful.

South African ESCos are used to the Eskom IDM funding model for DSM projects. Thus, ESCos have little to no experience with DSM project maintenance. A process is required that structures the required actions for project maintenance as part of an ESCo's business model.

Risk:

- ESCos do not have maintenance experience.

2.8 Conclusion

This study focused on Eskom IDM-funded projects because of Eskom's long-term involvement with DSM projects in South Africa over the past decade. As a result of the lack of maintenance on these projects after handover, Eskom IDM introduced a new DSM model that shifted all the risk to the ESCo. The risk involved with DSM projects funded under this model increases the likelihood that ESCos may want to pursue other DSM projects.

Fortunately, because the new Eskom IDM model still incorporates the project phases of the previous model, the lessons learned with Eskom IDM DSM over the last decade still apply. Because the Eskom funding models all have project components, they form a framework for processes that can be used with other DSM projects.

3

ESCO OPERATIONAL REQUIREMENTS

Chapter 3: This chapter discusses the operational aspects of a DSM project that an ESCo may encounter.

CHAPTER 3: ESCO OPERATIONAL REQUIREMENTS

3.1 Introduction

The topics discussed in this chapter are all associated with the operational aspects of an ESCo. Chapter 2 focused on the environment in which ESCos function, where Chapter 3 will grant insight into what is required for an ESCo to function.

Similar to Chapter 2, Eskom IDM-funded DSM projects are used as a framework for DSM projects in general. The assumption is made that ESCo management has a basic understanding of business. The goal is not to train an ESCo to do business, but rather to guide an ESCo to manage risk while doing business.

3.2 Project management principles

Project management is defined as a systems approach to managing a project where the cost, time and performance parameters are clearly stated [45], [46]. It is a field that requires experience and well-defined guidelines to be successful.

There are various project management guidelines available and all variants constitute a study in itself [47], [48]. The critique and specifications to these guidelines are project-, industry- and country-specific [47]. For the purpose of this study, the focus is on project management basics and the guidelines that apply to ESCos in the South African industry.

3.2.1 Project management in general

Any project has to be managed from start to finish. The life cycle or phases of a project are summarised as [45]:

- Conception and initiation;
- Definition and planning;
- Launch or execution;
- Performance and control; and
- Closure.

These phases align with the five project phases of the Eskom IDM DSM project model that is used as a framework for ESCo DSM projects.

Characteristic of all management standards is the basic steps that are required to be successful. Project management basics can be described as [45], [49]:

- **Defined goals** – The goals (the "what", the "how" and the "why") of a project must be clear.
- **Designated resources** – Project resources are defined as time, money, personnel and equipment. One or more of these resources are usually limited. Part of managing a project is managing resource limitations.
- **Prescribed methodology** – A project's methodology defines the scope of work. A well-defined scope of work is crucial. The smallest changes and unplanned events can have a detrimental effect on a project's goals [50].
- **Communication** – Continuous communication contributes to the success of effective project management [50].

To be successful at implementing these basic steps, personnel require the following experience [49]:

- Integration management;
- Scope management;
- Time management;
- Cost management;
- Quality management;
- Human resource management;
- Communication management;
- Risk management; and
- Procurement management.

These requirements may vary with the specification of the project's scope.

3.2.2 Project management in ESCos

ESCos can optimise the project management phases to be specific to the requirements of the DSM project environment. Table 3 summarises the comparison.

Table 3: Project phase comparison

General project phases	DSM project phases
Conception and initiation	Investigation
Definition and planning	Proposal

General project phases	DSM project phases
Launch or execution	Implementation
Performance and control	Performance assessment
Closure	Maintenance

As mentioned in Chapter 2, the new Eskom IDM DSM model is both performance- and project-orientated. Thus, all the normal project management principles apply to project phases. Upon project closure, the DSM project ends, which initiates the maintenance phase.

The maintenance phase can also be managed as a project. Table 4 shows how general project phases align with the steps of the maintenance phase.

Table 4: Maintenance project management

General project phases	Maintenance project phases
Conception and initiation	Initiate maintenance
Definition and planning	Maintain savings stipulated in contract
Launch or execution	Monitor performance
Performance and control	Report and manage savings
Closure	Hand project over to client or initiate client maintenance agreement*

*This phase will repeat the steps as described in Table 4 until maintenance is terminated

It is clear that project management is crucial to all aspects of DSM projects. The basic guidelines apply to all phases of these projects.

3.2.3 Project milestones

The key milestones for DSM projects are listed and defined in Table 5. These milestones are in the critical path of the project plan. This means that any delay in achieving a milestone will delay the project [48].

Table 5: Project milestones

Milestone	Action explained	Project phase
Project proposal submitted	Initiate the project life cycle with client or financier.	Initiate proposal phase
Baseline document completed	Sign off baseline document – this is a requirement before the project contract can be signed.	Proposal phase
Project contract signed	Client and ESCo sign DSM project contract.	Initiate implementation phase
Scope of work signed off	ESCo and client agree to the proposed scope of work.	Implementation
Documents ordered	Initiate third-party sub-contractor involvement (if required).	Implementation
Kick-off meetings held	Initiate physical project implementation on-site.	Implementation
Completion certificate issued	Complete final commissioning completed and hand project over to client. Initiate performance assessment.	End of implementation
Handover certificate signed off	Complete performance assessment and issue performance assessment certificate. Initiate maintenance phase. Successful completion will ensure that the ESCo receives their first payment.	End of performance assessment
Continuous tracking reports issued	Monitor the continuous tracking reports issued by the M&V team for the duration of the maintenance phase. Accurate and on-time reports will ensure that the ESCo receives payment.	Maintenance

3.3 ESCo product and service offering

The goal of DSM projects is to save clients money through energy cost savings and promoting energy efficiency [51]. This is achieved by implementing projects with:

- Energy efficiency characteristics; or
- Load management characteristics.

Efficiency projects aim to reduce the client's total energy consumption, while load management projects generate cost savings for clients on time-of-use (TOU) tariff structures.

A method to achieve this is by using energy management systems (EMS). An EMS forms part of the product offering an ESCo provides, while the design, implementation and maintenance of this system forms part of the services an ESCo provides [4], [34]. Another method is to supply, install/replace and maintain the hardware that a client requires to be more energy efficient.

Because EMSs, control philosophies and design solutions are unique to each client's site, the function of these solutions needs to be optimised per site. Part of an ESCo's service is training clients to use the EMS on their sites. Thus, training forms part of an ESCo's processes during project implementation.

3.4 Measurement and verification

The M&V process is a key aspect of the DSM project life cycle. Although a third-party M&V team manages the process independently, understanding the process and its requirements can be beneficial to an ESCo [52].

Despite the importance of the M&V function, ESCos often neglect to manage the process. This increases the turnaround time on M&V requests which in turn delays the project. ESCos can save time and money by anticipating and preparing for specific M&V requests even before these requests are issued [52]. The following sections briefly explain the M&V process and the milestone actions of which ESCos should take notice.

3.4.1 Responsibility of M&V

The function of M&V is quantifying project savings and the sustainability of those savings independently and objectively over the agreed period. M&V teams must provide impartial, credible, transparent and replicable processes. These can be used to assess and report on the savings and sustainability of DSM projects. The work that M&V teams conduct is governed by the South African National Standard (SANS) 50010 [53].

M&V risks to ESCos include modelling errors, poor data quality for M&V calculations, as well as errors resulting from measuring issues [18]. South African M&V teams rely on

ESCos to provide them with raw data and meter specifications. The M&V teams use the supplied information to do modelling and reporting. Understanding how these issues can affect a DSM project's reported performance is crucial to the success of DSM projects in South Africa.

Risk:

- Mismanaged M&V can affect project savings and completion times negatively.

3.4.2 ESCo M&V management

Managing the M&V process requirements can optimise company resources [52]. The requests of M&V teams can vary from data requests to having documents signed off. These requests are usually linked to project milestones. Thus, measures utilised by ESCos to optimise the turnaround time of M&V requests reduce the implementation time of DSM projects [52].

3.4.3 Data acquisition

M&V requires electricity usage data for baseline development and performance tracking [17]. This data can be obtained from client sites by logging the data or downloading it from client databases where available [44]. This has to be done as soon as possible, as delays in this process can delay the project contract placement [8], [52]. Contract placement can only continue if an agreed baseline has been signed off.

3.4.4 Baseline development

The baseline is the measured electricity usage before an ESCo intervenes. An ESCo's performance is measured against the baseline [5], [27]. M&V teams may use scaling methods depending on the type of project, technology and nature of the system and its parameters [17].

3.4.5 Performance assessment

Performance assessment of Eskom IDM DSM projects takes place over three months. At the end of the performance assessment period, an M&V team issues a performance certificate that reports on the average saving achieved over the assessment period [17]. The M&V team also reports at the end of each month on the average performance for that

month. Performance periods can vary between DSM projects. The required term is negotiated during contract placement.

3.4.6 Performance tracking

With the new Eskom IDM DSM model, M&V teams have to issue performance tracking reports every three months, which report on the average performance for that period [17]. This is crucial to the ESCo's cash flow, as performance during these periods will result in payment. Performance tracking is crucial with any performance contract, as payment to the ESCo is determined by the savings achieved.

3.4.7 Internal M&V management

The first ESCo M&V management process was developed for a small number of projects being implemented in parallel. The process was not scalable, and this critical flaw became apparent when an ESCo increased the number of projects implemented in parallel [52].

A basic illustration of this internal M&V process is shown is Figure 11. The resources required for this process is an M&V consultant and project engineers (the number of which is determined by the projects involved).

The ESCo's M&V consultant was responsible for all data processing, requests and correspondence between the ESCo's project team and the M&V teams.

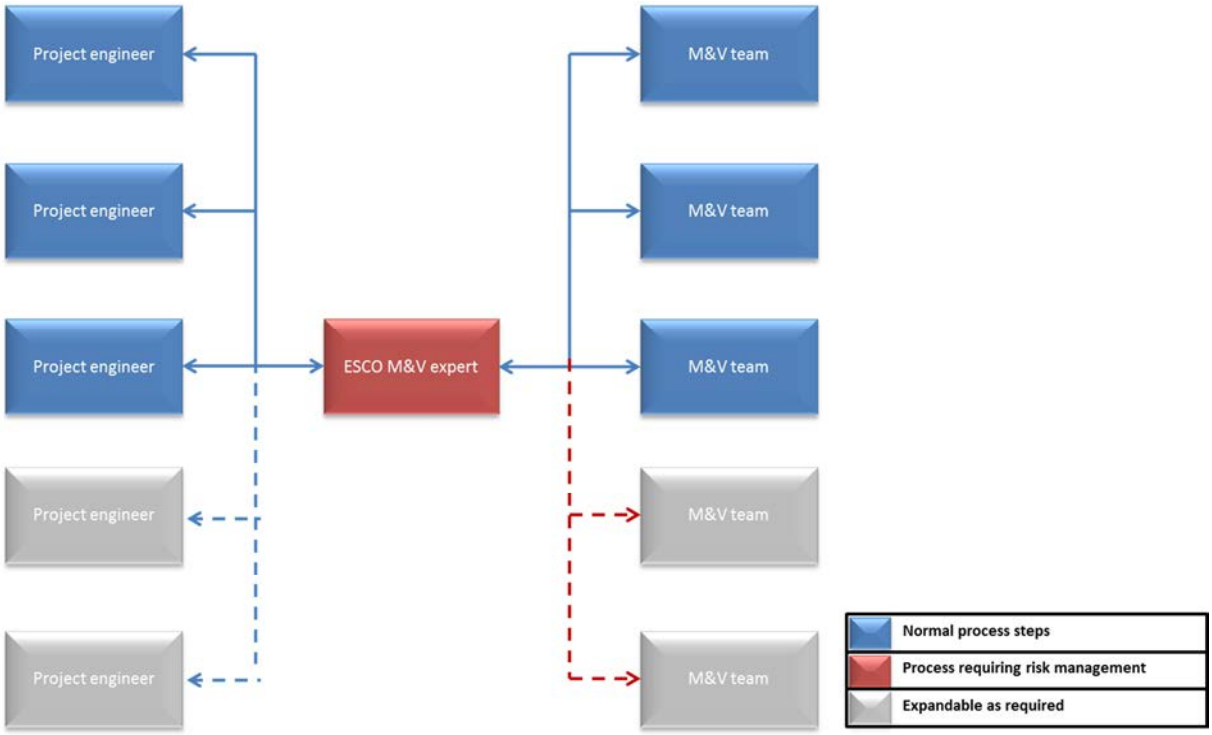

Figure 11: Internal M&V process

This process has a bottleneck where all the data, requests and correspondence were managed by the M&V consultant. The maximum capacity of the process was determined by the time that the M&V consultant had available.

Risk:

- Process is not scalable for multiple projects that are implemented in parallel.

3.5 Business model principles

There are various theories as to what constitutes the definition of a business model [54]. These definitions are subjective and were formulated to align with specific industries or business types during certain eras [54], [55]. The best general definition explains that a business model is the processes that a company uses to create economic value [56]. The value added may change over time or during the life cycle of a project and in doing so, constitute changes in the business model's processes [22]. For example, the new Eskom IDM DSM rules require an ESCo to implement and then to maintain a project [17]. The implementation and maintenance phases will require different and new business approaches.

For this study, it is assumed that an ESCo understands how to manage a business. The focus is rather on the business aspects relating specifically to ESCos and the DSM environment.

The business model for a South African ESCo must allow the ESCo to manage all five phases of a DSM project. The requirements for an industrial ESCo's business model can be defined from lessons learned by other ESCos in the energy management industry [57]. An ESCo's business model consists of [57]:

- Method of marketing;
- Product or service offering;
- Financing model;
- Resources management; and
- Competitive strategy.

These aspects are discussed in the following paragraphs.

Risk:

- ESCo business model is not sufficient for the new South African DSM requirements.

3.5.1 Marketing

Marketing is a skill on its own and includes various strategies that are industry-dependent [58]. In summary, marketing is defined as the need to convince clients of an offering aiding a solution to a particular need [59].

ESCo marketing will mainly take place during the investigation phase of a project. A potential client is approached for permission to start a DSM project investigation. As part of the first contact, the ESCo needs to market the skills and services that the client will benefit from.

Risk:

- Client misperceptions about energy management, DSM and ESCos need to be addressed.

3.5.2 Offering

An ESCo's offering is the service or product required by a client to manage energy efficiency or cost such as DSM maintenance, an EMS or consulting [57]. It can also be referred to as the ESCo's IP. During the proposal phase of a project, the value and need of the offering are considered by the client [29]. The ESCo may be contracted to implement the proposed solution if it aids in managing a client's problem.

Risk:

- Developed services or products must be protected from IP theft.

3.5.3 Financing

Many consider financing to be the biggest challenge for ESCos [2], [4]. In fact, the South African ESCo industry is labelled to have insufficient financing [2]. Eskom provided a range of financing schemes for South African ESCos, but these schemes were reduced to as the utility is suffering from cash flow problems [8].

Thus, as part of the business model, an ESCo must plan the generation of revenue and funding projects; decide on profit margins; and plan cash flow during implementation and maintenance phases. In the life cycle of a project, the majority of cash flow takes place during these two phases.

Risk:

- Selecting a suitable financing model.

3.5.4 Resources

Company resources are defined as time, money, personnel and equipment [45]. Competent personnel are required in each field of the business model. It is not uncommon for South Africans to be multi-skilled at business [60], [61]. South African ESCos are known to have multi-skilled personnel [57]. Multi-skilled personnel can be successfully applied to aid in the various requirements of the project and business.

Risk:

- Resources capacity must be adjustable to match the ESCo's workload.

3.5.5 Competitive strategy

Market competitiveness can be achieved through offering a superior service or product that is governed by a quality management standard, which means that quality management must be built into the ESCo's processes [62]. In addition, international ESCos focus more on low-input, high-output energy efficiency solutions to mitigate financing challenges [63]. South African ESCos can learn from the strategy in order to optimise their profit margins.

Risks:

- ESCos require an efficient business model.
- A quality management process is required to ensure product and service quality.

3.6 Energy management standard for ESCos

The business of ESCos is energy management. It is recommended that ESCos incorporate an energy management standard such as ISO 50001 in their products and services.

The ISO 50001 standard is based on the plan-do-check-act (PDCA) continuous improvement framework [64]. According to this framework, the energy management standard can be summarised as [64]:

- Plan: Conduct an investigation to establish a baseline, determine performance indicators, objectives, targets and action plans necessary to achieve energy savings.
- Do: Implement the energy management plan/project.
- Check: Monitor, measure and report on performance.
- Act: Take actions to continually improve and maintain performance.

These steps are captured in the essence of DSM project phases. The improved processes in Chapter 4 will align with this standard.

3.7 Quality management guideline for ESCos

The core of a quality management standard is establishing, documenting, implementing and maintaining a system that will improve the business of a company [65], [66]. This is also PDCA-orientated [65].

As is the case with other international growing and developing ESCo markets, South African ESCos can ensure trustworthy service to their clients by employing quality management standards in their businesses [11]. DSM financiers and clients, for example, Eskom IDM, can contractually require ESCos to be ISO 9001 (quality management) compliant [39].

Risk-based thinking is essential for achieving an effective quality management system. This will prevent the recurrence of known issues or the occurrence of anticipated issues [66]. This will result in improved results and prevent negative effects [66].

As mentioned, documentation control is one of the key aspects of quality control. The implementation process required to successfully implement documentation control can be summarised as the [67]:

- Definition of document requirements;
- Evaluation of existing systems;
- Identification of document management strategies;
- Design of a document management system;
- Implementation of the document management system; and
- Maintenance and continuous improvement.

It is clear that the quality management process applies even within itself. These steps will also be evident in the design of the improved processes discussed in Chapter 4.

3.8 Risk management defined

A definition of risk management is that it provides the basis for decision-making [68]. The ISO defines risk as the effect of uncertainty [66]. Thus, uncertainty must be identified or quantified to allow a decision to be made that will manage risk.

To help manage risk, ESCos can incorporate risk management standards such as the ISO 31000 risk management standard. As with the other ISO guidelines that were discussed, ISO 31000 also uses a PDCA approach [21], [69]. The ISO 31000 PDCA approach is to identify, analyse, evaluate and treat a risk. An identified risk is required to determine the correct action. To help analyse a risk, it can be evaluated by the following components [2]:

- Cost;
- Time;
- Resources; and
- Quality.

Risk evaluation is done from the perception of the risk-taker and this will determine how the risk is treated [20]. Treated risks fall into one of four categories [70]:

- Avoiding risk;
- Reducing risk;
- Sharing risk with other parties; or
- Accepting risk.

Guidelines issued by the US Department of Energy suggest risk-sharing when setting up a performance contract in order to manage known risks [4]. The new Eskom IDM DSM model does not make provision for risk sharing [17]. All the performance and financial risks involved with the project lie with the ESCo and its contractors [17]. Thus, it is important for South African ESCos to be aware of the risk and be equipped to manage it.

3.9 Environmental management in industry

Energy efficiency reduces CO_2 emissions, which reduces the carbon footprints for clients. Thus, a direct result of implementing DSM-type projects is the positive environmental effect that reducing CO_2 emissions has. Whilst implementing a project, the actions of an ESCo and its contractors may not contradict this benefit.

The performance and tracking reports generated by M&V teams report on the reduction in CO_2 emissions as a result of an ESCo's intervention [17], [35]. Eskom also reports on these benefits, as is evident in their annual reports [8], [71], [72].

Thus, the results of an ESCo's work affect more aspects than just energy savings. Environmental impact on the sites of the clients is also a key focus area. Thus, the environment must be considered while developing technologies, implementing projects and controlling systems.

Industrial clients will have environmental protection guidelines such as ISO 14001 in place. ISO 14001 helps to establish an environmental management system used to manage a client's impact on the environment [11], [73], [74].

Although an ESCo is not required to subscribe to such a guideline, it is advisable to have knowledge about it in order to act within its guidelines when working on a site where such standards are enforced. Failing to adhere to a client's environmental standards can result in the ESCo, sub-contractor or both being dismissed from the site. Large fines can also be applicable, depending on the severity of the infringement.

Eskom includes regulations regarding environmental protection in their project contracts. To avoid breach of contract, ESCos must adhere to these regulations. The same can apply to other DSM clients. These regulations will form part of the project contract.

Penalties will increase the stress on an ESCo's cash flow and thus also the risk of not completing the project successfully. Thus, understanding these standards can prevent potential risk leading to unfinished projects, unsatisfied contract terms and cash flow issues.

In summary, an environmental standard will define [75]:

- The guidelines on how to conduct work/business without affecting the environment;
- Actions on what should and should not be done;
- Auditing procedures; and
- Actions to deal with non-conformance.

3.10 Contract basics for ESCos

Contracts are an essential part of an ESCo's business model. Most new and developing ESCos, like other small companies, focus on the technical and financial aspects of the business model. The legal consequences that come into effect when the company enters into a contract are usually neglected [76].

During the project life cycle, an ESCo will encounter at least one contract, which will be in the form of a project contract. This contract employs the ESCo to perform its services. The ESCo may sub-contract work, which in turn will require contract agreements between the ESCo and a third party.

An ESCo can manage all the required outcomes of a contract that can be planned. However, random events outside the ESCo's control can result in temporary delays or permanent deviations depending on the nature of the event, for example, strike action or natural disasters.

A *force majeure* contract clause protects the ESCo in these events. When negotiating the contract, the two most important aspects to consider with this clause are [77]:

- What constitutes a *force majeure* event; and
- What are the rights and obligations of the parties when such an event occurs.

It is advisable that ESCos familiarise themselves with the legal aspects of contracts before entering into large project contracts [78]. If ESCo personnel do not have the required experience, it is advised that legal assistance be acquired. The cost of legal help will outweigh the risk of entering into an agreement that can potentially cripple an ESCo if something unforeseen happens.

3.11 Occupational health and safety in ESCos

Eskom, like most industrial clients, is strict when it comes to safety. Adherence to safety regulations is included in all of their contracts. Eskom's focus on safety is highlighted in their published integrated reports [8], [71], [79]. In order to comply with the terms of their project contracts, ESCos need to comply with safety rules and regulations as set out by Eskom. The regulations specific to an ESCo's operation will be reviewed during contract negotiations.

In addition to safety regulations, industrial clients also have health and safety rules that apply to conditions unique to their sites. These rules are governed by the Occupational Health and Safety Act of 1993 [80]. To ensure that ESCos and contractors are familiar with site-specific health and safety regulations, clients require them to undertake health and safety inductions before any work may commence on their sites.

Depending on the content and severity of the induction, experience showed that induction could take up to three weeks to complete. Health and safety are incorporated into the processes designed in Chapter 4.

3.12 Conclusion

The management standards and business basics required by an ESCo to implement DSM projects were discussed. These general guidelines adapt as the life cycle of the project progresses. Each phase of the project life cycle has different aspects. The technical and management aspects pertaining to DSM projects are part of the improved risk management processes designed in Chapter 4.

4

RISK MANAGEMENT PROCESSES FOR ESCOS

Chapter 4: This chapter discusses the improved process required to help ESCos manage risk when implementing Eskom IDM DSM projects.

CHAPTER 4: RISK MANAGEMENT PROCESSES FOR ESCOS

4.1 Introduction

The chapter comprises the improved processes that an ESCo requires to manage risk while implementing DSM projects. The structure of the phases and processes used to implement Eskom IDM DSM projects successfully are used as framework. From this framework, a general ESCo business model is designed with improved processes. By optimising the risk components of the processes, the risks facing ESCos are managed.

Each project is unique with unique circumstances, which may require additional processes that were not included in this study. This chapter discusses the processes generally used for each phase of a DSM project. These improved processes were developed using experience gained by working in the industry.

4.2 ESCo business model and resources

As discussed earlier in Chapter 3, a business model consists of a:

- Method of marketing;
- Product or service offering;
- Financing model;
- Resources management; and
- Competitive strategy.

All of these components are captured in the improved process design for the various phases of a DSM project. Thus, an ESCo business model is designed and improved by structuring and improving the processes that an ESCo uses. The process structure per project phase and the improvements to the processes are discussed in the following paragraphs.

An ESCo requires various resources to implement a DSM project successfully. The required resources are dependent on the number of projects an ESCo can handle, the technology requirements, the ESCo's cash flow and the experience of their personnel.

This section discusses the recommended resources required in the various project phases discussed later in the chapter.

The resource structure in Figure 12 shows the recommended ESCo resources. The resources are listed in levels of worth to the business. Top-level personnel have a higher cost to company than those on lower levels do. However, top-level personnel have more experience and assume more responsibility. Figure 12 shows a structure that is scalable. Should the ESCo receive more projects, expanding this structure as indicated by the grey blocks will allow the ESCo to manage more projects.

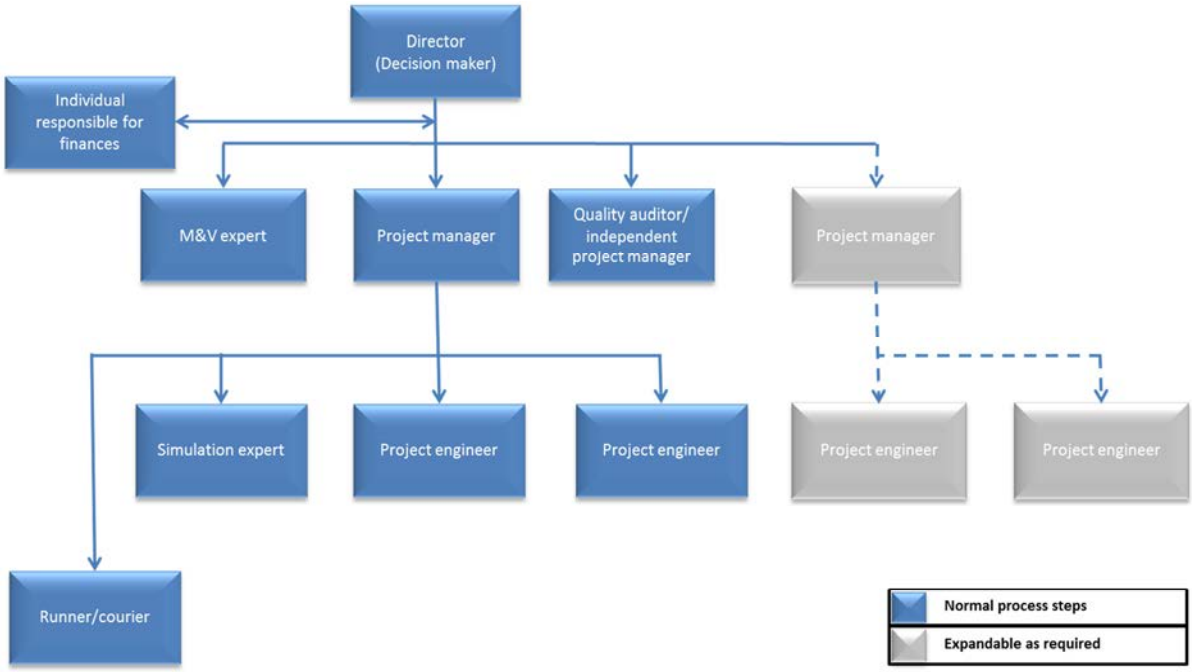

Figure 12: ESCo resource structure

Table 6 lists the ESCo resources along with their responsibilities and experience.

Table 6: ESCo resource responsibilities

Personnel	Responsibilities and experience
Director or decision maker (DM)	Responsible for managing the ESCo's business model and all decisions affecting its business. In a small business set-up, human resource management will also resonate under this portfolio.
Project manager (PM)	Responsible for project-related issues and managing project engineers.
M&V expert	Focuses on all M&V related issues and manages the ESCo's internal M&V for all projects.

Personnel	Responsibilities and experience
Quality auditor (QA)	A dedicated or independent senior personnel member responsible for quality management and audits.
Project engineer (PE)	Responsible for all issues relating to project implementation and project maintenance.
Simulation expert (SE)	Focuses on the simulations required to verify proposed control solutions or philosophies.
Runner/courier	Responsible for deliveries and collections as required by senior personnel.

4.3 General sub-processes

Some general sub-processes recur in the processes discussed in this chapter. These processes are discussed in detail in this section and are only mentioned briefly if they appear in later sections.

4.3.1 Communication process

The Communication Process (CPr) is crucial, as communication is required during most of the processes discussed in this chapter. An improved feature of this process is to have a communication paper trail such as emails resulting from multiple communication media. This is crucial when evidence is required in a dispute. The communication process is shown in Figure 13.

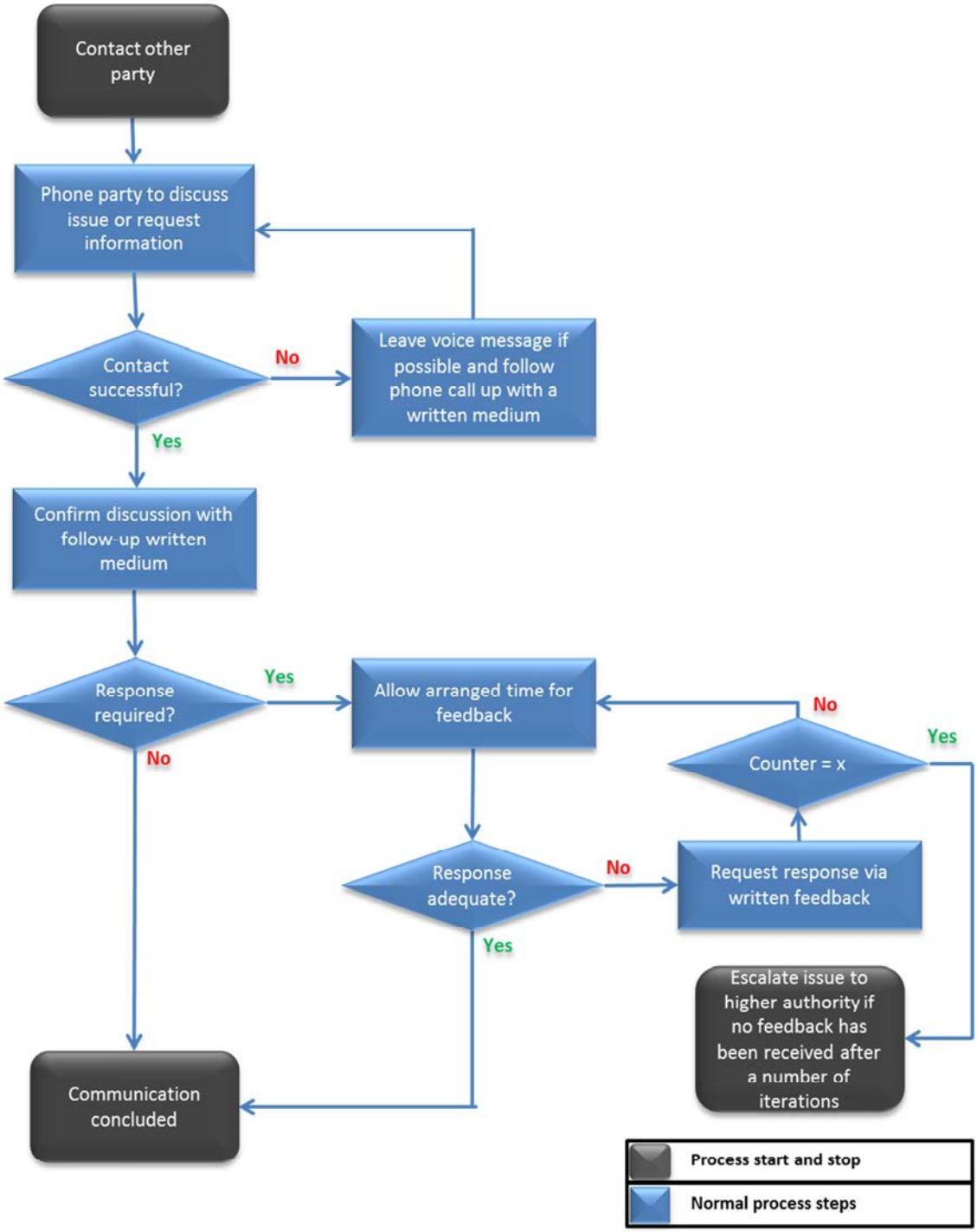

Figure 13: Communication process

In summary, the process can be described by the following steps:

a) Contact the other party;
b) Clearly define the request or statement;
c) Use multiple communication media; and
d) Follow up on requests.

4.3.2 Meeting process

Throughout the project life cycle, meetings form part of the processes an ESCo uses. Figure 14 shows the improved Meeting Process (MPr). An improved feature of this process is to have the minutes signed off at subsequent meetings. This transforms the minutes into an official record of decisions that have been made.

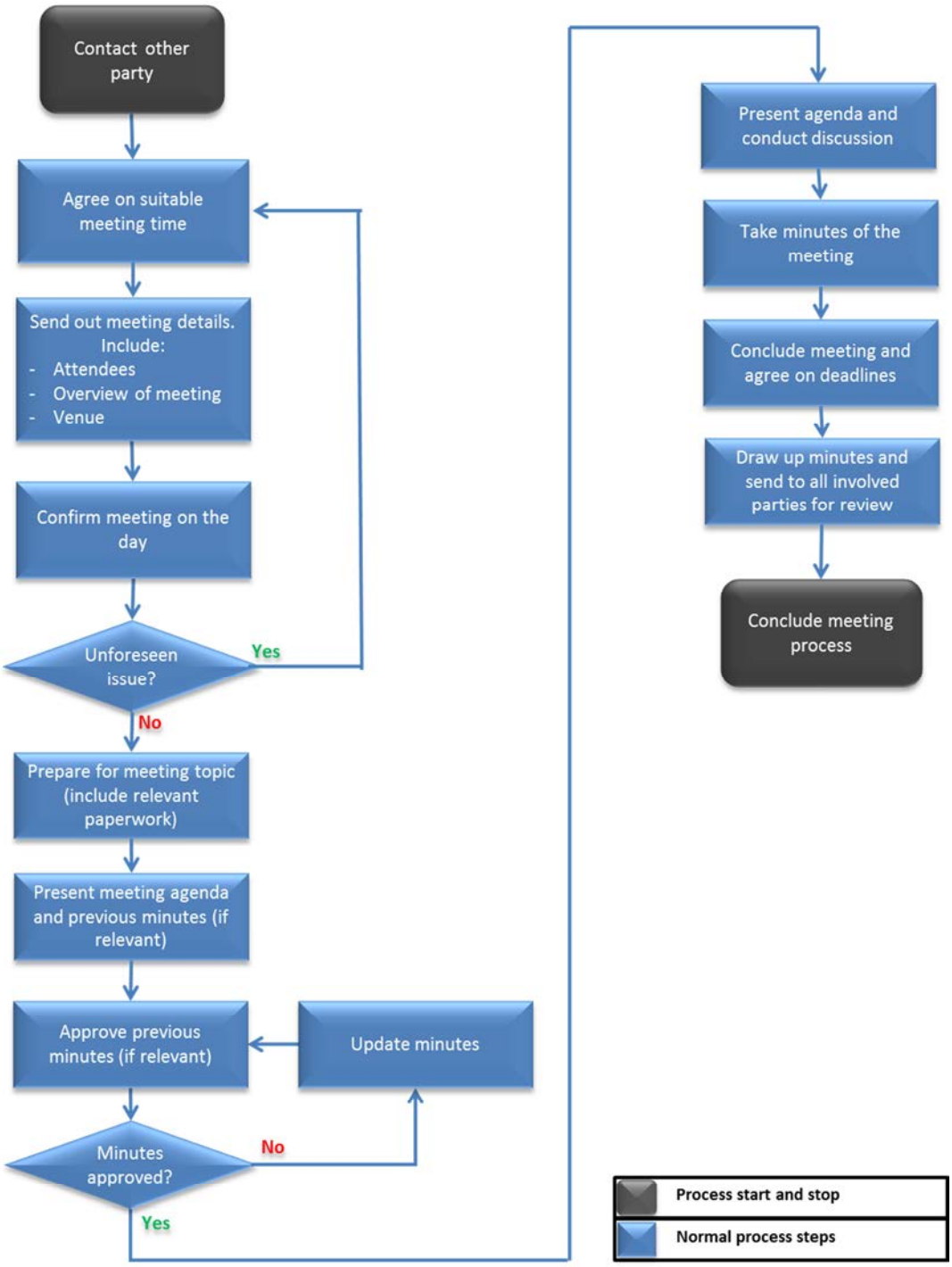

Figure 14: Meeting process

A document template for the minutes of a meeting and an attendance register can be found in Appendix A.

4.3.3 Payment process

ESCos mainly deal with payments during the implementation phase of a project, but the Payment Process (PPr) will apply to all required payments at any stage of the project.

Payment tracking and motivation for payment are key improvements to this process. Figure 15 shows the payment process. The process requires that the project and financial divisions do due diligence before an invoice is approved for payment. The project manager is responsible for submitting a payment request when payment is payment is due. After receiving a request for payment, the financial division checks to see if the invoiced amount is within the allowed budget allocated to the project. If approved, the payment will be processed.

In terms of B-BBEE procurement requirements, black contractors need to be paid within specific periods after invoices have been issued. It is essential to be aware of these requirements and to manage the payments accordingly. This will aid the company with its B-BBEE procurement rating.

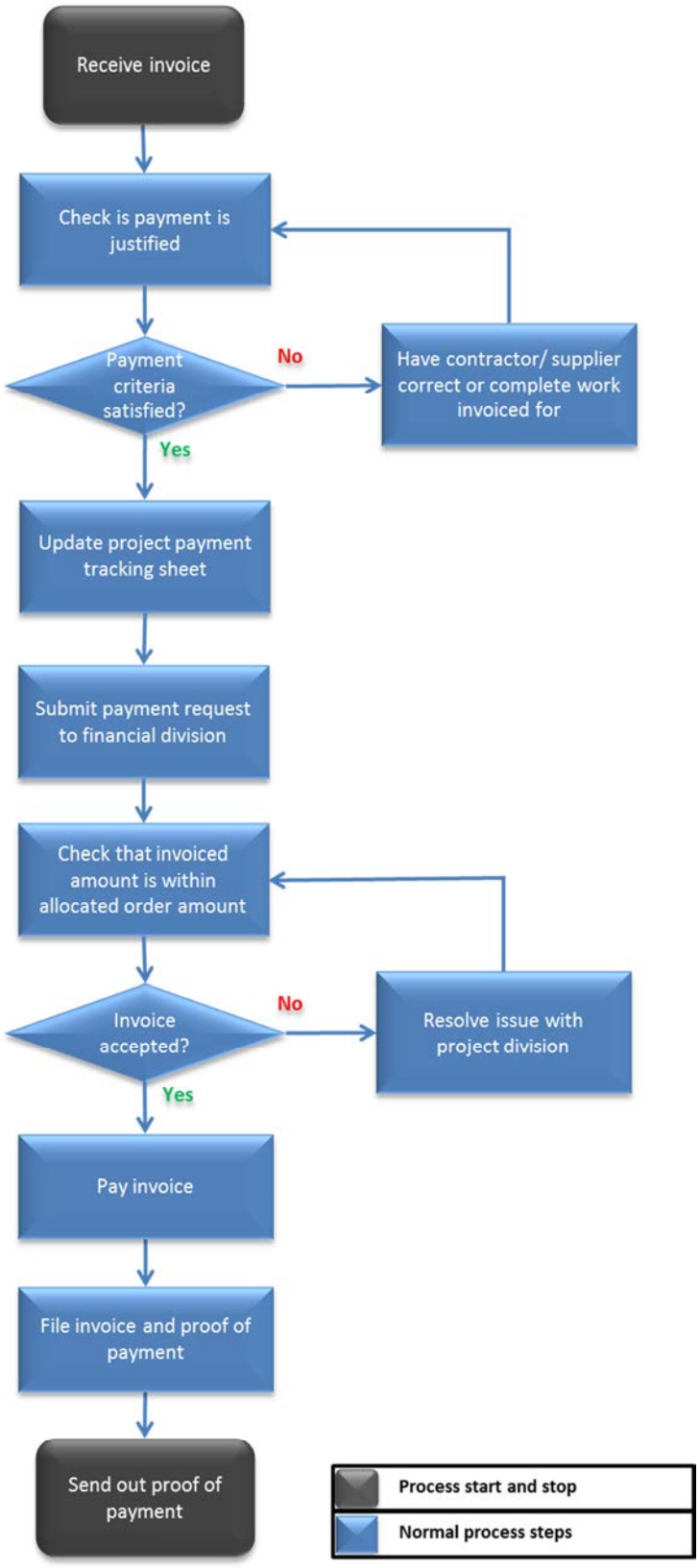

Figure 15: Payment process

A document template for a payment request can be found in Appendix A.

4.4 ESCo internal M&V management

The fulfilment of M&V requirements determines whether certain project milestones have been achieved. By managing the M&V process (M&V Pr) within the project phases, a project's completion time and financial overheads can be decreased while resource availability is increased.

The purpose of the M&V management process is assisting the ESCo in achieving this by being more efficient with its internal M&V. Since M&V is part of each project phase, this is seen as a general process applicable to all project phases. An improved internal M&V process is shown in Figure 16, which has the following improvements over the old process discussed in Chapter 3:

- The M&V consultant only reviews work and assists with problematic cases. Since M&V correspondence is no longer channelled through an M&V expert, the bottleneck and issue with scaling is resolved.
- Project engineers are responsible for the various steps in the M&V process and correspond directly with relevant M&V teams.
- Specific tasks, which are required to achieve certain M&V deliverables, are made part of the normal project management process.
- The process is made scalable – project engineers and M&V teams can be added and removed as an ESCo receives and completes DSM projects.

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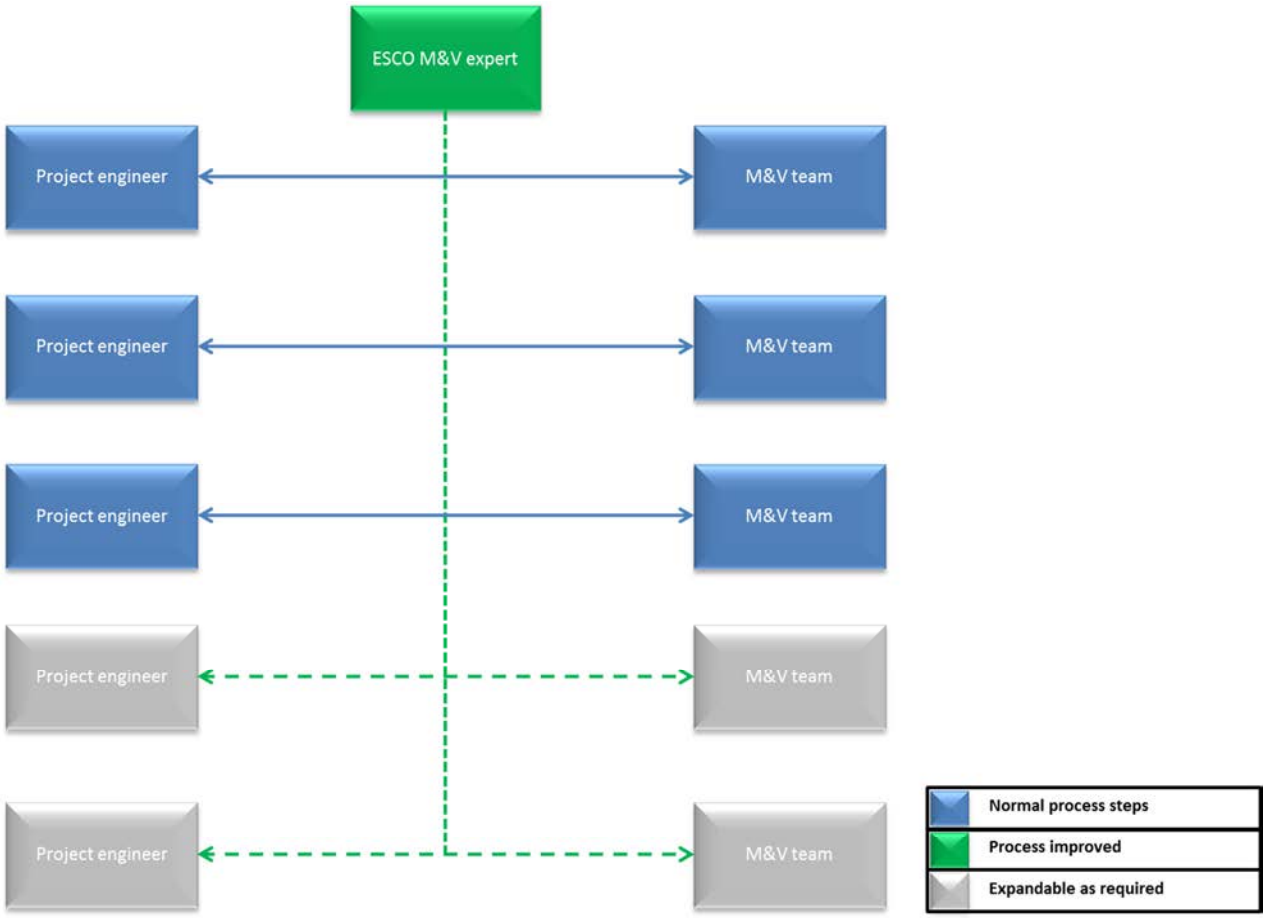

Figure 16: Improved internal M&V process

4.5 Project investigation phase

A detailed breakdown of the improved investigation processes with deliverables are listed in the sections that follow. The resources, requirements for funding and required documentation per process are listed with each process.

The improved processes in this phase are summarised as:

- Market DSM project and obtain non-disclosure agreement (NDA);
- Validate project (obtain relevant information);
- Compile findings report; and
- Compile project proposal.

Figure 17 shows the flow diagram for the improved investigation phase. The processes coloured in green indicate where improvements were made or new processes were added. The addition of a project simulations and validation processes manages the risk of

the proposed project savings being miscalculated. It also gives the ESCo the ability to determine if the proposed savings will be achievable and sustainable.

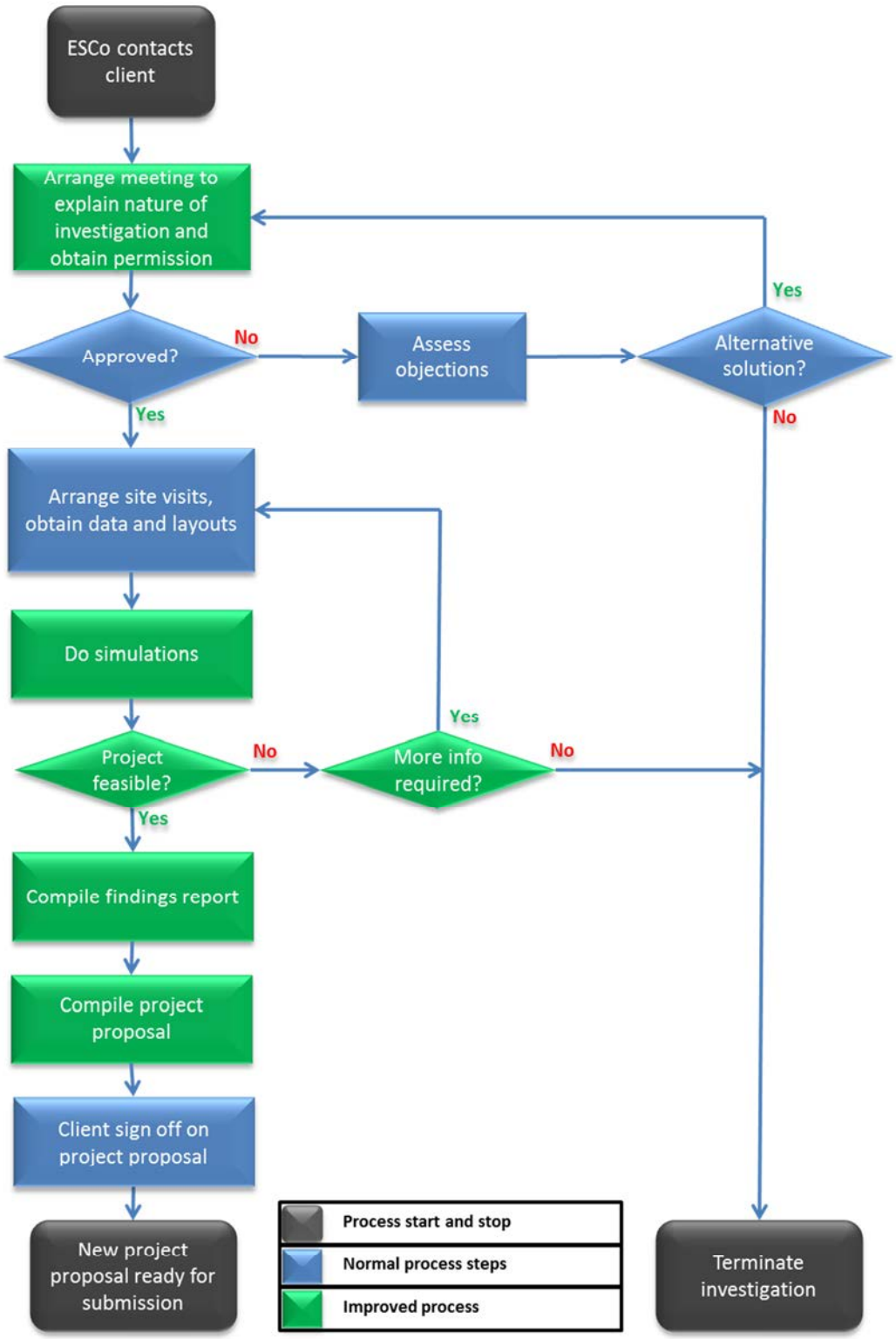

Figure 17: Project investigation phase

4.5.1 Marketing process

The purpose of the marketing process is to establish initial contact with a potential client, inform the client about the benefits of DSM projects and to obtain a signed NDA. Table 7 shows the marketing process summary.

Table 7: Marketing process

	Market DSM project	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Meet with client and do presentations to allow the ESCo access to client site.	CPr; MPr	PM; DM	Travel and man-hours	Signed NDA
b)	Negotiate NDA with client.		PM; DM		

A description of the process steps follows in the corresponding paragraphs below.

a) The purpose of the first contact visit with the client is to introduce the ESCo, their services and offering. All discussions are general and informative. Experience showed that technical details should not be discussed at this meeting for two reasons:
   - The information about DSM is already new and can be too overwhelming for the first round of discussions.
   - Without a signed NDA in place, the client can steal the ESCo's IP and attempt the project without the ESCo's involvement or compensation for IP.

   It may not be required at the first visit, but always be prepared to do a presentation that contains all the required information. Experience showed that being prepared reflects well on the ESCo's professional image.

b) The NDA agreement protects the interest of both parties while the investigation is being conducted. A short NDA document defining the basic terms and conditions makes sign-off easier than a long contract with multiple pages. See sample template in Appendix A.

A graphical representation of the process is shown in Appendix B.

4.5.2 Project validation process

The new validation process tests and simulates the proposed project technology. Table 8 shows the process summary.

Table 8: Project validation process

	Project validation	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Gather information and become familiar with the client system.	CPr; MPr	PM	Travel and man-hours	Required information, data and layouts
b)	Design experiments or simulate system.		SE	Man-hours	Technology-specific experiments or simulations
c)	Discuss simulations and proposed experiments with client.	CPr; MPr	PM	Travel and man-hours	Documentation of simulation results; risk assessment
d)	Conduct experiments.		PE	Travel and man-hours	Documentation of test results

A description of the process steps follows in the corresponding paragraphs below.

a) Meet with client technical personnel to gain an understanding of the specific system, its limitations and requirements. Request data, layouts and relevant information required for simulations. Experience showed that requesting correct and relevant data the first time saves time.

b) An analysis of the information gathered determines if a project will be feasible and whether the investigation should continue. Experience in the DSM field and ESCo technologies is required. Ideally, simulations are used to determine feasibility. When simulations are not possible, physical tests can be conducted on the system, which will always require the client's permission.

c) Discuss simulation results with the client and explain opportunities. If a simulation is not possible, discuss possible experiments that can be conducted to test feasibility. A risk assessment is required when testing the client's system outside

of its normal parameters/operations. This will be the guideline for a reaction plan should the system respond in a manner that has not been anticipated. Clients usually have a specific risk assessment template that must be used. The client's input is crucial in this step.

d) With the client informed and the risk assessment and reaction plan in place, the required experiments can be conducted. Experience showed that experiments should ideally be conducted when the system output parameters will be least affected in case something unexpected happens.

A graphical representation of the process is shown in Appendix B.

4.5.3 Compile findings report

The findings report is the written record of all work done during the investigation phase. The report includes a preliminary scope-of-work document that lists the critical requirements needed to achieve the proposed saving. This document also contains all the results from the simulations and on-site experiments. The information required to compile the project proposal document is drawn from this report. Table 9 shows the process summary for compiling the findings report.

Table 9: Findings report compilation process

	Compile findings report	**General sub-process**	**Personnel**	**Cost/cash flow**	**Deliverables**
a)	Compile preliminary scope of work.		PM; PE	Man-hours	Part of findings report
b)	Compile control philosophy.		PM; PE	Man-hours	Part of findings report
c)	Present scope of work and control philosophy to client for input and approval.	CPr; MPr	PM; PE	Travel and man-hours	Scope of work (part of findings report)
d)	Update changes and finalise preliminary scope of work.		PE	Man-hours	Final findings report

A description of the process steps follows in the corresponding paragraphs that follow.

a) The preliminary scope of work forms part of the findings report. It lists the critical components needed to achieve the proposed energy savings. An improvement learned from experience is using a project engineer or project manager with experience in the field for the costing process. This allows for more accurate costing predictions, which are used later in the proposal document.

b) The proposed control philosophy is also part of the findings report. This section describes the control philosophy and control parameters required to achieve the proposed energy saving. Energy management and environmental management standards are included in the design of the control philosophy. The results from the project validation process are required to complete the step.

c) Meet with the client representatives and present the proposed scope of work and control philosophy. Since this project will ultimately become the client's property, input and approval are required from the client. Minute all decisions made regarding the project scope and control philosophy.

d) Update the findings report if there were any alterations that were requested by the client. The final report must be filed for reference. An improvement to this process is that the reports are of a higher quality than before.

A graphical representation of the process is shown in Appendix B.

4.5.4 Compile proposal

This process assists with the writing of the complete DSM project proposal. Experience showed that it is required to contact the project approver (for example Eskom IDM) during this process to obtain a proposal template. Proposal requirements are continuously updated, thus by using the latest requirements when compiling a proposal, the risk of the proposal being disqualified when being evaluated is reduced. Table 10 shows the process summary.

Table 10: Proposal compilation process

	Compile proposal	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Acquire baseline data.	M&V Pr	PE; M&V expert	Travel and man-hours	Baseline checklist
b)	Compile project proposal document.		PM	Man-hours	Project proposal document

A description of the process steps follows in the corresponding paragraphs below.

a) As part of the internal M&V management process, experience showed that baseline data acquisition must be started as soon as the project is ready to be submitted. Project contracts cannot be signed without a signed baseline to measure the savings against. Starting with this process before it is requested by M&V will save time. The required data is by default part of the information required for simulations. Being thorough with this process will ultimately save time and reduce cost.

b) A proposal document is compiled from the information in the findings report. Ensure that all client-specific requirements are adhered to when compiling a project proposal for submission with a specific client. Request the client's specifications for project proposals before compiling the document.

A graphical representation of the process is shown in Appendix B.

4.6 Proposal submission and negotiation phase

Learning from experience with Eskom IDM DSM projects, the ESCo is involved with the M&V process, the negotiations for regulatory compliance requirements and contract terms during the proposal phase. The regulatory compliance requirements discussed are applicable when working for any government-owned entity.

The M&V and compliance requirements are included in the final contract. Figure 18 shows the flow diagram for the proposal phase. The processes coloured in green indicate where improvements were made. The yellow blocks indicate that there is still a degree of

risk that cannot be managed as the processes are not under the ESCo's control. The risk of the proposal being disqualified remains, but it can be reduced by submitting a quality proposal document that adheres to compliance requirements.

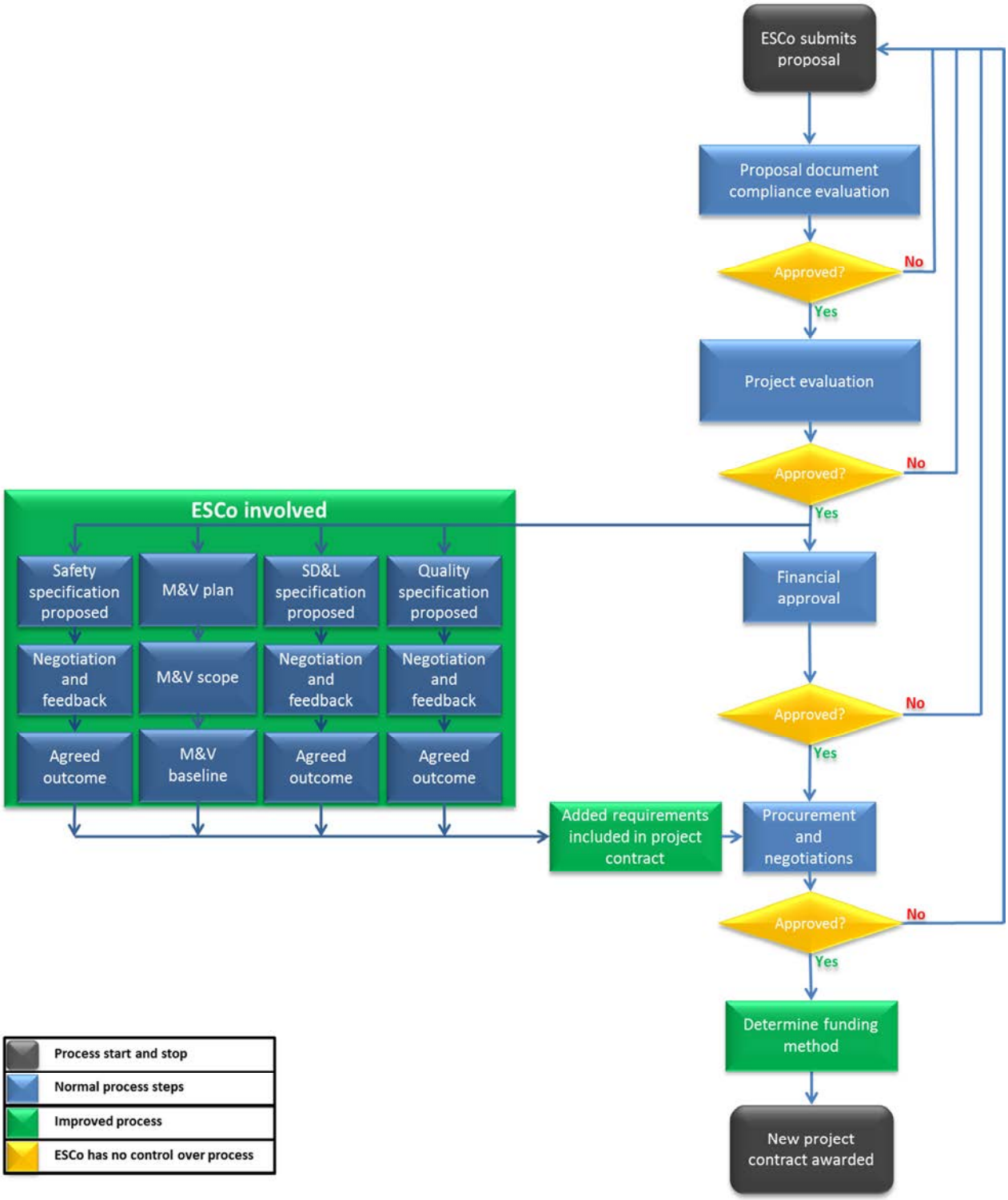

Figure 18: Project proposal phase

The process for this phase is a guide that the ESCo can use to submit a project proposal and manage all requests from the client and M&V teams while the proposal is being evaluated. Table 11 shows the process summary.

Table 11: Proposal submission process

	Proposal submission and negotiation	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Submit project proposal.		Runner	Travel and man-hours	Signed submission note
b)	Negotiate contract regulatory requirements.	MPr	DM	Travel and man-hours	Agreed compliance requirements included in the contract
c)	Sign M&V baseline.	M&V Pr	M&V expert		Signed baseline report
d)	Negotiate project contract with Eskom IDM.	MPr	DM	Travel and man-hours	Confirmation of documents received
e)	Determine funding scheme for project.		DM	Man-hours	Viable funding option
f)	Sign project contract with Eskom IDM.	MPr	DM	Man-hours	Signed project contract

A description of the process steps follows in the corresponding paragraphs below.

a) It can happen that a project proposal that was submitted to a client is misplaced. If the proposal is not in the Eskom IDM submission queue when projects are selected for procurement, then is it not considered. An improvement is to obtain proof of submission. Experience showed that the delivery note must be signed by an Eskom official when a project proposal is submitted.

b) Project contracts can have regulatory compliance that include:
   - Safety requirements;
   - SD&L requirements; and
   - Quality requirements.

These requirements are specific to each contract and thus the terms for each contract are negotiated with the ESCo. Experience showed that it is important to negotiate these requirements to be as realistically achievable as possible.

c) The new project contract can only be signed if the M&V baseline report has been signed. This is the reason why preparations for this step were made during the investigation phase. Once all required parties have signed the baseline document, the proposal can move to the negotiation process.

d) Before the project contract is signed, the ESCo will have the opportunity to negotiate the terms of the contract. Experience showed that important clauses to scrutinise when negotiating the contract are:
   - *Force majeure* conditions;
   - Payment terms and conditions;
   - Savings targets;
   - End dates;
   - Regulatory compliance commitments; and
   - Contractual commitments.

e) An important process in the phase is the funding method selection. With the Eskom IDM ESCo model, Eskom funded the project. Eskom IDM's new funding scheme is a modified performance-based model. Funding is received after implementation with no overperformance benefit. Thus, as with any other DSM project, an ESCo is required to find funding to implement the project. Funding options include self-funding, loans, third-party financiers etc. Since funds are required during project implementation (which will start with the signing of the project contract), securing funding at this stage is crucial to the success of the project.

f) If an agreement can be reached between all parties, the client will place a project contract on the ESCo. The terms of the contract will be clearly stated in the contract document.

A graphical representation of the process is shown in Appendix B.

4.7 Project installation and commissioning phase

The model of the improved processes in the implementation phase is similar in appearance to the old model. The high-level flow diagram shown in Figure 19 supports this statement. The improvements in risk management reside within the detail of each process. The processes coloured in green indicate where improvements were made. These are discussed in the following sections.

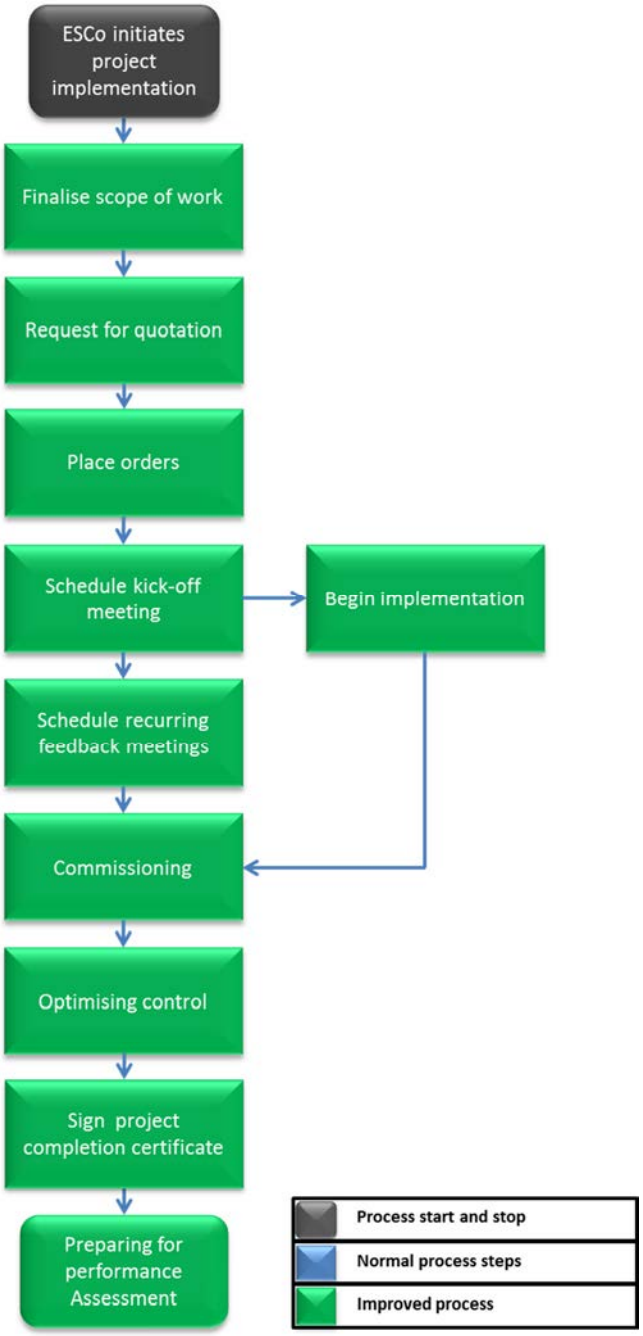

Figure 19: Implementation phase with improved processes

4.7.1 Project management processes

The project management process is generally required throughout the implementation phase. This process assists in managing the quality of the projects. Table 12 shows the project management process summary.

Table 12: Project management process

	Project management process	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Manage project plan and completion dates.		PM	Man-hours	Project plan, meeting minutes
b)	Manage sub-contractor commitments.	CPr	PM; PE	Man-hours	Project plan; order agreement
c)	Invoice and track payments.	PPr	PM	Man-hours; contractor payments	Payment documents
d)	Manage SD&L commitment.		PM	Man-hours	SD&L outcomes as per project contract
e)	Manage ESCo personnel.	MPr	DM	Man-hours	Weekly planning sheet and tasks
f)	Maintain client relations.	CPr	PM; PE	Travel and man-hours	Continuous recurring meetings
g)	Audit project milestones.		PM; PA	Man-hours	Audit checklists

A description of the process steps follows in the corresponding paragraphs below.

a) All the project deadlines must be agreed and signed off by the parties involved. Experience showed that a suitable opportunity to do this is at the project kick-off meeting. It is essential for all parties to be involved with this process to ensure cooperation. There are, however, costing and tender processes that take place before this meeting and it is the ESCo's responsibility to manage these processes according to schedule.

b) Should sub-contractors be used during the implementation phase of a project, their contractual obligation must be managed thoroughly. Any delay on a deadline is a delay that the ESCo suffers on its contractual commitments. A sub-contractor's contractual obligations will be stipulated in the order agreement. The improvement to this process is the increase in intervals during which a sub-contractor is monitored. The frequency is determined by the severity of the work and progress when compared with the project plan.

c) Large orders are usually invoiced in portions and it is thus crucial to keep track of payments made to avoid double payment. The project manager uses a payment tracking sheet to check invoiced hardware or services against the detail of the order. An improvement is to keep detailed payment tracking sheets showing invoice numbers, payments and critical dates of payment.

d) All new Eskom IDM contracts have SD&L commitments as part of the regulatory compliance in the contract. This will be the case with most South African government-owned entities. If these commitments can be met and approved before performance assessment starts, the ESCo will not face SD&L retention deductions. This new process requires the ESCo to fulfil all SD&L outcomes, compile a file with all supporting SD&L documents and to submit it to the authority that is responsible for approval. Experience showed that it is required to sign the files over upon delivery, as they can be misplaced.

e) Experience showed that planning meetings with ESCo personnel should be held on a regular basis to optimise efficiency. Strategic planning as a group provides a learning environment as part of the ESCo's business model. This allows the project managers to share thoughts on issues and find solutions in reduced time.

f) From experience, it has been learned that continuous feedback meetings should be held with the client to keep them informed and committed to the project. Any matters concerning the project schedule, access requirements etc. should be discussed at these meetings. The improvement is to adjust the frequency of these meetings as required. More frequent meetings are required during installation and commissioning to reduce the time between discovering issues and implementing solutions.

g) Auditing of project milestones is a new process that ensures that the quality of an ESCo's service, project documents, project files and general project management is on standard. Quality audits are scheduled as and when crucial project milestones are achieved. The project auditor uses a checklist to verify that all project and quality requirements for the achieved milestone are adhered to. This process is part of the ISO 9001 compliance required from ESCos. Thus, in terms of the PDCA approach, non-conformance to quality requirements require the issue to be addressed and re-evaluated until the quality requirement is met. A template audit check sheet is shown in Appendix A.

4.7.2 Costing and tender process

The costing and tender process is required to initiate the implementation phase of the project. Table 13 shows the costing and tender process summary.

Table 13: Costing and tender process

	Costing and tender process	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Update project parameters from investigation.	CPr	PM; PE	Travel and man-hours	Update findings report
b)	Re-evaluate proposed scope of work.		PM; PE	Man-hours	Internal review of design
c)	Draw up tender documentation.		PM	Man-hours	Request for quotation (RFQ)
d)	Conduct tender meeting and site visit.	MPr	PE	Travel and man-hours	Quotation submission deadline
e)	Receive and evaluate quotes.		PM	Man-hours	Contractor evaluation; bill of quantities (BOQ)
f)	Client agrees and signs off scope of work.	CPr	PM	Travel and man-hours	Signed scope of work
g)	Negotiate and place sub-contractor orders.	MPr	PM	Man-hours	Signed order document

A description of the process follows in the corresponding paragraphs below.

a) Experience showed that project proposals can be with Eskom IDM for extended periods. When a new project contract is finally received, the parameters of the

proposed project may have changed. This may be the case with other industries as well, especially South African government-owned entries. An improvement is to have the project parameters reinvestigated and simulated before any money is spent on the project. This will confirm whether the proposed project savings are still achievable.

b) A new process is to check if the proposed project and control philosophy are still relevant. Small changes can usually be accommodated by alterations to the original scope of work. However, if the changes affect the achievability and sustainability of the proposed savings, a decision should be made whether to continue with the project before any further work is conducted. In extreme cases, the project contracts must be cancelled to avoid financial losses resulting from underperformance on the proposed savings.

c) If sub-contractors are required to assist with installation on the project, the preliminary scope of work from the findings report is used to draft an RFQ document that is sent out to sub-contractors. A new process is to include sub-contractors in the regulatory requirements enforced by the project contract. This information is included in the RFQ documents as well, for example, training and job creation opportunities. The ESCo can use this information to share risk on achieving SD&L outcomes. A sample RFQ is listed in Appendix A.

d) Sub-contractors that are interested in quoting on the project are invited to a tender meeting that is conducted with an on-site introduction and investigation.

e) Contractors are required to submit tenders before a predetermined deadline. All tenders received by the deadline must be evaluated in terms of:
   - Cost: What rate and mark-ups are included?
   - Equipment: Is the proposed tender complete and according to specification?
   - B-BBEE and SD&L requirements: Does the contractor comply with the required SD&L requirements set by Eskom? (This is a new addition to the process.)
   - Contractor's skill: Is the contractor competent and capable of performing the work?
   - Financial due diligence checks: Are finances and tax clearance certificate etc. in order?

f) Once a suitable tender has been approved, the final BOQ and scope of work are approved and signed off by the client. The scope of work approval process has gone through several iterations. Experience showed that meeting with the client and discussing the scope of work and BOQ in detail saves time when approving documents. All decisions made are listed in the minutes of the meeting and signed by all parties.

g) A formal order agreement is placed on the contractor for the tender work. The agreement will include:
   - The payment terms;
   - Milestone dates;
   - Regulatory compliance;
   - Confidentiality; and
   - Contractual requirements.

   An important improvement to the process is the inclusion of a retention amount on the sub-contractor to ensure compliance with SD&L commitments. A sample order agreement is listed in Appendix A.

A graphical representation of the process is shown in Appendix B.

4.7.3 Project implementation process

While the project management process focuses on the project schedule and quality of the project, the project implementation process focuses on the actual work that is conducted. Table 14 shows the project implementation process summary.

Table 14: Project implementation process

	Project implementation process	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Schedule kick-off meeting.	CPr; MPr	PM; PE	Travel and man-hours	Project plan, project champions
b)	Order long lead items.		PE	Man-hours	Meeting minutes
c)	Go through induction process.	CPr	PE	Travel and man-hours	Safety files and medicals

	Project implementation process	General sub-process	Personnel	Cost/cash flow	Deliverables
d)	Install hardware.	CPr	PE	Travel and man-hours	Feedback on progress; installation checklists
e)	Configure software.		PE	Travel and man-hours	Software configuration checklists; savings reports
f)	Test and optimise control.		PE	Travel and man-hours	Savings reports

A description of the process steps follows in the corresponding paragraphs below.

a) The kick-off meeting is a crucial start to the project implementation process. The project champions from the client and ESCo are appointed, a project plan is agreed and an on-site induction is scheduled.

b) Since an induction process can take several weeks to be completed (depending on the site and industry), a new process is to order long lead items on the BOQ in advance. A method to identify long lead items is to look at components that will affect the critical path of a project if any delay is experienced.

c) The induction and medical procedures are site- and industry-specific. The induction procedure introduces the ESCo and sub-contractors to health and safety issues in general and to circumstances unique to each site. Experience showed that depending on the requirements of the induction, it could take several weeks to complete. This period should be considered when drawing up the project schedule and project costing. An improvement is to schedule off-site work for this period. This way, resource utilisation time is optimised.

d) Once induction has been completed, on-site work can commence according to the project schedule. An improvement to the process is to do as much as possible work in parallel. This allows extra time to test and optimise the system before performance assessment starts. Experience showed that in order to ensure that

all work is completed, a modified BOQ can be used as an installation checklist for completed work.

e) After the hardware installation has been completed, the software configuration can commence. Experience showed that it is recommended to use a checklist to ensure that all components are installed, settings are correct and connections are in place. This improves the quality of the product and the ESCo's service. It also saves time by not having to revisit work that has already been done.

f) Once all required equipment has been installed, control philosophy functionality tests can commence. Optimising the system controls before performance assessment starts will reduce the risk of underperformance during assessment.

A graphical representation of the process is shown in Appendix B.

4.7.4 Client personnel training process

The process required to train client personnel is explained in the paragraphs that follow. For example, client personnel are given product training to operate an EMS. Table 15 shows the training process summary.

Table 15: Client personnel training process

	Train client personnel	**General sub-process**	**Personnel**	**Cost/cash flow**	**Deliverables**
a)	Conceptual explanation of EMS.	MPr	PE	Travel and man-hours	EMS training manual
b)	Practical training.		PE	Travel and man-hours	Training certificate

A description of the process steps follows in the corresponding paragraphs below.

a) Effective training consists of theoretical conceptual training and the practical application thereof. An improvement is to hand out training manuals explaining the workings of the EMS and specific technologies. A manual serves as a fallback document to refresh training or as a guide when new personnel become involved with the EMS.

b) To improve the quality of training, a practical training process follows the training given in theory. New to this process is gathering proof of attendance to these training sessions for SD&L purposes. Thus, copies of personnel identification documents and a signed attendance register are required. This will serve as supporting documents in the SD&L file discussed earlier. As part of the training process, certificates acknowledging participation in the training course are handed out.

A graphical representation of the process is shown in Appendix B.

4.7.5 Project handover process

The project is ultimately handed over to the client. To ensure that all the project requirements and specifications are done to client standards, all project components are commissioned and signed off by the client. Table 16 shows the project handover process summary.

Table 16: Project handover process

	Project handover process	**General sub-process**	**Personnel**	**Cost/cash flow**	**Deliverables**
a)	Cold commissioning	MPr	PE	Travel and man-hours	Confirmation to start hot commissioning; risk assessment
b)	Hot commissioning	MPr	PE	Travel and man-hours	Commissioning certificates, data pack
c)	Project sign-off	MPr	PM; PE	Travel and man-hours	Completion certificate

A description of the process steps follows in the corresponding paragraphs below.

a) Cold commissioning grants an opportunity to evaluate the quality of installations. These evaluations include confirmation whether components are installed, if the installation complies with all requirements and if it can be tested as part of an active system. Client representatives are required to approve the installations and allow hot commissioning to commence. Clients prefer to have a risk assessment conducted to structure the process of hot commissioning and to identify the actions

required in case something goes wrong. An improvement to the process is to have the approval signed off. The meeting process can be used for this purpose.

b) During hot commissioning, all components implemented are tested as part of the system. As the components pass the quality standards and control requirements, commissioning certificates are signed off by all relevant parties. Experience showed that all relevant parties should be involved throughout the commission process. This saves time by not having to repeat tests. As part of commissioning, a data pack containing information about all the new hardware installed is handed over to the client. An improvement is for the ESCo to keep a copy of the data pack for their own records. Not only does it improve the quality of the record-keeping on the project, but it also serves as a backup copy should the client lose the data pack.

c) Once all the systems components have been successfully commissioned, the project completion certificate can be signed by the client. This milestone signifies the end of the implementation phase and the beginning of performance assessment.

A graphical representation of the process is shown in Appendix B.

4.8 Performance assessment phase

All Eskom IDM DSM models have a three-month performance assessment period. DSM projects implemented outside the Eskom IDM environment will also need to be assessed regarding their performance after implementation. The lessons learned and the improvements made to the processes in the Eskom IDM framework are discussed.

Figure 20 shows the improved flow diagram for the performance assessment phase. The processes coloured in green indicate where improvements have been made.

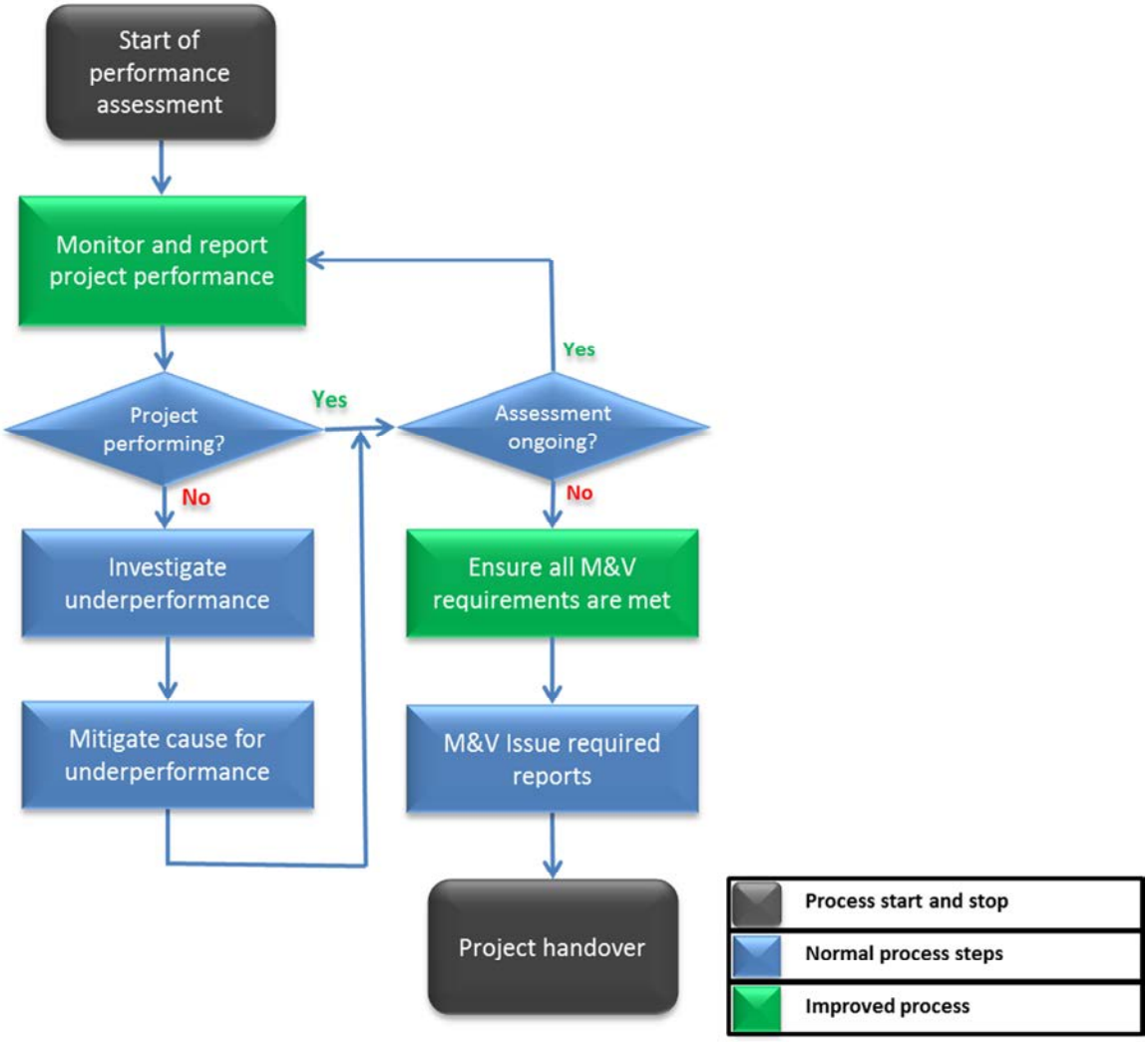

Figure 20: Performance assessment phase

4.8.1 Performance assessment process

Performance assessment is the period during which an ESCo proves the concept of the project. Successful completion of this phase will result in the ESCo's first payment. Table 17 shows the performance assessment process summary.

Table 17: Performance assessment process

	Performance assessment process	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Review baseline.	M&V Pr	PM	Man-hours	Relevant baseline
b)	Monitor and manage project performance.		PE	Man-hours	Report on project performance

	Performance assessment process	General sub-process	Personnel	Cost/cash flow	Deliverables
c)	Report on project performance.		PE	Man-hours	Savings reports
d)	Review performance assessment documents.	M&V Pr	PE	Man-hours	Performance assessment M&V reports
e)	Review performance certificate.	M&V Pr	PE	Man-hours	Performance certificate
f)	Sign handover certificate off.	CPr; MPr	PM	Man-hours	Signed handover certificate
g)	Invoice project.		PM	Man-hours; receive funding	Invoice

A description of the process steps follows in the corresponding paragraphs below.

a) The new process is to review the relevance of the project baseline. The baseline document will make provision for changes to the baseline should something outside the scope of the project affect the baseline. An incorrect baseline can lead to underperformance that will result in financial losses.

b) To ensure that the project is performing as intended, it is crucial to monitor the performance of the project continuously. Any underperformance will reduce the average savings and thus the funding the ESCo receives. Experience showed that continuous reporting to the client about the issues experienced reduces the risk of issues reoccurring.

c) To ensure that the client is informed about the project's performance, the frequency of reporting was increased. Savings reports should be sent out to the responsible client personnel on a daily basis. Experience showed that if clients are informed about the project's performance and the resulting benefits, the risk of the project being neglected is reduced.

d) The M&V team will issue a performance assessment report at the end of each month, which reports the average savings for the month. It is crucial for the ESCo

to check the content of these reports. This implies that the project engineer tracks the performance of the project and knows which savings to expect. Any issue with these reports must be challenged as soon as the issue is discovered. The improved M&V process helps to accelerate this process.

e) Similar to the monthly reports, the performance certificate is issued at the end of the performance assessment period. This report summarises the average savings for the performance period and ultimately the percentage of funding that the ESCo will receive with the first payment. The improved M&V process helps to accelerate this process.

f) The savings value on the performance certificate is the savings value that Eskom IDM issued on the MAD certificate. For other clients using handover certificates, this value may also be part of the document. It is important that this value is correct, as it is crucial when calculating ESCo payments.

g) Once the project has achieved the proposed savings, the payment linked to the performance of the project can be claimed (Refer to performance-based DSM funding models discussed in Chapter 2). This is achieved by invoicing for payment. Experience showed that similar to making payments, keeping track of invoices issued and following up on late payment is crucial to maintain a continuous cash flow.

A graphical representation of the process is shown in Appendix B.

4.9 Maintenance phase

Under the new Eskom IDM DSM model, ESCos are required to maintain a project for three years after implementation. In future, South African ESCos will thus be required to sustain projects in any funding model. Experience gained from maintenance contracts showed that the actions required by an ESCo to maintain a DSM project can be summarised as illustrated in Figure 21.

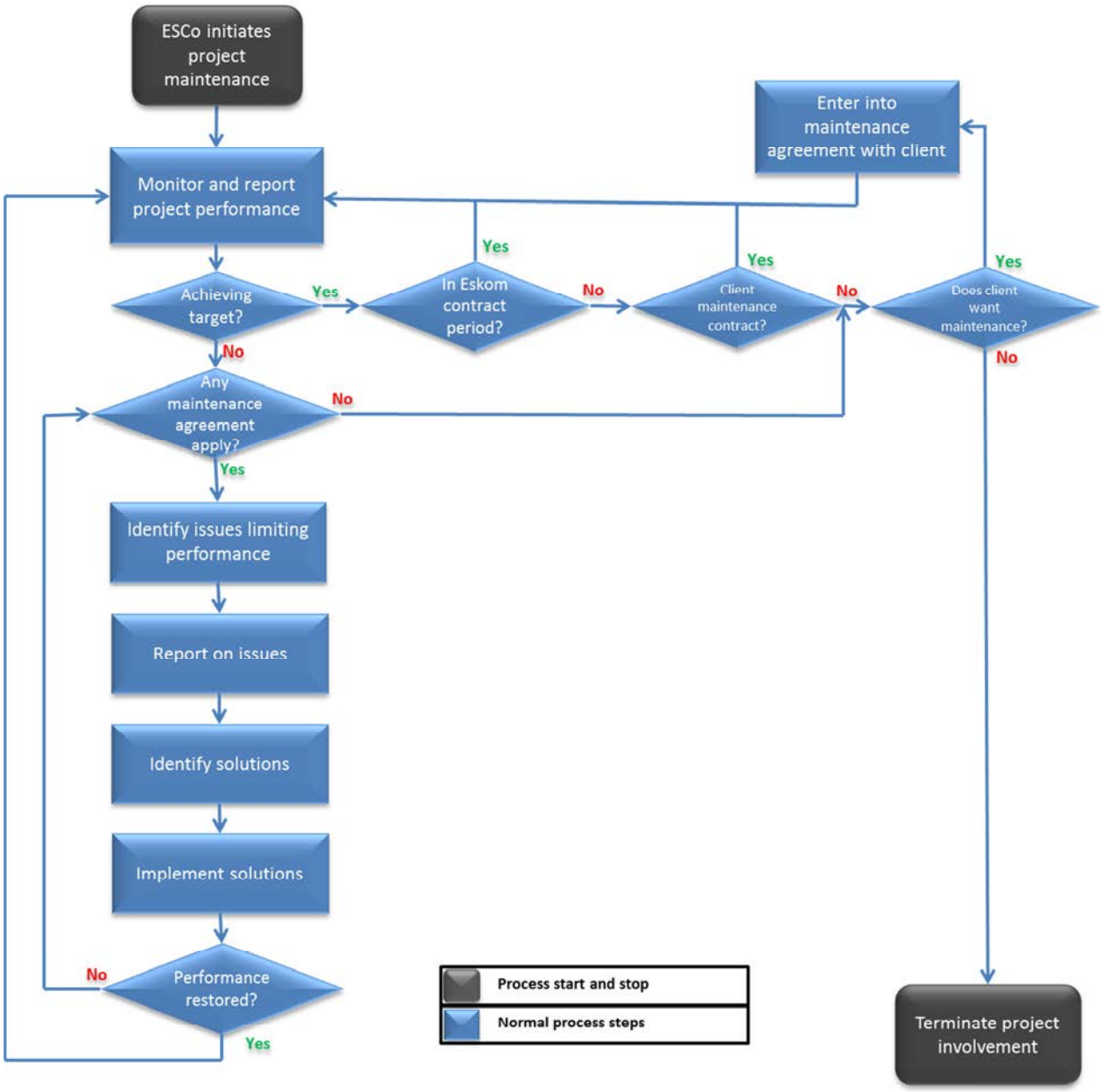

Figure 21: Maintenance phase

The purpose of this new process is managing project performance in order to achieve the proposed savings. The performance of a project is directly related to the periodic income that the ESCo will receive. Table 18 shows the maintenance process summary.

Table 18: Maintenance process

	Maintenance process	General sub-process	Personnel	Cost/cash flow	Deliverables
a)	Review baseline relevance.	M&V Pr	PM	Man-hours	Relevant baseline
b)	Monitor project performance.		PE	Travel and man-hours	Project performance feedback
c)	Report on project performance.		PE	Man-hours	Savings reports
d)	Review performance tracking.	M&V Pr	PE	Man-hours	Performance tracking – M&V reports
e)	Invoice project (maintenance periods).		PM	Man-hours; receive funding	Invoice
f)	Monitor control relevance.		PE	Man-hours	Effective control philosophy

The management of this process is the same as for performance assessment. The one difference is that the engagement period is longer. This requires an additional step to ensure that the control of the project remains relevant. Experience showed that client operations and infrastructure can change. This can result in the project control philosophy requiring updates. Maintaining the control philosophy is one of the services that the ESCo provides.

The ESCo can issue invoices at the end of each agreed performance term. Constant performance is required to ensure a continuous cash flow. The M&V tracking reports serve as proof and motivation for Eskom to pay the ESCo's invoices. Experience shows that these reports must also be managed by the internal M&V process to ensure accurate and on-time reporting. A graphical representation of the process is shown in Appendix B.

4.10 Conclusion

The processes that were designed and improved in this chapter were improved through experience. Even though the Eskom IDM DSM funding model continuously changes and new rules increase the risk that ESCos experience when implementing these projects, the fundamentals remain the same.

The goal of the study was verified when the old and improved process structures were compared in the project phases. The project phases before and after improvement remained the same, while improvements were made to the processes in order to manage the risk ESCos would experience.

5

IMPROVED PROCESS RESULTS

Chapter 5: The results for the improved ESCo processes and risk quantification tool are discussed in this chapter.

CHAPTER 5: IMPROVED PROCESS RESULTS

5.1 Introduction

As a case study, all the processes improved in this study were implemented and used by the largest ESCo in South Africa. This ESCo has been operating in the industry for more than a decade and it specialises in implementing and maintaining Eskom IDM-funded DSM projects at industrial clients. Since the start of the Eskom IDM DSM programme, the ESCo has successfully completed 129 DSM projects.

Due to the continuous improvements made to the processes, no project implemented by the ESCo used all of the final improved processes. In addition, the processes were developed as lessons were learned for challenges experienced. This resulted in not all the processes being used with each of the 129 projects.

The unique nature of each project made it difficult to do an accurate project-to-project comparison of the effect the processes had on the risks of the projects. However, a common denominator across the projects was the senior project managers who used all the processes. An evaluation of how risk is perceived with each process yielded measurable results on whether the new processes improved risk management.

Thus, to demonstrate that the improvements made to the processes were successful, it needs to be evident from the results that:

- The ESCo business model benefitted from the improved processes;
- Risk is managed by using the processes; and
- Risk perception can be quantified.

The following paragraphs will discuss these three topics. Refer to Appendix D for a list of details regarding the 129 projects considered.

PDCA is key with both the ISO quality (9001) and -risk (31000) management standards. Since these standards form part of the risk management processes developed in the study, the same method was used to monitor the processes after implementation. The successful monitoring of the processes will be evident in the perceived success achieved with the processes.

5.2 ESCo business model performance

As explained in Chapter 3, a business model comprises the processes a company uses to achieve economic value. Thus, any improvements to an ESCo-specific business model are the result of the improvements made to the processes that the ESCo uses. To evaluate the improved business model for ESCos, the impact of the processes on resource management, project performance and project completion times is evaluated.

The first four project phases focus primarily on project implementation and handover. The processes used during these phases are designed to investigate, propose, implement and assess DSM projects.

When Eskom IDM DSM started, the ESCo implemented two to three projects simultaneously in parallel using variants of the mentioned processes to achieve success. Figure 22 shows the number of projects awarded to the ESCo per year since the start of the Eskom programme. This data was retrieved from signed project contracts. Eskom IDM acquired more funding in 2006, which resulted in more project opportunities [81]. The ESCo submitted more project proposals and, as shown in Figure 22, the ESCo received its first large project contract in 2007.

The improvement of the discussed processes started in 2008 in an effort to manage the risk involved with implementing more projects in parallel. Continuous improvements through the PDCA method led to the processes discussed in this study. To accommodate the additional workload resulting from implementing more projects in parallel, the ESCo's resources had to be managed efficiently. The scalable resource structure and resource management processes discussed in Chapter 4 were used to accomplish this.

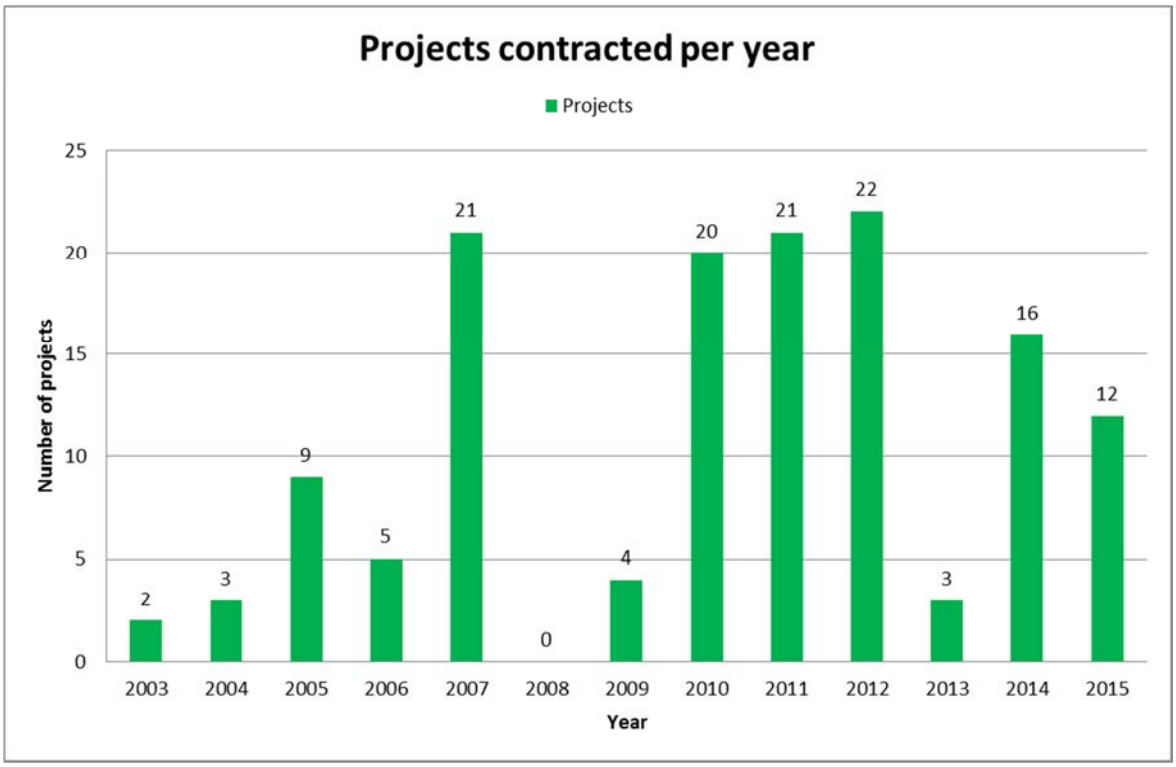

Figure 22: Project distribution

The reduction of projects in 2013 was due to funding issues experienced by Eskom IDM and is not a reflection on the ESCo's capability to handle more projects. On average, the ESCo completed six DSM projects per year during the first half of the Eskom IDM programme (2003–2009). This figure increased to 16 projects per year over the second half of the programme (2010–2015), which is a 260% increase. The success was due to the availability of projects and the ESCo's capability of implementing them.

Compiled from official M&V reports, the ESCo's project performance is shown in Figure 23. The ESCo continuously overperformed on the proposed project savings. An average overperformance of 14% was sustained after the implementation of 129 projects. The constant overperformance is significant for two reasons:

- More projects were implemented in parallel, which resulted in more risk from the increased exposure.
- As more projects were implemented, the subsequent projects became more difficult to complete. In other words, the lowest hanging fruit were plucked first and the subsequent projects involved more risk to accomplish.

Yet, as shown in Figure 23, the ESCo maintained its overperformance trend despite the increased risk. This was a result of the improved process used to investigate, propose, implement and assess these projects.

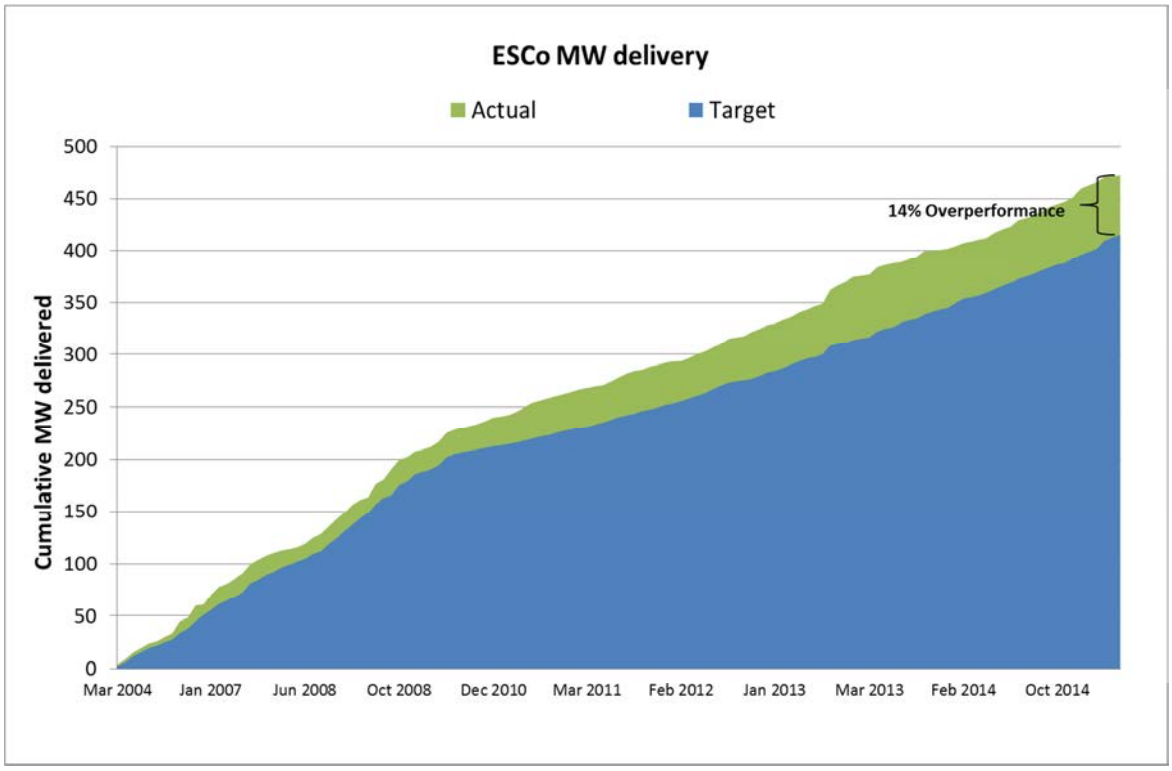

Figure 23: Case study – MW overperformance

According to the original signed contracts, the first Eskom IDM DSM projects had to be completed within 18 months. Over time, Eskom IDM reduced the completion time to 12 months and finally to only six months. Despite the increased risk because of the reduced completion times, the ESCo still managed to complete projects on average 18% faster than the contracted deadlines. Once again, this was as a result of the improved process used to implement the projects.

Figure 24 shows the ESCo's contracted versus actual completion times in accumulated days for the 129 completed projects. Signed project completion certificates prove the completion dates of the projects.

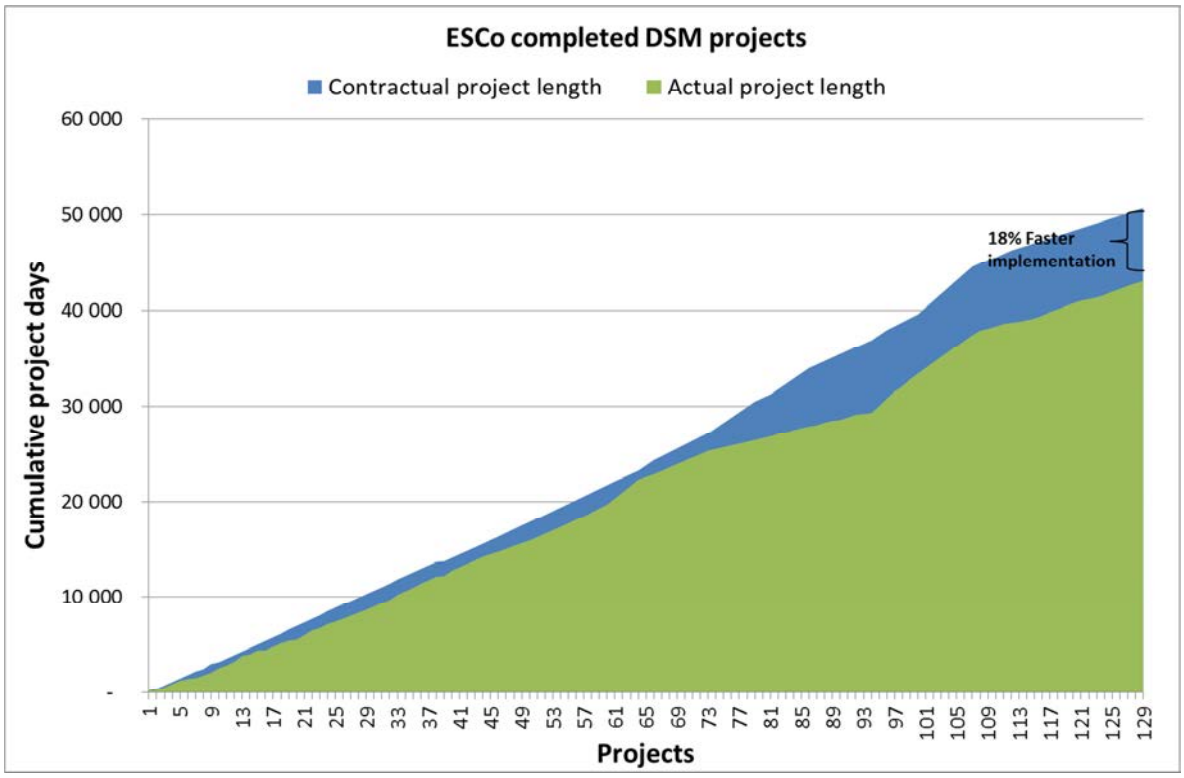

Figure 24: Case study – project completion success

Thus, the on-time delivery and achieved savings of projects resulted in a reduced risk of penalties. In addition, successfully implementing more projects resulted in more revenue for the ESCo. In terms of the business model definition in this study, it is clear that the improved processes resulted in outcomes that increased the economic value of the ESCo. In fact, the ESCo was not charged with any penalties while implementing the 129 projects.

As mentioned in Chapter 2, DSM project maintenance was not mandatory for ESCos with Eskom IDM DSM projects until 2015. However, since it became evident that project savings decreased after project handover, the ESCo started with DSM project maintenance in 2012. The ESCo engaged with clients where projects were neglected. Maintenance agreements were signed with these clients and the projects were revived. Figure 25 shows the average normalised savings of the projects revived and maintained by the ESCo.

An average 280% increase in savings was achieved as a direct result of the ESCo's involvement. These savings were achieved by utilising the maintenance process. This data was obtained from official savings reports that were issued to, and accepted by the ESCo's clients.

The revived projects were all load-shifting projects that required clients to reduce electrical load during Eskom peak periods. It can clearly be seen that the neglected projects did not achieve the desired load shift before the ESCo intervened. After the ESCo revived the projects, load-shifting control philosophies were implemented and the project savings were restored.

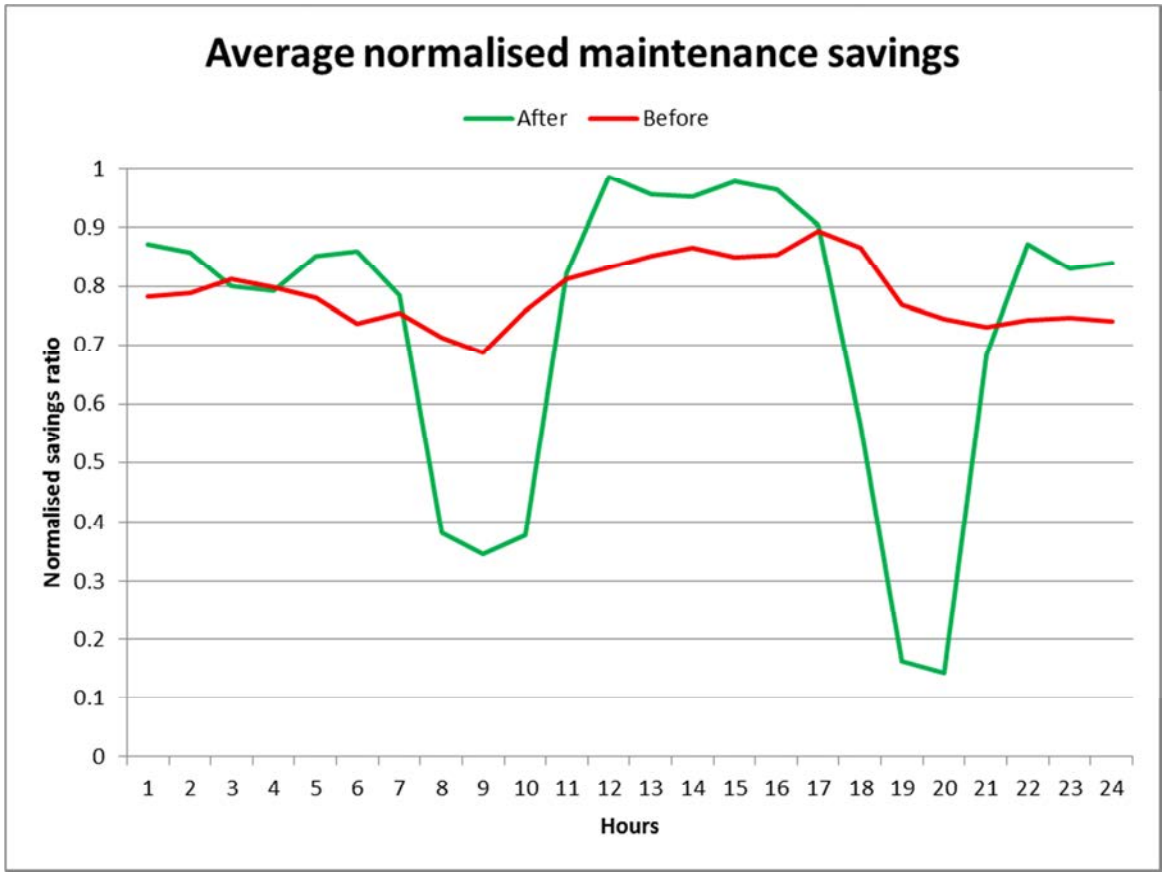

Figure 25: Average normalised maintenance savings

Thus, the processes improved in this study allow ESCos to be efficient at sustaining savings of DSM projects.

5.3 Risk quantification

To demonstrate the improvements to the risk management properties of the processes, the risk quantification tool was developed. A risk score for the processes was obtained by interviewing senior project managers involved with the ESCo and asking them to use the tool to score the perceived risk. These senior project managers (referred to as the interviewees) have on average eight years' experience with the ESCo and its processes.

The interviewees were asked to quantify the perceived risk involved with each process before and after improvements were made. The risk quantification tool, the procedure of the interviews and the results are discussed in the following sections.

5.3.1 Risk quantification tool

A risk quantification tool was developed by using basic risk management standards. As mentioned, risk is a perception. Thus to evaluate risk, the risk-taker's perception of risk needs to be quantified. The process developed to quantify risk has four steps. Figure 26 shows these process steps in chronological order and Table 19 explains the process.

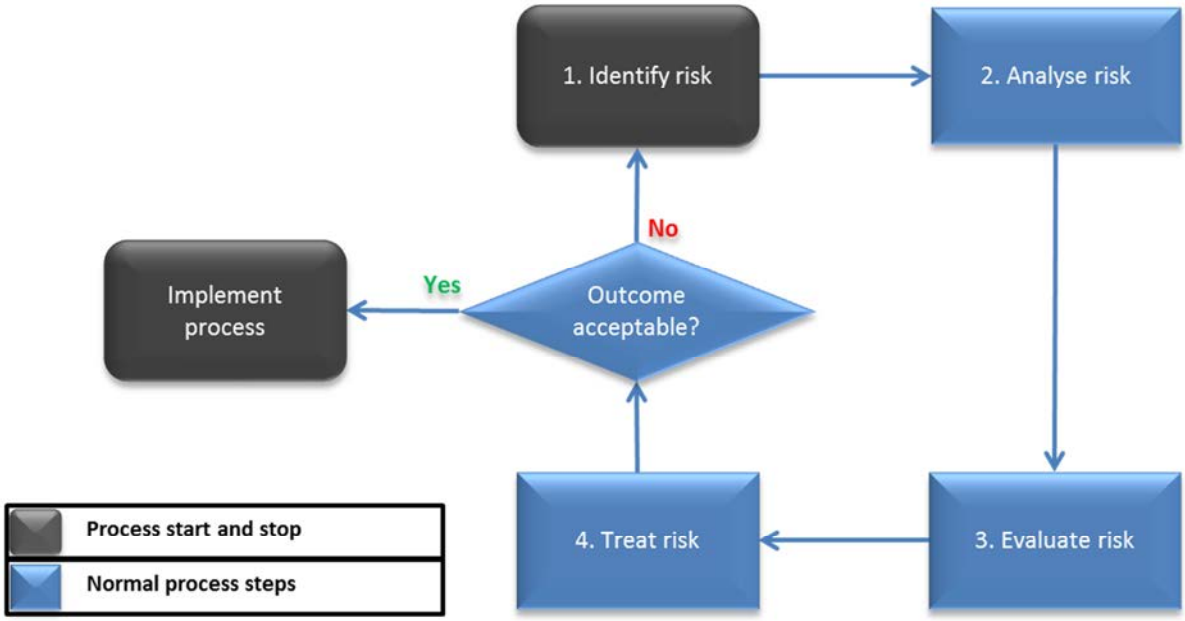

Figure 26: Risk quantification process

Table 19: Risk quantification process

	Steps	Explanation
1.	Identify risk.	Identify the risk to the process.
2.	Analyse risk.	Analyse the effect of the risk on the four process components. These are: • Cost (business experience profit or losses); • Time (project completion time increased or decreased); • Resources (consider the cost and time of personnel or equipment used); and • Quality (increase or decrease in the quality of the ESCo's service or product). The effect risk has on these four components forms the basis for the evaluation tool's results.
3.	Evaluate risk.	Qualify the perceived risk using the evaluation matrix (explained after the table). Each process component is evaluated on the perceived probability of the risk condition occurring and the severity if it occurs.
4.	Treat risk.	Based on the outcome of the risk evaluation, four questions need to be answered to aid the decision that is to be made. These are: • Has the risk been avoided? • Has the risk been reduced? • Can the risk be shared? • Is the risk acceptable? Process optimisation to manage risk must continue until the risk-taker deems the risk acceptable.

Risk evaluation:

As described in Table 19, perceived risk evaluation is done by scoring each of the four process components. Each component is scored according to the probability of a risk condition occurring and the severity if it does occur. A score of 1 to 10 is used to quantify the perceived probability and the severity of a risk occurring. A score of 10 would be the most probable and most severe; a score of 1 would be the least probable and least severe.

Figure 27 shows the scoring matrix for each process component. The probability and severity score per component is marked in the corresponding quadrant of the matrix. These scores are multiplied to yield a score out of a 100 per component. To achieve the final risk score, the average of the four component scores is calculated. Thus, a lower risk score is desired for the improved processes when compared with the previous versions of the process. This will prove that the perceived risk of a process was managed.

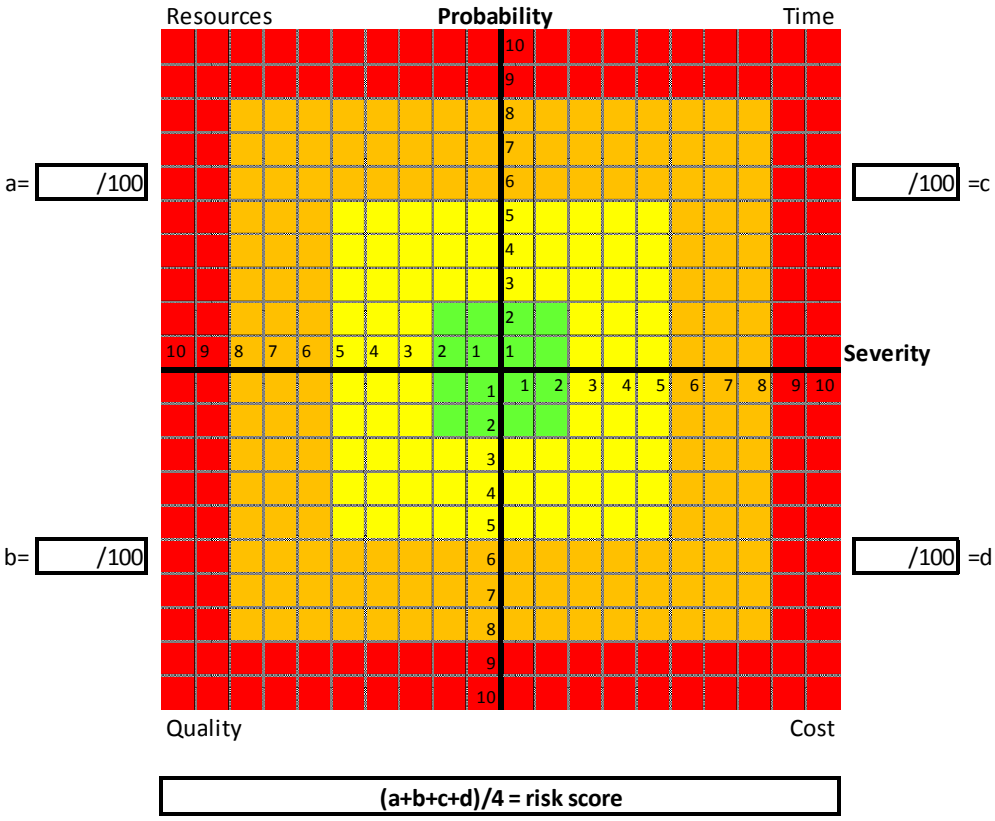

Figure 27: Risk evaluation matrix

5.3.2 Process for obtaining risk results

The reason for using an interview-based format was twofold:

- The interviewer informed the interviewee about the background pertaining to the study and explained how to use the new risk quantification tool.
- It ensured that the participants stayed on topic. Thus, normalising the context of the interview and the use of the new risk quantification tool.

The structure of the interviews was as follows:

- Each participant was handed a questionnaire that explained the purpose of the interview and how to use the risk quantification tool. The questionnaire used during the interviews is shown in Appendix C.

- The background and purpose of the study were explained to each participant before the process evaluation started.
- Each process, its background and its improvements were explained to the participants. They were then required to score the perceived risk with each process before and after improvement.
- Upon completion, all questionnaires were signed by the participants and filed for record-keeping purposes.

The results of the interviews are discussed in the section that follows.

5.4 Summary of interview results

The results need to prove two claims:

- The research states that risk is the perception of the risk-taker. Do the test results support this statement?
- Were the improvements made to the processes perceived as managing the risk involved?

Five senior project managers (hereafter referred to as the interviewees) who are involved with the ESCo and its processes were interviewed. Table 20 lists the relevant details about the interviewees.

Table 20: Summary of interviewees' credentials

Qualifications	5 × PhDs in engineering 5 × Pr. Eng. status
Average ESCo experience	8 years
DSM involvement	Eskom IDM DSM projects, client-funded projects, DSM project maintenance and DSM M&V

The results from the interview questionnaires are shown in Table 21. Appendix C lists the signed declaration of participation of all interviewees who participated in the interviews.

Table 21: Results from interviews

Process name	Interviewee 1		Interviewee 2		Interviewee 3		Interviewee 4		Interviewee 5		Average		Average perceived improvement
	Old	New	Old	New	Old	New	Old	New	Old	New	Old	New	
Communication	54.25	17.75	36.75	13.50	74.25	10.75	26.25	8.00	51.25	15.75	48.55	13.15	65%
Meeting	49.50	11.00	40.75	16.25	81.00	15.25	25.50	13.75	52.75	12.75	49.9	13.8	64%
Payment	47.75	6.50	28.75	19.75	23.75	3.00	20.50	7.50	75.25	10.50	39.2	9.45	70%
Internal M&V	46.25	7.00	41.25	22.25	83.50	20.75	34.00	6.00	64.50	17.00	53.9	14.6	61%
Marketing	58.75	15.25	36.75	22.00	64.25	27.25	32.75	8.25	53.50	21.75	49.2	18.9	70%
Project validation	46.25	24.00	53.25	11.75	64.75	25.00	24.00	5.00	58.50	15.25	49.35	16.2	67%
Findings reports	44.25	7.25	49.25	20.25	69.25	37.25	35.50	7.50	62.50	19.00	52.15	18.25	66%
Proposal compilation	28.50	13.00	49.25	20.25	61.50	31.00	31.50	4.50	81.00	21.00	50.35	17.95	68%
Proposal submission & negotiations	48.25	6.00	40.00	19.75	71.50	17.25	37.50	5.50	79.25	21.00	55.3	13.9	59%
Project management	78.50	3.00	52.00	15.50	68.75	40.50	23.25	4.00	70.25	25.00	58.55	17.6	59%
Costing and tender	57.50	13.50	45.00	9.75	66.25	28.25	29.75	5.00	73.00	21.00	54.3	15.5	61%
Project implementation	49.75	17.00	37.50	8.75	66.75	28.00	39.00	5.00	72.50	25.00	53.1	16.75	64%
Client personnel training	33.50	11.75	33.75	13.00	43.00	30.25	38.25	5.50	62.75	19.75	42.25	16.05	74%
Project handover	42.75	8.50	32.50	14.75	37.50	22.50	30.25	5.50	72.50	17.00	43.1	13.65	71%
Performance assessment	29.75	13.50	42.50	15.00	51.75	34.75	28.50	5.25	86.25	21.00	47.75	17.9	70%
Maintenance	35.00	13.25	43.75	9.00	29.50	34.25	30.00	5.25	61.25	25.00	39.9	17.35	77%
											49.18	**15.69**	**67%**
Avg. risk score per interviewee	46.91	11.77	41.44	15.72	59.83	25.38	30.41	6.34	67.31	19.23			
Avg. improvement per interviewee	65%		74%		66%		76%		52%		**67%**	**Total average**	
Normalised risk improvement	75%		62%		58%		79%		71%		**69%**	**Total average**	

As mentioned in Section 5.3.1, a lower risk score implies an improvement in risk management.

Figure 28 shows the interview results per process. From these results, the following conclusions can be made:

- The average perceived risk with all the processes were reduced by 67%, and
- The risk management improvements to all the process were successful.

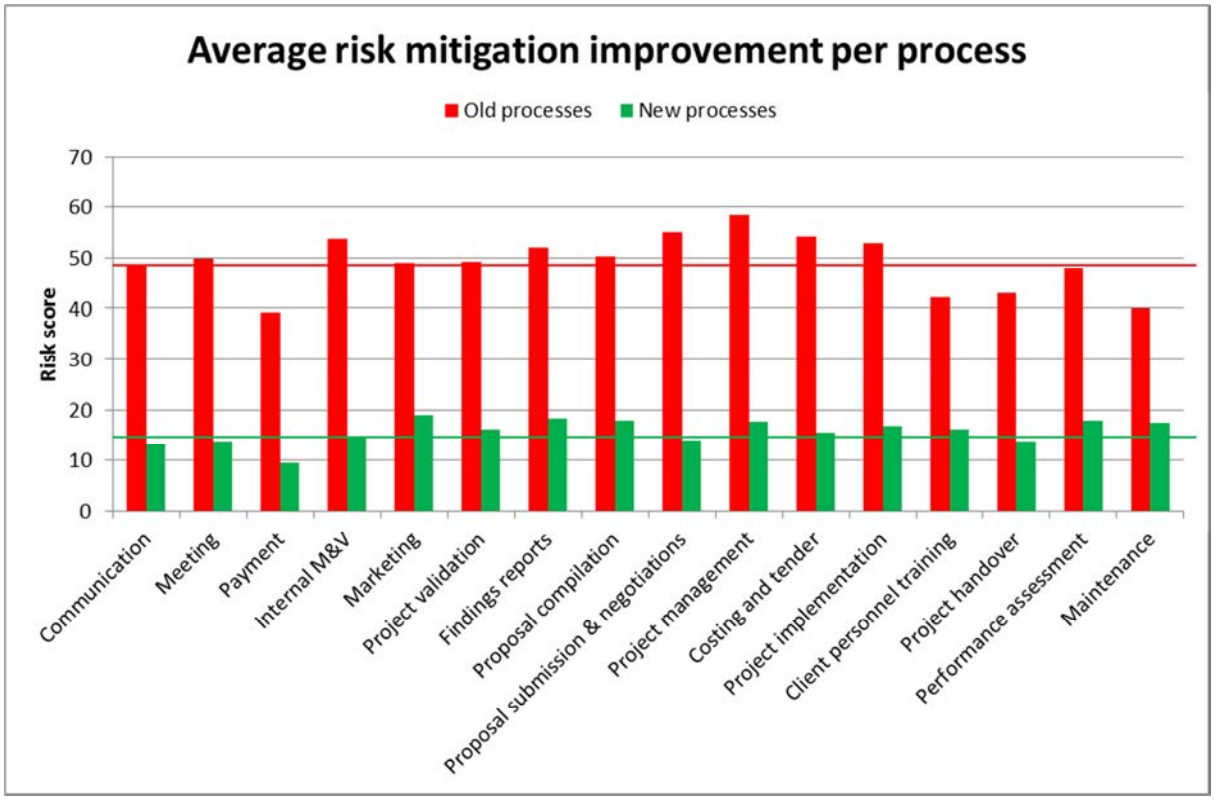

Figure 28: Perceived risk – old versus new processes

Figure 29 shows the average risk perception of each interviewee for the processes before and after improvement. From these results, the following can be concluded:

- Each interviewee perceived the risk differently. Consider the risk scores of the old processes that varied between 30 and 67. It can be concluded that perceived risk is unique to each risk-taker.
- All five interviewees perceived the risk management improvements made to all the processes to have been successful.
- A maximum 11% deviation was found with the risk scores of the improved processes. This still yields a conservative 58% improvement in risk management with these processes.

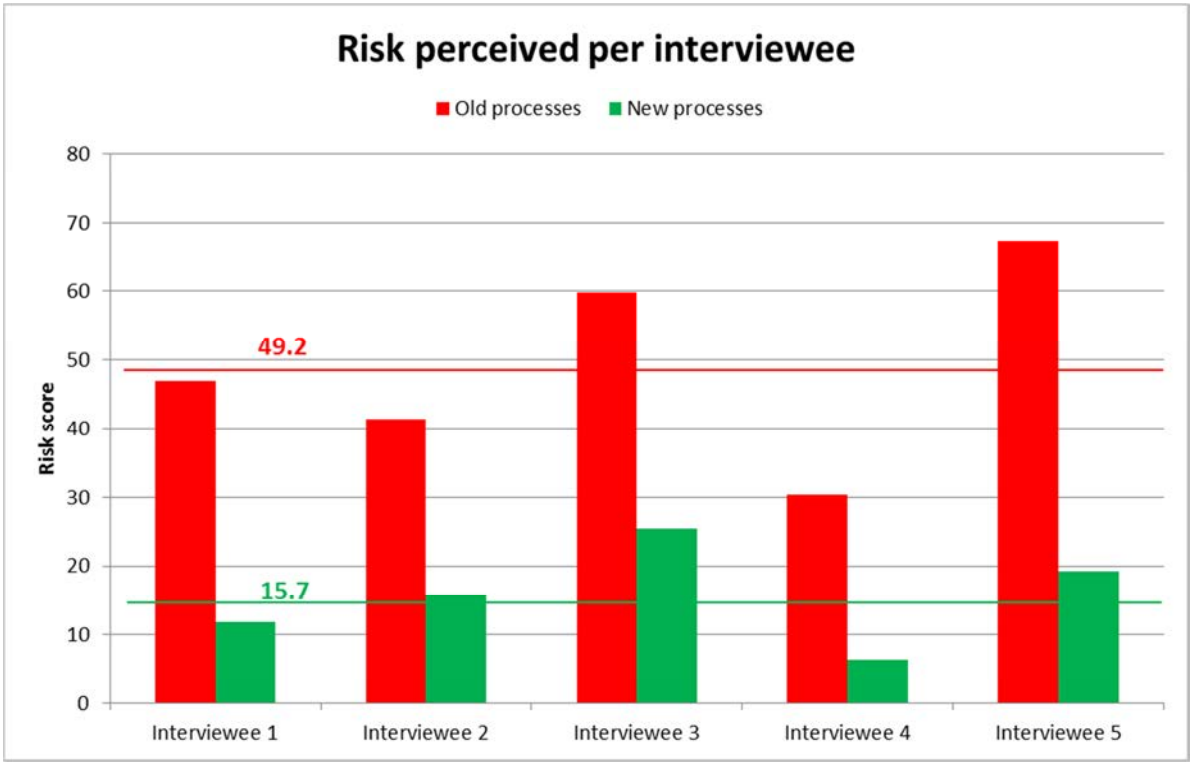

Figure 29: Perceived risk per interviewee

To achieve a better representation of the improvements made, the average results from each interviewee were normalised in terms of the risk perceived with the initial processes. Figure 30 shows the normalised perception of the interviewees. The data from this approach yields an average 69% improvement in risk management.

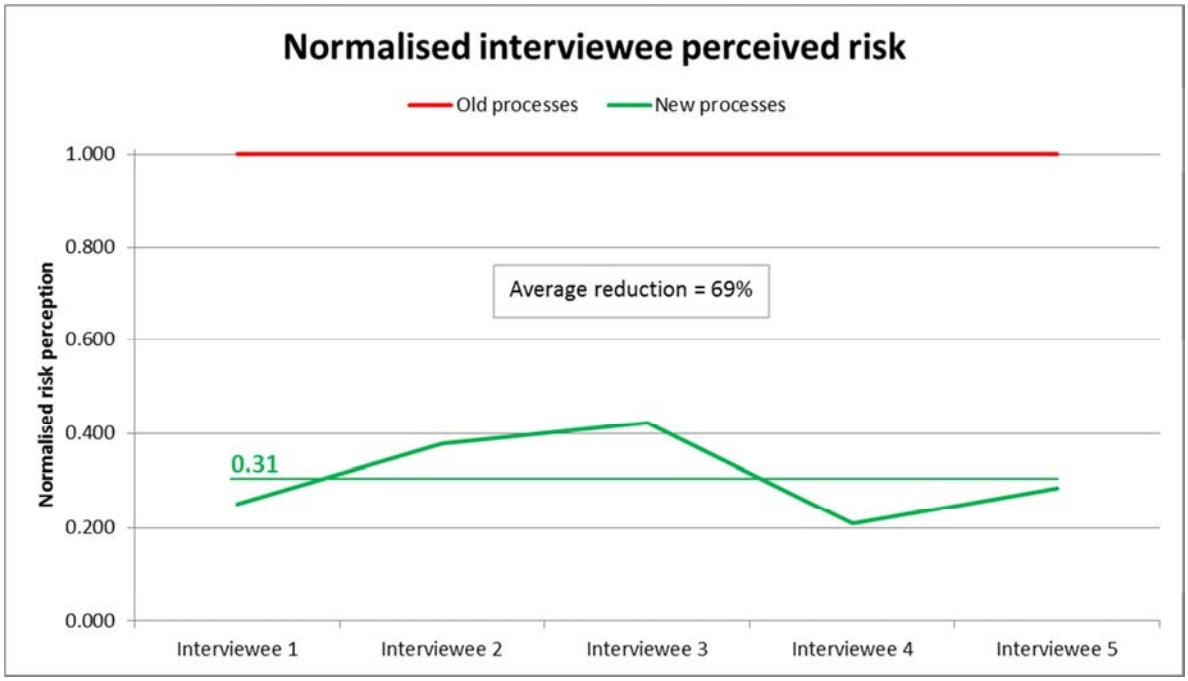

Figure 30: Normalised interviewee risk perception

Step 4 of the risk evaluation tool asked how the interviewees perceived the risk after improvement. In 100% of the cases, the risk with the improved processes was perceived to be reduced and acceptable. Risk was perceived as shared in all processes where other parties were involved in the process and were required to sign documents such as order agreements, minutes etc.

The risk quantification tool proved to be a valuable approach in achieving measurable results for the risk management of the processes. The tool focused on measuring the risk-takers' perceptions of a risk and was successfully used by the interviewees to evaluate the risk components of the DSM project processes. Thus, the tool succeeded in its purpose of quantifying perceived risk in terms of a score.

5.5 Conclusion

The ESCo used as case study maintained an average overperformance of 14% with DSM project savings. This was achieved despite a 260% increase in projects implemented in parallel and projects becoming more complex as subsequent projects were implemented. In addition, projects were continuously implemented on average 18% faster than contracted deadlines. These figures all support the success of the business model and resource structure that comprised the improved processes the ESCo utilised.

Since being involved with DSM maintenance, the ESCo managed an average increase of 280% in the savings of neglected DSM projects using the discussed maintenance process.

To evaluate the risk management properties of the improved processes, the senior project managers who used these processes were interviewed and asked to evaluate the processes. Although the perceived risk per process differed between the interviewees, the consensus was that the risk management properties per process were improved by 67% on average. All improved processes were also deemed acceptable.

The tool designed to evaluate the perceived risk of the processes were used with success during the interviews. It surpassed its goal to produce a score that quantifies a risk as perceived by the risk-taker.

Thus, it can be concluded that the business model and resource structure designed as part of this study was successful in improving an ESCo's ability to implement DSM projects. The risk management, as perceived by those who used the improved processes, was found to have reduced the risk involved with the processes. In addition, even though the risk perception of the processes differed between those who used it, risk could be quantified and evaluated.

6

RECOMMENDATIONS AND CONCLUSION

Chapter 6: The study, its results and success are discussed in this chapter. The final conclusion and recommendations form part of the discussion.

CHAPTER 6: RECOMMENDATIONS AND CONCLUSION

6.1 Summary

The South African ESCo industry is one of the smallest ESCo industries in the world. Not only does it experience the same challenges that international ESCos face, but it also faces challenges that are unique to South Africa. For more than a decade, DSM in South Africa has been primarily funded by Eskom IDM. However, the recent changes to this funding model are placing more risk on ESCos who choose to do projects with Eskom IDM.

A business model consisting of processes that would help manage risk when implementing Eskom IDM or other similar DSM projects in South Africa was required. Fortunately, because the funding models are similar in terms of the required processes, the lessons learned from earlier models still applied.

Using the largest ESCo in South Africa as a case study, processes were developed that together formed an ESCo business model. Through experience, these processes were improved to an acceptable point where the risks associated with them were managed. It was verified that the same approach as the DSM project phases was followed. However, by improving the processes to manage risk, the ESCo business model was improved to sustain project savings, implement projects faster and manage ESCo resources.

The ESCo maintained an average overperformance of 14% with DSM project savings despite the increasing complexity of projects as more were implemented. Projects were also continuously implemented 18% faster than their contracted deadlines. The new internal M&V process contributed towards this achievement.

In addition, the ESCo also managed the risk associated with resource management. The result was that from 2009–2015, the ESCo implemented 260% more DSM projects than the previous six years. These figures all support the success of the business model and resource structure that comprises the improved processes.

Where the ESCo revived neglected DSM projects, the maintenance process was utilised to achieve and sustain a 280% increase in savings. It proves the effectiveness of the

maintenance process required to help sustain new DSM projects. This is significant because for all new Eskom IDM DSM projects, ESCos are responsible for project maintenance and will require the maintenance process to be successful.

The quality of the processes and the business model was inherently improved by the changes that were made. To ensure that the improved quality is maintained, a new quality management process was created. Using an ISO 9001 approach, projects were audited when critical project milestones are achieved.

Evaluating the risk associated with the processes validated the improvements made to the processes. However, to do this, a tool that could score the perceived risk with these processes was required. As part of the study, such a tool was designed. The risk-taker would identify the risk and score the perceived probability and severity of the risk under four components (cost, time, resources and quality).

Risk is the perception of the risk-taker, thus individuals who had experience with the improved processes were required to score the improvements made to the processes. Senior project managers employed by the ESCo, which was used as case study, were interviewed. The purpose was using the tool and quantifying their perception of the risk associated with the improved processes. Because risk is a perception, it was expected that the risk score obtained with the risk evaluation tool would have variations and this was proved true.

The results were normalised and an average 69% improvement in the perceived risk associated of the improved processes was measured. The results from the interviewees had a maximum 11% deviation from the average. This means that there is a conservative 58% improvement in risk management with the improved processes in this study. The use of the newly developed risk evaluation tool was a success. The risk evaluation scores resulting from the interviews and use of the tool proved to be valuable.

Thus, the newly developed risk evaluation tool, the improvements made to the process and the business model were successfully used to evaluated and manage risk associated with an ESCo implementing DSM projects.

The aim of the study was to reduce the risk that South African ESCos experience when implementing DSM projects. It was verified that improvements to the existing processes

and project phases reduced this risk. Risk management improvements were validated by designing an evaluation tool to measure risk perceived with each process. All results validated a 69% improvement in risk management with the improved processes and continuous business success with the business model.

Thus, it can be concluded that the study succeeded in developing improved processes for South African ESCos to implement DSM project with industrial clients.

6.2 Recommendations for future work

It is recommended that the risk management processes be improved continuously. By using the principles used to improve the processes in the study, processes specific to other industries can also be improved to manage risk. The risk evaluation tool was designed to incorporate the ISO 31000 risk guideline. As mentioned, this ISO guideline also integrates the PDCA approach. This in itself encourages continuous improvement.

Even though the risk evaluation tool has been developed to measure the perceived risk of the processes used by ESCo, its application can also be used to evaluate the perceived risk of processes in other industries. It is recommended that the tool be used to help improve processes to manage risk on an acceptable level in other industries as well.

The Eskom IDM funding model continues, but the risks involved with implementing DSM projects under this model are going to increase. Using the discussed business model, it is recommended that funding options be pursued directly with clients. This in itself will reduce risk exposure to ESCos. Where a new ESCo is entering the ESCo industry, an altered format of this thesis can serve as a guide on how to implement DSM projects in South Africa.

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APPENDIX A: DOCUMENT TEMPLATES

Chapter 4 references documents required for the new processes. Table 22 lists the document templates –shown in the Appendix– that support the processes.

Table 22: Appendix A summary

Number	Template
A1	Minutes of a meeting
A2	Attendance register
A3	Payment request form
A4	Non-disclosure agreement
A5	Audit checklist
A6	Request for quotation
A7	Sub-contractor order agreement

A1: Minutes of a meeting template

Document Identifier: MOM
Template Identifier: 2015-10-01_Minutes_of_Meeting_TMP_1D
Page: 1 of 2

ESCo logo

M I N U T E S

Meeting:	(XXXX DSM Project)
Venue:	XXXX
Date:	(Date, Time)
Note taker:	Note taker's name

Attendees:

- Person Name **(PN)** Company Name
  Name.surname@email.co.za 080 000 0000

Apologies:

- Person Name **(PN)** Company Name
  Name.surname@email.co.za 080 000 0000

Verification:

Minutes was compiled and checked by:

Author:_____ Supervisor: _____
Signed:_____ Signed: _____
Date: _____ Date: _____

ESCo logo

Document Identifier: MOM
Template Identifier: 2013-06-24_Minutes_of_Meeting_TMP_07D
Page: 2 of 2

Minutes for the (XXXX DSM Project) project meeting held at (XXXXX), (Date, Time).

Point(s) of discussion	Responsible person	Delivery date	Status
1. Welcoming a. Welcoming done by __. b. The previous minutes is accepted as correct. c. The agenda is presented and accepted.			
2. Outstanding Issues a. b.			
3. Next Meeting a. Time and dates to be confirmed b.			
4. Minutes Accepted _____ ESCo and Client representative			

A2: Attendance register template

ESCo logo

Document Identifier: Document1
Template Identifier: 2015-10-01_Attendance_Register_TMP_01D.dotx
Page: 1 of 1

Attendance register

Meeting:	[Name of meeting]		
Venue / Project:	[Venue of meeting / Project name]		
Date:	[Year-Month-Day]	**Time:**	[0:00]
Meeting organiser:	[Name of organiser]		

Name & Surname	**Email address**	**Cell phone number**	**Business unit / company**	**Position**	**Signature**

A3: Payment request form template

Request - Payment to Supplier					
Company:		**Date:**			
Project name/Project type:					
Hardware:					
Quantity:	Description:		Tax invoice nr:	Proforma invoice nr:	Amount (Ex VAT):
Total			Excluding VAT		**R 0.00**
Total			Including VAT (14%)		**R 0.00**

Supplier					
Supplier				**Invoice amount**	**Outstanding amount**
Bank detail: Account Name:		**Total Order (excl VAT)**			**R 0.00**
Account Number:					
		Invoiced and paid to date (excl VAT)		**R 0.00**	**R 0.00**
Our Reference:		**Other payment request outstanding (excl VAT)**		**R 0.00**	**R 0.00**
Bank:					
Branch Name:		**This payment request (excl VAT)**		**R 0.00**	**R 0.00**
Branch Code:					

1. Request - Generated					
Motivation:					
Signed delivery note or client approval attached?		Supplier statement attached?		Project payment summary attached?	
Person:		Date:		Signature:	

2. Project Manager Approval					Still to be paid (including this payment)	#DIV/0!
Comment:						
Progress satisfactory?		Less than 10% retention left?		SD&L outcomes achieved (if less than 1		
Person:		Date:		Signature:		

3. Payment	Person	Date	Signature		
Funds received from financer?					
Tax invoice reconciled with: i) Finances ii) Project engineer payment summary iii) B-BBEE status					
	Status of valid B-BBEE certificate	**B-BBEE level**		**Expiry date**	
Financial manager approval					
		Project Register	☐	**Asset Register**	☐
Payment loaded on financial system					

A4: Non-Disclosure template

Document Identifier: Document1
Template Identifier: 2015-10-01_Minutes_of_Meeting_TMP_1D
Page: 1 of 1

ESCo logo

NON-DISCLUSURE AGREEMENT: R&D ON ELECTRICITY SAVINGS MEASURES ON *{CLIENT SITE NAME}*

In the R&D process, *{client company name}* will present *{ESCo name}* with confidential information. No information received from *{client company name}* will be divulged to any third party.

{ESCo name} is given permission by *{client company name}* to do the R&D for energy cost savings measures for potential DSM projects on the *{potential system}*. The costs for the R&D and subsequent proposals will be fully borne by *{ESCo name}*.

To protect *{ESCo name}*'s investment, *{client company name}* agrees not to submit their own proposals or allow another person or company to submit DSM proposals on this R&D. *{client company name}* also agrees not to disclose any information on *{ESCo name}* R&D to another outside party without prior written consent of *{ESCo name}*. This Non-Disclosure is valid for XX months.

For *{client company name}*	
Name	
Signature	
Designation	
Date	

For *{ESCo name}*	
Name	
Signature	
Designation	
Date	

Witness	
Name	
Signature	
Designation	
Date	

A5: Audit checklist template

Document Identifier: 2015-10-01_Audit_Book_TMP_01D
Template Identifier: :2015-10-01_Audit_Book_TMP_01D
Page 1 of 1

ESCo logo

First Audit

Project: #ESCo Project name (DSMnumber)#

Project Engineer: #ESCo Project Engineer Name#

Date of project audit: YYYY/MM/DD

Requirement for first audit:

		Y/N
1	Signed new project contract	
2	Scope approved by client	
3	Order agreement signed by sub-contractor	
4	Motivation for sub-contractor selection	
5	Project file up to date	

Rating Scale: 1 = Document did not meet requirements: poor quality
2 = Document complies with requirements: fair quality
3 = Document complies with requirements: excellent quality

Scope of work:

2 Signed letter or minutes in which the client approved the project scope. (Original must be filed)

Y/N	Reviewer Name	Rating

Order agreement:

3 Signed order agreement with sub-contractor. (Original must be filed)

Y/N	Reviewer Name	Rating

Motivation for sub-contractor selection :

	Y/N	Reviewer Name	Rating
4 Letter of recommendation.			

Project file:

	Y/N	Approved by
5 All relevant documents filed and up to date:		

Non conformance (if required):

Date of Review	Comments	Filed & Documented

#ESCo DSM Manager Name# **DSM Manager**

#ESCo Quality Representative Name# **Quality Representative**

#Project Manager Name# **Project Manager**

Confidential

Document Identifier: 2015-10-01_Audit_Book_TMP_01D
Template Identifier: :2015-10-01_Audit_Book_TMP_01D
Page 1 of 1

ESCo logo

Second Audit

Project Name: #ESCo Project name (DSMnumber)#

Project Engineer: #ESCo Project Engineer Name#

Date of project audit: YYYY/MM/DD

Requirements for second audit:

		Y/N
1	Completion certificate signed by client	
2	EMS/Technology operational	
3	Project completed according to design	
4	Commissioning completed	
5	Subcontractor SD&L commitments complete	
6	Performance assessment can start	
7	Project file up to date	

Supporting documentation:

Rating Scale: 1 (=)Document did not meet requirements: poor quality
2 (=)Document complies with requirements: fair quality
3 (=)Document complies with requirements: excellent quality

		Filed (Y/N)	Reviewer Name	Rating
1	Signed completion certificate			
2	Proof of EMS/Technology operational			
3	Proof of project completed according to design			
4	Signed commissioning certificate			
5	Proof of subcontractor SD&L achievements			

Project file:

		Y/N	Approved by:
7	All relevant documents filed and up to date:		

Non conformance (if required):

Date of Review	Comments	Filed & Documented

#ESCo Quality Representative Name#
Quality Representative

#Project Manager Name#
Project Manager

Confidential

Document Identifier: 2015-10-01_Audit_Book_TMP_01D
Template Identifier: :2015-10-01_Audit_Book_TMP_01D
Page 1 of 1

ESCo logo

Final Project Audit

Project Name: #ESCo Project name (DSMnumber)#

Project Engineer #ESCo Project Engineer Name#

Date of project audit: YYYY/MM/DD

Requirements for final project audit:

		Y/N
1	Performance assessment certificate available	
2	Hand over certificate signed by client	
3	Data pack delivered to ESCo & client	
4	Training completed	
5	Project file up to date	
6	Project payments reconciled	
7	All project funding received	

Supporting documentation:

Rating Scale: 1 = Document did not meet requirements: poor quality
2 = Document complies with requirements: fair quality
3 = Document complies with requirements: excellent quality

		Y/N	Reviewer Name	Rating
1	Performance Assessment Certificate			
2	Signed hand over certificate			
3	Data pack received confirmation:			
	Client representative	#Client representative name#		
	ESCo representative	#ESCo Project Engineer Name#		
4	Training support documents			

Project File:

		Y/N	Approved by
5	All relevant documents filed and up to date:		

Finance:

		Y/N	Approved by
6	All project payments reconciled		
7	All project funding received		

Non conformance (if required):

Date of Review	Comments	Filed & Documented

#ESCo Quality Representative Name#
Quality Representative

#Project Manager Name#
Project Manager

#ESCo DSM Manager Name#
DSM Manager

#ESCo Financial Representative Name#
Financial Representative

Confidential

A6: Request for quotation template

Document Identifier: RFQ
Template Identifier: 2015-10-01_RFQ_TMP_1D
Page: 1 of 5

ESCo logo

Mr/Ms XXX
XXX Pty Ltd

ESCo name
REG NO xxxx/xxxxxx/xx
Postal address

yyyy/mm/dd

Dear XXX

REQUEST FOR QUOTATION

Attached is a formal request for your company to quote on *{description of work}*.

Best wishes

XXX
Project Engineer

ESCo logo

1 Project background:

1.1 *{ESCo name}* plans to complete an energy *cost savings/efficiency* project on *{site and system name}* ("the client").

1.2 *{ESCo name}* needs a contractor to supply, install, and commission all equipment and infrastructure required for the control of the *{site and system name}* project. The work required *{Brief description of work}*.

1.3 All work is the sole responsibility of the successful contractor. Where the contractor lacks expertise, suitable sub-contractors may be used on condition of acceptance by *{ESCo name}* and the client. The client will not be responsible for any work on the project unless stated otherwise.

2 Project scope:

2.1 *{ESCo name}* will implement *EMS/technology* to create energy *cost savings/efficiency* on *{site and system name}* system.

2.2 The *EMS/technology* will *{describe the goal of the EMS or technology}*.

2.3 *{Describe what is required from the contractor}*.

2.4 In Appendix A a layout drawing of the *{site and system name}* is attached. A tender meeting will be held on **yyyy/mm/dd** where the scope will be discussed.

2.5 The quotation must be supplied with the understanding that it will be a turnkey project that is **performance based**. The **final responsibility** and **liability** lies with the contractor to ensure that the *{system name}* can be controlled as stipulated under conditions 2.1 and 2.2 above.

2.6 The completion date of the project will be XXX months after the order has been placed.

3 Project Requirements

The following hardware is required for the successful control of the *{system name}* at the client's site:

{list project requirements}

ESCo logo

Document Identifier: RFQ
Template Identifier: 2015-10-01_RFQ_TMP_1D
Page: 3 of 5

4 Other Requirements

4.1 *{ESCo name}* subscribes to B-BBEE (Broad-Based Black Economic Empowerment). A certified copy of the main contractors valid B-BBEE Certificate must accompany the quote / tender document.

4.2 Skills development and localisation are important issues for the country. The following table must be completed and submitted with the quote / tender document:

Skills development		
Average number of previously disadvantaged employees		
Do you have a training programme for previously disadvantaged employees?		
How many previously disadvantaged employees attended training programs?		
How many previously disadvantaged employees completed training programs successfully?		
How many female previously disadvantaged employees completed training programs successfully?		
Localised spend	**%**	**Rands**
Total amount of this tender		
Total value of this tender spent locally		
- local labour		
- local equipment and supplies		
Total value of this tender not spent locally		
- overseas labour		
- overseas equipment and supplies		

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Document Identifier: RFQ
Template Identifier: 2015-10-01_RFQ_TMP_1D
Page: 4 of 5

5 Enquiries

All enquiries regarding the project should be directed to the following contact persons:

XXX
Project Engineer

Contact numbers:

Tel : XXX
Cell : XXX
Fax : XXX
e-mail : XXX

XXX
Project Engineer

Contact numbers:

Tel : XXX
Cell : XXX
Fax XXX
e-mail : XXX

Postal address:

Physical address:

ESCo logo

Document Identifier: RFQ
Template Identifier: 2015-10-01_RFQ_TMP_1D
Page: 5 of 5

6 Submission of the quotation

6.1 Respondents to the RFQ are to submit the completed, detailed quotation, including a detailed project plan and time line before ***yyyy/mm/dd.***

6.2 The quotation must be addressed to the contact person as given in *Section 4* and submitted to *{ESCo name}* by post, fax, e-mail or personal delivery.

6.3 Quotations received after the date and time given in 5.1 may be disregarded.

6.4 Quotations must indicate available resources for this project and the time schedule of this project with other projects.

6.5 A presentation or the solution(s) may be requested.

7 Appendix A

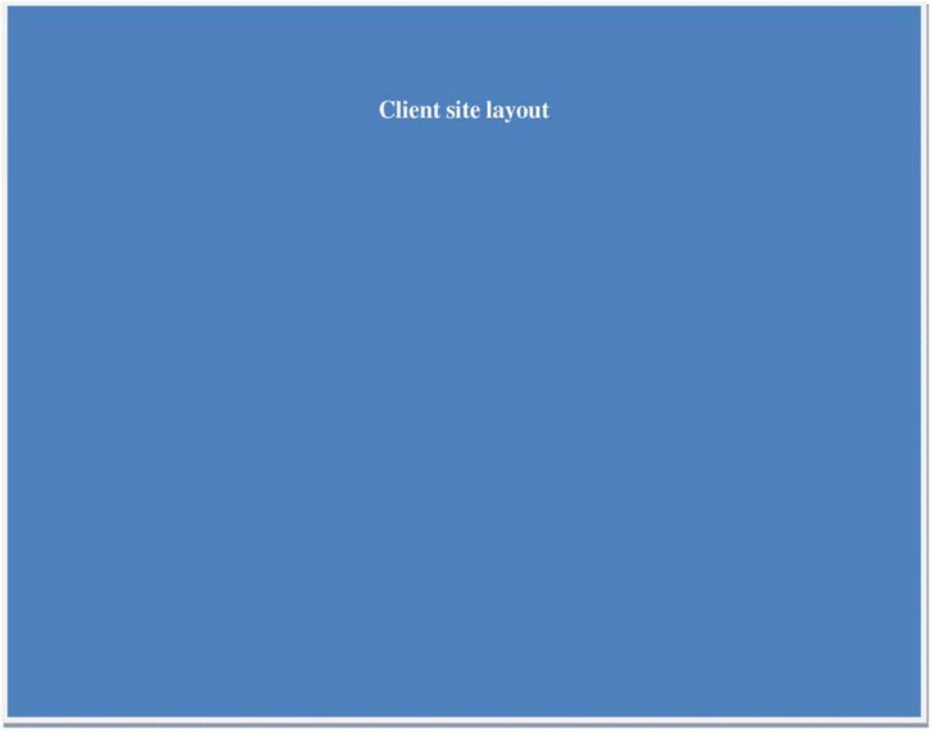

Figure 1 – Client site

A7: Sub-contractor order agreement template

Document Identifier: Orde agreement
Template Identifier: 2015-10-01_Order_TMP_1D
Page: 1 of 10

ESCo logo

AGREEMENT BETWEEN

{FULL ESCo company name}
(Hereafter referred to as "*{ESCo name}*")

AND

XXX Pty Ltd
(Hereafter known as the "main contractor")

A. Definitions

1. *{Full ESCo company name}* is referred to as "*{ESCo name}*" and their representative is *{ESCo representative name}*.
2. *{Full client company name}* is referred to as "the client" and their representative is *{Client representative name}*.
3. *{Full contractor company name}* is referred to as "the main contractor" and their representative is *{Contractor representative name}*.
4. Data pack refers to all relevant manuals, documents, drawings, software and/or layouts created by the main contractor to be presented to the client in print and electronic format after commissioning.
5. PLC or Programmable Logic Controller is a digital computer used for automation and control of equipment.
6. SCADA or Supervisory Control and Data Acquisition is a centralised computer system that collects data from remote sensors and sends instructions to equipment such as PLCs etc.
7. PID (Proportional Integral Derivative) is a generic control loop feedback mechanism.
8. Intellectual property (IP) refers to a number of distinct types of creations. It includes but is not limited to documents, knowledge, knowhow, methodologies, software, code, interfaces, drawings, pictures, processes, systems, etc.
9. The specifications of the project is *{Summary of project scope}*.

Initial ESCo representative _____ Initial ESCo witness_____

Initial Main Contractor representative _____ Initial Main Contractor witness_____

Confidential – Page 1 of 10

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B. Background:

1. The client have contracted *{ESCo name}* to implement *{Describe technology}*. The aim is to reduce the energy consumption of *{Client system name}*.
2. The main contractor agrees to supply, install and commission equipment that will allow *{ESCo name}* to *{implemented and use control philosophy}*. All equipment must be supplied and installed to the client's standards and satisfaction.
3. This agreement specifies a turnkey project. The final responsibility and liability are with the main contractor to ensure that *{project scope is achieved}*.
4. The order number for this project is ***DSM xxx***.

C. Project scope:

1. *{Describe project scope in detail}*.

D. Project Implementation:

1. The client has accepted the main contractor for the project by signing the Scope of work given in Quote_xxx. This does not imply client or *{ESCo name}* responsibility or liability should any aspect of the main contractor installation not work, or if costing is wrong in any way whatsoever.
2. The main contractor will ensure that all installations comply with specifications and requirements of the client. All installations will be completed timeously within specific client time schedules.
3. The main contractor takes full responsibility for integrating this project and its equipment into any existing infrastructure, equipment, hardware, software and network equipment etc. All costs for the integration of new equipment with existing equipment are included in this order.
4. Any changes made to existing infrastructure, equipment, hardware, software, network equipment etc. of the client will be done with the documented approval of the client.
5. The main contractor acknowledges being aware of all specifications, terms and conditions applicable to implementing projects on the premises of the client.
6. The main contractor will adhere to all the relevant specifications and regulations as specified by the client, relevant authorities, regulatory bodies, government agencies, etc. This includes all health, safety and access rules.

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Initial Main Contractor representative _____ Initial Main Contractor witness_____

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7. Equipment and any current functionalities of the client's equipment must remain in the same or better condition as before this project started. Any deterioration as a result of work done by the contractor will be restored to its original working condition at the cost of the main contractor.
8. All work will be done safely. The main contractor accepts full responsibility for all safety aspects of this project. Any safety incident will be handled by the main contractor in full cooperation with the client, *{ESCo name}* and all relevant authorities. This includes all health, safety and access rules.
9. A factory acceptance test must be accepted and signed off by the client before the equipment is installed on-site.
10. The main contractor must present a cold commissioning certificate for each installation. These certificates must be signed by an authorised *{ESCo name}* and client representative.
11. The main contractor must ensure that a final commissioning and handover certificate is signed by authorised *{ESCo name}* and client representatives as soon as the project has been completed.
12. As part of this project, it is the main contractor's responsibility to clean up work areas and relocate old equipment to a location specified by the client.
13. With final commissioning, the client must receive adequate training and a complete data pack. This must enable the client to maintain newly-installed equipment.
14. A recommended spares list should also be handed to the client with final commissioning.

E. Project Management:

1. The main contractor is fully responsible for maintaining positive relationships between all parties involved with the project.
2. The main contractor agrees never to communicate any negative aspect about the project, *{ESCo name}* or the client to any other party.
3. The relevant contact persons for each of the three parties are the following:
   i. The client: xxx
   ii. *{ESCo name}*: xxx
   iii. The main contractor: xxx
4. A detailed project plan will be developed by the main contractor using input from *{ESCo name}* and

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the client. The final plan must be submitted to *{ESCo name}* within seven calendar days after the order has been signed by *{ESCo name}*.

5. The project plan will be updated before each project meeting and compared with the first plan submitted at the start of the project. Discrepancies will be highlighted and reasons for delays will be documented and distributed to all parties. When activities have been delayed, possible solutions will be presented before the next project meeting.
6. Full responsibility of managing all aspects of equipment installation lies with the main contractor. However the responsibility of installing the valves and flow meters remains that of the client and the main contractor cannot be held liable for delays if the client does not install these as per schedule.
7. The main contractor will liaise with the client and ensure cooperation regarding: i) planning of project work, ii) access to installation sites, iii) scheduling of work to be done on the client's site, iv) work that must be done by the client, and v) provision of services at installation locations such as power and water supplies. Should assistance or cooperation be unsatisfactory, the main contractor will, with the assistance of *{ESCo name}*, liaise with the client representative to solve any issues.
8. The main contractor will organise and attend project meetings as required by the client and/or *{ESCo name}*.
9. The main contractor will provide updated documentation on any aspect of the project including photographs, specification sheets, and written feedback reports etc. on a weekly basis.
10. During final commissioning of equipment, *{ESCo name}* and the client must be present to sign off completed work. Invoices will only be received afterwards.

F. Costing

1. The main contractor must ensure that all specifications are correct. This arrangement is to ensure a working solution at the fixed project price in F7, acceptable to both *{ESCo name}* and the client.
2. Any order placed by the main contractor on any other entity (sub-contractor) will be similar to this order. Most important is that these orders must be fixed-price agreements with pre-determined delivery times. These agreements must be outcome-based or turnkey agreements with fixed deliverables. This implies, inter alia, that no agreement may be signed where other parties are paid per hour. This excludes salaried employees.
3. Should any mistake or omission in the specifications and/or costing be discovered after signing this

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agreement, the responsibility to solve the problem lies with the main contractor. The main contractor will be fully liable for any problem solving action even if it includes additional costs.

4. Clause F3 does not include a change in specification. Should the client change any specifications that will increase costs, the main contractor will cooperate fully to solve this problem by *inter alia* obtaining a separate order from the client, or to change components to lower cost items etc. No solution may delay the completion of this project.
5. It may happen that some equipment included in the original quotation mentioned in section D1, is not installed or replaced with lower cost alternatives. Should that happen, the order amount will decrease by the applicable amounts for the supply, installation or commissioning of the omitted or replaced equipment.
6. Invoices will be paid up to 90% of the total order value stipulated in F7. The residual 10% is payable within 30 days after signature of the completion certificate by the relevant client personnel.
7. *{ESCo name}* will pay the main contractor a total fee of **RXXX** (VAT exclusive) for the projects.

G. Financial Terms:

1. The main contractor will allow all information on this project to be available for audits by personnel or agents of *{ESCo name}*, the client, SARS or any other government agency. The main contractor will give full cooperation should such audits be requested.
2. The client requires all invoice items to be shown in detail and be accompanied by the relevant delivery notes and equipment photographs. Delivery notes will be for: i) the delivery of equipment to the premises of the main contractor; or ii) delivery of equipment to the premises of the client. The main contractor will ensure that the signatory of the delivery note is authorised to sign for accepting equipment at the premises of the main contractor or the client.
3. Invoices, delivery notes and equipment photographs will be submitted to the *{ESCo name}* Project Manager given in E3.
4. No invoices from the main contractor will be considered for payment without complete detailed documentation as required by *{ESCo name}*. This documentation will be submitted in both printed and electronic format.
5. Payment will be considered for delivered equipment 30 days after being signed-off by the project managers of *{ESCo name}* and the client. Payment may be withheld if *{ESCo name}* or the client

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Initial Main Contractor representative _____ Initial Main Contractor witness_____

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are not satisfied with the quality of the invoiced equipment or the quality of the main contractor's work.

6. The VAT number of *{ESCo name}* is XXXXXXXXXX and must be printed on all VAT Invoices for this project.
7. Any transgression of statutory requirements by the main contractor may be grounds for *{ESCo name}* to withhold payment. *{ESCo name}* also has the right to cancel this agreement should the main contractor persist for fourteen days with a transgression.

H. Project dates:

1. The final completion date for this order is **dd/mm/yyyy**. The main contractor will be charged a late penalty of 1% of the project value for each week that the completion certificate cannot be signed by the client due to outstanding issues caused by the main contractor. The total penalty will not exceed 10% of the total project cost.
2. If negligence by client personnel causes delays, *{ESCo name}* will be supplied with detailed documentation and proof within seven days after an incident.
3. The main contractor will be held responsible and liable for any delay, penalties, or any other result due to the late delivery of this order
4. The 12-month period after the client has signed the delivery note will be regarded as a warranty period. During this time the main contractor will give full support, at no cost to *{ESCo name}* or the client, to ensure that all equipment of this project stays in full working order. This implies that the warranty period starts when the completion certificate is signed-off and not when equipment was purchased. The main contractor will not be liable for damages caused by the client's negligence.
5. In the event that a dispute arises between *{ESCo name}* and/or the client the main contractor, the parties will endeavour in good faith to resolve the dispute.
6. In the event that *{ESCo name}* or the client is not satisfied with the progress or quality of the work, *{ESCo name}* may cancel the order on the main contractor. *{ESCo name}* will pay for equipment delivered to the client up to that cancellation date. Ownership of paid equipment will reside with *{ESCo name}* and the client.
7. The main contractor will be liable to correct or pay for the correction of defects of original software and system control for a period of 52 weeks from commissioning and handover date.

Initial ESCo representative _____ Initial ESCo witness_____

Initial Main Contractor representative _____ Initial Main Contractor witness_____

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I. Others deliverables:

1. *{ESCo name}* fully subscribes to Broad-Based Black Economic Empowerment (B-BBEE). A certified copy of the main contractors B-BBEE Certificate must accompany the quote / tender document.
2. Skills development and localisation are important drivers for the country. The following table must be completed and submitted with the quote / tender document:

Skills development		
Average number of previously disadvantaged employees		
Do you have a training program for previously disadvantaged employees?		
How many previously disadvantaged employees attended training programs?		
How many previously disadvantaged employees completed training programs successfully?		
How many female previously disadvantaged employees completed training programs successfully?		
Localised spend	**%**	**Rands**
Total amount of this tender		
Total value of this tender spent locally		
- local labour		
- local equipment and supplies		
Total value of this tender not spent locally		
- overseas labour		
- overseas equipment and supplies		

J. Confidentiality

1. All intellectual property (IP) of *{ESCo name}*, its associated companies, owners, directors, personnel, the client, and/or other clients must be protected and kept secret.
2. The main contractor will ensure that its employees sign confidentiality agreements before starting this project. These agreements must be presented to *{ESCo name}* on request.
3. Employees of *{ESCo name}*, the client and main contractor will continue to protect the IP of all parties involved in this project even after someone resigns.
4. The protection of IP will continue after termination of any agreements between *{ESCo name}*, the client and the main contractor.

Initial ESCo representative _____ Initial ESCo witness_____

Initial Main Contractor representative _____ Initial Main Contractor witness_____

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5. No aspect of this project may be published in any form whatsoever without the written permission of *{ESCo name}*.

K. General Terms:

1. No variations, modifications, alterations, amendments, or additions to this order shall be of any force or effect unless reduced to writing, and signed by authorised representatives of *{ESCo name}* and the main contractor.
2. All communications about this project will be sent to all three parties: *{ESCo name}*, the main contractor and the client.
3. The main contractor indemnifies *{ESCo name}*, its associated companies, owners, directors, personnel, agents, students or other associated entities against any of the following: i) loss and damage to property; ii) death of, or injury to any person, iii) any claims, proceedings, compensation or losses that may result from this order.
4. The signatories hereby warrant that they have the necessary authority to sign and bind the respective legal entities to this agreement.
5. This order replaces any previous orders placed on the main contractor for this project.
6. Should key personnel of the main contractor become unavailable for the project, *{ESCo name}* may cancel this order immediately. *{ESCo name}* may appoint another entity as main contractor and all designs, drawings, equipment, or any object purchased for the project etc. must be handed over to *{ESCo name}*. This applies to all equipment whether there is outstanding work or not.
7. *{ESCo name}* and the main contractor will always honour and respect one another's good name, image and reputation in relation to each other and to third parties. Both *{ESCo name}* and the main contractor will act with great care and good faith towards one another in complying with the terms and conditions of this agreement. The parties will refrain from any commission or omission which may cause, assist or lead to any damages to the good name, image and reputation which both parties may enjoy.
8. This order agreement becomes legally binding when the main contractor and *{ESCo name}* have both signed and witnessed each page and it is delivered to *{ESCo name}* before or on **dd/mm/yyyy**.
9. All aspects of this project will be regarded as confidential. The main contractor will ensure that all

Initial ESCo representative _____ Initial ESCo witness_____

Initial Main Contractor representative _____ Initial Main Contractor witness_____

ESCo logo

personnel agents, contractors etc. are also covered by a separate confidentiality agreement. This also implies that no aspect of this project may be published without the written permission of *{ESCo name}*

10. In the event that a dispute arises between *{ESCo name}* and the main contractor, the parties will endeavour in good faith to resolve the dispute.
11. In the event that *{ESCo name}* or the client is not satisfied with the progress or quality of the work, *{ESCo name}* may cancel the order on the main contractor. *{ESCo name}* will pay for equipment delivered to the client up to the cancellation date. Ownership of paid equipment will reside with *{ESCo name}* and the client.

L. Interpretation details:

1. Headings to clauses in this contract appear only for reference purposes and shall not govern their interpretation.
2. Any number of days referred to in this agreement refers to calendar days including Saturdays, Sundays and public holidays.
3. Any reference to one gender shall include the other gender and vice versa.
4. Words in the singular number shall include the plural and vice versa.
5. Any reference to natural persons shall include legal persons and vice versa.
6. The laws of the Republic of South Africa shall govern this agreement.
7. Should any part of this agreement in any manner contravene a law of the Republic of South Africa, that part of the agreement will be deemed to be severable. It shall not affect any other provision of this agreement and will not affect the enforceability of those remaining provisions that are not in contravention of any law.
8. *{ESCo name}* and the main contractor hereby consent to the jurisdiction of the relevant Courts in Pretoria in respect of any action or proceedings that may result from this agreement.
9. In the event of a conflict between the terms and conditions of this agreement and any other agreement or document, the terms and conditions of this agreement shall apply.

Initial ESCo representative _____ Initial ESCo witness_____

Initial Main Contractor representative _____ Initial Main Contractor witness_____

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M. Signatures

1. Order placed by *{ESCo name}*

Signed at..... on the..... day of..... .....

.....	.....
Name of ESCo representative	Signature of ESCo representative
.....	.....
Name of ESCo witness	Signature of ESCo witness

2. Terms and conditions accepted by the main contractor

Signed at..... on the..... day of..... .....

.....	.....
Name of the main contractor representative	Signature of the main contractor representative
.....	.....
Name of the main contractor witness	Signature of the main contractor witness

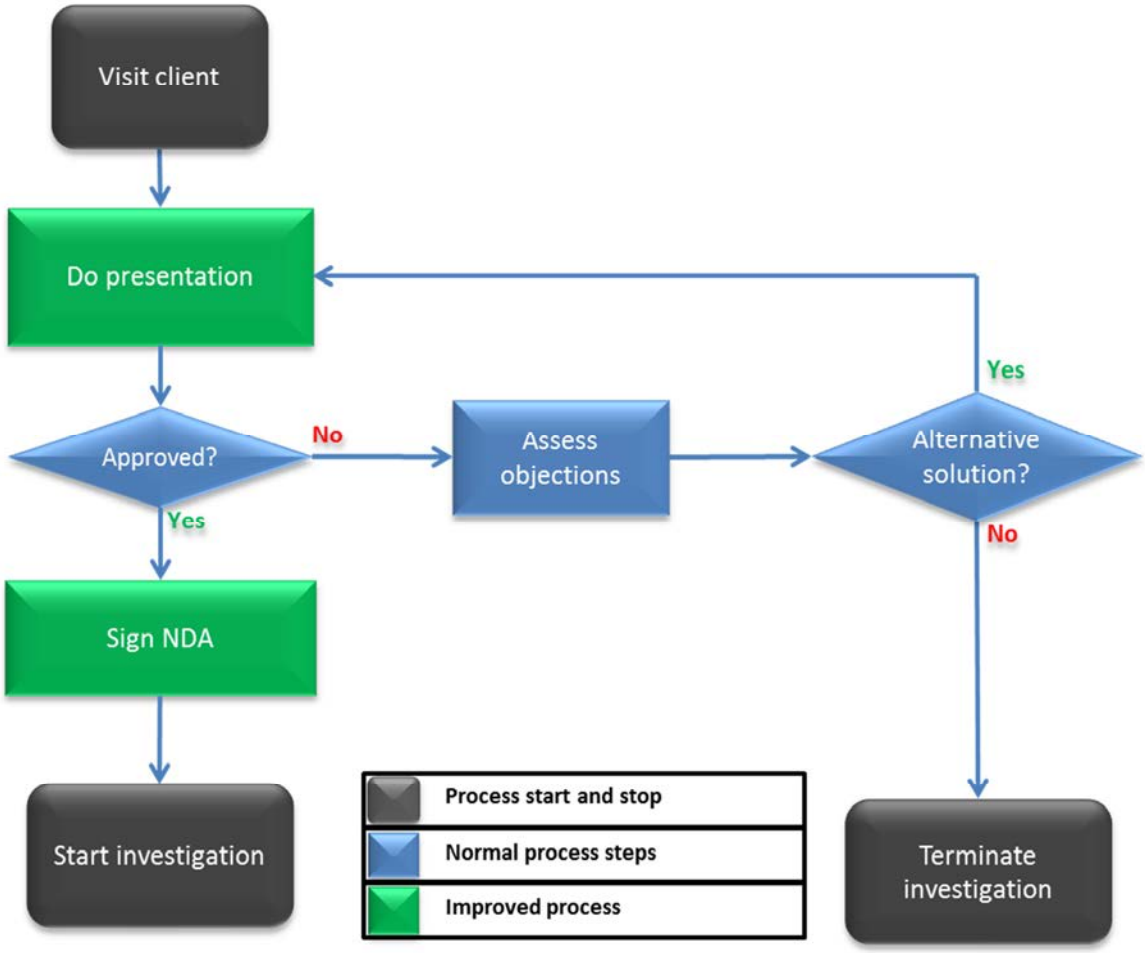
APPENDIX B: PROCESS SCHEMATICS

Chapter 4 references the schematic layouts that graphically represent each of the new processes. Table 23 lists the schematics –shown in the Appendix– for the processes.

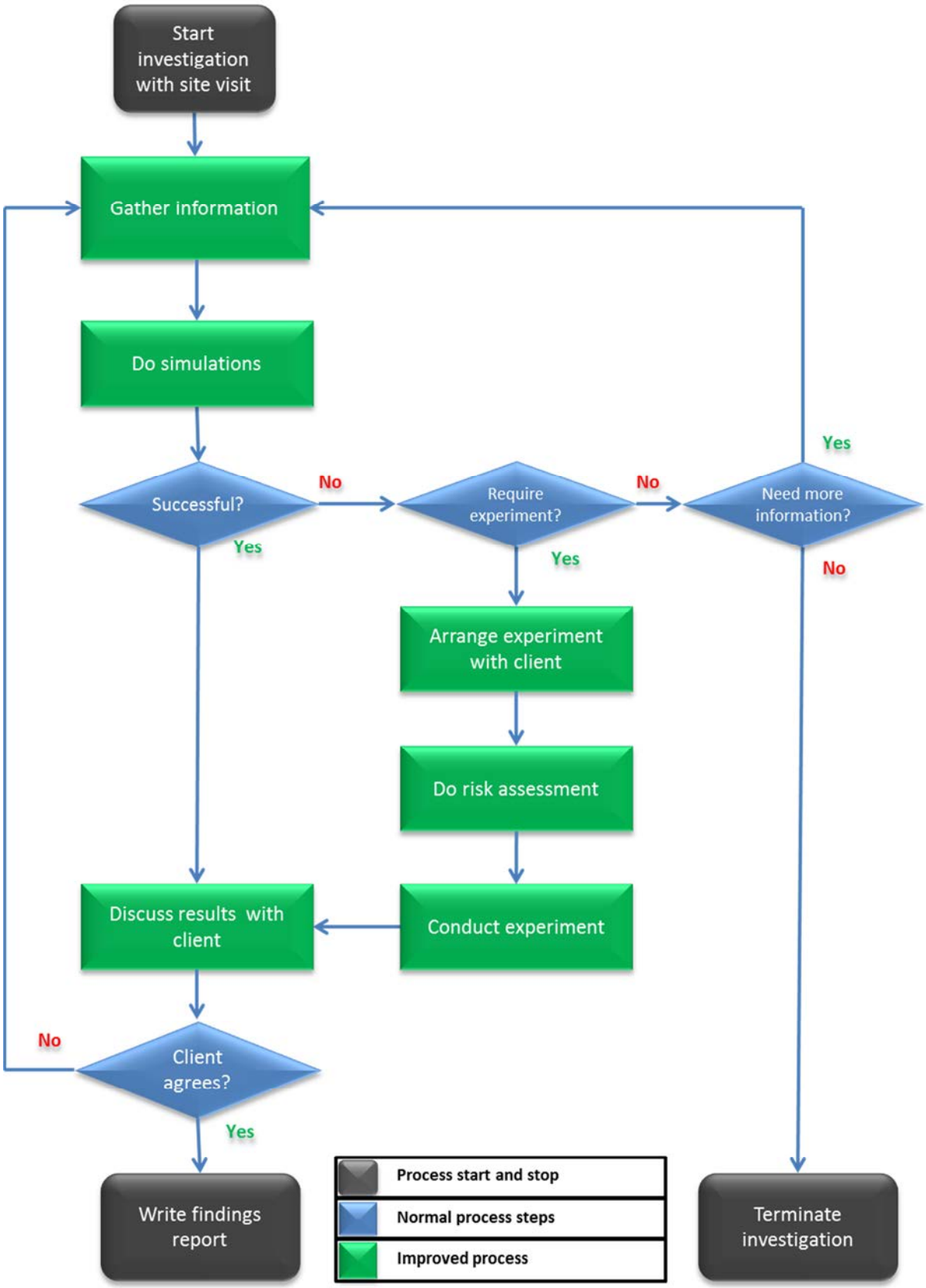
Table 23: Appendix B summary

Number	Process
B1	4.5.1 Marketing
B2	4.5.2 Project validation
B3	4.5.3 Compile findings report
B4	4.5.4 Compile proposal
B5	4.6 Proposal submission and negotiation
B6	4.7.2 Costing and tender
B7	4.7.3 Project implementation
B8	4.7.4 Client personnel training
B9	4.7.5 Project handover
B10	4.8 Performance assessment
B11	4.9 Maintenance

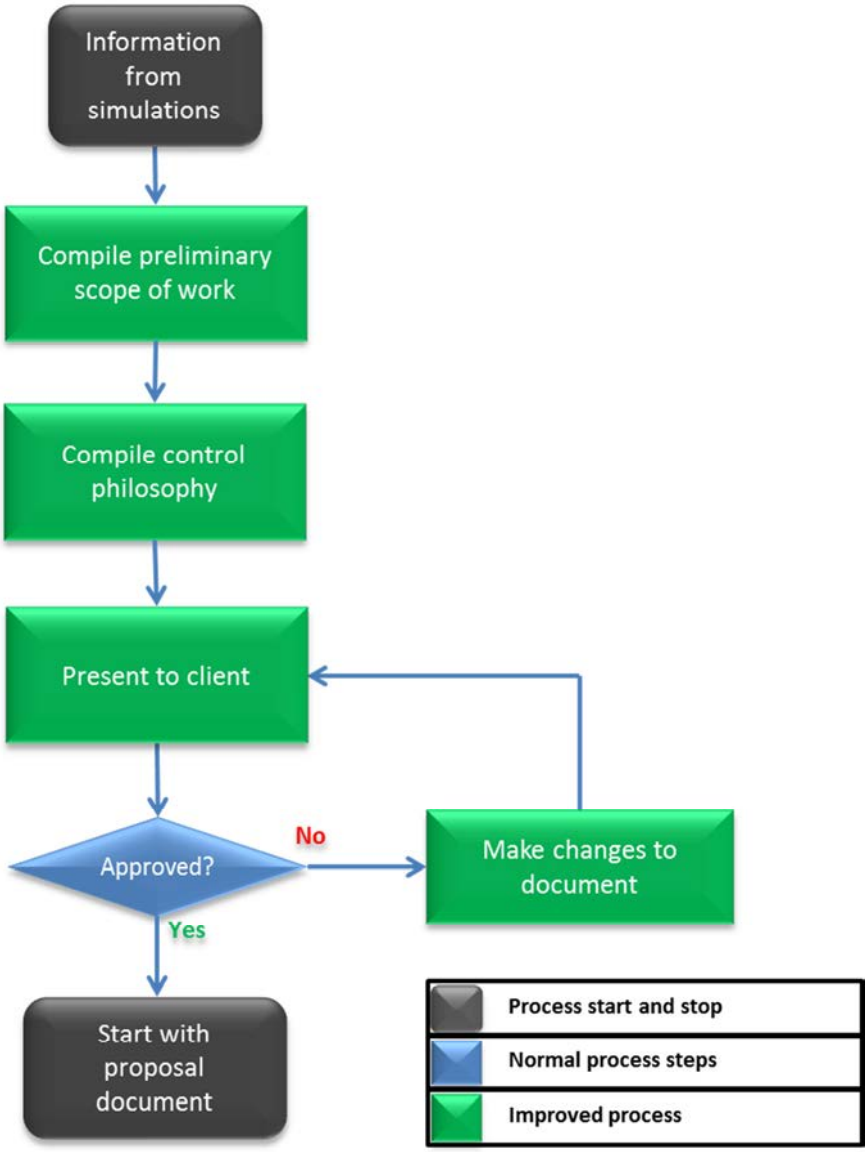
B1: Marketing process



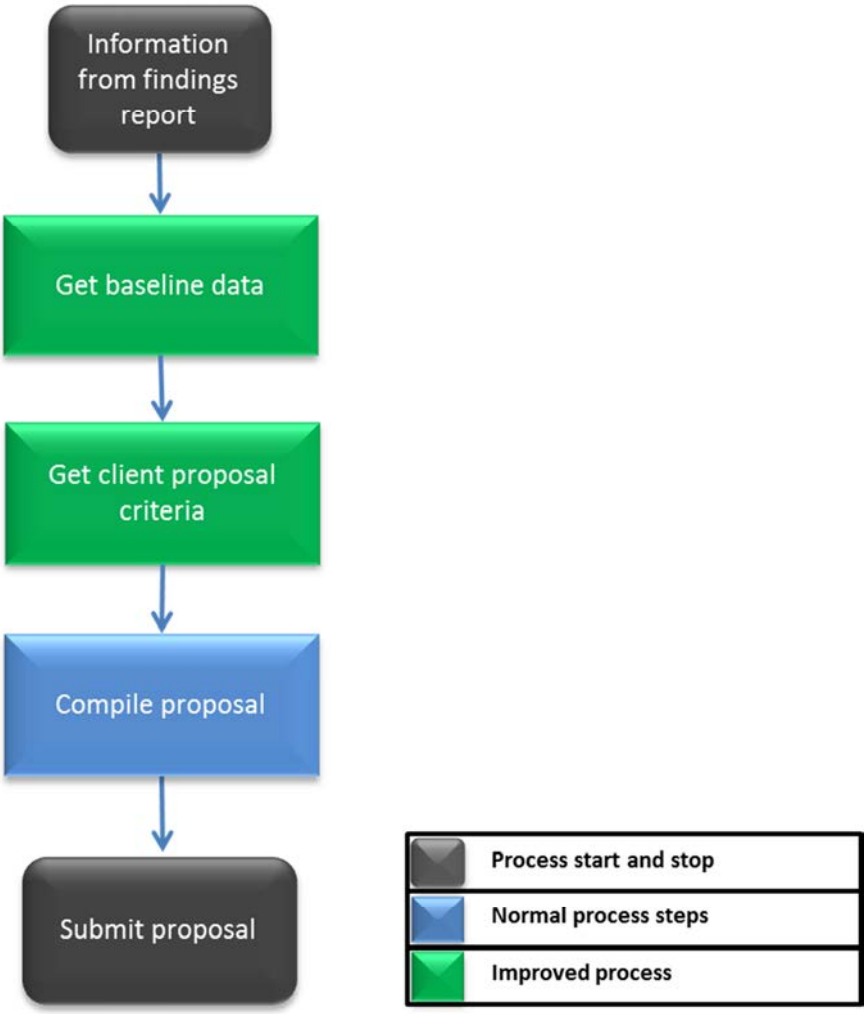
B2: Project validation process



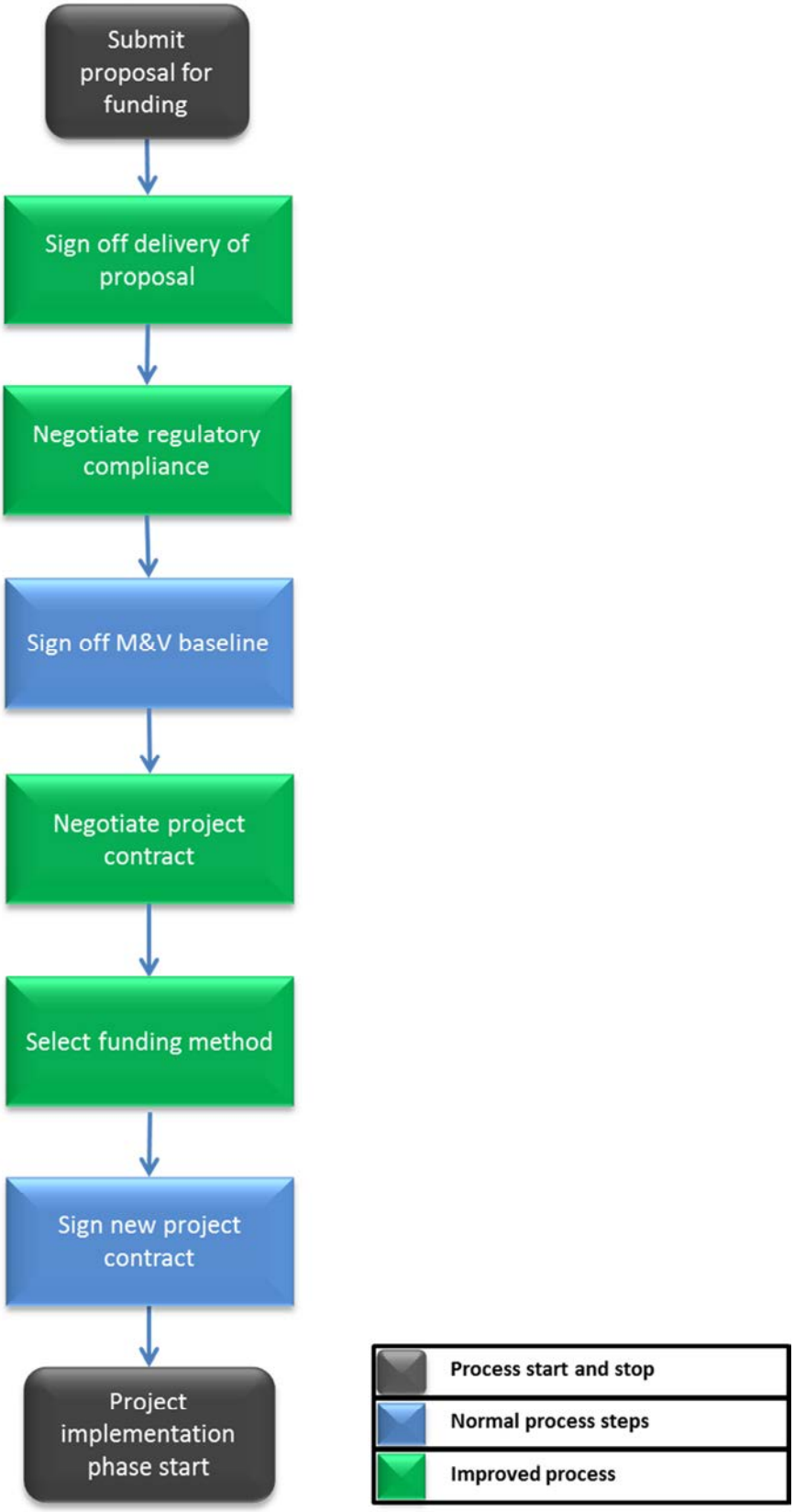
B3: Compile findings report process



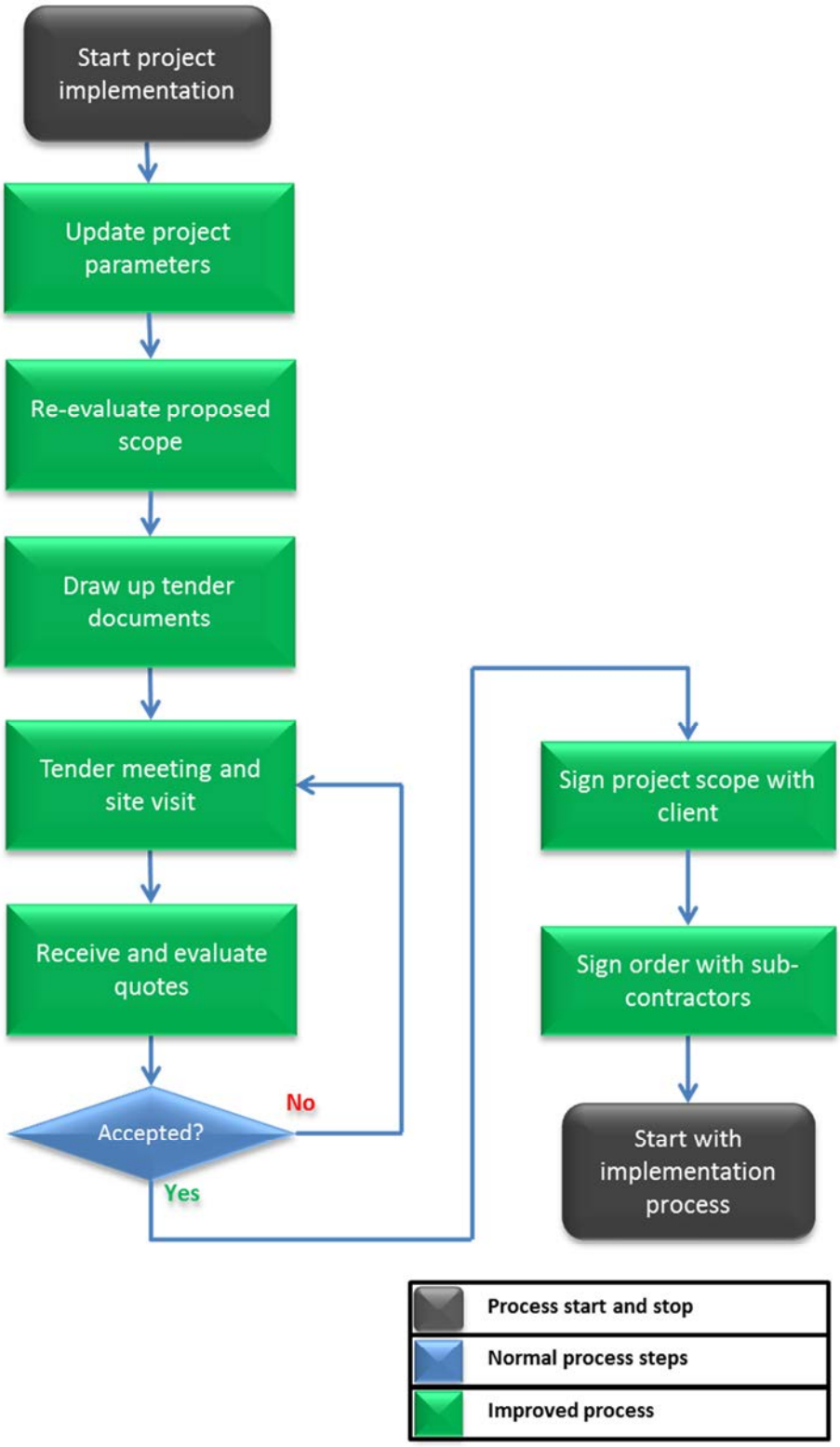
B4: Compile proposal process



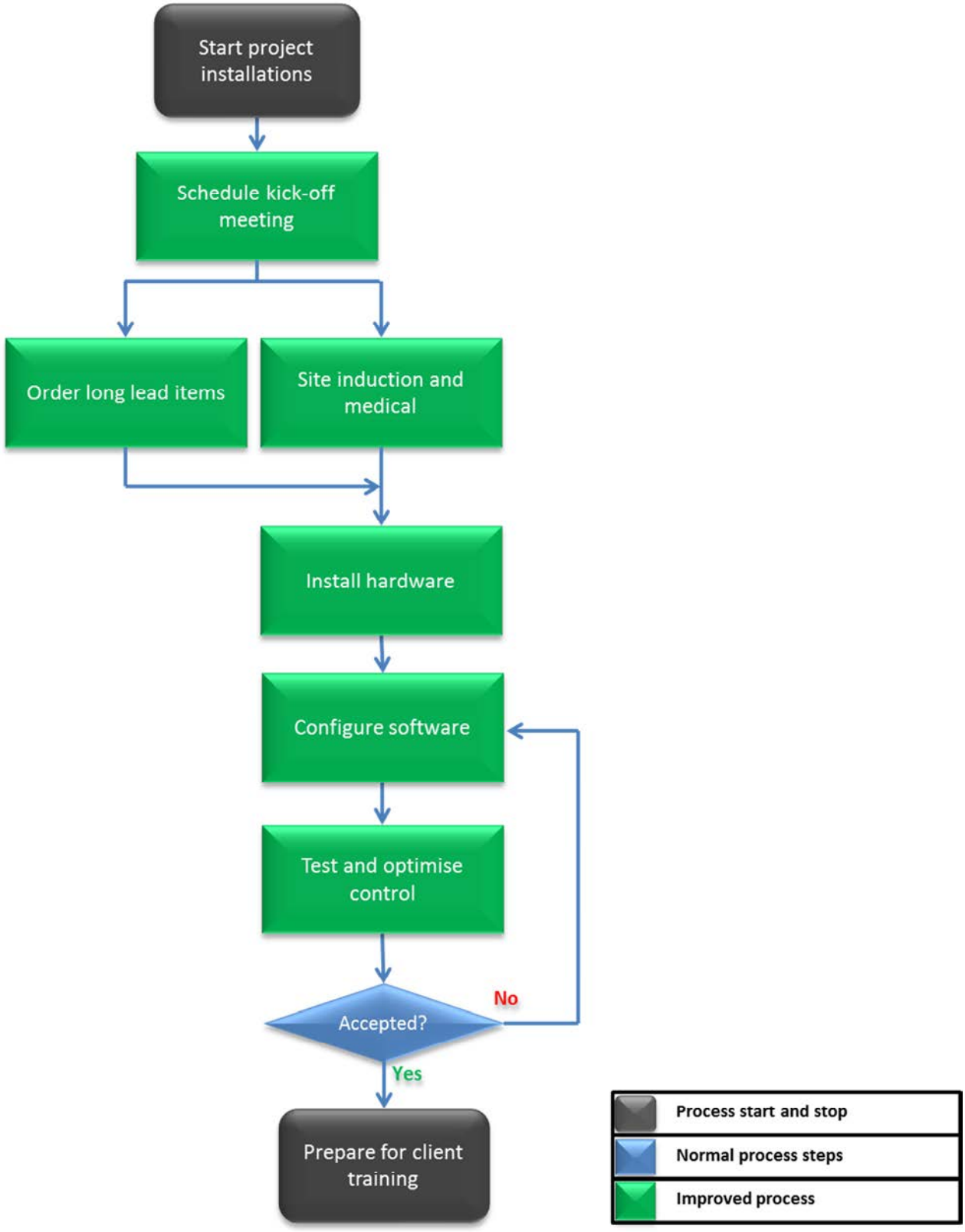
B5: Proposal submission and negotiation process



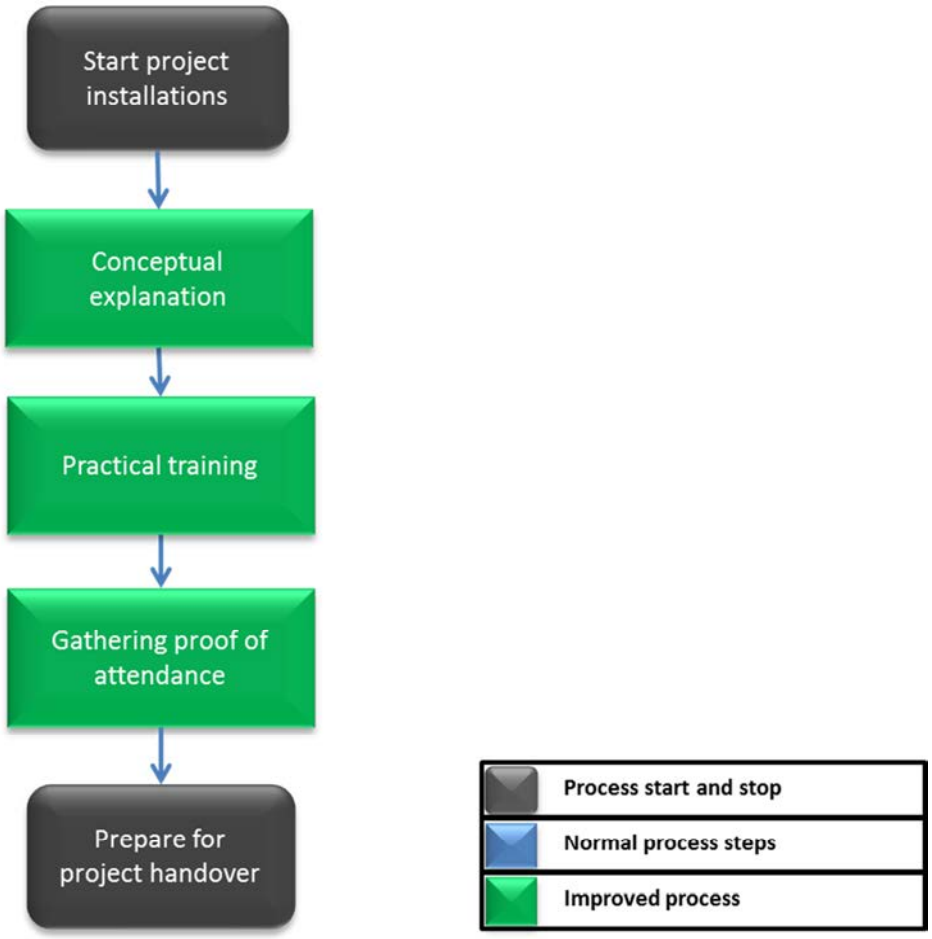
B6: Costing and tender process



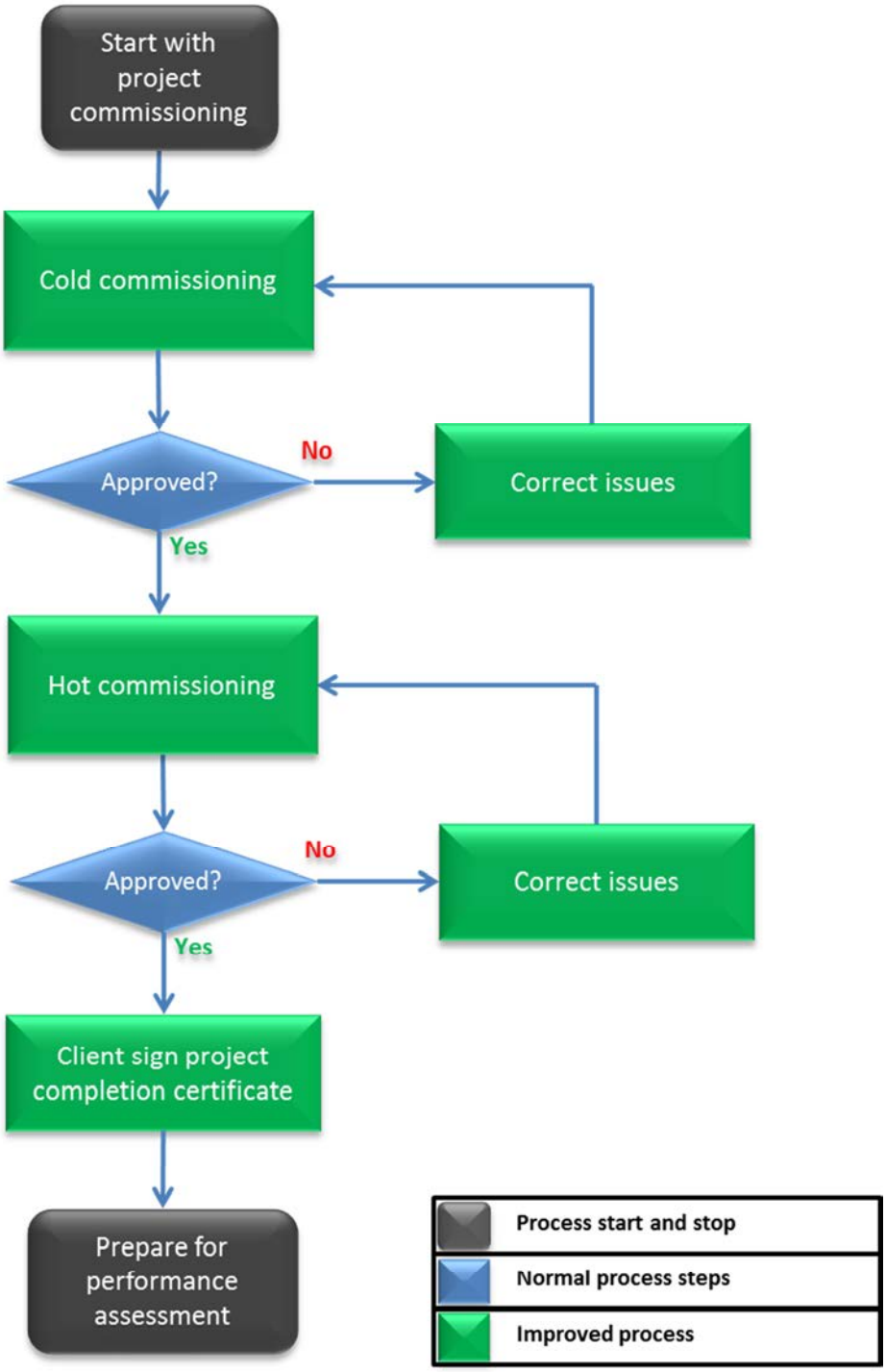
B7: Project implementation process



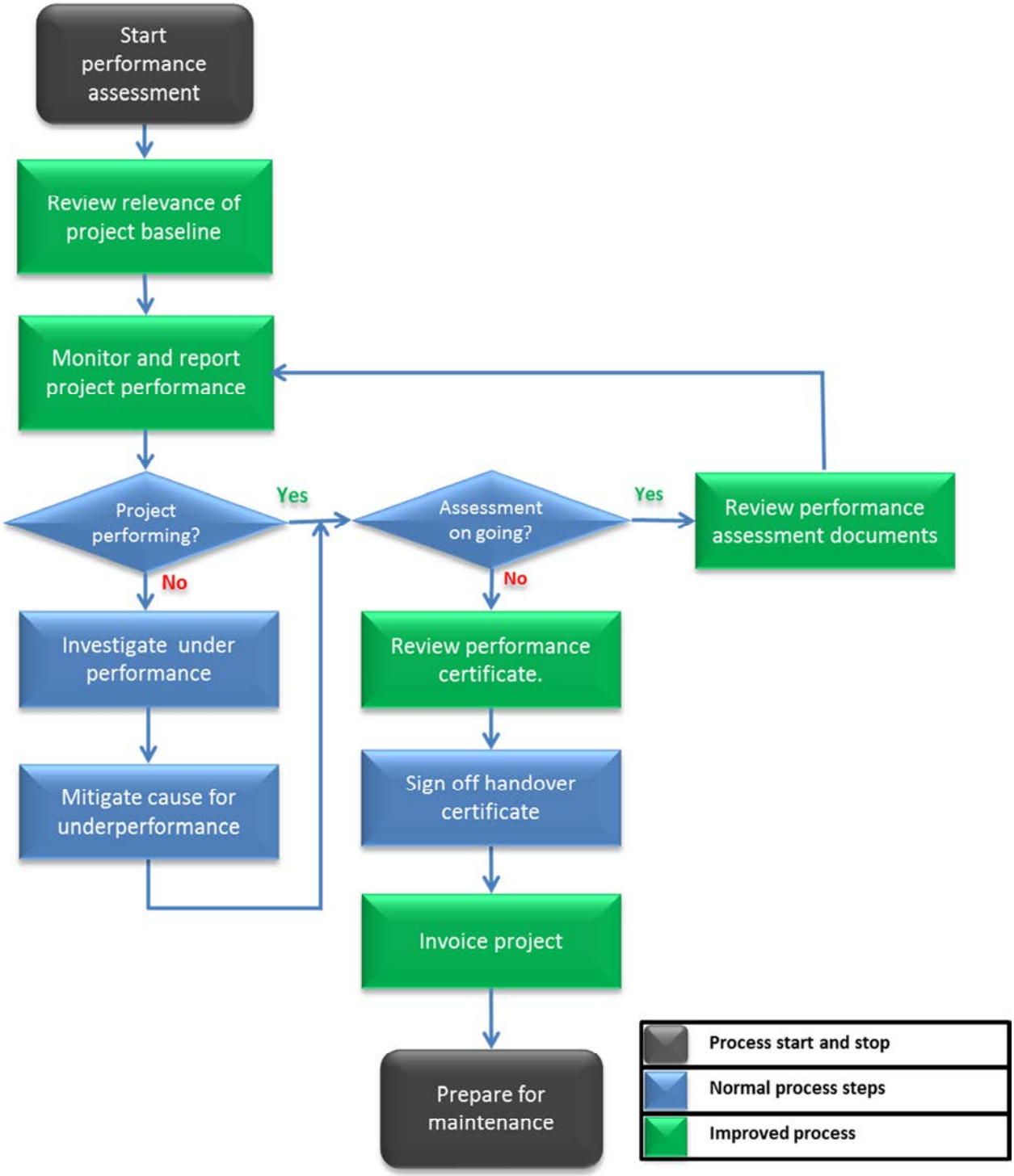
B8: Client personnel training process



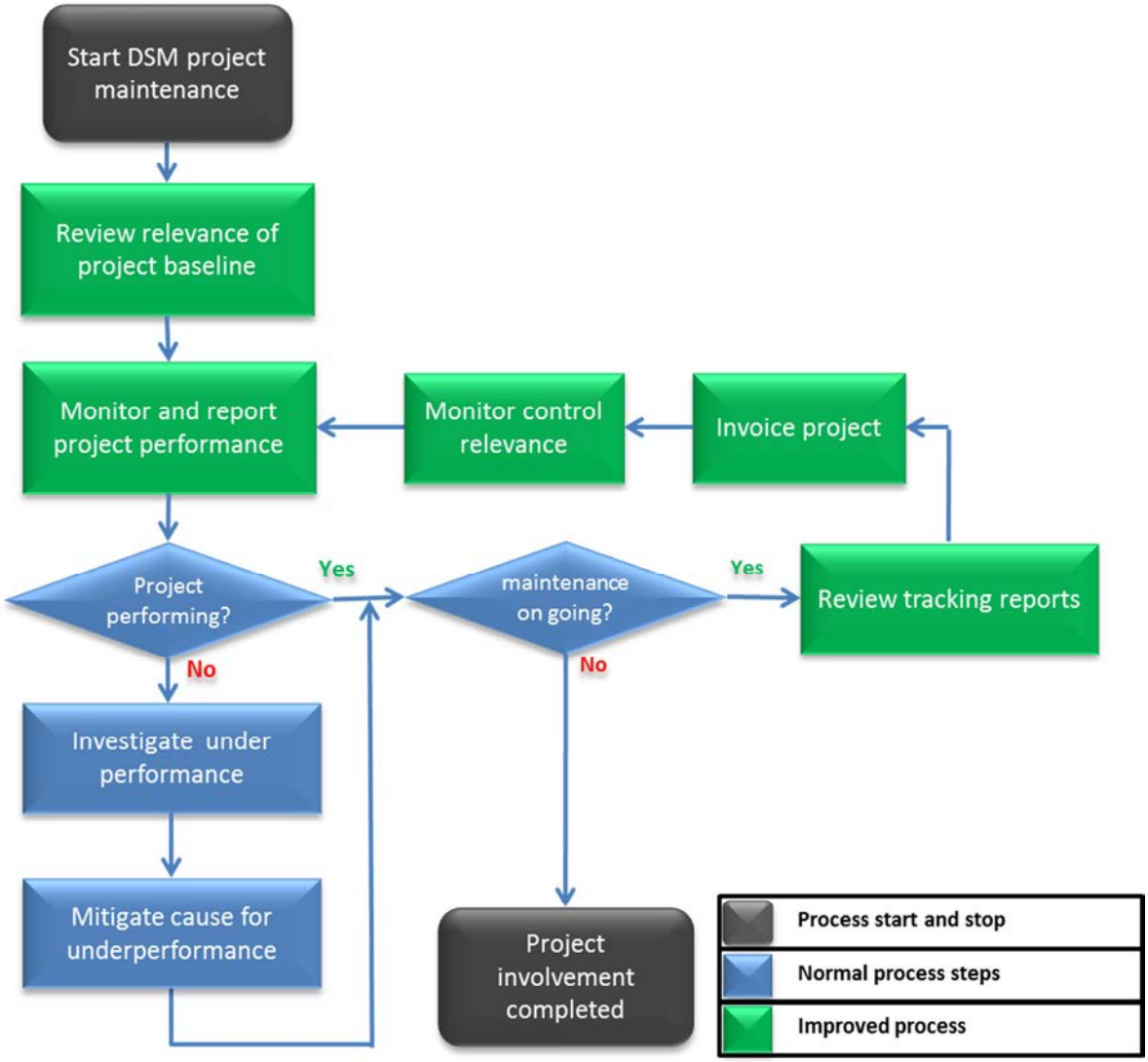
B9: Project handover process



B10: Performance assessment process



B11: Maintenance process



APPENDIX C: RESULTS QUESTIONNAIRE

Chapter 5 references the questionnaire used during the interviews. A sample questionnaire and declaration of participation by the interviewees are shown.

Risk quantification questionnaire

This questionnaire pertains to the thesis study entitled: *Improved risk management processes for South African industrial ESCos* by HPR Joubert. The results for the processes improved in the study rely on the risk perception of individuals that use them in the industry. It will be greatly appreciated if you could take the time to evaluate the processes as directed in this document.

Explaining the risk quantification process:

Risk is the perception of an individual. To quantify the effectiveness of the optimised process in the study, a risk quantification tool was developed.

There are four steps in the process of risk quantification. Figure 1 shows the process and its chronological order and Table 1 explains the process.

Figure 1: Risk quantification process

Table 1: Risk qualification process

	Steps	Explanation
1.	Identify risk.	Identify the risk to the process.
2.	Analyse risk.	Analyse the effect of the risk on the four process components. These are: • Cost (business experience profits or losses); • Time (project completion time increased or decreased); • Resources (consider the cost and time of personnel or equipment used); and • Quality (increase or decrease in the quality of the ESCo's service or product). The effect risk has on these four components forms the basis for the evaluation tool's results.
3.	Evaluate risk.	Qualify the perceived risk using the evaluation matrix (explained after the table). Each process component is evaluated on the perceived probability of the risk condition occurring and the severity if it occurs.
4.	Treat risk.	Based on the outcome of the risk evaluation, four questions need to be answered to aid the decision that is to be made. These are: • Has the risk been avoided? • Has the risk been reduced? • Can the risk be shared? • Is the risk acceptable? Process optimisation to manage risk must continue until the risk-taker deems the risk acceptable.

Instruction to participant:

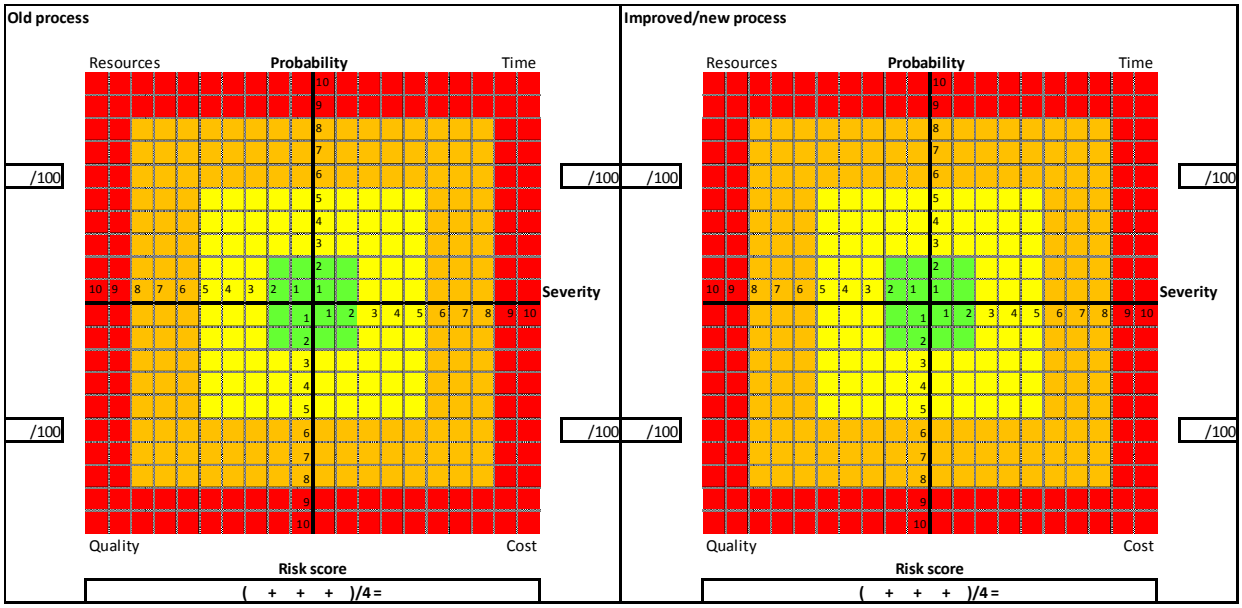
Consider the optimised processes listed in Chapter 4 of the thesis. Using the discussed evaluation tool and your experience in the industry, quantify the probability and severity of the perceived risk to a project.

There are two variants to the optimised processes.

1. The process has in improvement in one or more of the process components over the previous process; or
2. It is a new process to the project phase that aims to reduce the risk perceived with that phase.

Risk scoring sheet per process:

(The scoring table shown is repeated in the full questionnaire document for each process discussed in Chapter 4. In an interest to save space in this document, a single table is shown as an example).

Risk name:	*{Process name}*							
Identify risk:								
Analyse risk:	**Cost**		**Time**		**Resources**		**Quality**	
Evaluate risk:								
								
Treat risk:	**Avoided**		**Reduced**		**Shared**			

Interviewee's details:

Name	
Surname	
Qualification	
Experience	
Period of experience	
Signature	**Date**

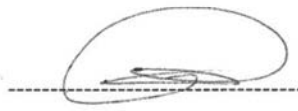
Chapter 5 references the signed declaration of participation by the interviewees. The signed deceleration is shown.

We the undersigned, confirm that we took part in the interviews as described in the thesis entitled "Improved risk management processes for South African industrial ESCos".

We were all interviewed by Mr. HPR Joubert and completed the questionnaire as described by the aforementioned study.

We agree with the final results.

Dr. JF van Rensburg

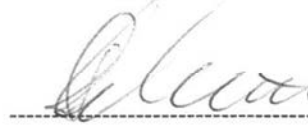


Date: 25/11/2015

Dr. W Booysen

Date: 2015/11/25

Dr. A Schutte

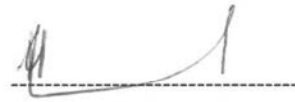


Date: 2015/11/25

Dr. AJM van Tonder

Date: 2015/11/25

Dr. HJ Groenewald



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APPENDIX D: CASE STUDY PROJECT DETAILS

Chapter 5 references to the details of the projects considered to evaluate the developed business model. Details regarding the 129 projects are listed in Table 24.

Table 24: Case study project details

Project no.	Project technology	Client industry	Inception date	Percentage performance	Percentage faster completion
1	Pumping	Gold mine	2004	139%	151%
2	Pumping	Gold mine	2004	160%	117%
3	Pumping	Gold mine	2004	109%	125%
4	Pumping	Gold mine	2004	111%	100%
5	Pumping	Gold mine	2004	114%	100%
6	Pumping	Gold mine	2005	80%	155%
7	Pumping	Gold mine	2005	135%	171%
8	Refrigeration	Gold mine	2005	123%	95%
9	Pumping	Gold mine	2005	189%	144%
10	Pumping	Gold mine	2005	73%	121%
11	Pumping	Gold mine	2005	169%	-52%
12	Pumping	Gold mine	2005	15%	92%
13	Compressed air	Gold mine	2006	202%	75%
14	Pumping	Gold mine	2005	136%	30%
15	Winders	Gold mine	2006	92%	159%
16	Pumping	Platinum mine	2007	116%	195%
17	Compressed air	Platinum mine	2006	107%	100%
18	Compressed air	Platinum mine	2006	101%	100%
19	Refrigeration	Gold mine	2007	131%	147%
20	Pumping	Gold mine	2007	95%	171%
21	Pumping	Gold mine	2007	90%	137%
22	Refrigeration	Gold mine	2007	55%	106%
23	Compressed air	Platinum mine	2007	46%	129%
24	Winders	Gold mine	2007	64%	121%
25	Compressed air	Platinum mine	2007	124%	113%
26	Compressed air	Gold mine	2007	130%	112%
27	Pumping	Water scheme	2007	115%	112%
28	Compressed air	Platinum mine	2007	101%	104%
29	Compressed air	Gold mine	2007	132%	104%
30	Refrigeration	Gold mine	2007	100%	80%
31	Pumping	Gold mine	2007	126%	104%
32	Pumping	Gold mine	2007	73%	100%
33	Pumping	Gold mine	2007	50%	100%

34	Compressed air	Gold mine	2007	141%	100%
35	Pumping	Gold mine	2005	68%	92%
36	Compressed air	Gold mine	2007	392%	79%
37	Pumping	Gold mine	2007	94%	95%
38	Compressed air	Platinum mine	2008	68%	100%
39	Pumping	Gold mine	2007	76%	50%
40	Compressed air	Gold mine	2009	100%	100%
41	Compressed air	Gold mine	2009	126%	100%
42	Compressed air	Gold mine	2009	113%	100%
43	Compressed air	Gold mine	2009	100%	100%
44	Air network optimisation	Platinum mine	2010	108%	128%
45	Air network optimisation	Platinum mine	2010	151%	136%
46	Air network optimisation	Gold mine	2010	167%	123%
47	Air network optimisation	Gold mine	2010	186%	123%
48	Air network optimisation	Gold mine	2010	226%	123%
49	Air network optimisation	Platinum mine	2010	104%	131%
50	Air network optimisation	Gold mine	2010	120%	107%
51	Water supply optimisation	Gold mine	2010	197%	109%
52	Water supply optimisation	Gold mine	2010	259%	105%
53	Air network optimisation	Gold mine	2010	90%	107%
54	Water supply optimisation	Gold mine	2010	204%	104%
55	Compressed air	Gold mine	2006	104%	59%
56	Air network optimisation	Platinum mine	2010	183%	101%
57	Air network optimisation	Gold mine	2010	87%	38%
58	Air network optimisation	Gold mine	2010	104%	105%
59	Air network optimisation	Platinum mine	2010	150%	92%
60	Air network optimisation	Platinum mine	2010	152%	92%
61	Air network optimisation	Platinum mine	2010	99%	92%
62	Air network optimisation	Platinum mine	2010	74%	25%
63	Air network optimisation	Platinum mine	2010	50%	25%
64	Pumping	Gold mine	2011	149%	150%
65	Pumping	Platinum mine	2011	135%	149%
66	Water supply optimisation	Gold mine	2010	215%	16%
67	Cooling auxiliaries	Gold mine	2011	173%	117%
68	Process line optimisation	Cement plant	2011	37%	167%
69	Cooling auxiliaries	Gold mine	2011	208%	115%
70	Air network optimisation	Gold mine	2011	97%	114%
71	Air network optimisation	Gold mine	2011	90%	114%
72	Air network optimisation	Gold mine	2011	88%	114%
73	Pumping	Platinum mine	2011	3%	114%
74	Process line optimisation	Cement plant	2011	127%	165%
75	Process line optimisation	Cement plant	2011	140%	166%
76	Process line optimisation	Cement plant	2011	100%	113%

77	Pumping	Water scheme	2011	101%	165%
78	Pumping	Water scheme	2011	103%	165%
79	Pumping	Water scheme	2011	176%	165%
80	Air network optimisation	Platinum mine	2011	109%	76%
81	Air network optimisation	Gold mine	2012	101%	164%
82	Compressed air	Platinum mine	2012	110%	145%
83	Air network optimisation	Gold mine	2012	112%	155%
84	Water supply optimisation	Gold mine	2012	116%	164%
85	Refrigeration	Gold mine	2012	88%	170%
86	Process line optimisation	Cement plant	2012	148%	170%
87	Compressed air	Gold mine	2012	93%	145%
88	Cooling auxiliaries	Gold mine	2012	233%	164%
89	Cooling auxiliaries	Gold mine	2012	cancelled	cancelled
90	Air network optimisation	Gold mine	2012	100%	155%
91	Pumping	Gold mine	2011	156%	70%
92	Air network optimisation	Gold mine	2011	298%	23%
93	Air network optimisation	Gold mine	2012	201%	180%
94	Process line optimisation	Cement plant	2012	165%	180%
95	Air network optimisation	Gold mine	2011	56%	19%
96	Cooling auxiliaries	Gold mine	2011	336%	56%
97	Pumping	Gold mine	2011	124%	60%
98	Pumping	Water scheme	2012	92%	150%
99	Air network optimisation	Gold mine	2012	111%	125%
100	Pumping	Water scheme	2012	25%	120%
101	Process line optimisation	Cement plant	2013	103%	167%
102	Cooling auxiliaries	Platinum mine	2012	206%	119%
103	Pumping	Water scheme	2012	142%	119%
104	Pumping	Water scheme	2012	0%	119%
105	Pumping	Water scheme	2012	55%	119%
106	Cooling auxiliaries	Platinum mine	2012	69%	119%
107	Pumping	Water scheme	2013	50%	105%
108	Compressed air	Platinum mine	2012	79%	121%
109	Cooling auxiliaries	Gold mine	2012	cancelled	cancelled
110	Water supply optimisation	Gold mine	2012	97%	118%
111	Cooling auxiliaries	Gold mine	2012	121%	118%
112	Process line optimisation	Cement plant	2013	39%	161%
113	Process line optimisation	Gold mine	2013	139%	137%
114	Pumping	Water scheme	2013	107%	137%
115	Pumping	Water scheme	2013	87%	137%
116	Process line optimisation	Cement plant	2013	212%	129%
117	Process line optimisation	Cement plant	2013	80%	125%
118	Bulk air coolers	Platinum mine	2013	110%	93%
119	Bulk air coolers	Gold mine	2013	126%	88%

120	Refrigeration	Gold mine	2013	144%	80%
121	Pumping	Gold mine	2013	86%	100%
122	Cooling auxiliaries	Gold mine	2013	195%	69%
123	Pumping	Water scheme	2013	90%	65%
124	Pumping	Water scheme	2013	195%	65%
125	Bulk air coolers	Water scheme	2013	108%	49%
126	Pumping	Water scheme	2013	55%	100%
127	Pumping	Water scheme	2013	69%	100%
128	Pumping	Water scheme	2013	12%	100%
129	Pumping	Water scheme	2013	48%	100%