University of Pretoria

EXPLORING STAGES/PHASES AND GATES AS A PROJECT MANAGEMENT APPROACH FOR SOUTH AFRICAN CLEAN DEVELOPMENT MECHANISM PROJECTS

by

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Title of thesis	Exploring Stages/Phases and Gates as a Project Management Approach for South African Clean Development Mechanism Projects
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Abstract

Climate change is a global problem that is at least partially caused by human induced greenhouse gas emissions. Various initiatives were developed in the 1990's to incentivise greenhouse gas emission reductions below legal limits. One of these systems is the Kyoto Protocol's Clean Development Mechanism (CDM). In these incentive schemes parties can sell (the Seller) their greenhouse gas emission reductions to other parties (the Buyer) who need to offset their emissions. Emission reduction incentivised projects have technical aspects, financial aspects and regulatory requirements. The complexity of emission reduction schemes are further increased due to the levels of scrutiny and diverse sources of scrutiny that a project undergoes.

As a developing country South Africa (SA) has a lot to gain by the successful implementation of CDM projects. Unfortunately very few successful CDM projects exist in South Africa. It was then the aim of this research to explore why there are so few projects and what are the current CDM project management approaches followed for CDM projects in SA?

During the investigation aspects of the project management landscape of SA CDM projects were structured by means of a stage/phase and gate approach. This was done to aid in addressing the specific requirements of CDM projects and to combine this with the limited real world experience of successful CDM projects in SA. A stage/phase-gate model was developed because of the

model's ability to manage risk per stage/phase and overall risks, as well as the ability of these models to assist in portfolio management.

Various research methods were used to develop the final proposed stage/phase and gate project management model (Model β). These methods included over and above literature reviews:

- Two rounds of questionnaires to develop the model;
- Interviews with individual experts through identified cases to validate the first version of the model; and
- Interaction with the South African Clean Development Industry Association to validate the second version of the model.

Model β should not be seen as a stationary model. The model should rather be adapted by each emission reduction project developer to suit the developer's company specific requirements. Furthermore the evolving regulatory environment of emission reduction systems will lead to the continued adapting and updating of Model β. The model could then be useful for:

- Project developers to plan and execute their projects; and
- Buyers or Investors in projects as to quickly ascertain current project status and progression.

It is envisaged that applying Model β, or a derivative, will:

- Manage risk due to increased project management through a stage/phase and gate approach;
- Decrease project development time and ensure all required outputs are achieved quicker; and
- Due to decreasing development time, costs could be managed better.

Keywords:
emission reduction incentive, project management, stage/phase-gate

Declaration

I declare that this thesis, which I hereby submit for the degree Philosophiae Doctor (Engineering Management) at the University of Pretoria, is my own work and has not been previously submitted by me for a degree at another university.

.... 2011-01-04 ....

Marco Lotz Date

Acknowledgements and Dedications

"I dedicate it to all the kids and adults out there that have ever been picked on or made to feel inadequate."
Korn, MTV Unplugged
(Introduction to Creep)

"For with much wisdom comes much sorrow, the more knowledge, the more grief."
Ecclesiastes 1:18

To thank:

As a student I was historically constantly reminded of the pecking order of an academic institution. The lower one finds oneself in this pecking order the longer it takes to obtain feedback from the academic staff. This was not the case with Alan (Professor Brent). As a student there is then no greater compliment than to say that I got quick feedback irrespective of Alan's work load or where he found himself in the world. The feedback provided was also of value and aided in completion of this research. I can then recommend Alan as a promoter to other students and can only hope that we work together in the future.

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To the administrative staff at the University of Pretoria for doing an unappreciated job exceptionally well. Marlene Mulder is especially thanked for her efforts.

On a personal note:

This PhD was done to repay a debt - a debt to my friends that did not have the opportunity of tertiary education. Some did not have the financial means or stable family life that enables one for further education. Some simply did not have the ability. I would like to name you to eternalize you in the same sense that this work is now eternalized, but you are not the type of people who ever sought public recognition. In your small town lives with small dreams you found serenity not attainable by academic or financial success. This I realize now. I consider each time I struggled during this research as an insult to you. For insulting you I humbly apologize.

To God, the Holy Trinity, for not being as impatient with me as I am with Him.

To my parents (Christo and Nita) for enabling me to pursue this study. In the end there is no project as cumbersome and complex as the project management of children. And no book, no PhD, will ever encompass this field.

To Christo and Sanet for reading the articles that were produced by this research and looking interested. To Stefan and Colyn for letting us experience the world once more as untainted and new – with eyes that only children can offer adults.

Looking back over the years some of the best memories involved my grandparents. When I thought about it the memories were so great because my grandparents never confined my thinking to reality and my imagination could roam free. An unattainable dream then became a mere thought away. In the same sense a PhD is considered by most to be so exclusive and so unattainable. The reality was that it was then only a thought away. The dreaming then propagated quite naturally into adulthood. This I owe to my grandparents.

To Doctor Andrew Gill. (a.k.a. the Gillamonster). It is an honour calling you 'doctor', my friend. Andrew who was born into socio-economic hardship. Andrew that obtained a tertiary education against all odds. And then reaching the pinnacle of his field as a doctor. Andrew who did not blame his circumstances on his family, society, the government or God. You put all of us born into means to shame and inspire everyone that has far less. Nice going, Andy.

To the friends that passed away. I will never forget you, but I have to move on. I have to silence my demons because nothing buried alive will ever die.

Table of Contents

List of Figures

List of Tables

List of Abbreviations

CDM	Clean Development Mechanism
CER	Certified Emission Reduction
COP	Conference Of the Parties
DME	Department of Minerals and Energy, replaced by Department of Energy
DNA	Designated National Authority
DOE	Designated Operational Entity
EB	Executive Board
GHG	Green House Gas
GWP	Global Warming Potential
IPCC	Intergovernmental Panel on Climate Change
PDD	Project Design Document
PIN	Project Identification Note
PMBOK	Project Management Body of Knowledge
PP	Project Proponent
SA CDM IA	South African Clean Development Mechanism Industry Association
SD	Sustainable Development
UN	United Nations
UNFCCC	United Nations Framework Convention on Climate Change
VER	Verified/Voluntary Emission Reduction

Chapter 1: Introduction and background

"All across the world, in every kind of environment and region known to man, increasingly dangerous weather patterns and devastating storms are abruptly putting an end to the long-running debate over whether or not climate change is real. Not only is it real, it's here, and its effects are giving rise to a frighteningly new global phenomenon: the man-made natural disaster."
Barack Obama (3rd of April 2006)

1.1. Climate change and the Kyoto Protocol's Clean Development Mechanism (CDM)

Climate change is a global problem that will not be solved without long term vision and commitment. In 1997 the Kyoto Protocol was adopted at the Third Session of the Conference of the Parties (COP) to the United Nations Framework Convention on Climate Change (UNFCCC, 2007). Thereby, Annex-I countries, or industrialised countries, accepted legally binding commitments to reduce greenhouse gas (GHG) emissions. The signatory countries agreed to reduce their anthropogenic emissions of GHGs by at least 5% below 1990 levels in the commitment period 2008 to 2012. The targeted GHGs are CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6 (UNFCCC, 2007).

Companies can satisfy the locally applicable air pollution legislation and still vent large amounts of GHGs to the atmosphere. Technologies exist that could potentially help alleviate GHG emissions (Johnson, 2006), but there must exist an incentive for companies to go beyond the legislative requirements regarding air pollution. Various such financial incentives exist for GHG reduction. The Kyoto Protocol drives one such an incentive, the clean development mechanism (CDM) (UNFCCC, 2007), whereby industrialised countries, and the companies within these countries, could earn GHG emission reduction credits. The incentives for developing countries to participate in the CDM are acquiring technology, acquiring foreign capital and accelerated growth. The CDM aims to mitigate GHG emissions by offering a regulatory framework for proven emission reductions in developing countries though technological interventions by developed countries. Emission reductions are quantified in so called certified emission reduction (CER) units that are tradable on the open market. A CER is simply the prevention of one tonne of carbon dioxide gas equivalent emitted in a developing country. The other targeted GHGs are all related via a global warming potential (GWP) rating back to an equivalent carbon dioxide. For example, methane (CH_4) has a 21 fold GWP potential than carbon dioxide (CO_2). This implies that one tonne of CH_4 emissions prevented is equivalent to 21 tonnes of CO_2 emissions prevented (UNFCCC, 2007).

Hasselknippe (2003) describes the mechanisms of emission trading. In essence CERs are traded on the open market at a price driven by supply and demand pertaining to specific projects; the trends in the carbon market are reported by the World Bank (Capoor, 2007). Michaelowa (2003) provides more information regarding CDM transaction costs. The CDM is governed by the Executive Board (EB) under the Kyoto Protocol, whilst the trading of the CERs is facilitated by many entities such as the Carbon Finance Unit of the World Bank (2007).

1.2. The CDM: A Project Based Approach

Each CDM project is unique, but each CDM project will have the same generic components and types of parties involved.

The party that is interested in registering a CDM project is referred to as the Project Proponent (PP). The Project Proponent can also be a group of parties depending on the commercial arrangement of the company/entity with the potential for emission reductions, parties/entities with the know-how to develop CDM projects, and potential investors in such projects. The potential investors can invest by acting as buyers of the resulting credits or the credits can be sold to a 3^{rd} party. The PP will then be the seller of the credits earned.

All CDM projects need host country approval before the Executive Board, under the Kyoto Protocol, will start to evaluate the merit of a project. The CDM term used for the governmental entity in the host country that must provide this approval is the Designated National Authority (DNA). In South Africa the DNA is hosted by the Department of Minerals and Energy (DME, 2007).

An impartial third party is required to validate, verify and certify all emission reductions resulting from a CDM projects. This impartial third party is known as the Designated Operational Entity (DOE) and has to be accredited by CDM Executive Board for the services it will provide to Project Proponents. Normally these DOEs are traditional auditing firms.

As stated earlier the CDM is governed by the CDM Executive Board (EB). Only the EB can register a CDM project and issue associated CERs.

Figure 1.1 illustrates the components of a CDM project, the flow of the project, and the involvement of the various parties discussed above.

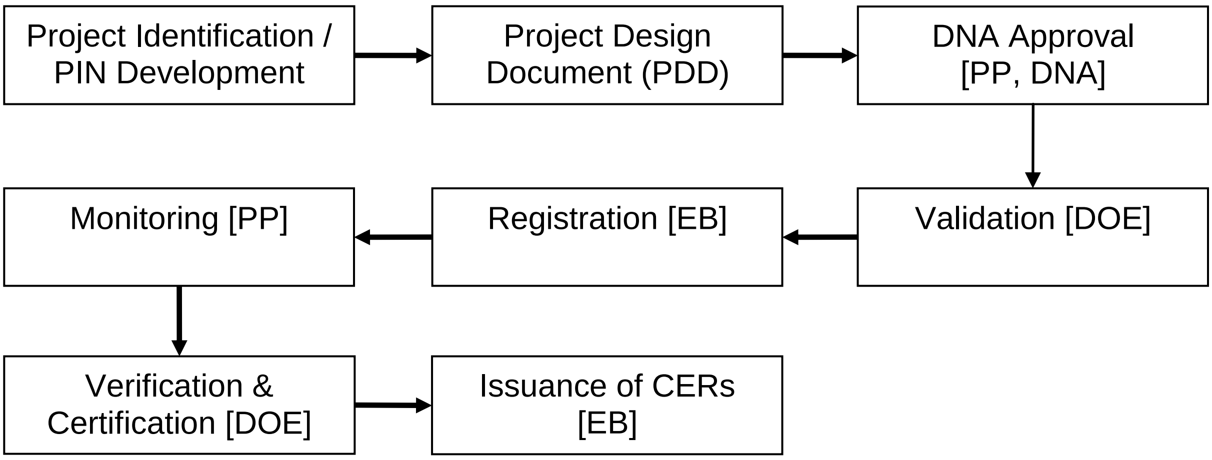

Figure 1.1: Flow diagram of CDM process and party involvement (adapted from UNDP, 2006)

First, a Project Identification Note (PIN) is drawn up which briefly states the goals and processes to be used in a potential CDM project. In South Africa the Project Proponent can at this early stage apply for provisional host country approval from the DNA. It must be noted though that drafting and submitting a PIN is considered to be a voluntary step.

As a next step every CDM project is required to submit a Project Design Document (PDD). This PDD is a comprehensive document that indicates how an approved CDM methodology will be applied. The methodology sets the rules used by which certain technologies are used to mitigate/reduce GHGs in the proposed project activity[1]. If no approved methodology exists that can be applied to the proposed project activity then a new methodology has to be drafted and approved by the CDM EB as part of the proposed project activity[2]. The purpose of a methodology is also to establish the GHG baseline for the proposed CDM project activity. In this context the concept of the baseline has a specific definition implying "*the scenario that reasonably represents GHG emissions that would occur in the absence of the proposed project activity*." – see Mizuno (2007).

The DNA must provide final host country approval when the PDD with approved methodology has been completed. It is at this stage that a DOE is required to evaluate the proposed project, and if the DOE is satisfied with the methodology and PDD, then it can be submitted to the CDM EB for registration. The final decision for project registration rests solely at the CDM EB.

[1] In the CDM context a methodology is a non-project specific guideline that must be adhered to. The methodology, which requires approval by the EB to be usable, defines monitoring principles whereas a project specific monitoring plan will have to be followed to monitor the achieved emission reductions. The emission reductions achieved is then audited and quantified through the process of verification. The PDD is the document that indicates how the non-project specific CDM methodology is applied to a specific project.

[2] Methodologies and PDDs are comprehensive documents. Examples of Methodologies and PDDs can be downloaded from the UNFCCC's website: http://cdm.unfccc.int/

In order to earn CERs after project registration the Project Proponent needs to apply the monitoring plan, as described in the PDD and methodology, to prove that GHG emission reduction was achieved. The verification and certification of this GHG mitigation is then the task of the DOE. Only after the verification and certification by the DOE will the CDM EB issue CERs to the Project Proponent.

1.3. Rationale of the research

As a project-based system, emission reduction schemes necessitate the approval of aspects of the project relating to technical aspects, distributed regulatory approval, and distributed financial approval. As early as 2000 the World Business Council for Sustainable Development (Moorcroft, 2000) identified various barriers, represented as choke valves, in the CDM project life cycle. Moorcroft (2000) stated that: "*CDM methodologies and processes will create bottlenecks and raise transaction costs*". (These barriers are depicted in Figure 1.2.)

Moorcroft further stated that the: "*CDM project investment carries with it an important new dimension: it attracts a global level of scrutiny, over and above host country processes which must be satisfied for any project investment, regardless of the CDM. The investment and trade-related functions of the CDM therefore need to be organised with the minimum of bureaucracy and it will be particularly important to keep additionality*[3] *and baselines*[4] *as simple as possible*".

[3] Additionality is the concept whereby a potential CDM project proves that the project activity would not have taken place in the absence of the financial incentive offered by the CDM. Proving additionality is mandatory for all CDM project. The Additionality Tool developed by the CDM Executive Board may be used to prove additionality.

[4] The project baseline is the GHG emissions that would have taken place if the project is not implemented.

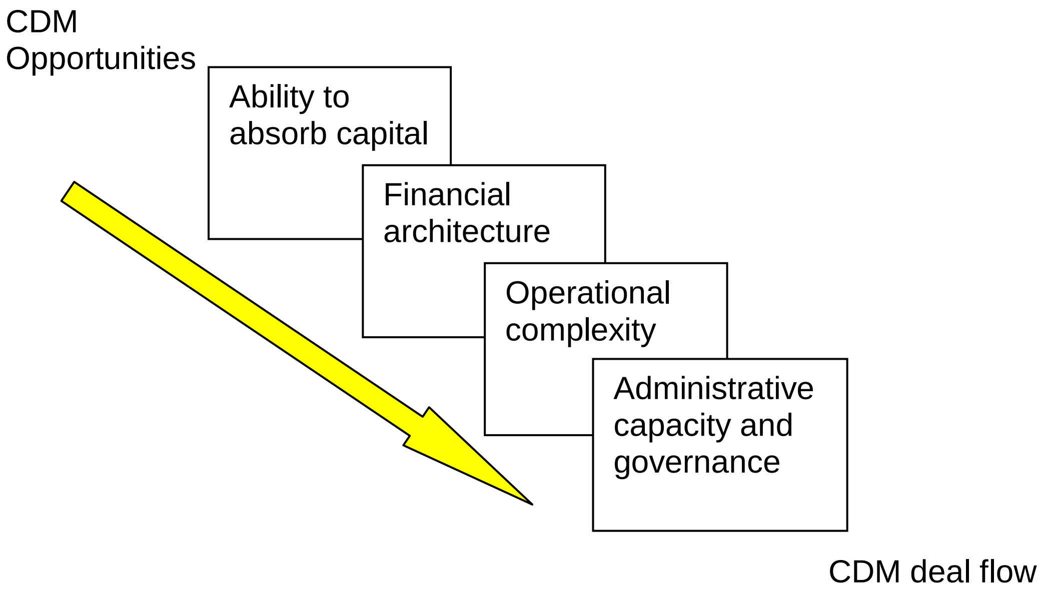

Figure 1.2: Barrier analysis of CDM process (Moorcroft, 2000)

Much research has been done on the issues raised by Moorcroft, but it would seem that at least some of these concerns still exist and other concerns have been highlighted by researchers. Examples of this include:

- Moorcroft identified the "ability to absorb capital" as a concern and that it depends on various factors including political and security risks, the prevailing ethical and legal frameworks, and business and investment infrastructures. It is interesting, if the view of Leqocq and Ambrosi (2007) is also considered, that capital constraint countries, especially those in sub-Saharan Africa, account for a very small percentage of all credits traded. It can then arguably be stated that the ability of sub-Saharan Africa to absorb capital has not significantly increased between 2000 and 2007.

- The "financial architecture" will either exacerbate or improve the ability of CDM projects to attract investment – see Moorcroft (2000) for further details. With banks and financial institutions having international reach it can be argued that banks in developing countries ought to have developed financial architecture abilities for carbon projects or at least have access to these skills.

- The “operational complexity” refers to the CDM methodologies and processes that, according to Moorcroft, will create bottlenecks and raise transaction costs. The greater the complexity the lower the deal flow. Winkler et al. (2005) also raise transaction cost and lack of potential sustainable development benefits as reasons why emission reduction projects outside of the CDM could be considered for African projects. Brent et al. (2005) indicated the complexities associated with sustainable development criteria for CDM projects specific to South Africa. “Governance and administrative capacity”, which forms part of the operational complexity, refers to possible administrative delays and barriers that will depend on the CDM governance system, the structure, roles and processes that are adopted. It is stated that there will be constraints on the number of projects that can be serviced with competent, experienced and professional staff. There are considerable lead times associated with project development which can take years, especially with large projects. Winkler et al. (2005) aimed to address the institutional capacity issues especially regarding DNAs in Africa. Arguably governance and administrative capacity is still considered a concern in the South African context as will become clear later on in the research.

It is then the aim of this study to focus on CDM projects in Africa, and specifically South Africa. The reason being that so few African projects exist (Leqocq and Ambrosi, 2007) and although South Africa has had some success with CDM projects there is still a strong driving force to increase the amount of projects (Little et al., 2007).

The study aims to focus on risk management and the integration of all the additional aspects encountered in CDM project development. This will be done by looking at some aspects of the project management landscape of CDM projects in South Africa.

1.4. Related theory

A brief overview of some project management principles and models will be presented here as an introduction of the discussion to follow. Obtaining information on the classical project management approach followed today is an easy matter. Various project management models and standards have been developed since the middle of the 20^{th} century. These models and standards include, amongst others, PRINCE2 (2005) and PMBOK (2004). There are large similarities amongst classical project management models and/or standards irrespective of which model and/or standard is used. The generalized project management sequence is depicted in Figure 1.3: Generalized project management sequence (adapted from Openlearn, 2007), which is rather similar to the typical PMBOK (2004) phases in a project life cycle. The question then is: how does project management differ in an emission reduction project?

Figure 1.3: Generalized project management sequence (adapted from OpenLearn, 2007)

Novel aspects of emission reduction projects have been researched. These aspects include the influence of CDM transaction costs (Michaelowa et al., 2003) and specifically how it relates to South Africa (Little et al. 2007). Another focal point of research was the contentious issue of CDM additionality which was studied in depth as early as 2000 – 2001 (Shrestha and Timilsina, 2001, Gustavsson et al., 2000) and later by Michaelowa (2005) and Streck (2009). Also recently Michaelowa (2009) discussed the evolution of the theoretical definition of additonality and importantly real world implementation in CDM projects.

The intricacy of stakeholder engagement is a further important aspect that should be discussed along with CDM transaction cost and additonality. In the South African (SA) context the National Environmental Management Act (NEMA) of 2006 (SA DEA, 2006) referred to Environmental Impact Assessment (EIA) considerations that should be adhered to before specific projects can be undertaken - there are specific listed items that would trigger a project to do a full EIA report before government consent will be given. The regulations of 2006 included much more stakeholder participation than any previous environmental legislation - previous legislation would be the original NEMA act (SAGG, 1998). The same can be said for the 2010 NEMA (cape>gateway, 2010), which broadened the compulsory stakeholder participation even further and thereby increased complexity and timelines. The SA DNA will not provide any host country approval for any project if a project does not conform to the SA NEMA and subsequent acts.

CDM projects also require stakeholder participation and in the PDD the PP must specify:

- Which local stakeholders' comments were invited;
- A summarized description of how comments by local stakeholders have been invited and compiled;
- A summary of the comments received should be given; and
- Report should be given on how due account was taken of the comments received.

Brown and Corbera (2003) have used a stakeholder multi-criteria scheme to explore the range of stakeholders, their roles, interests and perspectives, based on a carbon sequestration by means of forestry project in Mexico. However, an integrated strategy to manage all the stakeholders was not developed. Little et al. (2007) also discussed the intricacies and perceived complexities that exist in SA CDM stakeholder participation.

Haites and Yamin (1999) have already argued as far back as 1999 that the amount of registered CDM projects and the ease of implementation will benefit from a flexible pragmatic approach. They state that: "*there is no right way of doing business under the CDM*". This statement indicates a lack of structure in managing CDM projects and shows the ad hoc intervention which characterized early CDM project management approaches.

Furthermore, ZhongXiang (2005) states that developing countries typically lack a "clear institutional structure" and an "implementation strategy" system for application, approval, and implementation of CDM projects. ZhongXiang (2005) concludes that through capacity building aspects such as established streamlined and transparent CDM procedures, including sound governance must be developed through an integrated framework. Specific to South Africa Little et al. (2007) focussed on identifying various seemingly loose standing factors which they grouped into facilitating and inhibiting factors.

In this study the various historical attempts made at investigating the project management landscape and approaches of the CDM system will be grouped as indicated in Figure 1.4.

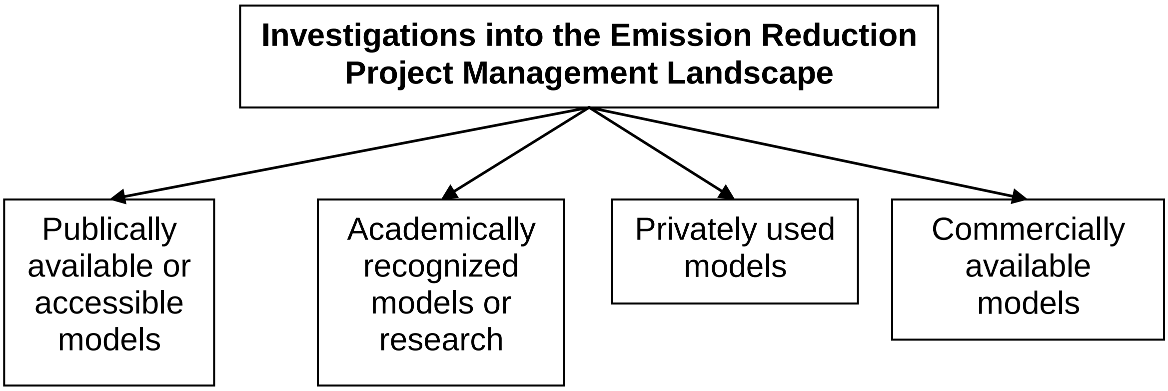

Figure 1.4: Grouping historical investigations into the project management landscape of the CDM

Focussing on publically available or accessible models:

In this research publically available or accessible models will include information that is easily accessible by using tools like an internet search engine. It will exclude:

- Work published in academic journal or conferences. See academically recognized models or research for this; and
- Models and/or computer programmes that can be bought. See commercially available models for this.

One of the first comprehensive management approaches to CDM project management was developed by the European Bank for Reconstruction and Development (Ecofys, 2004). Their project management model addresses the additional requirements posed by CDM project management as illustrated in Table 1.1. Extra project management requirements are included in parallel to the classical project management approach.

In the “Feasibility Assessment” phase the applicability of the CDM to the proposed project must be investigated. Issues like the economic viability of the project without CDM registration must be answered. The number of potential CERs must be quantified and the influence of these credits on the projected project revenue.

During the “Project Structuring Phase” additional documentation, like the project design document (PDD), must be completed. During this phase the contribution of the proposed CDM project to the sustainable development of the host country must also be addressed.

Table 1.1: Additional project management steps required in the CDM process (Ecofys, 2004)

Conventional Project Cycle	Additional CDM Steps
1. Project Identification	
2. Feasibility Assessments Project design Environmental feasibility Technical feasibility Financial feasibility Identify partners	Preliminary assessment of possible delivery of credits Preliminary assessment of possibility to monitor emissions
3. Project Structuring Phase Contracts Power purchase agreements Governmental permits Environmental permits Building permits Arranging finance and signing agreements (grants, loans, etc)	Development of project design document (PDD) Preparation of environmental impact assessment (EIA) Organisation of public consultation Development and validation of baseline and monitoring plan
4. Implementation Phase Construct or upgrade plant / facilities	Install monitoring facilities
5. Operational Phase Monitoring and evaluation: Financial, environmental and technical aspects	Monitoring and verification and/or certification of emission reductions

Another model was developed by SouthSouthNorth (Kantor, 2005), entitled the CDM Practitioners' Toolkit. This toolkit made a lot of progress in addressing the interlinked concepts of, amongst others:

- The climate context;
- Technology;
- Emission reductions;
- Finances;
- Sustainable development;
- Project architecture;
- Team management; and
- EIAs and stakeholder consultation.

Unfortunately, in the opinion of some South African CDM experts[5], this model did not gain wide spread acknowledgement or use. When it was asked why this model wasn't used the comments included that the model was:

- Too complex for practical use;
- Not geared to stay updated with CDM regulatory changes; and
- Extremely rigid in its application.

As of October 2010 the model is no longer available to the public.

Focussing on academically recognized models:

Initial research done by Janssen (2001) pointed to possible investment risk management of CDM and Joint Implementation (JI) projects by using methods of insurance and diversification. Similarly, Laurikka and Springer (2003) developed a framework for evaluating the investment risk for CDM projects. The result of the study was the conclusion that risk can be mitigated by following a portfolio approach. The reason given is that not all projects are affected by the same risk factors or affected to the same extent. The mentioned research unfortunately does not take the South African, or indeed African, scenario into account where project diversification is not always possible due to a lack of possible projects. The intricacies of technological, environmental, social and economic factors were highlighted by Laurikka and Springer (2003).

Flamos et al. (2005) highlighted the complexities of the CDM with regards to additionality, contribution to sustainable development, and financial feasibility including transaction cost - also see Dyer et al. (2006) regarding the complexities of sustainability and sustainable development. Flamos et al. (2005) aimed to address some of these complexities by developing the Clean Development Pre-Assessment Tool (CDM-PAT) and Dyer et al. (2006) developed software called CDM-Select. Both models were developed to be freely available to users via the internet. Unfortunately the tools are not currently (January 2011) available online anymore.

[5] See section 4.4 for a discussion on who these "experts" were and how they were chosen.

Prengel (2004) focuses on risk mitigation of Chinese CDM wind energy projects. Although the research is quite focussed there are some general concepts that can be extrapolated for other technologies in other developing countries. One such concept is found in the discussion regarding standardization. According to the researcher the lack of "*clear rules and approval processes on a national level is seen as a main barrier for CDM investments*." This can be related back to the SA CDM landscape if one considers the institutional shortfall highlighted by Little et al. (2007) to be similar. It is then argued that a more integrate management approach can be followed to aim to address these shortfalls.

Focussing on privately used models:

Arguably many CDM project developers will have software used in-house to trace project development, project management and risk management. For this research access to these resources were limited or non-existing. The success of these models, for the African and South African perspective, is highly debatable if considered that international CDM developers are present in South Africa and still there are very few registered CDM projects. This aspect is discussed later.

Focussing on commercially available models:

Carbonflow (2010) developed commercially available software like Connect+, amongst other tools, to aid in managing carbon project emissions. The company claims that their products can aid in managing the worldwide stakeholder process involved in CDM project development. Another benefit of the software is that it also aims to aid in portfolio management. It is then safe to say that Carbonflow acknowledges the complexity associated with CDM projects and aims to provide a management tool.

One major drawback of the software is actually one of its strengths being that the software aims to manage the inputs of all stakeholders. The result is that if all parties (PP, DNA, and others) do not use the software and update it frequently then much of the benefit is lost.

Unfortunately the widespread use of any of these commercially available CDM software platforms is highly questionable within the South African CDM space according to South African CDM experts[6]. The only way in which it is possible to trace back the application of these software tools to registered CDM projects in South Africa will be to ask South African CDM experts. It is of interest to note that the South African DNA commented favourably on the use of the Carbonflow software - the SA DNA is as DNA not directly involved in project development, but should provide host country approval for any CDM projects.

Another player in the commercial CDM software space is ICF International (2010). From their literature it is clear that, as in some of the cases mentioned above, country-specific CDM issues and portfolio management are recognized as aspects that should be managed during CDM project development.

IFC International has various software packages and applications, including the:

- Carbon Planning Model – This tool aids in carbon market scenario analysis for modelling carbon prices. Carbon price modelling is important to address risks issued with project income, but has little to do with other project development risks; and
- Kyoto Project Risk Management System – This system aims to address and quantify risks associated with CDM projects. This is achieved using a spreadsheet question and answer approach which then weighs the input factors. This can indeed be a very handy tool, but project risk and the weighting there of is a dynamic process implying

[6] See section 4.4 for a discussion on who these “experts” were and how they were chosen.

that the once off evaluation of a project is not sufficient. Risks should be identified and managed on a continuous basis for various aspects throughout the CDM project development lifecycle. Managing risk once off or separating it from project management does not necessarily result in successful CDM projects as continuous project management is also required.

It is important to note that many of the sources of information (academic, commercial or in-house models) identified similar concerns, but try to manage these concerns differently. What is also of interest is to note that the diverse sources all aim to achieve aspects of risk management and project management without simply adding another layer of complexity to standard project management tools such as PRINCE2 and PMBOK.

1.5. Problem Statement and Research Objectives

The research questions then become:

- Why are there so few registered SA CDM projects?
  - What are the current CDM project management approaches followed for CDM projects in SA?
  - Do SA CDM developers use and know of above mentioned research?
  - Do SA CDM developers need some other tool to be more successful?
  - How can project management (current and amended) procedures be formalised with regards to CDM projects in the SA context?

It is considered critical for this research to involve SA CDM experts as to ensure that the output can practically be used. This research then aims to investigate the overall strategy for CDM project development in Africa, and South Africa in specifically, as opposed to focussing on the individual aspects such as additionality. The objective will be to achieve risk mitigation through SA CDM specific project management.

The focus of this research is then to shift from individually researched CDM novelty aspects, to investigating overall risk mitigation through project management. Figure 1.5 is a flowchart representing the research problem statement, questions raised, research objectives and propositions.

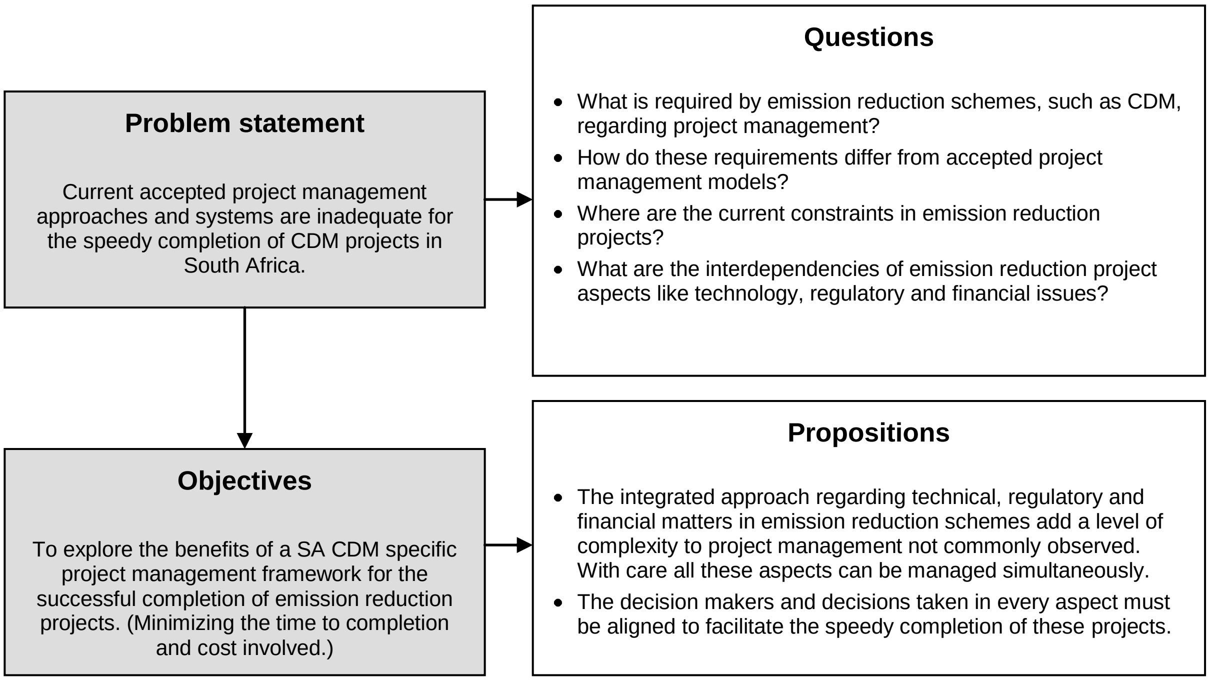

Figure 1.5: Research problem statement and objectives

The success and completion of an emission reduction project is defined as achieving registration and subsequent issuance of CERs.

One of the aspects of these emission reduction projects that this research aims to address, but cannot formally quantify, is the speedy completion of the projects. Hopefully, with time, the practical application of the research and the evolvement of the results will aid in speeding up emission reduction projects.

1.6. Benefits of aligning CDM project management with standard project lifecycle phases

Aligning the CDM project process and project lifecycle phases with specific application to Africa and South Africa is a field of study not widely exploited yet. The following benefits are envisaged for aligning and integrating the CDM project process and project lifecycle phases:

- The ad hoc project management commonly found in CDM projects, according to the SA CDM experts[7], can be structured;
- The need to force CDM project management into standard project management models designed for other types of projects will be alleviated; and
- The state of development of CDM projects will become more apparent to parties who are not CDM experts.

1.7. Importance of the research problem

This research will be valuable to the following parties:

- Entities interested in developing emission reduction projects, including companies in the private sector;
- Entities involved in emission reduction project evaluation, such as the designated national authority (DNA) of South Africa and designated operational entities (DOE) certified by the UN to audit such projects; and
- Entities already developing emission reduction projects, such as CDM developers.

[7] See section 4.4 for a discussion on who these "experts" were and how they were chosen.

1.8. Limitations and assumptions of the study

This study focuses only on the CDM emission reduction project structure. Currently the first commitment period of the Kyoto Protocol and CDM will expire in 2012. The timeframe of the emission reduction scheme could be viewed as a limitation with regards to this research. It must be remembered that emission trading as such is guaranteed to be a viable business case far beyond the Kyoto Protocol's first commitment period 2012 expiry date if one considers that the European Union Emission Trading Scheme Phase II will run to end 2012 (Kopp, 2007) and then Phase III will come into effect 1 January 2013 running up to end 2020 (Kettner et al., 2009). Furthermore the USA California Global Warming Solutions Act (2006) that aims to cut emissions by 80% below 1990 levels. The lessons learned from the CDM in combination with this research can help the emission reduction protocol that is to replace and/or extend the Kyoto Protocol.

CDM projects are open source information once a project is in the validation process and the PDD is open for public comment, but until such time each developer guards project specific information. This, combined with the competitiveness of project developers in general, can hamper the sourcing of data needed for questionnaires, surveys and interviews.

For this reason the technical complexity of each individual project does not influence the applicability of the model. This research also does not aim to prescribe how technical aspects beyond the CDM realm should be addressed in individual projects. Let us consider the example where emission reductions will be claimed for energy efficiency in a new building. The model proposed in this research could be applied for the emission reduction aspect of the project, but standard/existing project management approaches should still be followed for the civil/construction aspects of the project.

It is important to note that this research will mostly be of exploratory nature. The reasons for this include:

- The lack of peer reviewed academic literature on the project management of emission reduction incentive projects specifically focussed on Africa and South Africa. The result is that previous theories or work could not be tested as there are little or no previous work; and
- The amount of CDM registered projects in South Africa. At the start of the research there were 10 registered projects in South Africa and this number grew to 17 at the end of the research. Establishing statistical evidence from a population size of 17 is misleading.

1.9. Proposed research approach and strategy

The approach to the research is set out in Figure 1.6.

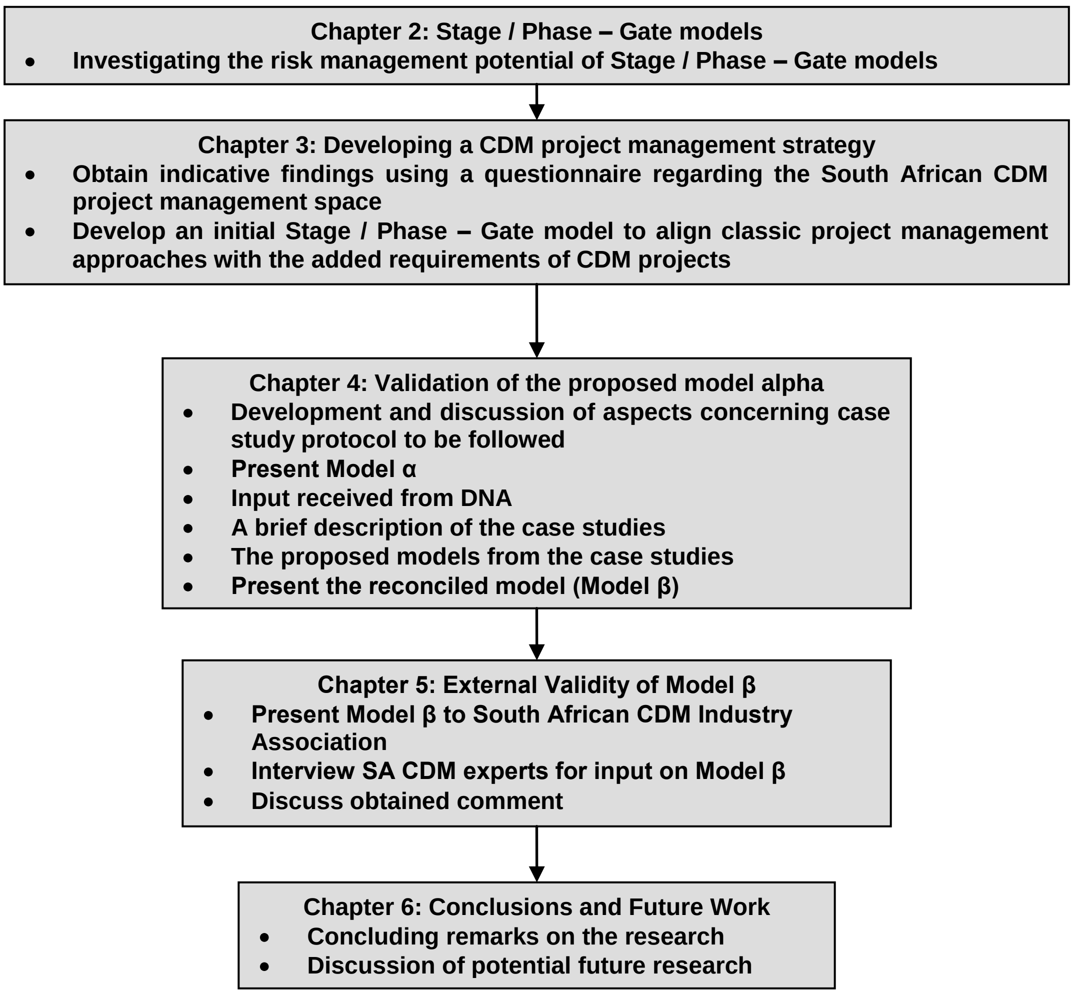

Figure 1.6: Strategy of the research study

Chapter 2: Investigating the risk management potential of a stage/phase-gate project management approach[8]

> **"I have also found that the overall effectiveness of a risk management process is primarily determined by two factors, namely, technical sophistication and implementation efficiency."**
> **Edmund H. Conrow**

2.1 Introduction

A set of phases and gates adopted within a company often forms the basis of a comprehensive project management methodology of the company; policies and procedures relating to a variety of aspects such as cost management, risk management, environmental, safety and health, procurement, project communication, amongst others, are defined for each phase of a project. Criteria that need to be met regarding each of these aspects are defined for each project phase.

At first glance it would seem that stage/phase-gate models could be applied with success to CDM projects. This is true if the CDM risk management literature (see previous chapter) and the distinguishable deliverables of a CDM project is taken into account. This said, more investigation is needed and Chapter 2 focuses on investigating stage/phase-gate models.

Labuschagne (2005) and Brent and Petrick (2007) attempted to establish some conformity between a range of views regarding project management phases; sixteen different references that suggest various project lifecycle phases or stages are listed (2007). Table 2.1 gives an adapted version of the latter work with the different phases, aligned as far as possible to generate a generic project management model.

[8] This chapter has been published in a peer-reviewed journal: Lotz M, Brent AC, Steyn H, 2009. Investigating the risk management potential of a stage/phase-gate project management approach. Journal of Contemporary Management 6, 253-273.

Table 2.1: Phases in the project lifecycle (adapted from Brent and Petrick (2007))

No.	Reference	No. of phases	Project phases									
1	Parker and Skitmore, 2005	4	Concept	Contract awarded	Execution phases							
					Design	Planning						
2	Labuschagne and Brent, 2005	7	Conceptual	Planning	Testing	Implementation	Closure					
3	Labuschagne and Brent, 2005	7	Idea generation	Pre-feasibility	Feasibility	Development and execution	Commissioning	Launch	Post implementation review			
4	Pillai et al., 2002	9	Project selection phase			Project execution phase			Implementation			
			Screening	Evaluation	Selection	Technology development	Production development	Performance development	Production		Marketing	Sales
5	Kartam et al., 2000	6	Feasibility	Design	Procurement	Construction	Start-up	Operation				
6	Jaafari and Manivong, 1998	5	Planning	Design	Procurement	Construction management	Commissioning of facility					
7	Vanhoucke et al., 2005	6	Conception	Definition	Planning and schedule	Execution	Controlling (monitoring)	Termination of project				
8	Cleland, 2004	4	Definition	Planning	Execution/ control	Close-out						
9	X-PERT Academy, 2005	5	Initiation	Planning	Execution	Controlling	Close-out					
10	PMI, 2002	5	Initiation	Planning	Execution	Controlling	Closing					
11	Kerzner, 2001	5	Conceptual	Planning	Testing	Implementation	Closure					
12	Steyn et al., 2003	6 – 8	Clarifying need	Feasibility	Definition (design and development)	Implementation (project execution)	Hand over and project closure	Support and maintenance				
13	Steyn et al., 2003	6 – 8				Execution			Start-up and hand-over		Evaluation and operation	
			Pre-feasibility	Feasibility	Basic development	Detailed design		Procurement	Construction			
14	Tarr, 2003	9	Pre-feasibility	Site selection	Feasibility	Feasibility report		Board decision	Detailed design	Construction	Operation	Closure
15	Buttrick, 2000	7	Proposal	Initial investigation	Detailed investigation	Develop and test		Trial	Launch/ close	Post implementation		
16	DANTES, 2005	6	Idea	Concept	Investigation	Development		Validation	Launch			

The risk management advantages of such a staged/phased project management approach are much neglected in literature. The objective of this chapter is to investigate how a staged/phased project management approach may lower project risk.

The risk managing potential considered is both overall and within project phases by considering project life-cycle phases as stages. Historically stage/phase and gate processes were primarily used for product development projects. Risk reduction that results from the overall staged/phased approach is differentiated form risk reduction achieved by each of the embedded stages/phases. At a micro risk management level (the level of the embedded stages/phases) each phase/stage of a project should contribute to systematically reducing the risk associated with a project. This is briefly addressed by Anderson (1996) when he states that risk is managed by allocating development funds based on the successful completion of each phase/stage of development. For a more detailed discussion see Lotz et al (2009).

2.2 Project lifecycle stages and phases

Projects are, by definition, unique endeavours. This implies unknown factors, uncertainty and risk. The cumulative cost of a project typically follows an S-curve. Initially, during the early phases such as the idea phase and feasibility phase, costs rise gently. During the design or definition phases, costs increase somewhat and as the implementation/construction/manufacturing phase is reached, costs – and therefore risk - rise exponentially. Therefore, while relatively accurate, detailed plans for the immediate future are possible, only “broad-brush”, “rough-cut”, high-level plans are possible for the longer term. The use of phases and gates is underlying to rolling-wave planning that implies that, while overall, high-level plans should always exist, detailed plans are only developed for an imminent phase of a project.

Each phase has the objective of reducing the risk of subsequent phases in a cost-effective way; a relatively small amount of money is spent on a phase to lower the risk of subsequent phases. If the risk of subsequent phases cannot be reduced sufficiently, the project can be terminated at the end of an early phase.

The project manager can provide a high-level plan for the overall project and a detailed plan for the imminent phase only. Ideally the project manager commits himself only to the detail plan for the imminent phase.

The end of a phase is an important milestone in the lifecycle of a project where the project team typically presents the work performed to a project review board (comprising of customers and other stakeholders). If one considers the customer to be the client of the CDM project developer then this can be seen as a feedback session to the client. The benefit will be that the client is kept up to speed with project development. This point also serves as a gate that needs to be opened for work on the succeeding phase to be authorised.

The review board therefore has two functions to perform at the milestone: to look back to validate the work performed during the phase, and looking ahead to evaluate detailed plans for the subsequent phase as well as updated high-level plans for the rest of the project. The function of looking ahead also involves assessment of risks and authorisation of the next phase. Allocation of project funds for each phase is based on the successful completion of the preceding phases and where a preceding phase does not succeed in reducing risk satisfactorily, it can be addressed; for example additional work may be requested before authorization is given to proceed to the next phase.

Looking back should prove that the objectives of the phase and all criteria set for the phase have been met. The review board evaluates, validates and approves the work performed during the phase and formally accepts the deliverable or deliverables of the phase. Before the phase is formally closed out, it is confirmed that there are no outstanding issues. Payments are typically made following such formal approval.

As the work performed during a project phase typically provides more information, the overall plan for the rest of the project can be updated. Also, the completed phase typically provides inputs for detailed planning of the succeeding phase.

Following the approval of a completed phase, the project team typically presents to the review board a proposal or tender for the next phase, based on detail planning that has been done for the imminent phase. The review board evaluates the sufficiency of the detailed planning for the next phase, availability of resources, risks involved and the feasibility of the rest of the project. If the review board is satisfied, the next phase of the project is authorized.

The Stage-Gate process of Cooper (2001) is considered a typical example of a project management approach with stages (phases) and gates that include pre-project phases such as Discovery and Idea Screening (see Appendix A). The National Renewable Energy Laboratory (NREL, 2001) states that such a stage/phase-gate management process is an approach for making disciplined decisions about research and development that lead to focused process and/or product development efforts. The purpose of such a project management approach is to reduce costs and time to market for product development (NREL, 2001). A staged/phased-gate project management model is also used by companies in the process industry, e.g. Exxon and Rohm and Haas, system developers, utility companies, the construction industry, defence industry, and many others.

2.1. Components of a staged/phased-gate project management model

As the name implies, this practice makes use of stages and gates, where a gate implies that a part of the project activity is reviewed and a stage defines a specific work load that has to be completed before moving on. A table summarizing what ought to be achieved and verified at each stage and gate respectively is provided in Appendix A (Cooper, 2001). The complete high-level five-stage process of Cooper (2001) that includes pre-project phases is illustrated in Figure 2.1.

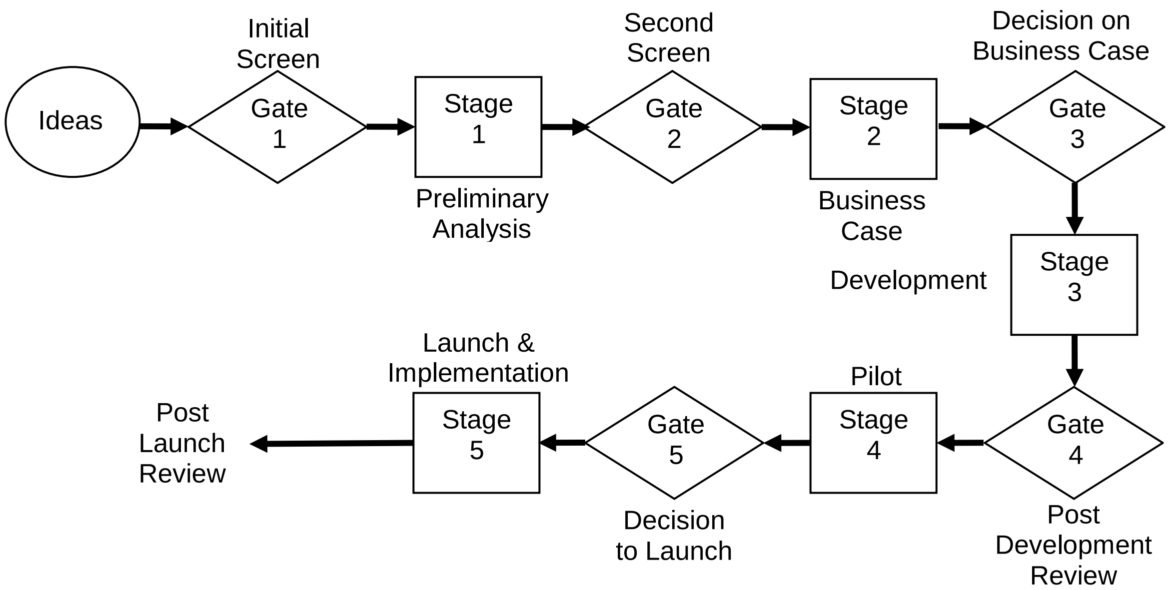

Figure 2.1: Comprehensive Stage Gate Project Management Model (SGPMM) as suggested by Cooper (2001)

The project reviewing at a gate has the following objectives (NREL, 2001):

- Proof that objectives of the previous gate and stage have been met;
- Proof that the objectives of the current gate have been met; and
- Set objectives for the following stage and formulate the next gate criteria.

The gate evaluation process can contribute to portfolio management (Cooper, 2001). To prioritize projects a "right-hand side" was added to the block representing a gate and the relative importance of the project is compared to projects that require the same limited amount of resources. Figure 2.2 illustrates the proposed dual purpose gate structure. Gate evaluations can have the following outcomes (NREL, 2001; Riley, 2005; Ayers, 1999):

- Pass – the goals of the previous stage were met and it is decided to further pursue the specific project;
- Recycle – all goals are not met, the current stage needs further work/investigation;
- Hold – work on the project is suspended for various possible reasons; and
- Stop – the project is stopped permanently due to various possible reasons.

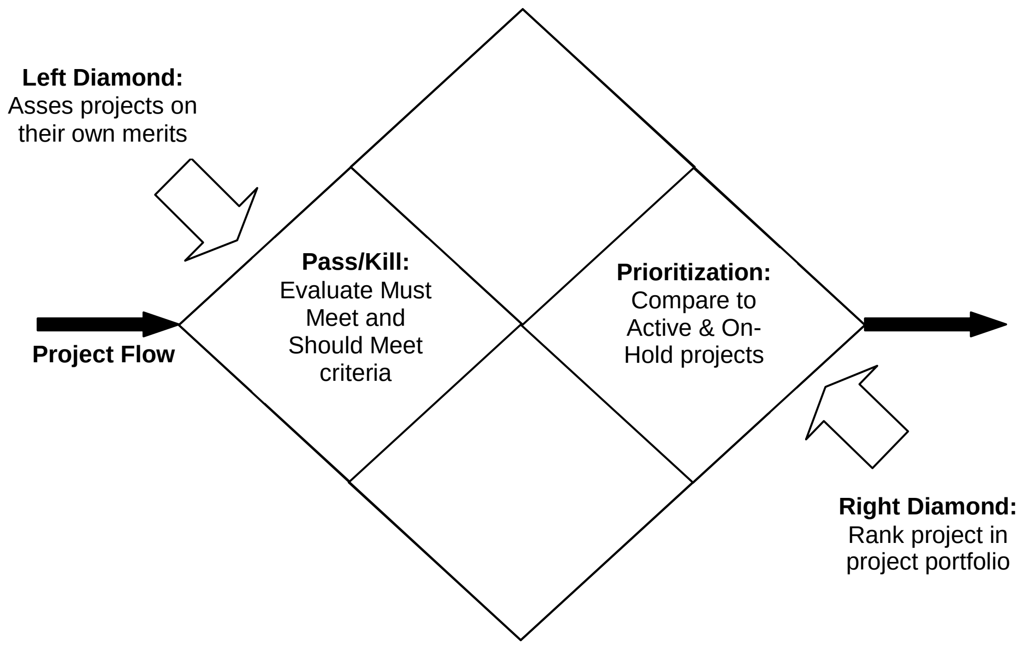

Figure 2.2: The gate structure as proposed by Cooper (2001)

Cooper et al. (2000) warn against having gates with poor decision criteria. A gate should predominantly result in a pass/stop decision and a prioritization process rather than a simple checklist of completed tasks. They propose the use of a scorecard with “must meet” non-negotiable criteria and a “should meet” scoring system. Various other systems for scoring exist, e.g. a matrix approach. Table 2.2 illustrates the gate scorecard proposed by Cooper et al. (2000).

Table 2.2: The proposed "must meet" and "should meet" structure of Cooper et al. (2000)

Must Meet Criteria	**Should Meet Criteria**
Evaluated as binary ‘Yes’/’No’ decision. Typical Must Meet criteria:	Evaluated using a scoring system (0 – 10 scale). Typical Should Meet criteria:
• Strategic alignment • Technical feasibility • Positive return Vs. Risk • Project killers	• Strategic fit • Product advantage • Market attractiveness • Business synergies • Technical feasibility • Risk Vs. Return

2.2. Advantages and disadvantages of a staged/phased-gate project management approach

It is argued that the advantages of a staged/phased-gate model include (Cooper, 2001):

- Capital expenditure is controlled as an exit at every gate;
- Time spent on projects are controlled as an exit at every gate;
- Adding clarity and flexibility to project management, especially in research;
- Weak projects are ended sooner;
- Focus on quality of project execution, important project steps and completeness of the project;
- Allows for fast-paced, parallel processing with a multifunctional team approach;
- Cross departmental collaboration; and
- Strong customer/competition orientation.

In contrast to the foreseen advantages it was noted by the NREL (2001) that a staged/phased-gate process can lead to artificial gate decisions. The impression can be given that the gates represent a simple checklist of future events that are known for certain. It can be argued that this is not the case since the resulting project plan of a staged/phased-gate process represents the best guess estimate of future events (Cooper, 2001). The fact is that all project planning is based on estimates; it is not unique to the staged/phased-gate process and this should obviously not prevent project planning. The guessing nature of the model will have to result in frequent updating of a project plan. The staged/phased-gate process should not be seen as a stagnant once-off model, but rather as an evolving process with definite early termination possible at every gate (see section 2.2).

The linear appearance of a staged/phased-gate process might lead one to assume that, if all project stages are completed sequentially, the time and cost advantages of parallel stage execution cannot be achieved. Overlapping of activities and of phases (fast tracking) is however commonly practised and a staged/phased-gate process does allow for parallel stage execution, but this has to be described explicitly in the staged/phased-gate process as the parallel execution of stages still requires authorization at relevant gates. It must be noted that a project phase is typically performed by a multi-disciplinary, cross-functional team and could deliver multiple outputs. Concurrent engineering (Smith, 1997) dictates that these multiple outputs should not be developed in series.

Sebell (2008) and Bessant et al. (2005) raise various concerns regarding the rigidness and the innovation potential of a staged/phased-gate process. Their concerns, and arguments against such concerns, are summarized in Table 2.3.

Table 2.3: Addressing concerns raised by critics of a staged/phased-gate process

Critic source	Critic	Response from the researcher
Sebell (2008) **Bessant (2005)**	A staged/phased-gate process is only applicable for incremental innovation and not breakthrough ideas or innovation. Breakthrough innovation requires a more dynamic model.	In a stage/phase-gate process time could be allocated to idea generation. Some ideas can be incremental advances and other ideas can lead to breakthrough innovation. The limit to the level of innovation is determined by the quality of the ideas and not by the stage/phase-gate process.
Sebell (2008)	Unanswered questions in the early stage will not let the truly breakthrough ideas to pass initial gates.	The objective of early project gates is to do early idea screening. It is accepted that early stages/phases will not deliver qualitative answers for gate appraisals.
	Backing from top management is necessary for innovative breakthroughs. A project team alone is not sufficient.	Idea generation can come from a top-down approach or a bottom-up approach. These ideas could be breakthrough ideas irrespective of the origin.
	Staged/phased-gate processes are logic driven and resource allocation based. It is about consensus decision-making driven down into the organization.	After idea generation the project team has the authority and responsibility to be able to act autonomous to other company activities or projects.

2.3 The risk management potential of stage/phase-gate models

Risk mitigation that results from the overall approach includes doing the *right project*; it includes pre-project phases and forms part of the project portfolio management process. In addition, each phase *within* a project contributes to *doing the project right*. Risk can also be eliminated by terminating the project; in the case of pre-project phases as well as in the case of within-project phases, the ‘gate’ at the end of a phase can lead to the termination of the project in order to eliminate risk.

Jafaari (2001) states that risk management is a fundamental characteristic of project management and backs this argument by indicating that risk management is one of the nine project management characteristics as described in the PMBOK (2004).

It can be argued that a stage/phase-gate should aim to reduce the risk associated with projects. This is in agreement with Anderson (1996) who states that a phased approach provides a disciplined system for managing product development, ensuring that steps are not skipped, quality stays high, and technical and marketing risks are controlled by senior management.

Before risk can be managed it must be assessed. One way to quantify risk is to consider the impact (often the monetary value) of a risk event at stake and the uncertainties of events occurring. The relationship of the amount at stake and the uncertainties of events are illustrated in Figure 2.3.

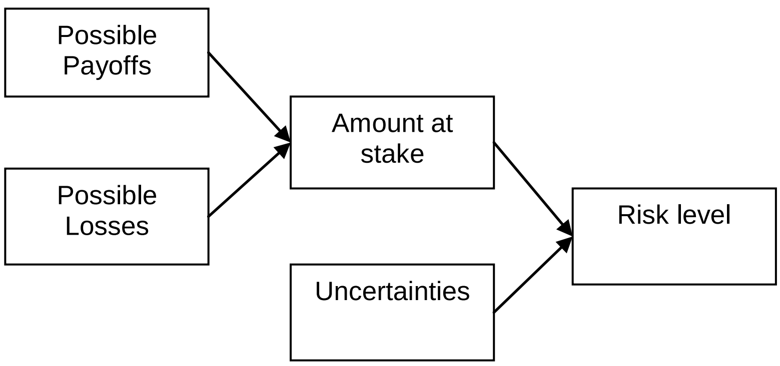

Figure 2.3: Adaptation of Cooper’s (2001) view on risk

Combining possible monetary payoffs with possible monetary losses provides insight into the monetary value at stake. The uncertainties of the “amount at stake” monetary value must be ascertained to establish the level of risk of the project. This view on risk is similar to that of the PMBOK (2004) where risk is defined as the probability of an event occurring and consequence of such an event.

At a micro risk management level each phase/stage of a project should contribute to systematically reducing the risk associated with a project. This is briefly addressed by Anderson (1996) when he states that risk is managed by allocating development funds based on the successful completion of each phase/stage of development.

Despite the recognition of the contribution that phases/stages and gates make to empower senior management and other stakeholders to control the project, and despite the fact that the purpose of each phase should be to contribute to systematic risk reduction, the notion of phases/stages and gates is still much neglected in project management literature.

2.4 An exploratory case study to illustrate the risk management potential of stage/phase-gate models

An illustrative case study, based on Lotz (2006), is used to demonstrate the risk management potential of a stage/phase-gate project management approach. In this case study steel plates were to be manufactured by a new facility. Some of these steel plates could have had defects and the steel plates made with defects had to be scrapped.

The first option that the designers of the new facility had, was to use an existing control system on the market. This control system acted as a predictive model for identifying whether the steel plates were made to specification or not. The existing control system required twenty inputs to be measured from the manufacturing facility and had a guaranteed predictive performance of 73%.

The cost of the predictive control system available on the market was estimated at US$ 1,200,000. This included the installation and implementation of the complete control system as well as maintenance for three years.

The problem with the existing, available control system was that the predictive accuracy fell to zero if one of the required twenty inputs were not available to the control system. Ensuring that all twenty inputs from the manufacturing facility were available at all times was problematic. Furthermore, management, plant operators from similar facilities, and the design team of the new production facility had differing opinions regarding which variables had a larger impact.

It was known from other similar manufacturing plants that 5% of all steel plates manufactured had had defects. As stated, with the available predictive control system on the market 73% of all defects could be predicted. The result was that at least 1.35% of product with defects would be delivered to the clients as final product. Furthermore, if one also takes into account that the combined reliability of the twenty sensors required was 94.2% then the actual amount of defects passed on to the clients was 1.43%; the annual reliability of the twenty sensors was simply the product of the annual reliability to the power of the amount of sensors (see Appendix B for calculations).

The loss of revenue would have been the 1.43% of rejected product and as the annual revenue was estimated at US$100,000,000 then the loss of revenue would have been US$1,433,609.

The total three year cost would then have been the cost of the available predictive control system and the three year loss of revenue. The result was US$5,500,826 (see Appendix B). The cost of a newly developed predictive control system then had to be lower or at least had to be equal to this amount to be advantageous.

Management authorized a study to investigate whether the control system available on the market was the best possible solution or whether a new system should rather be developed from a financial risk perspective. This beckoned the following technical questions:

- Was it necessary to measure all twenty variables?
- If not, which variables had to be measured?
- Could a more optimized model be developed?

A further prerequisite of management, for the possibility whether a new model had to be derived, was that the model had to be human interpretable. The current predictive control system available on the market, at that stage, was considered to be a black box model. Management deemed that the derivation of another black box predictive model would have added little understanding of underlying process fundamentals even if it used less than twenty input variables.

A process consisting of stages/phases and gates was applied. A cross-functional and diverse project team was assembled consisting of:

- Project manager – Acting as the leader of the project team;
- Plant operator(s) – These individuals worked with the steel plate manufacturing equipment on a daily basis. Valuable input was provided by them, although these individuals could not be dedicated to the project team on a full time basis;
- Process engineer(s) – These individuals had extensive knowledge of the design of the steel plate manufacturing equipment, operation and broader plant operation; and

- Computer programming and data mining expert(s) – These individuals had experience in extracting underlying fundamentals from data and how to program this.

Members of the project team had the opportunity to come up with innovative approaches and ideas during the Discovery Stage. The plant operators gave valuable input from their plant experience. The process engineering staff and programming experts formulated technical approaches based on these inputs. Some of these ideas were eliminated during the first gate due to technical difficulty and time restrictions.

The first stage focussed mostly on refining some of the technical aspects of the Discovery Stage as “market place merits” of this project were not an applicable stage objective (see Appendix C for details). A budget of US$ 40,000 was allocated to this stage, which had to be used to search for new technologies that could be used.

During the second gate emphasis was placed on the “must meet” and “should meet” criteria of the project. Preliminary ideas were discussed with management to refine the project objectives and technical feasible options.
The second stage focussed on improving the technical aspects of the project and refining the estimated costs. A business case was developed, which specified the project costs compared to the estimated increase of income due to project implementation.

In this case study the issue of marketing of the product/newly developed predictive control system is not applicable as it is a system specifically developed for this project.

The second stage had limited resources and time for development. A budget of US$ 85,000 was allocated to this stage.

The third gate was executed as another meeting with all related parties including top management. The project definition and outcomes were fixed. Managerial approval and backing were obtained even though the project team could operate autonomously.

A laboratory-tested model was derived as the outcome of the third stage. The model used fewer variables than the original predictive model. The plant operators, process engineers and data mining experts all provided inputs during the development process.

The incremental improvements from stages one and two, together with the options eliminated during previous stages, implied that third stage progressed quite quickly. Expensive modelling software had to be purchased, which made this stage run over the allocated budget. The stage was budgeted at US$ 190,000 and came in at US$ 210,000. The budget overrun could be approved by the project manager because of the autonomous nature of the project team.

This model was tested (gate four) on real time data, but still in a laboratory environment.

Parallel model implementation (stage four) was done on a similar plant so that the same input was sent to the predictive control system and the newly derived model. The new model used less input variables to deliver comparable predictive accuracy to that of the old model.

The cost of stage four was kept low because the predictive control system derived in the previous stage could be applied as is. Furthermore, the single input used by the new predictive control system was already available as it was measured as an input to the predictive control system already in use. The cost of stage four was US$ 80,000.

The loss of revenue of the newly developed predictive control system was determined in exactly the same manner as was done in the case of the existing predictive control system available on the market. The overall reliability of the newly developed control system is higher due to the fact that the new system only requires one input parameter from one sensor. This increased reliability directly results in fewer losses due to send backs of the steel plates by clients.

Approval was given to install the newly developed predictive control system in the new plant (gate five) after all parties (project team, management, etc.) came to the conclusion that the system was ready for launching.

Stage five was then the implementation of the new predictive control system in the new production facility. The single sensor that will act as input parameter was installed. The specialized sensor and controls cost US$ 440,000 for the complete installation.

The phased/staged approach also limited the expenditure of the complete project. The result is that the capital for development, implementation and maintenance of the newly developed system was less than that of the available control system on the market. The cost was again worked out for a period of three years (see Appendix B).
A post-launch review took place, during which certain perceptions and views were raised by the project team and management. These perceptions and views were discussed and resolved where needed.

The results of the project were the following (Lotz 2006):

- An optimized predictive model was developed;
- This new predictive control system required only one input variable compared to the twenty variables of the old predictive model;
- The new predictive control system had comparable predictive accuracies to that of the old model;

- The singular model input resulted in a human interpretable model since it was known now that a specific variable had to be controlled precisely to ensure correct steel plate manufacturing; and
- The development and implementation of a new predictive control model cost came in 10.6% lower on a three-year payback basis as compared to the control system available on the market (the financial calculations are presented in Appendix B).

Figure 2.4 compares the financial implications of developing a newly developed control system with the application of the available control system. Figure 2.5 summarises the stage/phase-gate development of the case study as a binary decision tree.

The following advantages were observed in this project due to application of a stage/phase-gate project management model:

- The cross functional dedicated project team was completely responsible and empowered for the project - this led to project completion since separate departments did not have to wait for each other or miss-communicate requirements;
- The incremental addressing of all project aspects during each phase led to the identification of wrong project options quicker; and
- Financial project risk was controlled well due to the incremental cost incurred in the stage/phase-gate process.

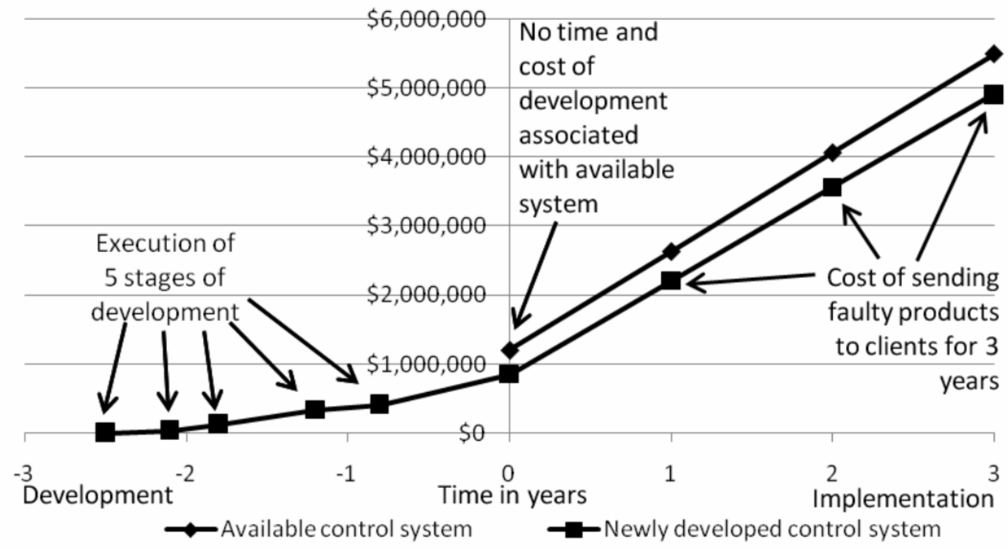

Figure 2.4: Comparing development and operational cost of a newly developed control system with the costs of an existing control system

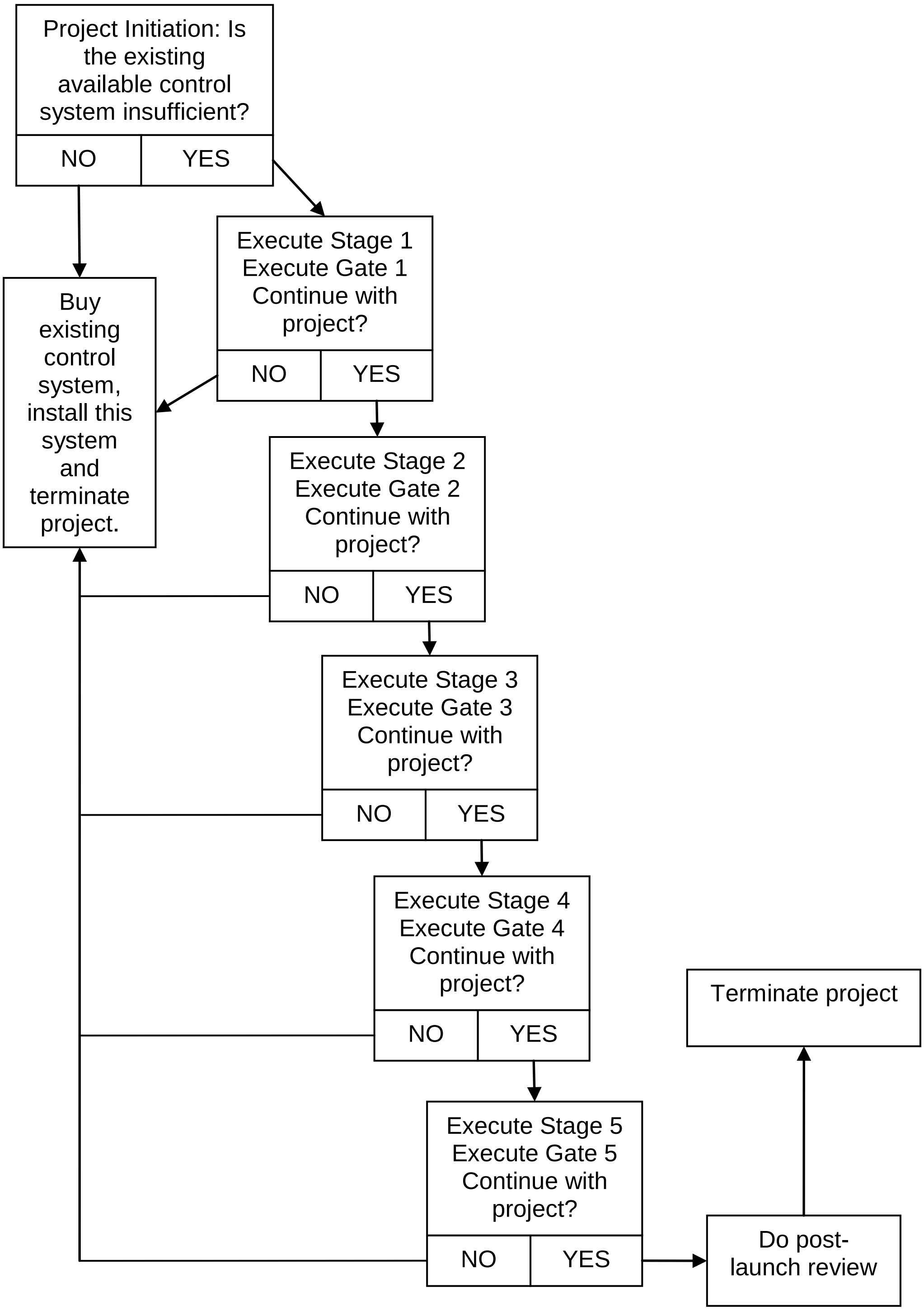

Figure 2.5: Binary decision tree representation of the case study

2.5 Chapter conclusions

The use of phases (or stages) and gates is a well established in literature and in industry. Phased project management approaches are used because of the risk management potential that it offers. The potential of a stage/phase-gate model was also established from literature. This chapter describes the relationship between risk management, project phases and rolling-wave planning. Risk management at the end of phases within a project is distinguished from the contribution that a phased approach can make to the management of a portfolio of projects if pre-project phases are included. The improved risk management potential of phases and gates was demonstrated by means of an illustrative case study.

Chapter 3: Investigating the need for a Clean Development Mechanism (CDM) specific stage/phase-gate project management strategy[9]

3.1 Introduction

This chapter focuses on the project management aspect of the CDM. The Project Management Body of Knowledge (PMBOK, 2004) defines project management as "the application of knowledge, skills, tools and techniques to project activities to meet project requirements". The objectives of this chapter are subsequently to:

1. Establish the current formalised state of CDM project management approaches in South Africa;
2. Establish the perceived need for a formalised CDM project management approach in South Africa; and
3. Explore the application of a stage-gate project management model to address the specific needs of CDM project management in South Africa.

A questionnaire was compiled to establish how formalised the approach to CDM project management was in industry and related bodies. From the limited questionnaire responses certain shortfalls within the South African CDM project management landscape could be identified.

3.2 CDM opportunities for South Africa and Africa

It is generally accepted that Africa will not be a major earner of CERs on a global scale (Cosbey et al., 2005). Studies differ regarding the estimates of the global CER market share that Africa will have, but it has been estimated as 4 to 14% (Haites, 2004) with 5% (Ellis et al., 2007) being a common figure used. This said Africa still holds significant potential for carbon dioxide

[9] This chapter has been published in a peer-reviewed journal: Lotz M, Brent AC, Steyn H, 2009. Addressing the need for a Clean Development Mechanism (CDM) specific project management strategy. South African Journal of Economic and Management Sciences 12 (2), 228-241.

sequestration through increased agricultural activities and soil carbon increase (Ringius, 2002).

Institutional capacity, including the presence of a DNA, was identified by Silayan (2005) as one of the major contributing factors for successful registration of CDM projects. Silayan (2005) states this to be one of the reasons of Honduras's recent success in registering CDM projects. In general, most developing countries with high absolute emissions have built institutional capacity in the form of a DNA. Countries with significant institutional capacity include China, India, Brazil, South Korea, Indonesia, Mexico and notably South Africa as the only country from Africa (Ellis et al., 2007).

Jung (2006) assessed 114 host countries on their CDM attractiveness. The criteria used for classification were mitigation potential, institutional CDM capacity and general investment climate. The countries with the highest potential for CDM (excluding forestry) projects were China, India, Brazil, Argentina, Mexico, South Africa, Indonesia and Thailand. It is interesting to note that South Africa was the only African country that gained the highest rating.

It would then seem that South Africa is perfectly suited to benefit from CDM project activities, although the benefit of CDM for Africa as a whole is limited. Heller and Shukla (2003) points out that other Southern African countries could potentially emulate South Africa regarding CDM success and in this way a larger section of Africa can benefit from the CDM.

According to the SA DNA (2010) there are 156 CDM projects were submitted to the unit. Of the 156 projects submitted 123 were Project Idea Notes (PINs) and 33 were Project Design Documents (PDDs). It should be noted that some of the PINs were submitted up to 5 years back and the recent activity of some of these projects are highly doubtful. Of these projects 17 have been registered and another project is up for review (UNFCCC, 2010). According to the UNEP Risø Centre (2010) SA has got 37 sent for "validation/determination." Although the sources to do not exactly agree regarding the number of projects what seem to be clear is that approximately

25% of projects that submitted PINs to the SA DNA will submit a PDD for validation and only 10% to 15% of all CDM projects that the SA DNA received formal communication from will get to be registered CDM projects.

3.3 Engaging the South African CDM industry

Little et al. (2007) have described the South African CDM landscape to some extent. They interviewed thirty "experts involved in the South African CDM process" and focused not on the management of the CDM process, but rather the identification of factors that inhibit and accelerate the CDM process in South Africa. As an extension of the study of Little et al. (2007) the South African CDM Industry Association (SA CDMIA), which was being formed during 2007, was engaged as a case study. A questionnaire consisting of twelve high level questions, and some sub questions, was used as basis for the engagement (See Appendix D[10]). One hundred potential affiliates of the then informal SA CDMIA were targeted. Only eight responded positively to the engagement.

The limited response is mainly attributable to the lack of formal structure of the SA CDMIA at the stage of the investigation; there was no single point of entry to engage the SA CDMIA in its entirety, although this is now changing. Those affiliates that did not respond positively also highlighted a concern about the potential use of sensitive information; by answering some of the questions posed in the questionnaire one would have easily identified the specific role-player in the small SA CDMIA community.

Although the low number of responses means that the SA CDMIA case study does not statistically represent the South African project management landscape, some insight can be gained regarding the maturity of the SA CDMIA, and specifically how CDM projects are viewed and approached in SA.

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[10] The questionnaire in the appendixes is the 2nd questionnaire sent out. The 2nd questionnaire will be discussed in subsequent chapters. The 1st questionnaire consisted of the first 12 questions of the 2nd questionnaire.

In evaluating the answered questionnaires it was found that the positive respondents had been involved in at least three CDM projects already registered. At the time of the investigation South Africa had ten registered CDM projects in total as verified by the DNA (Department of Energy, 2010). The respondents further indicated that more than four CDM projects per respondent were in different stages of development, i.e. a total of at least thirty-two new projects; the total number of CDM projects under development in South Africa at the time of the investigation could not be determined, but some indications was provided in the previous section.

The questionnaire required the respondents to indicate their relative fields of expertise pertaining to the technical[11], financial[12] and regulatory[13] aspects of CDM project management[14]. Six of the eight respondents considered themselves partial towards the technical and financial aspects of CDM projects as opposed to the regulatory aspects. Since provincial/regional, national, international and CDM-specific regulatory approval could all be necessitated, depending on the specific project; the lack of regulatory associated expertise in the SA CDMIA is noteworthy.[15] To this end the questionnaire also aimed at establishing where CDM project developers and related parties perceived bottlenecks in the successful completion of a CDM project.

The perceived bottlenecks were also divided into financial, technical and regulatory aspects, and a distinction was made between domestic (South African) and foreign perceived bottlenecks. The South African regulatory environment was seen as the single largest bottleneck. This is true even of the efforts of the South African DNA to facilitate the development of CDM projects. Little et al. (2007) also identified the regulatory aspects, namely foreign, local and CDM specific, as major inhibitors. The bottleneck perceived

[11] Pertaining to the technical/engineering design required in an emission reduction project.
[12] Pertaining to the financial and banking requirements associated with an emission reduction project.
[13] Pertaining to the regulatory rules, both domestic and foreign, within which an emission reduction project must operate.
[14] Appendix F represents a summary of the results obtained from the 1st questionnaire.
[15] It is important to note that CDM developers in SA typical have 3 – 15 staff members. The result is that there are mostly no legal, technical or other discrete departments. Staff members have to fulfil various roles although they will have areas of focus.

as second largest was foreign technical requirements (An example could be sourcing equipment from overseas.) due to South Africa's dependence on foreign technological imports. Neither local nor foreign financial requirements were viewed as priority bottlenecks. This outcome differs from the outcomes of Little et al. (2007); they document "Africa (is) not an investment destination" as the 4th highest of a total of fifty six identified inhibitors/facilitating factors. Even without a local versus foreign breakdown it was clear that financial concerns were considered to be the least important in the South African CDM environment. Given the expertise of the respondents does bring into question whether the perceived importance of regulatory bottlenecks is real or whether a lack of regulatory expertise on the part of the respondents induces a higher perceived risk of the regulatory aspect of CDM projects.

In terms of project management approaches, the following two issues were highlighted in the SA CDMIA:

- Only three of the eight respondents indicated that they follow a formalised CDM project management approach although seven of the eight respondents indicated a perceived need for such an approach. With a lack of formalised CDM project management followed in SA it was deduced that most project management is done on an ad hoc basis.
- Of the eight respondents, five indicated that they had a dedicated person/group acting as project manager for CDM projects. All five positive respondents concluded that the person/group acting as project manager succeeded in facilitating the development of the CDM projects.

From the comments received from the respondents regarding what specific project management models were used, two distinct approaches became clear (see Table 3.1):

- In the one approach CDM projects were forced to conform to a project management strategy or model that would be used by the respondents in other types of projects (non-greenhouse gas emission reduction projects).

In doing so the need for project management conformity overruled practical project management considerations.

It would then seem that the additional requirement of a CDM project and classical project management approaches followed in SA have not been merged well at all.

- On the other hand some respondents stated that the uniqueness of every CDM project implied that ad hoc project management was the only realistic strategy.

These issues and comments were useful to derive a proposed CDM project management model.

Table 3.1: Summary on comments regarding CDM project management models used and why the specific model is in use

First approach:	**Second approach:**
Force existing project management approaches on CDM projects	Deal with CDM projects on a purely ad hoc fashion
Comments received and reason for approach:	**Comments received and reason for approach:**
Some companies used an “internal project management system” or “internal developed standard”; These project management systems were based on company “political decisions”; It was stated that “all projects need to conform to this” internal “standard”	Projects are very diverse, with different approach needed for each one; Various role players each has own systems that don’t always integrate; Inadequate training/experience in project management

3.4 Proposed CDM project management model - Model α

The research objective was then to merge the indicative findings. The indicative findings were produced and incorporated as follows:

- The specific requirements of a CDM CER (UNFCCC, 2007) project;
- The South African specific emission reduction project environment was discussed with the founding members of the SA CDM IA;
- From there the 1st questionnaire was compiled and distributed as discussed in section 3.3;
- Parallel to the 1st questionnaire all published academic literature on CDM focussed on South Africa was reviewed such as Little et al. (2007) and other sources; and

- Project management specific literature was reviewed. This included:
  - PMBOK (2004) and other sources for general project management guidelines; and
  - Cooper (2000) for guidance specifically regarding stage/phase-gate composition.

These inputs were combined to produce an initial stage/phase-gate model that was called Model α. The purpose of this model was to alleviate the perceived and real bottlenecks of CDM projects. A stage-gate model consists of project stages or phase followed by gates. Each phase is treated as a discreet separate entity (Perez-freije and Enkel, 2007) as if each phase was a separate project. The gates act as go/no-go points after evaluation of the objectives of a phase (Tingström, Swanström and Karlsson, 2006). Gates are also used for project portfolio ranking purposes. The reasoning is that scarce resource will be better allocated to more promising projects (Cooper, 1999). Figure 3.1 is a graphical representation of the developed stage-gate model.

In total thirteen phases were identified interlinked with ten gates. After the evaluation of Gate 10 the project returns to Phase 9 for monitoring of data for another year. This loop is then executed for the duration of CDM project registration.

The phases, which have to be completed by parties other than the project proponents were lumped together and indicated as “External phases.” These phases are completed by entities such as the DOE, DNA, and others.

Reference is made to an annual post-mortem. During this stage/phase problems that arose during the year are investigated and hopefully solved. It should be noted that the verification process, and subsequent issuance of CERs, can be done whenever the project owner wants to do it. The proposed annual post mortem is then not necessarily directly linked to the verification process The annual post mortem should rather be seen as a proposed formalized annual meeting to have all parties involved share their thoughts regarding issues that arose the past year.

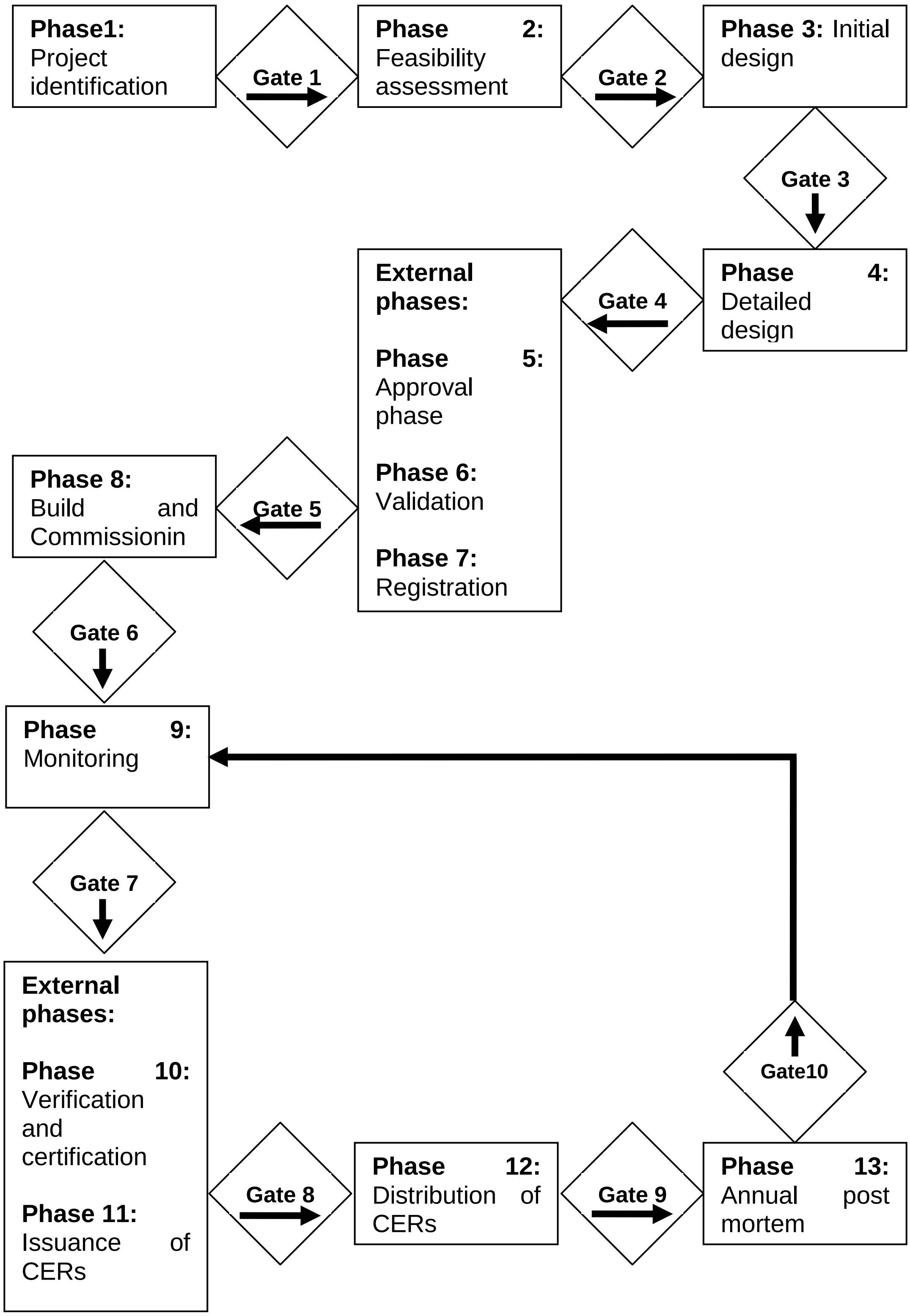

Figure 3.1: Stage-gate Model α for CDM project management

Only the summarised stage-gate flowchart is shown above for brevity. Each phase consists of certain objectives that have to be achieved. The evaluation of how successful each phase was is done during the gate analysis that follows on the specific phase. The gate consists of Go/Kill criteria and Ranking criteria. Go/Kill criteria implies that a certain objective must be completed before the next stage can start. If the Go/Kill criteria cannot be achieved at all then the project is killed. Stages during which all Go/Kill criteria were successfully completed now enter the Ranking part of the gate. Specific ranking criteria were established for each gate. A score of 1 to 10 will be given to each ranking criteria - a higher score indicates a more favourable circumstance. As an example for logistical concerns a project closer to the resources of the project developer will be favoured. Another example could be that projects resulting in more offsets could be preferred due to higher revenue potential. At this stage no weightings are included, but it is foreseen that project developers or other users of the model could subjectively add more value to a certain criteria. Weights can also be applied to the ranking criteria, but this was not done during the development of this stage-gate model. The weights of ranking criteria can be determined internally by model users as to fit specific company needs and resources.

The proposed stage-gate model merges existing project management lifecycle stages, like “detailed design” phase, with CDM project specific required phases like “distribution of CERs” phase. This will then be the first stage-gate model to be developed to incorporate the needs of CDM project management specifically for the South African context[16].

Table 3.2 is a typical example of a summary of a stage and gate - the complete Model α is presented in Appendix F. It is specifically the criteria for Phase 2: Feasibility assessment and the criteria for Gate 2.

[16] It is noted that CDM developers could have far more complex in-house project management models, but these models where not derived for the South African CDM environment and did not aim to consolidate experience from South African CDM developers.

Table 3.2: Phase objectives, Go/Kill and Ranking criteria for Phase 2 of Model α: Feasibility assessment

Phase name	**2. Feasibility assessment**			
Purpose of project phase	1	Clarify the need for the project. (revenue / corporate responsibility / etc)		
	2	Do an initial estimate of the emission reductions		
	3	Asses what is necessary in monitoring the inputs to calculate emission reductions		
	4	Do initial assessment of project risk (financial, technical and regulatory)		
	5	Obtain initial approval[17] from local DNA		
Gate 2 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Is there a need for this project?	Kill	Go
	2	Does the initial emission reduction warrant a CDM project?	Kill	Go
	3	Is the project risk level acceptable?	Kill	Go
	4	Are all inputs required measurable / obtainable?	Kill	Go
Comments	1	Various strategic reasons can exist for proposed emission reduction projects. Clarifying the need of these projects will help in obtaining backing from management.		
	2	If the estimated emission reduction achievable is too small then no CDM project exists. The project proponents should decide what they consider to be the lower cut off value regarding emission reductions achieved.		
	3	Projects should be stopped as soon as project risk reaches unacceptable levels.		
	4	It is foreseeable that insufficient data are available to accurately establish emission reductions. If the emissions reductions are not measurable then the project should be stopped.		
Ranking criteria	**No**	**Criteria**		**Score**
	1	Are there any perceived or real objections from the local DNA?		
	2	How attractive is the amount of CERs earned?		
Comment	1	In the development of this model it is proposed to get initial host country approval for a project at the earliest possible stage. This will help in managing project risk from the start although host country approval is according to CDM guidelines not strictly necessary at such an early stage.		
	2	The amount of carbon credit revenue earned is a direct function of the amount of CERs obtainable. All else being equal projects producing more CERs should take preference.		

[17] Initial approval can be obtained from the DNA in the form of an e-mail acknowledging the acceptance of a PIN which can also state that no objection is raised during this very early part of project development.

3.5 Layout transformation

As discussed in the previous chapter each stage/phase should result in the completion or progression of specific criteria required to complete an emission reduction project. These 'criteria' were labelled in this chapter with a 'C'. No stage/phase can be considered completed without accomplishing what the stage/phase criteria stated should be achieved.

After each stage/phase a gate follows. A gate consists of binary criteria and ranking criteria. Binary criteria are formulated as binary questions which will result in 'Yes'/'No' answers. For a stage/gate to be considered complete and to progress to the next stage/phase all answers should be positive from the project's point of view. In the models to follow the binary criteria were labelled with a 'B'[18].

There might be specific reasons why it is preferred to progress with a certain project faster than another project even though the binary criteria of both project's gates were met. To facilitate such portfolio management ranking criteria are also evaluated at the gates. The results of the ranking criteria is not a binary 'Yes'/'No' answer, but rather a score for example between 1 and 10 or a qualitative argument. In the models to follow the ranking criteria were labelled with an 'R'.

Due to physical page layout constraints the normal representation of a stage/phase-gate model was not followed. Instead each stage/phase with its accompanying gate was presented as a column labelled with 'C', 'B' and 'R' to represent the criteria, binary criteria and ranking criteria of each stage/phase and gate respectively. Figure 3.2 illustrates the conversion from the normal stage/phase-gate representation to the representation used in this chapter.

[18] In some cases the binary criteria will simply confirm that the criteria of a stage/phase were met. In other instances the binary criteria will have application in the ranking a project for portfolio management purposes.

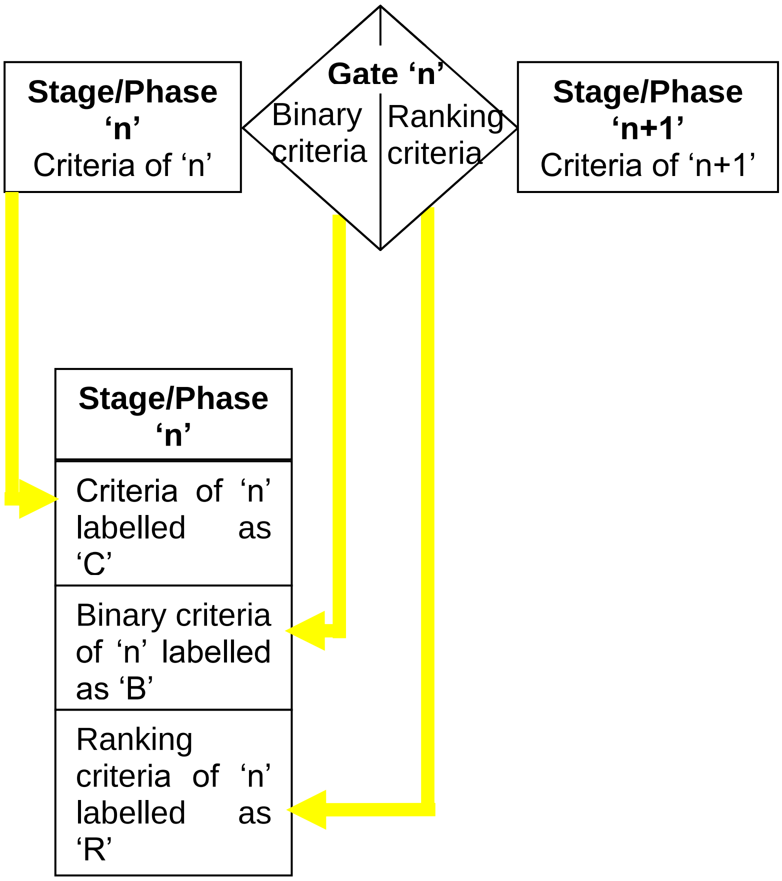

Figure 3.2: Conversion of normal stage/phase-gate representation to the representation used in the models

3.6 Model α layout transformation

Model α's layout will be transformed here as discussed in the previous section. The following are some comments to note regarding Model α:

- It consists of an arbitrary thirteen stages/phases. This implies that the number of stages/phases used is not crucial to the model although the model criteria, binary criteria and ranking criteria are considered fundamentally important;
- The criteria "How easy are the technical aspects?" were repeated in Model α as R.3.1 and R.4.1 and "Is the required capital relatively low?" was repeated as R.3.3 and R.4.3; and
- The ranking criteria R.9.1 "Identify and rank all steps that can be taken to increase the accuracy of the monitored data while still complying with the PDD" and R.13.1 "Identify and rank changes that can be made to increase the amount of CERs issued in the following year" were considered very similar. They were consolidated and presented to the interviewed experts as: "Identify and rank changes that can be made to increase the amount of CERs to be issued" and labelled R.C.1 (Consolidated Ranking criteria 1).

Figure 3.3: Model α

Phase 1

C.1
C.1.1 Identify potential emission reduction projects

C.1.2 Ascertain eligibility of projects regarding fundamental CDM criteria

B.1
B.1.1 Does this project conform to the fundamentals of the CDM?

B.1.2 Does the project fit the strategic business alignment of the project proponents?

R.1.1 What is the strategic importance of the proposed project?

R.1.2 Is this project reproducible?

Phase 2

C.2
C.2.1 Obtain initial approval from local DNA

C.2.2 Clarify the need for the project. (revenue / corporate responsibility / etc)

C.2.3 Do an initial estimate of the emission reductions

C.2.4 Asses what is necessary in monitoring the inputs to calculate emission reductions

C.2.5 Do initial assessment of project risk (financial, technical and regulatory)

B.2
B.2.1 Is there a need for this project?

B.2.2 Does the initial emission reduction warrant a CDM project?

B.2.3 Is the project risk level acceptable?

B.2.4 Are all inputs required measurable / obtainable?

R.2
R.2.1 Are there any perceived or real objections from the local DNA?

R.2.2 How attractive is the amount of CERs earned?

Phase 3

C.3
C.3.1 Do initial design for early estimates of regulatory / financial / technical requirements and iterate to determine initial best fit

C.3.2 Build and evaluate initial financial model

B.3
B.3.1 Is the project technically viable?

B.3.2 Is the project regulatory viable?

B.3.3 Does the project make financial sense?

R.3
R.3.1 How easy are the technical aspects?

R.3.2 Is the regulatory environment in place?

R.3.3 Is the required capital relatively low?

Phase 4

C.4
C.4.1 Do a detailed design for the financial / technical and non-CDM specific regulatory requirements and iterate to determine optimal case

C.4.2 Identify/develop the required CDM methodology

C.4.3 Develop the PDD

C.4.4 Develop all documentation required by the DNA

B.4
B.4.1 Does the detailed optimal design prove a bankable project?

B.4.2 Does the appropriate CDM methodology exist or can it be developed?

B.4.3Is the CDM PDD developed and completed?

B.4.4 Is all the documentation required by the DNA developed?

R.4
R.4.1 How easy are the technical aspects?

R.4.2 Is the regulatory environment in place?

R.4.3 Is the required capital relatively low?

R.4.4 Is there an existing appropriate CDM methodology?

R.4.5 Can the PDD be completed with relative ease?

Phase 5,6,7

C.5, 6, 7
C.5,6,7.1To achieve project approval

C.5,6,7.2 To achieve project validation

C.5,6,7.3 To achieve project registration

B.5,6,7
B.5,6,7.1 Are all the necessary written approvals in place from the host party? (From DNA and other parties.)

B.5,6,7.2 Was the project validated by the selected DOE?

B.5,6,7.3 Was the project registered by the CDM EB?

R.5, 6, 7
No ranking criteria suggested

Phase 8

C.8
C.8.1 To build and commission all equipment associated with the project activity

B.8
B.8.1 Are equipment built, commissioned and operating properly?

R.8
R.8.1 Can the building and commissioning phase be completed quicker with acceptable increases in cost?

Phase 9

C.9
C.9.1 To monitor all inputs required as prescribed in the registered PDD

B.9
B.9.1 Are all inputs measured in accordance to the PDD and all applicable tools?

R.9
R.9.1 Identify and rank all steps that can be taken to increase the accuracy of the monitored data while still complying with the PDD.

Phase 10,11

C.10, 11
C.10,11.1 Obtaining verification and certification of CERs from DOE

C.10,11.2 Obtain issued CERs from UNFCCC EB

B.10, 11
B.10,11.1 Did the DOE verify and certify the CERs?

B.10,11.2 Did the UNFCCC EB issue the CERs?

R.10,11
No ranking criteria suggested

Phase 12

C.12
C12.1 To distribute the CERs to the relevant parties

B.12
B.12.1 Were the CERs distributed to the relevant parties as contractually agreed upon?

R.12
No ranking criteria suggested

Phase 13

C.13
C.13.1 To investigate and correct any shortcomings that exist in the project activity

B.13.1 Annual post-mortem: Can all problems be overcome?

R.13
R.13.1 Identify and rank changes that can be made to increase the amount of CERs issued in the following year

3.7 Further discussion and clarification of Model α

With first glance Model α can seem either intimidating or to have certain preferences that are unclear. The purpose of this section is then to discuss diverse points that can arise while investigating Model α:

- The complete monitoring process should be discussed in the monitoring plan. This includes the frequency of monitoring, who the responsible parties are and what will be monitored (inputs to be monitored). In initial phases/stages of the model the focus is primarily on understanding what the inputs are and how it will be monitored. As project development progresses the complete concept of monitoring must be developed;
- The reference to doing an initial assessment of project risk, first highlighted in C.2.5, should be an ongoing process. Various types of risks should be evaluated. As indicated this should include an evaluation of financial, technical and regulatory risk. During the risk evaluation CDM risks should be differentiated from non-CDM risks;
- The question posed whether the initial emission reduction warrant a CDM project, see B.2.2, is the abbreviated version of the question: Would the initial emission reduction credit estimation make it likely that CER revenues would generate sufficient profit to cover the project risks? According to Little et al. (2007) in the South African CDM space the minimum annual CER range ought to be in the range of 20,000 tCO_2e/annum. This then links to the following point of CER price expectations;
- It is not only the possible number of credits that can be earned that is necessary to warrant a project but also the foreseeable price of the CERs. The CER price, and study thereof, is a complex field. This study will not directly contribute to these discussions, but the importance of the influence of price on the viability of a CDM project should be noted. For discussions regarding CER price and market behaviour see Capoor and Ambrosi (2007) and later publications. Sources like PointCarbon (2010) provide frequently updated information on CER prices and price predictions;

- What exactly is deemed to be acceptable risks in CDM project development will differ from one project developer to another. Model α does not aim to prescribe to each project developer what risk level they should accept, but rather aims to ensure that risk quantification and addressing risk is done throughout CDM project development;
- The ranking of CDM projects as part of portfolio management should be a continuous process. It should be noted though that the accuracy of the ranking process will increase as project development and PDD development progresses;
- At this stage the binary criteria and ranking criteria will not be weighted. It is foreseen though that eventual in-house application of the proposed model will result in model tweaks that could include weighting of factors;
- The reproducibility of a CDM project is typically seen as a great advantage as the developer can potentially rollout a specific CDM project with ease as compared to developing the project from scratch. This should however be juxtaposed with factors like the strategic importance of the proposed project (R.1.1);
- If one takes a look at Brent and Patrick (2007) it would seem that project development phases are typically broken down into 4 – 9 stages/phases. The amount of stages/phase of Model α was initially specified as 13 as to have less items per stage/phase. The number of phases/stages used could vary as external validity is investigated in the following chapter;
- The components of Model α must be viewed in its widest possible definition. It is then up to the validation of the model (chapter to follow) to ascertain whether the criteria/components are all required or if other components should be inserted. More on this in chapter 4;
- Regulatory viability, first mentioned in B.3.2, does not initially differentiate between domestic or international CDM regulatory viability. Differentiation between different types of regulatory risks and adding detail to the investigation can be driven in parallel with PDD development; and

- The purpose of criterion C.4.2 (Identify/develop the required CDM methodology) is to identify whether an approved methodology does exist that can be used for the CDM project being developed. If an appropriate methodology does not exist then a methodology could possibly be developed. It should be noted that the development of a new methodology can be costly and time consuming.

3.8 Potential inefficiencies of the developed stage-gate Model α

The Kill/Go criterion is binary. To terminate a CDM project according to this measure could be seen as extremely harsh and will only be done if criteria cannot be met. This is especially true the further a project progresses as a loss of time and money will certainly be incurred if projects are terminated. It is then important to stress that all possible actions must be taken to satisfy the Kill/Go criteria. This also true if credit issuance is rejected as the project can reapply for issuance. It is only when no acceptable solution can be found that a project should be terminated. This approach ensures that lingering unsuccessful projects are taken off the project portfolio as to maximise available project development resources.

According to Model α many parties (all project proponents, DNA, DOE, CDM EB, financial institutions, etc.) can execute the Kill/Go criteria. This decentralised control structure induces risk as the number of parties increase. This said the decentralised control of a CDM project exists whether the project management structure points it out or not. What the stage-gate then actually achieves is coordination of the stakeholders and other parties involved during the development of a CDM project and this is advantageous. Getting all the stakeholders and parties involved to agree can be tedious. It is then imperative for the stage-gate model to identify only the relevant stakeholders and parties involved in each stage. By doing this the amount of parties and stakeholders per stage, and thus the level of decentralized control, can be minimized.

Bessant et al. (2005) argue that stage-gate models do not manage the innovation of "breakthrough innovations" effectively. This is not seen as detracting from the appeal to use a stage-gate model in CDM projects, since CDM projects are arguably not "breakthrough innovations." CDM projects have to follow a strict predetermined regulatory path, which suites the stage-gate model approach.

The uniqueness of each CDM project can lead to incompatibilities with project management models. For this reason a more generic approach to stages and gates were proposed in the developed stage-gate model. It is foreseen that some CDM projects will greatly differ in the time and money required per stage.

Chapter 4: Validation of Model α

4.1 Introduction

Model α was derived from evaluating the following sources of information:

- A literature review; and
- The results of a questionnaire.

The purpose of this chapter is to evaluate the validity of the derived model through case studies and to expand or alter the model if and where necessary, based on the findings of the case studies. The research questions for this component of the study are:

- Does a project management model address at least some of the difficulties encountered in CDM projects?
- How does the proposed emission reduction project management model cope with the requirements of the CDM?
- Why is the current model adequate/inadequate?
- How should the model be altered to achieve successful emission reduction project management?

This also correlates with Yin's (2004) view on case study application in which he states that case studies are suitable to investigate research questions of "How?" and "Why?".

4.2 Background on case study research

Yin (2004) defines a case study as an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident.

To expand on this definition Yin (2004) states that a case study inquiry:

- copes with technically distinctive situations in which there will be many more variables of interest than data points as one outcome of the inquiry;
- relies on multiple sources of evidence, with data needing to converge in a triangulating fashion as another outcome of the inquiry; and
- benefits from the prior development of theoretical propositions to guide data collection and analysis in the inquiry.

Yin (2004) and Darke et al (1998) argue that case study research is a complete research methodology that goes far beyond data gathering. Criticism of the case study research technique should then be aimed at the incorrect or incomplete application of the research technique rather than at the research technique itself.

Case study research is often underrated due to prevalent misunderstandings of such research. Flyvbjerg (2006) states that the five largest misunderstandings regarding case study research are:

- Misunderstanding 1: General, theoretical (context-independent) knowledge is more valuable than concrete, practical (context-dependent) knowledge;
- Misunderstanding 2: One cannot generalize on the basis of an individual case. Therefore, the case study cannot contribute to scientific development;
- Misunderstanding 3: The case study is most useful for generating hypotheses. That is, in the first stage of a total research process, whereas other methods are more suitable for hypotheses testing and theory building;

- Misunderstanding 4: The case study contains a bias toward verification, that is, a tendency to confirm the researcher's preconceived notions; and
- Misunderstanding 5: It is often difficult to summarize and develop general propositions and theories on the basis of specific case studies.

Flyvbjerg (2006) discusses these misunderstandings in his research and concludes by stating that:

- A scientific discipline without a large number of thoroughly executed case studies is a discipline without systematic production of exemplars, and a discipline without exemplars is an ineffective one; and
- Social science may be strengthened by the execution of a greater number of good case studies.

Darke et al. (1998) state that research bias could exist in case study research due to the data collection and data analysis processes, which could be subject to the influence of the researcher's characteristics and background, and rely heavily on the researcher's interpretation of events, documents and interview material. That, said Darke et al. (1998), then also refers to the view of Yin (2003) noting that bias may enter into the design and conduct of other types of research also.

Some of the concerns surrounding case study research bias could be alleviated by using the accounts of different participants to draw upon multiple perspectives. According to McDonnell (2000) this form of triangulation is an important feature of the case studies. The result is the development of a more complete, holistic and contextual portrayal of real-life situations like case studies (McDonnell, 2000).

It is generally accepted that case studies can be subdivided in three categories. The three categories and main attributes are illustrated in Figure 4.1 (Yin, 2004).

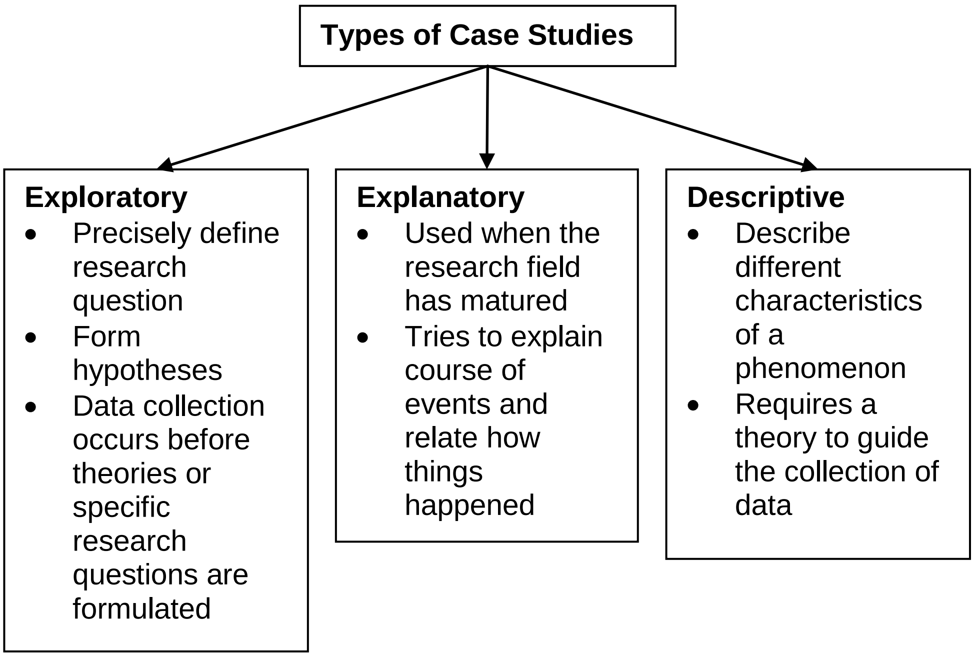

Figure 4.1: Summary of Yin's (2004) view on case study types

It is often possible for case study research to have components of various types of case studies. Regarding project management of emission reduction projects the following can be said:

- Data was available before the onset of the research. It was actually the review of data that prompted the research. This said data collection, for completeness, was undertaken during the research. The research was then more exploratory than descriptive since no theory was required before data collection started; and

- The "research field" is not mature. Emission reduction projects are a recent phenomenon. (See discussion on the origins and implementation of the UNFCCC's CDM (2010.) It can be argued that due to the extensive research already done in project management that project management as a field is mature, but the combination of project management of a new project type results in a non-mature research field. The research was then arguably exploratory rather than explanatory.

As a conclusion it is then stated that this research was mostly in the form of exploratory case study research. Some components of other case study methodologies, and indeed other research methodologies, were also used to a lesser extent.

4.3 Case study approach

Figure 4.2 illustrates the steps taken in the case study research.

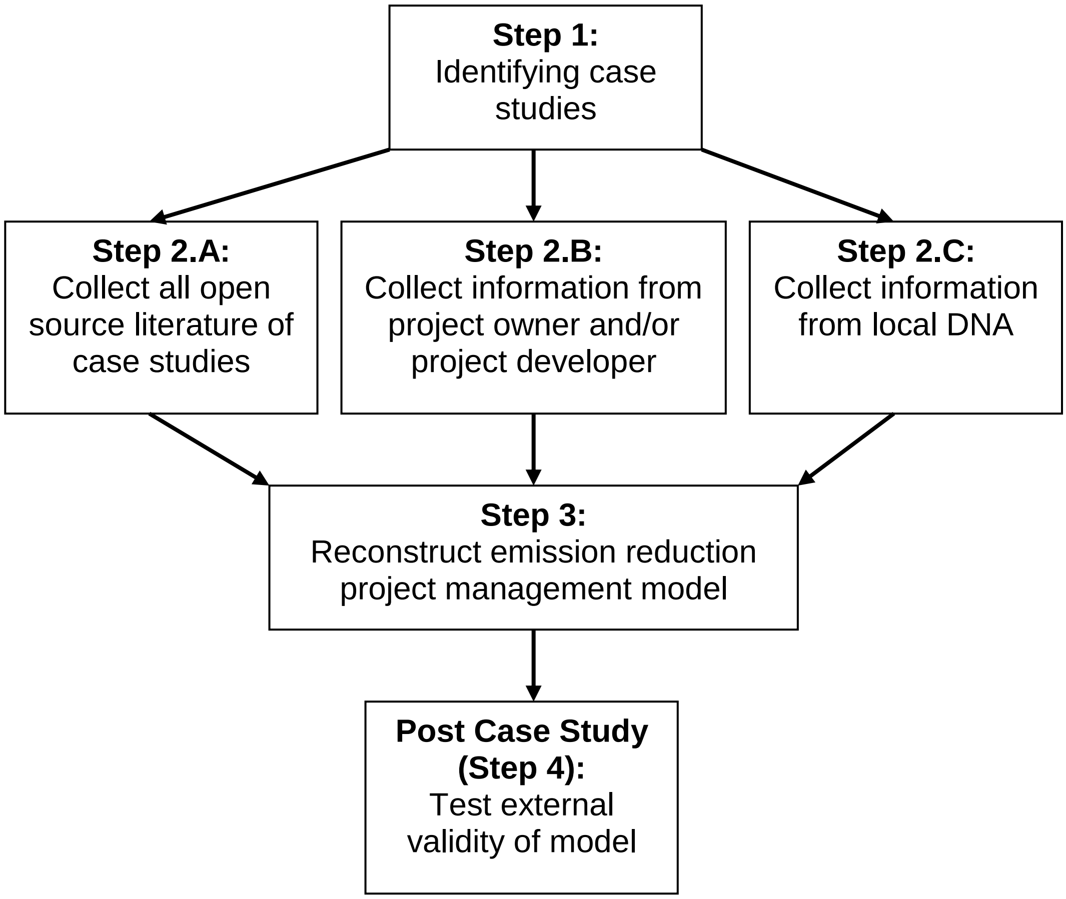

Figure 4.2: Order of case study research steps

4.4 Discussion of case study protocol steps

Step 1: Case study identification

One of the first important decisions in case study research is to decide on the structure and amount of case studies to be investigated. Yin (2004) and Darke et al. (1998) states that multiple case studies overall offer more robust research design if executed correctly. Darke et al. (1998) argues that multiple case studies can strengthen research findings analogous to how multiple experiments strengthen experimental research findings. The research resource requirements of multiple case studies exceed that of single case studies. The resources required for multiple case study research detracts from the attractiveness of such an approach if an individual researcher is involved.

The aims of the multiple case study approach were further to achieve:

- A comprehensive and reliable research design overcoming the perceived and real shortcomings of single case study research (Yin, 2004; Flyvbjerg, 2006; Darke et al., 1998);
- A manageable research load for a single researcher, with in-depth knowledge of the case studies. A single case study would most probably have resulted in an easier research load, but could potentially have sacrificed some of the robustness associated with multiple case study research. On the other hand expanding the number of case studies could have led to an unmanageable research load for a single researcher. Furthermore, as described by Darke et al. (1998), there is no ideal number of case studies when it comes to case study research;
- Replication logic could be applied between case studies. Literal replication is expected since similar results for the various case studies are expected (Yin, 2004); and
- Replication and expansion of future research of other CDM sectors would follow an easy modular approach - this will be part of theoretical replication.

The focus of this investigation is on projects aimed at the CDM emission reduction scheme, but can be just as easily changed to Voluntary Emission Reduction (VER) type projects. The reasons for limiting the research to the CDM were:

- The CDM is perceived as the most strict emission reduction scheme. This argument is made since the CDM has more levels of regulatory approval and external checks as compared to voluntary emission reduction systems which are not governed by the UN. So if the project management model works for CDM then the idea is that it will satisfy most emission reduction schemes;
- The CDM documentation is open source and easily obtainable; and
- The CDM has an industry association in South Africa. The result is that the sector is more formalized as compared with other emission reduction schemes.

The criteria for the selection of case studies must be stated and completely transparent as to ensure the non-bias of the research. The criteria used for case study selection in this research were that the cases studies:

- Are projects in South Africa;
- By implication all the cases then went through the South African Designated National Authority (DoE, 2010);
- Logistically South African projects were also more realistic;
- Are relevant to the South Africa energy sector since all the case studies selected combust energy rich gases[19]; and
- Required approachable project owners and/or developers.

[19] All the case studies aim to produce electricity or at least could produce electricity in theory. The reason for focussing on potential electricity producing CDM projects is that South Africa has an electricity shortage. Due to the abundance of coal future CO_2 emissions associated with electricity production seems imminent. For more details on this see 'energy policies for sustainable development in South Africa' (Winkler et al., 2006).

The multiple case study design consisted of three case studies with a single embedded unit of analysis in two case studies, and two units of analyses in the other case study. All three case studies dealt with emission reduction projects primarily aimed at the CDM. The embedded units of analyses of one of the case studies are logical subunits as both deal with the destruction of mine emitted methane. Figure 4.3 illustrates the case study and embedded units of analyses that will be followed during this research.

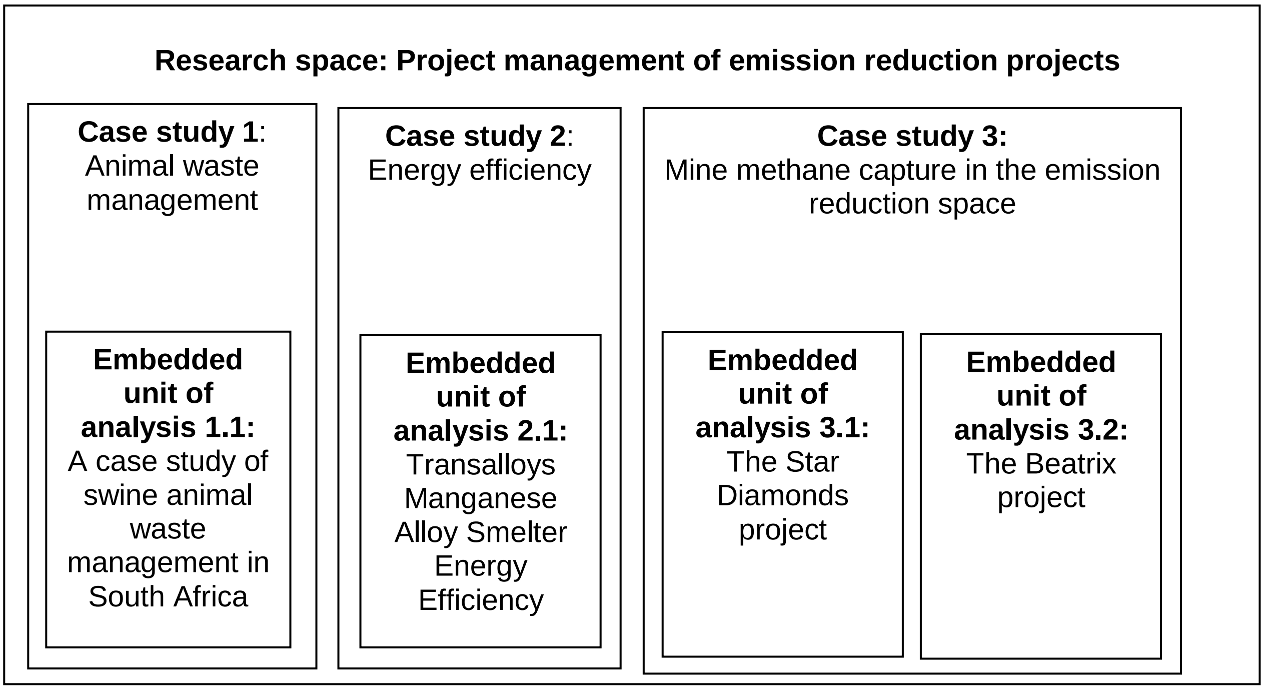

Figure 4.3: Illustration of how unit of analysis and case studies fit in the research space

At this stage it is important to disclose any involvement of the researcher in the chosen case studies. This is done to prevent any perceived or real research bias. The researcher was an observer of case study 3 and also assisted in the development of certain aspects of the embedded units. At no time was the researcher appointed in a role where the project management or portfolio management was solely under his control. For this reason his involvement in case study 3 is deemed as an observer participant. The researcher was not involved in the other case studies.

Step 2.A: Collect all open source literature for the case studies

The main source of information was the CDM website of the United Nations (UNFCCC, 2009). The documents that were sourced were the:

- CDM approved methodology used by the case studies to quantify the emission reductions achieved; and
- Project Design Document (PDD) that is developed to obtain CDM registration.

Other sources of information included:

- Host country, in this case South Africa, specific CDM sustainable development criteria. These criteria are easily obtainable from the website of the South African DNA (DNA, 2009). The purpose of this document is to establish the criteria and method which will be used by the local DNA to provide or withhold host country approval; and
- Articles in popular and other literature, which are valuable in determining the public exposure of the project activity.

Step 2.B: Collect information from project owner and/or project developer

Interviews where held with the project owners and/or project developers of all the case studies. All interviews with project developers were with individuals at director level. The information that was retrieved during these interviews included:

- A narrative on the history and progression of the project and where project specific issues arose. This information proved to be very valuable in determining perceived and real problems experienced by the project developer and/or project owner.
- Subjective views on the efficiency of the local DNA, various CDM bodies, DOEs, and other parties external to the project developer and/or owner.
- The release of confidential information for academic research. The aim of this research was discussed during the interview phase of data collection. Some of the people interviewed disclosed confidential

information as they were satisfied with the intent of the research and researcher.

- Information for the reconstruction and completion of an emission reduction specific project management model based on the model derived in chapter 3.

Step 2.C: Collect information from local DNA

As mentioned earlier a CDM project has two objectives:

- Firstly to ensure that real and measurable greenhouse gas emissions occurred in an project activity; and
- Secondly to ensure that the sustainable development of the host country was aided due to the project activity.

It is the objective of the Designated National Authority (DNA) to evaluate the sustainable development benefits of proposed emission reduction projects.

An interview was held with the DNA to gather information regarding:

- The evaluation of sustainable development criteria in the South African CDM space in general; and
- The specific application of CDM country specific sustainable development criteria to the case studies evaluated in this research.

The DNA gave project-specific feed up regarding the selected case studies and some general feedback regarding their perception and difficulties on various aspects of the CDM. The general feedback can be found in Appendix G.

Step 3: Reconstruct the emission reduction project management model

The real value added by the interviewed experts[20] was deemed to be more than just the information regarding the historical case study events. The experts also provided great insight into the applicability of Model α and what possible changes could be made to this model. An ideal was to obtain inputs from the experts regarding the validity of the derived α Model. This proved to be challenging. The following options were identified as to obtain input on such an emission reduction project specific management model:

- **Disclose Model α to the experts that were interviewed**

  Showing the experts Model α and asking for input could have led to research bias. The experts could potentially simply accept the model since they are all busy professional people. This would not have aided in ensuring that the model is correct or to establish external validity. On the other hand if the model was simply rejected by the experts without clearly stating why and how the model should be changed then little would also have been gained.

- **Carte blanche approach**

  Another option to obtain input from the experts, without bias to the current Model α, was to ask the experts to provide the researcher with a proposed emission reduction project management model. By doing this the individual views of the experts could have been captured. This approach proved to be futile for various reasons, including:

[20] The experts interviewed during this research were all directly involved with project development or project developers themselves. These experts were responsible for 5 out of the 10 registered CDM projects as on 15 July 2009. The experts all insisted on being anonymous as the input given was considered confidential.

  - The experts could have construed the development of such a model as too much effort and not partake in the research further; and
  - Providing no guidance to the experts could have led to such diverse inputs that reconciling it to produce a single project management approach could potentially have been impossible.

Not one of these two approaches would have captured, entirely, the value obtainable from the expert input. A delicate balance had to exist between providing guidance to the experts without inducing bias towards the existing Model α. The following approach was decided on to facilitate the expert input process:

- **Reconstruction approach**

  To guide the experts' input it was decided to deconstruct Model α into the fundamental three components:
  - The objectives that had to be accomplished per stage/phase;
  - The binary criteria evaluated at the gates; and
  - The ranking criteria that was evaluated at the gates of Model α.

  The experts were provided with the following:
  - The three fundamental model components as discussed above. The three individual lists were randomized as not to prejudice the order in which the experts allocated the components;
  - An illustrative example of a stage/phase-gate model, the purpose of which was to illustrate the structure of the model that was aimed for; and
  - Space was provided for comments and additional stage criteria, binary gate criteria and ranking criteria.

The experts were asked to construct a stage/phase-gate emission reduction project specific model from the inputs provided. Certain limitations were placed on the experts and certain degrees of freedom were provided including:

- The model had to be constructed keeping in mind the case studies of this research which the expert was involved with;
- The number of phases/stages to be used was up to the discretion of the experts;
- The stage/phase-gate figure was for illustrative purposes only and was not meant to restrict the input of the experts;
- Additional components could be added to the model;
- Not all the identified components had to be allocated to stages/phases and gates;
- Components could be allocated to more than one stage/phase or gate; and
- All additional input and comments could be provided in the comments section.

The models proposed by the interviewees had to be reconciled to a single model. This was made difficult by the fact that no set number of phases and/or gates where prescribed to the interviewees. It was however assumed that all proposed models started at the same point and aimed to finish with a successful project.

Two of the three model interviewees recommended that ±15 stages would suffice although they used 18 to 20 phases. As a first step then an arbitrary number of 15 phases were chosen for the reconciled model.

It is then apparent that two of the proposed models had to be condensed so that the 18 and 20 phases they respectively consisted of fitted into the 15 phases of the reconciled model. Nevertheless, condensing did not imply that any of the phase criteria, gate binary criteria or ranking criteria of the model of the interviewee could be omitted. All it meant was that some phases and some gates had to be combined.

In the same manner the interviewee model that consisted of only 8 phases had to be split up in the proposed 15 phases of the reconciled model. This could be achieved if one remembers that all models start at the same point and aims to end with a successful project.

Figure 4.4 illustrates the process of reconciling two input models of 3 and 5 phases respectively to a model consisting of 4 phases:

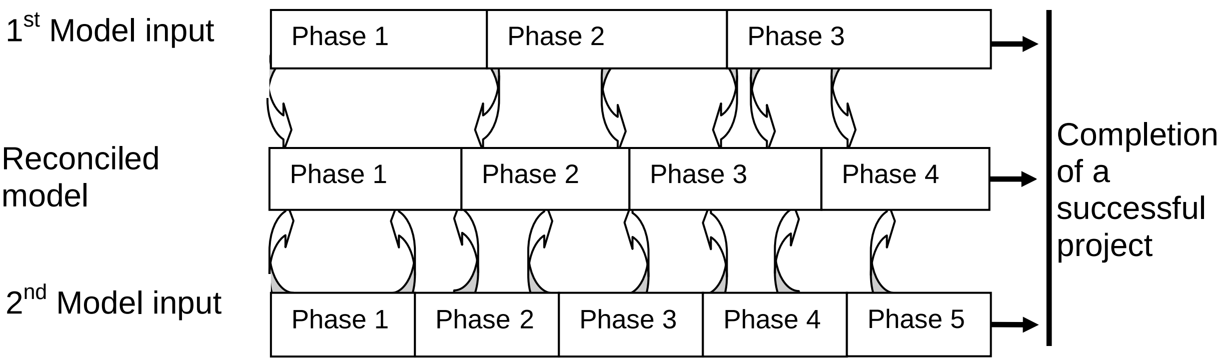

Figure 4.4: Euclidean length approach to phase consolidation

A set of rules were necessary to achieve this reconciliation. The rules for Phase criteria, Binary criteria and Ranking criteria allocation were:

- Rule of Consensus – if all proposed models had criteria in the same phase then the criteria were allocated to that phase in the reconciled model.
- Rule of Majority – if most models (2 of 3) put criteria in a specific phase then those criteria were allocated to that phase of the reconciled model.

- Rule of Score – if no clear consensus or majority existed for criteria allocation then the Euclidian length[21] of the phase in which the interviewee allocated that criteria was compared to the length of the reconciled model.

  In terms of the latter, as an example, the Euclidian length of the 1st Input model had to be lengthened to illustrate that this model also leads to a successful project even though it consisted of fewer phases. Now Phase 1 of the 1st Input model is "longer" than Phase 1 of the reconciled model. The result was then that most of the criteria of Phase 1 of the 1st Input Model were allocated to Phase 1 of the Reconciled Model. This was done by using the "lengths" of the phases to calculate the percentage that was allocated, namely 80% of Phase 1 of the 1st Input Model was allocated to Phase 1 of the reconciled model and 20% to Phase 2 of the reconciled model.

  The "lengths" of the 2nd Input Model had to be shortened in order to have the same Euclidian length as that of the reconciled model. The overlapping lengths of phases were then used to allocate criteria from the 2nd Input Model to the reconciled model. As an example it is clear that all criteria from Phase 1 of the 2nd Input Model should be allocated to Phase 1 of the reconciled model. Furthermore 33% of the criteria of Phase 2 of the 2nd Input model had to be allocated to Phase 1 of the reconciled model.

- Rule of Earliest phase association – If two or more phase have same score then criteria were allocate to the earlier stage.

[21] The concept of "Euclidian length" implies here that in Figure 4.4 Phase 1 of the 1st Model was "longer" then Phase 1 of the Reconciled model. This is only true since both models aim to achieve the same goal. In the same way the 2nd Model's Phase 1 is "shorter" then Phase 1 of the reconciled model since the 2nd Model consisted of more phases to achieve the same goal as the Reconciled model.

- Rule of Binary criteria - If binary criteria were allocated to a phase before the phase in which that criterion was executed, then the binary criteria were moved to the phase of execution. The reason is that the successful completion of a criterion (listed as "B") cannot be expected before the model indicated that criterion (listed as "C") had to be executed.

- Rule of Eliminating empty phases - A phase with no criteria associated after executing the rules is deleted. This was done separately for Criteria, Binary and Ranking. Then the results were merged. Some smaller alterations still took place. The smaller alterations included formatting and eliminating redundancies that resulted due to copying.

The application of the above set of rules will become apparent in the following section which demonstrates how the rules have been applied.

4.5 Discussion of the proposed project management model of Case Study 1

The expert interviewed in Case Study 1[22] had an interesting view on the application of the ranking criteria during project execution. The expert's view was that ranking should run concurrent and parallel to the stages/phases and binary gate evaluation and should not form part of the gate evaluation itself. The implication is that ranking can be executed at any stage as it is not associated with specific gates. Figure 4.5 illustrates the parallel and concurrent Stage/Phase independent ranking proposed by the interviewed expert.

[22] See Appendix I for a brief summary of Case Study 1

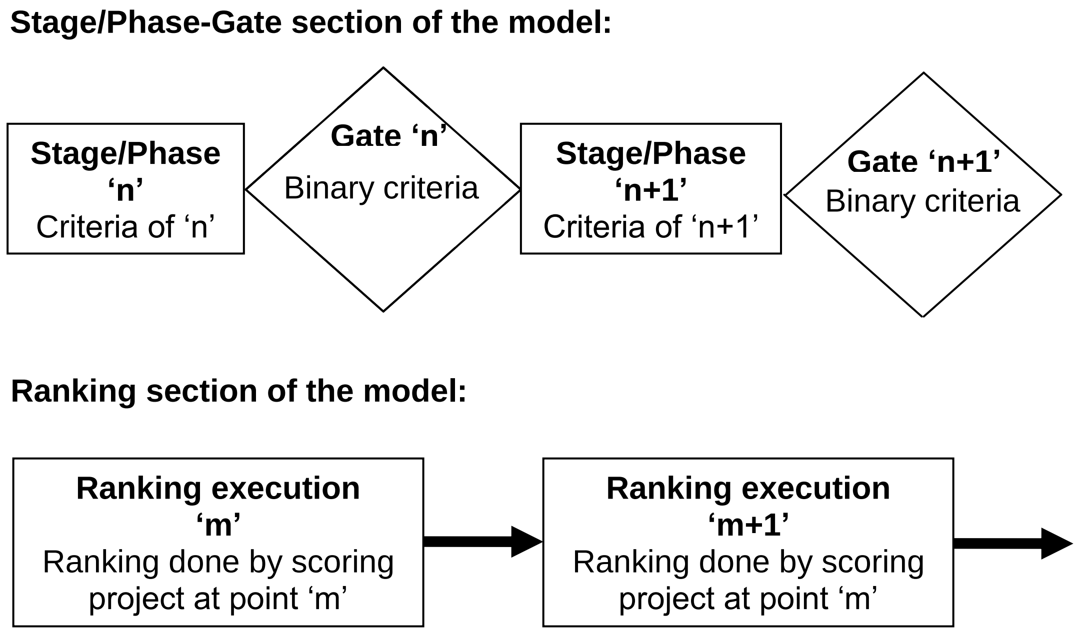

Figure 4.5: The view of the interviewed expert of Case Study 1 on the split between Stage/Phase-Gate execution and parallel concurrent ranking

The interviewed expert added or expanded on the following components of Model α:

- During the grouped Phase 3,4,5 the following stage/phase criteria was added: "Acquire a mandate." The expert explained that it was imperative to get the client to sign a contract with the developer so that the developer can be assured that the CDM work is allocated to that specific developer and no other;
- In Phase 12,13 the criteria "To achieve project validation" was expanded to "To achieve project validation (and final DNA approval)."Do remember that validation is performed by the DOE. It was the view of the expert that this would also be the best time to finalize all outstanding issues that the DNA could have had which could result in withholding host country approval; and

- The expert also proposed an additional ranking criterion: "Where is the project situated geographically?" The expert indicated that simple logistics plays a big role in the timely completion of existing projects and hence the evaluation of new projects. The importance of this additional ranking criterion to the expert is evident from the fact that the expert placed this additional ranking criterion in the first set of ranking criteria to be executed.

The expert indicated that the number of stages used by him, which was 20, was not a hard constraint. He indicated that he suspects that the final CDM project management model should consist of ±15 stages/phases. Taking this comment into account some of the expert's stages/phases were lumped together as illustrated in Figure 4.6.

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Figure 4.6: Case Study 1

Phase 1,2

C.1.1 Identify potential emission reduction projects

C.1.2 Ascertain eligibility of projects regarding fundamental CDM criteria

B.1.1 Does this project conform to the fundamentals of the CDM?

Ranking 1

R.1.1 What is the strategic importance of the proposed project?

R.1.2 Is this project reproducible?

R.2.2 How attractive is the amount of CERs earned?

R.3.3 Is the required capital relatively low?

R.4.1 How easy are the technical aspects?

R.4.4 Is there an existing appropriate CDM methodology?

NEW Where is the project situated geographically?

Phase 3,4,5

C.2.2 Clarify the need for the project. (revenue / corporate responsibility / etc)

C.2.3 Do an initial estimate of the emission reductions

C.2.4 Asses what is necessary in monitoring the inputs to calculate emission reductions

C.2.5 Do initial assessment of project risk (financial, technical and regulatory)

NEW Acquire a mandate

B.1.2 Does the project fit the strategic business alignment of the project proponents?

B.2.1 Is there a need for this project?

B.2.2 Does the initial emission reduction warrant a CDM project?

B.2.3 Is the project risk level acceptable?

B.3.2 Is the project regulatory viable?

Ranking 2

R.4.2 Is the regulatory environment in place?

Phase 6

C.3.2 Build and evaluate initial financial model

B.3.3 Does the project make financial sense?

Phase 7

C.2.1 Obtain initial approval from local DNA

Phase 8

C.4.2 Identify/develop the required CDM methodology

B.2.4 Are all inputs required measurable / obtainable?

B.4.2 Does the appropriate CDM methodology exist or can it be developed?

Ranking 3

R.2.1 Are there any perceived or real objections from the local DNA?

Phase 9

C.3.1 Do initial design for early estimates of regulatory / financial / technical requirements and iterate to determine initial best fit

B.3.1 Is the project technically viable?

Phase 10,11

C.4.3 Develop the PDD

C.4.4 Develop all documentation required by the DNA

B.4.3 Is the CDM PDD developed and completed?

B.4.4 Is all the documentation required by the DNA developed?

B.5,6,7.1 Are all the necessary written approvals in place from the host party? (From DNA and other parties.)

Ranking 4

R.8.1 Can the building and commissioning phase be completed quicker with acceptable increases in cost?

Phase 12,13

C.5,6,7.1To achieve project approval

C.5,6,7.2 To achieve project validation (and final DNA approval)

C.5,6,7.3 To achieve project registration

B.5,6,7.2Was the project validated by the selected DOE?

B.5,6,7.3 Was the project registered by the CDM EB?

Phase 14

C.4.1 Do a detailed design for the financial / technical and non-CDM specific regulatory requirements and iterate to determine optimal case

B.4.1 Does the detailed optimal design prove a bankable project?

Ranking 5

R.C.1 Identify and rank changes that can be made to increase the amount of CERs issued in the following year

Phase 15

C.8.1 To build and commission all equipment associated with the project activity

Phase 16

C.9.1 To monitor all inputs required as prescribed in the registered PDD

B.9.1 Are all inputs measured in accordance to the PDD and all applicable tools?

Phase 17,18

C.10,11.1 Obtaining verification and certification of CERs from DOE

C.10,11.2 Obtain issued CERs from UNFCCC EB

B.10,11.1 Did the DOE verify and certify the CERs?

B.10,11.2 Did the UNFCCC EB issue the CERs?

Phase 19

C.13.1 To investigate and correct any shortcomings that exist in the project activity

B.8.1 Are equipment build, commissioned and operating properly?

B.13.1 Annual post-mortem: Can all problems be overcome?

Phase 20

C12.1 To distribute the CERs to the relevant parties

B.12.1 Were the CERs distributed to the relevant parties as contractually agreed upon?

Ranking 6

R.4.5 Can the PDD be completed with relative ease?

4.6 Discussion of the proposed project management model of Case Study 2

Without being instructed explicitly the expert interviewed in Case Study 2[23] associated specific ranking criteria with specific stages/phases. This was also analogous to how Model α was constructed in that each stage/phase had a specific gate associated with it and during the execution of that gate both binary criteria and ranking criteria were evaluated. (Remember this was not a view shared by the expert interviewed in Case Study 1.)

The interviewed expert did not add or expand on the any of the components of Model α. The expert did however duplicate the following components:

- C.2.4 "Asses what is necessary in monitoring the inputs to calculate emission reductions" in stage/phase 2, 6 and 7;
- C.4.2 "Identify/develop the required CDM methodology" in stage/phase 1 and 2;
- C.9.1 "To monitor all inputs required as prescribed in the registered PDD" in stage/phase 6 and 7;
- B.2.4 "Are all inputs required measurable / obtainable?" in stage/phase 3 and 7;
- B.13.1 "Annual post-mortem: Can all problems be overcome?" in stage/phase 3, 7 and 8; and
- R.1.1 "What is the strategic importance of the proposed project?" is stage/phase 1 and 3.

The repeated components will be underlined in Figure 4.7.

The expert used only 8 stages. By implication to achieve project completion each stage/phase and gate had more criteria associated with it then what was proposed in Model α.

[23] See Appendix J for a brief summary of Case Study 2

Figure 4.7: Case Study 2

Phase 1

C.1.1 Identify potential emission reduction projects

C.1.2 Ascertain eligibility of projects regarding fundamental CDM criteria

C.2.2 Clarify the need for the project. (revenue / corporate responsibility / etc)

C.2.3 Do an initial estimate of the emission reductions

C.4.2 Identify/develop the required CDM methodology

B.1.1 Does this project conform to the fundamentals of the CDM?

B.1.2 Does the project fit the strategic business alignment of the project proponents?

B.2.1 Is there a need for this project?

B.2.2 Does the initial emission reduction warrant a CDM project?

B.3.3 Does the project make financial sense?

R.1.1 What is the strategic importance of the proposed project?

R.1.2 Is this project reproducible?

R.2.2 How attractive is the amount of CERs earned?

R.3.3 Is the required capital relatively low?

Phase 2

C.2.4 Asses what is necessary in monitoring the inputs to calculate emission reductions

C.4.2 Identify/develop the required CDM methodology

B.4.2 Does the appropriate CDM methodology exist or can it be developed?

R.4.4 Is there an existing appropriate CDM

Phase 3

C.2.5 Do initial assessment of project risk (financial, technical and regulatory)

C.3.1 Do initial design for early estimates of regulatory / financial / technical requirements and iterate to determine initial best fit

C.3.2 Build and evaluate initial financial model

C.4.1 Do a detailed design for the financial / technical and non-CDM specific regulatory requirements and iterate to determine optimal case

C.13.1 To investigate and correct any shortcomings that exist in the project activity

B.2.3 Is the project risk level acceptable?

B.2.4 Are all inputs required measurable / obtainable?

B.3.1 Is the project technically viable?

B.3.2 Is the project regulatory viable?

B.4.1 Does the detailed optimal design prove a bankable project?

B.5,6,7.1 Are all the necessary written approvals in place from the host party? (From DNA and other parties.)

B.13.1 Annual post-mortem: Can all problems be overcome?

R.1.1 What is the strategic importance of the proposed project?
R.2.1 Are there any perceived or real objections from the local DNA?
R.3.1 How easy are the technical aspects?
R.3.2 Is the regulatory environment in place?
R.4.5 Can the PDD be completed with relative ease?

Phase 4

C.4.3 Develop the PDD

C.4.4 Develop all documentation required by the DNA

B.4.4 Is all the documentation required by the DNA developed?

Phase 5

C.2.1 Obtain initial approval from local DNA

C.5,6,7.2 To achieve project validation

B.4.3Is the CDM PDD developed and completed?

B.5,6,7.2 Was the project validated by the selected DOE?

Phase 6

C.5,6,7.1To achieve project approval

C.5,6,7.3 To achieve project registration

C.2.4 Asses what is necessary in monitoring the inputs to calculate emission reductions

C.9.1 To monitor all inputs required as prescribed in the registered PDD

B.5,6,7.3 Was the project registered by the CDM EB?

R.8.1 Can the building and commissioning phase be completed quicker with acceptable increases in cost?

R.C.1 Identify and rank changes that can be made to increase the amount of CERs issued in the following year

Phase 7

C.2.4 Asses what is necessary in monitoring the inputs to calculate emission reductions

C.8.1 To build and commission all equipment associated with the project activity

C.9.1 To monitor all inputs required as prescribed in the registered PDD

C.10,11.1 Obtaining verification and certification of CERs from DOE

C.10,11.2 Obtain issued CERs from UNFCCC EB

B.2.4 Are all inputs required measurable / obtainable?

B.8.1 Are equipment built, commissioned and operating properly?

B.9.1 Are all inputs measured in accordance to the PDD and all applicable tools?

B.10,11.1 Did the DOE verify and certify the CERs?

B.10,11.2 Did the UNFCCC EB issue the CERs?

B.13.1 Annual post-mortem: Can all problems be overcome?

Phase 8

C12.1 To distribute the CERs to the relevant parties

B.12.1 Were the CERs distributed to the relevant parties as contractually agreed upon?

B.13.1 Annual post-mortem: Can all problems be overcome?

4.7 Discussion of the proposed project management model of Case Study 3

The results from the expert interviewed in Case Study 3[24] indicated a strong correlation of the stage/phase criteria and binary gate criteria associated with stages/phases and gates as compared to Model α. What did differ was that the expert mostly associated the ranking criteria with the middle stages/phases. From this it was concluded that it was the view of the expert that the viability and attractiveness of a project (and compared to other projects) was evaluated only after the successful completion of initial stages/phases.

The interviewed expert did not add or expand on any of the stage/phase criteria components or ranking criteria of Model α. The expert did however exercise his discretion regarding the binary criteria as follows:

- Omitting B.3.1: "Is the project technically viable?"; and
- Duplicating B.2.2: "Does the initial emission reduction warrant a CDM project?" in stage/phase 4 and 6 as underlined in Figure 4.8.

As was the case with the expert of Case Study, 1 the expert in Case Study 3 indicated that the number of stages used by him was not a hard constraint. (The expert of Case Study 3 used 18 stages/phases.) Taking this comment into account some of the expert's stages/phases were lumped together as illustrated in Figure 4.8.

[24] See Appendix K for a brief summary of Case Study 3

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Figure 4.8: Case Study 3

Phase 1,2

C.1.1 Identify potential emission reduction projects

C.1.2 Ascertain eligibility of projects regarding fundamental CDM criteria

C.2.2 Clarify the need for the project. (revenue / corporate responsibility / etc)

B.1.1 Does this project conform to the fundamentals of the CDM?

B.2.1 Is there a need for this project?

B.3.2 Is the project regulatory viable?

Phase 3

C.3.1 Do initial design for early estimates of regulatory / financial / technical requirements and iterate to determine initial best fit

Phase 4

C.2.3 Do an initial estimate of the emission reductions

C.2.5 Do initial assessment of project risk (financial, technical and regulatory)

B.2.2 Does the initial emission reduction warrant a CDM project?

B.2.3 Is the project risk level acceptable?

Phase 5

C.3.2 Build and evaluate initial financial

B.3.3 Does the project make financial sense?

Phase 6

C.5,6,7.1 To achieve project approval

B.1.2 Does the project fit the strategic business alignment of the project proponents?

B.2.2 Does the initial emission reduction warrant a CDM project?

R.1.1 What is the strategic importance of the proposed project?

R.1.2 Is this project reproducible?

R.2.1 Are there any perceived or real objections from the local DNA?

R.2.2 How attractive is the amount of CERs earned?

R.3.1 How easy are the technical aspects?

R.3.2 Is the regulatory environment in place?

R.3.3 Is the required capital relatively low?

R.4.4 Is there an existing appropriate CDM methodology?

R.4.5 Can the PDD be completed with relative ease?

R.8.1 Can the building and commissioning phase be completed quicker with acceptable increases in cost?

Phase 7

C.4.2 Identify/develop the required CDM methodology

C.4.4 Develop all documentation required by the DNA

B.4.2 Does the appropriate CDM methodology exist or can it be developed?

B.4.4 Is all the documentation required by the DNA developed?

Phase 8

C.2.1 Obtain initial approval from local DNA

C.2.4 Asses what is necessary in monitoring the inputs to calculate emission reductions

B.2.4 Are all inputs required measurable / obtainable?

Phase 9,10

C.4.1 Do a detailed design for the financial / technical and non-CDM specific regulatory requirements and iterate to determine optimal case

C.4.3 Develop the PDD

B.4.1 Does the detailed optimal design prove a bankable project?

B.4.3 Is the CDM PDD developed and completed?

R.C.1 Identify and rank changes that can be made to increase the amount of CERs issued in the following year

Phase 11

C.5,6,7.2 To achieve project validation

B.5,6,7.2 Was the project validated by the selected DOE?

Phase 12

C.13.1 To investigate and correct any shortcomings that exist in the project activity

B.9.1 Are all inputs measured in accordance to the PDD and all applicable tools?

Phase 13

C.5,6,7.3 To achieve project registration

B.5,6,7.1 Are all the necessary written approvals in place from the host party? (From DNA and other parties.)

B.5,6,7.3 Was the project registered by the CDM EB?

Phase 14

C.8.1 To build and commission all equipment associated with the project

B.8.1 Are equipment built, commissioned and operating

Phase 15

C.9.1 To monitor all inputs required as prescribed in the registered PDD

B.13.1 Annual post-mortem: Can all problems be overcome?

Phase 16,17

C.10,11.1 Obtaining verification and certification of CERs from DOE

C.10,11.2 Obtain issued CERs from UNFCCC EB

B.10,11.1 Did the DOE verify and certify the CERs?

B.10,11.2 Did the UNFCCC EB issue the CERs?

Phase 18

C12.1 To distribute the CERs to the relevant parties

B.12.1 Were the CERs distributed to the relevant parties as contractually agreed upon?

Omitted

B.3.1 Is the project technically viable?

4.8 Discussion of the reconciled model – Model β

The proposed project management models of the various case studies were consolidated using the Euclidian geometrical "lengths" attributed to each stage/phase and gate as discussed in the previous chapter.

All the new or altered components, as suggested by the interviewed experts, were included in Model β. These components were:

- C.5,6,7.2 Was altered to "To achieve project validation (and final DNA approval)" in stage/phase 7;
- "Acquire a mandate" was a new criterion inserted in stage/phase 4; and
- "Where is the project situated geographically?" was a new ranking criterion inserted in stage/phase 1.

It is also interesting to note that Model α consisted of 13 stages/phases and after reconciling the case study project management models Model β was derived consisting of 12 stages/phases.

In accordance with the "Rule of Binary criteria" presented above. B.5,6,7.3 ("Was the project registered by the CDM EB?") was moved from phase 7 to phase 9. This was done since the successful completion of the criterion (listed as "B") cannot be expected before the model indicated that criterion (listed as "C") had to be executed.

Model β is presented in Figure 4.9.

Figure 4.9: Model β

Phase 1

C.1.1 Identify potential emission reduction projects

C.1.2 Ascertain eligibility of projects regarding fundamental CDM criteria

C.2.2 Clarify the need for the project. (revenue / corporate responsibility / etc)

B.1.1 Does this project conform to the fundamentals of the CDM?

B.1.2 Does the project fit the strategic business alignment of the project proponents?

B.2.1 Is there a need for this project?

R.1.1 What is the strategic importance of the proposed project?

R.1.2 Is this project reproducible?
R.2.2 How attractive is the amount of CERs earned?
R.3.3 Is the required capital relatively low?
R.4.1 How easy are the technical aspects?
R.4.4 Is there an existing appropriate CDM methodology?
NEW Where is the project situated geographically?

Phase 2

C.2.3 Do an initial estimate of the emission reductions

B.2.2 Does the initial emission reduction warrant a CDM project?

Phase 3

C.2.4 Assess what is necessary in monitoring the inputs to calculate emission reductions

C.2.5 Do initial assessment of project risk (financial, technical and regulatory)

C.3.2 Build and evaluate initial financial model

C.4.1 Do a detailed design for the financial / technical and non-CDM specific regulatory requirements and iterate to determine optimal case

B.2.3 Is the project risk level acceptable?

B.3.2 Is the project regulatory viable?

B.3.3 Does the project make financial sense?

Phase 4

C.2.1 Obtain initial approval from local DNA

NEW Acquire a mandate

B.2.4 Are all inputs required measurable / obtainable?

B.4.2 Does the appropriate CDM methodology exists or can it be developed?

B.4.4 Is all the documentation required by the DNA developed?

R.3.2 Is the regulatory environment in place?

Phase 5

C.3.1 Do initial design for early estimates of regulatory / financial / technical requirements and iterate to determine initial best fit

C.4.2 Identify/develop the required CDM methodology

C.4.4 Develop all documentation required by the DNA

B.3.1 Is the project technically viable?

B.4.1 Does the detailed optimal design prove a bankable project?

R.2.1 Are there any perceived or real objections from the local DNA?

R.3.1 How easy are the technical aspects?

R.4.2 Is the regulatory environment in place?

R.4.5 Can the PDD be completed with relative ease?

R.8.1 Can the building and commissioning phase be completed quicker with acceptable increases in cost?

Phase 6

C.4.3 Develop the PDD

B.4.3 Is the CDM PDD developed and completed?

B.5,6,7.2 Was the project validated by the selected DOE?

Phase 7

C.5,6,7.1 To achieve project approval

C.5,6,7.2 To achieve project validation (and final DNA approval)

Phase 8

C.13.1 To investigate and correct any shortcomings that exist in the project activity

Phase 9

C.5,6,7.3 To achieve project registration

C.8.1 To build and commission all equipment associated with the project activity

C.10,11.2 Obtain issued CERs from UNFCCC EB

B.5,6,7.3 Was the project registered by the CDM EB?

B.5,6,7.1 Are all the necessary written approvals in place from the host party? (From DNA and other parties.)

B.8.1 Are equipment built, commissioned and operating properly?

B.9.1 Are all inputs measured in accordance to the PDD and all applicable tools?

B.10,11.2 Did the UNFCCC EB issue the CERs?

R.C.1 Identify and rank changes that can be made to increase the amount of CERs issued in the following year

Phase 10

C.9.1 To monitor all inputs required as prescribed in the registered PDD

Phase 11

C.10,11.1 Obtaining verification and certification of CERs from DOE

B.10,11.1 Did the DOE verify and certify the CERs?

B.13.1 Annual post-mortem: Can all problems be overcome?

Phase 12

C12.1 To distribute the CERs to the relevant parties

B.12.1 Were the CERs distributed to the relevant parties as contractually agreed upon?

4.9 Overall results, conclusions and next steps

During the interviews with the experts it became apparent that no expert had a strong opinion regarding the number of stages/phases that should be used. The large variance in the number of stages/phases used by the experts, which ranged from 8 to 20, is also notable. The two experts that identified 18 and 20 stages/phases did indicate that they would consider ±15 stages/phases to be a reasonable number.

Allowing the interviewed experts to add, alter, repeat and omit any of Model α's components resulted in the most flexible and non-prescribed responses while still providing them with guidance. The various project management models envisaged by the experts could be reconstructed from their input and consolidated to produce Model β.

Model β can now be present to the South African Clean Development Industry Association (SA CDM IA) for comments, critic and feedback. The input from the SA CDM IA will then result in the increased external validity of Model β.

Chapter 5: External validity of Model β

Model β was presented to the members of the South African CDM Industry Association. The purpose of this was to test the external validity of model β. All members had the opportunity to provide criticism on model β. The criticism was obtained by adapting the initial questionnaire developed in this research. The initial questionnaire, on which Chapter 3 was based, was sent out and completed by the respondents in the second half of 2007. The SA CDM IA, SA CDM landscape and indeed the CDM as a whole had developed substantially from then and it was decided to repeat the questionnaire in the first half of 2009.

It was decided to repeat all the questions that were in the 1st questionnaire and to include some additional questions specifically focused on Model β. The original questions were repeated so as to investigate whether there were substantial shifts in the answers due to developments in the ±18 month time laps that took place between the 1st and the 2nd questionnaire. Questions 13 to 15 were the additional questions added to evaluate the respondents' view of Model β (See Appendix D).

As stated at the end of the previous chapter Model β was presented to the SA CDM IA and feedback was requested via this 2nd questionnaire. At the end of the first half of 2009, the SA CDM IA consisted of 32 active individuals and parties[25]. Nine members decided to partake in the 2nd questionnaire[26]. It is unfortunate that not more active individuals and parties partook in the research. However, a 28% feedback is at least sufficient for indicative reasoning purposes.

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[25] "Individuals and parties" here implies that either a company has joined the SA CDM IA or an individual. "Active" refers to the fact that the member is not an historical member that was dormant at that stage and whose future involvement with the SA CDM IA was questionable.

[26] It is not possible to identify if respondents overlapped between the 1st and 2nd questionnaire since respondents were assured that they will stay anonymous. Respondents replied to the study leader to prevent any perceived research bias or perverse action as the researcher is involved in the SA CDM space.

It is important to remember that the complete CDM process consists of open source information. The result is that the only advantage that one CDM developer has over another is in how the open source information is applied and how internal company specific protocols aid in the development of successful CDM projects. From this point of view the perceived reluctance of the SA CDM IA individuals and parties to partake in this study is understandable. To address this reluctance all possible reassurance was given to the respondents in that no names of companies or individuals would be mentioned. Furthermore, as the researcher is intimately involved in the CDM industry it could lead to the perception that the respondents' personal views could be used against them. For this reason respondents could contact the study leader directly as to bypass the researcher. The sanitized information that the study leader then sent to the researcher alleviated possible concerns regarding sensitive information.

5.1 Discussion on the answered questionnaires and identified trends

In evaluating the 2nd round of questionnaires it was found that the respondents were involved in at least five registered SA CDM projects. This showed an increase as in the 1st questionnaire respondents were involved in at least three registered SA CDM projects.

The success achieved by the CDM industry, as measured by the number of registered CDM projects, increased in the 18 months time laps between the two questionnaires. At the completion of the 2nd round of questionnaires (July 2009) South Africa had 15 registered CDM projects (UNFCCC, 2009) as opposed to the 10 ten registered CDM projects at the end of the 1st round of questionnaires (September 2007).

Most of the respondents[27] of the 2nd questionnaire indicated that they were working on more than 10 CDM projects concurrently. This is up from the more than four CDM projects per respondent that was the result of the 1st questionnaire.

It is interesting to note that the location of the current CDM endeavours did not change at all. In the 1st and 2nd questionnaires it was found that 91% of the current focus was on South Africa. The conclusion is that the expected future African continent endeavours that from the 1st questionnaire were to increase from 2% to 12% either did not occur yet or will not occur at all. From the 2nd questionnaire it was found that future African endeavours were expected to increase to 25%. This is doubtful considering that the previous expected African endeavours increase did not happen or at least haven't happened yet. Furthermore none of the respondents of the 2nd questionnaire had any plans for CDM endeavours not based on the African continent.

The respondents considered their relative average fields of expertise as indicated in Table 5.1.

It is interesting to note how the expertise of the respondents of the 2nd questionnaire had exactly the inverse expertise order rating as compared to the 1st questionnaire. One possible explanation of the changing of the fields of expertise could be attributed to a realization in industry that more regulatory expertise is required for these projects. This can though not be stated as a fact as the number of respondents was just too few.

[27] The author acknowledges that tables and figures reflecting percentages from a very small sample may generate unfounded statistical confidence. The inferred characteristics or attributes should be viewed as indicative.

Table 5.1: Percentage of expertise as provided by respondents of 1st and 2nd questionnaire

Expertise:	Percentage as provided by respondents:	2nd Questionnaire
Financial	44%	17%
Technical	41%	29%
Regulatory	14%	54%

In summary the following was deduced from the 2nd round of completed questionnaires regarding CDM project management:

- Only 1 of 9 (as opposed to 3 of 8 in the 1st questionnaire) respondents indicated that they follow a formalised CDM project management approach although 8 of 9 (as opposed to 7 of 8 in the 1st questionnaire) respondents indicated a perceived need for such an approach. It is then assumed that in 18 months very little progression was made in the industry regarding the application of a CDM specific project management approach. With a lack of formalised CDM project management it is considered that project management prevailed on a ad hoc basis; and
- Of the 9 respondents, 8 (as opposed to 5 of 8 in the 1st questionnaire) indicated that they had a dedicated person/group acting as project manager for CDM projects. Although the sample groups are small it tends to indicate a growing acknowledgment of the complexities of CDM and that dedicated project managers are required.

Some of the questions in the questionnaire were aimed at establishing where CDM project developers and related parties perceived bottlenecks in successful completing a CDM project. The perceived bottlenecks were divided into financial, technical and regulatory aspects. Furthermore a distinction was made between domestic (South African) and foreign perceived bottlenecks.

University of Pretoria

The 2nd questionnaire also repeated the questions regarding the perceived bottlenecks experienced by respondents. This is summarized in Table 5.2.

Table 5.2: Breakdown of perceived bottlenecks in successful completion of a CDM project – comparing answers of the 1st questionnaire with the 2nd questionnaire

1st perceived importance rating:	Perceived bottleneck:	1st questionnaire percentage:	2nd questionnaire percentage:	2nd perceived importance rating:
1	Local regulatory environment	28%	15%	combined 3rd
2	Foreign technical requirements	25%	22%	2
Combined 3rd	Foreign regulatory environment	17%	28%	1
Combined 3rd	Local financial environment	17%	9%	5
4	Foreign financial environment	7%	11%	4
5	Local technical requirements	6%	15%	combined 3rd

Taking cognisance of the fact that the respondents in the 2nd questionnaire had the inverse speciality fields as compared to the 1st questionnaire it is of importance to note that the top part of Table 5.2 still comprised of the same components. It is then reasonable to assume that the major perceived bottlenecks of CDM were still the same, although the subjective perception of the severity of the bottlenecks changed with time or with respondent group expertise.

In the 1st questionnaire the South African regulatory environment was seen as the single largest bottleneck for the successful completion of a CDM project. This has now changed as in the 2nd questionnaire the foreign regulatory environment was identified as the largest bottleneck. Two possible explanations can be given for this:

- It is possible that the South African regulatory environment (DNA and others) had grown and that capacity expansion alleviated this perceived restriction on progress; and/or
- The foreign regulatory environment of the CDM (UNFCCC related bodies) became more stringent in the application of CDM rules and processes. (This was done as to increase the robustness of the CDM system as corruption occurred in certain countries that had CDM projects. The evolving UNFCCC (2010) CDM rules and history of the rules can be traced on their website.)

The second largest perceived bottleneck remained to be the foreign technical requirements. This can be attributed to various reasons including South Africa’s dependence on foreign technological imports.

It is interesting to note that even in the 2nd questionnaire neither local nor foreign financial requirements are viewed as priority substantial bottlenecks. This differs from Little et al. (2007) where it is documented that the 4th highest rated inhibitor was that of “Africa (is) not an investment destination.”

Table 5.3 then summarizes the findings of the 1st and 2nd questionnaire. This table combines the local and foreign categories and only distinguishes between regulatory, technical and financial bottlenecks. Again it is important to note that the percentages are only important in order of magnitude and final ranking order.

The question then asked the completion of the 1st questionnaire regarding whether the perceived regulatory bottlenecks that were identified are real or whether a lack of regulatory expertise from the 1st questionnaire's respondents induced perceived added risk can then be arguable answered. The finding was that the regulatory environment was still perceived as the most limiting aspect of the CDM followed by technical requirements and financial requirements. From an order of importance view this did not change in 18 months irrespective of the expertise of the questionnaire respondents.

Table 5.3: High level perceived bottlenecks in successful completion of a CDM project

Perceived importance rating:	Perceived bottleneck:	Percentage:	2nd
1	Regulatory environment	45%	43%
2	Technical requirements	31%	37%
3	Financial environment	24%	20%

5.2 Experts' input on what is considered to be the success and failure criteria for CDM projects

Respondent 1 noted that for an outsider / uninformed person the CDM process seems simple and appears to make sense, but once you get involved and try to get a project registered and approved the process proves to be tremendously complicated. Respondent 1 further stated that the CDM process has so many pitfalls that success can only be achieved and judged on:

- The level of knowledge that the CDM developer has of the CDM process; and
- Whether it is possible to generate the required paperwork to the satisfaction of the DOE and CDM EB. In contrast to this it is relatively simple to do the calculations depicted in phases 1 – 3 of Model β which provides guidelines of probable success.

It is interesting to note that Respondent 6 stated that even if all the "required paperwork" (Respondent 1) for the CDM is generated it is still difficult to achieve project registration due to:

- A lack of DOE resources;
- The tedious nature of the administration procedures (validation, registration, verification); and
- The approach taken by the DOE and CDM as a whole that the project developers are aiming to abuse the CDM system.

In conclusion, Respondent 1 summarizes his/her experience by saying that the success of a CDM project is highly dependent on the degree to which one can anticipate pitfalls in the process and generate the paperwork to bridge the pitfalls with success.

Table 5.4 summarizes the "pitfalls", as described by Respondent 1 and the "required paperwork" that is required as stated by Respondent 3:

Table 5.4: Summary of how the Respondents' comments were taken into account

Criteria	**Respondent**	**Where this is addressed in Model β**	**Comment**
Approved methodology	3	Phase 5: C.4.2	
Proof of Additionality	3	Phase 1: C.1.2	Additonality is seen as a fundamental aspect of CDM and hence falls under Phase 1: C.1.2
Sufficient ER achievable to be financially viable (IRR or other basis)	3, 6, 7,8, 9	Phase 2: B.2.2 Phase 2: C.2.3	
Able to carry transaction cost and raise capital	3, 7, 8, 9	Phase 2: B.2.2 Phase 2: C.2.3	
Good CDM consultants	3	Not Addressed	This model is to be applied by CDM developers and does not aim to rate the competency of the people at plant level or support at any level
Competent people on plant level (input to PDD, monitoring and technical design, financial competency)	3, 8	Not Addressed	
Political and Executive support including a Project Champion	8	Not Addressed	The importance is recognised though
Integration with other processes like EIA	3	Phase 3: C.4.1	
Compliance with local regulatory requirements (EIA etc)	3	Phase 1: C.1.2	Compliance with Host Country specific legislation is seen as a fundamental of CDM and hence falls under Phase 1: C.1.2
Upfront integration of CDM and technical challenges	3	Phase 3: C.4.1	

Respondent 3 reiterated the importance of client management so that the client appreciates the time that is required to complete a successful CDM project. This expectation management is especially important if taken into consideration that according to Respondent 7 the CDM process is still largely unknown in Africa.

5.3 Expert comment on the proposed CDM model (Model β) regarding applicability, completeness, practicality, areas that are unclear or any other comment.

In general Model β was perceived to be:

- A good model with "hardly a step that is not very important" (Respondent 3);
- Fairly clear (Respondent 6); and
- Practical, very comprehensive and very useful (Respondent 9).

It was the opinion of Respondent 1 that some changes have to be made to the developed model based on the "reality pertaining to the development of CDM projects." This "reality" was stated to be that the primary intent of every CDM developer is to:

- Save money;
- Make money; or
- To improve public image.

And that a reduction in greenhouse gases is a secondary effect of the project.

Respondent 1 concluded by stating that Model β should be considered with a view to make some changes to the cognisance of the above. Model flexibility was also identified in the 1st questionnaire as an important factor for success.

As conclusion it was the view of Respondent 7 that the model should in the early phases also include an analysis of the external environment and project forces: Political, Economic, Social, Legal, Technological and Environmental (PESTLE). Furthermore, Respondent 7 wanted to include an analysis of the internal environments of companies to ascertain whether they do have the correct structures in place to follow this model.

Chapter 6: Conclusions and future work

Emission reduction incentive schemes, like the CDM, have altered the way in which industry views pollution. No longer is the objective to be just below the legal compliant limit, but the aim has shifted to that of emitting as little greenhouse gases (GHG) as possible. The reason for this is that emission reduction incentive schemes (CDM's CERs and VERs) added a revenue stream to pollution prevention. Very few successful CDM projects exist in South Africa, although South Africa has relative potential[28] for CDM projects.

The research questions then raised were:

- Why are there so few registered SA CDM projects?
    - What are the current CDM project management approaches followed for CDM projects in SA?
    - Do SA CDM developers use and know of above mentioned research?
    - Do SA CDM developers need some other tool to be more successful?
    - How can project management (current and amended) procedures be formalised with regards to CDM projects in the SA context?

A literature analysis indicated that there is little or no focus regarding CDM concerns in Africa and South Africa The literature was useful though to identify the additional requirements of such projects as compared to traditional projects – traditional projects refer to projects where project management approaches are well developed, such as construction projects.

The problem statement was: Current accepted project management approaches and systems are inadequate for the speedy completion of CDM projects in South Africa. This was upheld as it could be at least one reason why there are so few successful CDM projects in South Africa.

[28] SA has a lot of CDM potential compared to other African projects according to Little et al. (2007).

An exploratory analysis found that CDM project management approaches in South Africa relied on ad hoc day-to-day management. Some of the CDM developers were aware of existing CDM management approaches, but found them very rigid or developed without taking country-specific concerns for South Africa into account. A need was identified for a more structured CDM project management approach focussed on CDM and the local South African concerns.

After exploring the field of stage/phase-gate project management of CDM projects in South Africa various models were developed and investigated to add structure to this field. It is important to note that South Africa has only a few successful CDM developers to date and the research involved obtaining feedback from actual CDM experts with experience in SA CDM projects.

The proposed Model β then aims to add structure to the emerging field of project management of South African and African CDM projects. This is a new field of project management as there was historically no financial incentive to pollute less than the legal requirement. The added levels of complexity and global scrutiny of emission reduction projects brings with it additional project management requirements. The primary aim of Model β is to facilitate the successful completion of emission reduction incentive projects, like CDM projects. Model β also transverses the interdependencies (financial, technical, regulatory) of the emission reduction project environment.

Model β was well received by industry as discussed in the previous chapter. It is then deduced that at least the majority of the issues faced historically in individual projects by CDM project developers in South Africa were addressed and managed by Model β. This is then the first comprehensive emission reduction project specific management model to be developed for the South African CDM environment[29].

[29] Take into account that Ecofys (2004) highlighted the additional requirements of emission reduction incentive projects, but did not present a project management model. It should also be stated that some project developers periodically disclose some information pertaining to their project management approaches followed. Unfortunately these in-house document sources are contradictory, haphazardly presented, and have no academic backing.

Historically, project developers focussed on only a few projects at a time. More and more projects were developed concurrently by project developers as the industry has expanded in the last ±5 years. The result was that portfolio management became increasingly important. Model β is also one of the first, if not the first, models to assist South African CDM project developers to do portfolio management in the country specific context. In this respect Model β is truly beneficial.

The regulatory environment of emission reduction incentive projects is fast changing as new rules and regulations are adopted and changed frequently. The result is that the management requirements should also be adjusted frequently. It is important to note that Model β should not be seen as a stationary model, but rather as a dynamic model, that must be tweaked frequently. It will be very difficult for Model β, if it was a stationary model, to aim to manage a dynamic process. This will be true for any stationary model.

Another important point is that Model β must be considered flexible enough by South African CDM project developers to alter it for their specific requirements. These requirements can be influenced by factors including, but not limited to:

- Company structure, including management structure;
- Business unit structure; and
- Cultural influences.

It is foreseen that Model β, or company specific derivates, could be automated in software. This could aid in project management as long as the software application does not restrict the model flexibility.

The real practical use of this research will only be proven in the application of Model β. To aid in this the SA CDM IA will be sent copies of this research once it has completed its external review process. All interested parties will have access to Model β to apply in a form as solely decided by the parties in question. In this way the SA CDM IA can take ownership of the project management process followed to achieve successful emissions reduction projects.

Future academic research can then focus on ascertaining the diverse applications and derivatives of Model β. By doing this a long term research relationship can be established between project management research and the SA CDM IA. Only then can the success of Model β, or a derivative, to manage the speedy completion of the CDM process within South Africa be assessed.

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Appendixes

Appendix A: Discussion of Cooper (2000) on the Stage-Gate process

Cooper (2000) differentiates between the Stage-Gate process and conventional project management practices by stating: “Stage-Gate is a macro process – an overarching process. By contrast, project management is a micro process.” This is also debatable as concurrent engineering (Smith, 1997) can also be seen as a macro process, but is still a project management method. Cooper (2000) further states that project management remains applicable as part of more complex stages. The question then becomes what are the criteria that a process should satisfy to be considered project management? Various sources exist that provides information regarding the desired criteria of a project management approach. The following table evaluates the criteria of project management against the objectives of the Stage-Gate approach:

Table A.1: Project Mangement criteria vs. Stage-Gate objectives:

Project management criteria	Does the Stage-Gate process satisfy this?	Source of project management criteria
The application of knowledge, skills, tools, and techniques to project activities to meet the project requirements	Yes. The Stage-Gate is the application of knowledge proposed by Cooper (2000). It can be seen as a tool and/or technique to be used to achieve project requirements.	PMBOK (2004)
The planning, monitoring and control of all aspects of a project and the motivation of all those involved in it to achieve the project objectives on time and to specified cost, quality and performance	Yes. The cross-functional team approach of the Stage-Gate process aims to “control … all aspects of a project.” The Stage-Gate process furthermore addresses objectives of cost, quality and performance.	British Standards (BS6079, 2010)

The conclusion drawn from the comparison between what is considered to be criteria for project management and what the Stage-Gate process aims to achieve is that the Stage-Gate process aims to achieve project management. However, the project management characteristics of a stage/phase-gate process are not unique to the Stage-Gate process of Cooper (2000). Any of the stage/phase-gate approaches presented in Table 2.1 will satisfy the criteria for project management. The conclusion is then expanded to state that all stage/phase-gate processes can be viewed as project management models if they satisfy the criteria as stated in the above table of this Appendix. Furthermore, the uniqueness of the parallel development process of the Stage-Gate process is highly debatable as parallel development forms the basis of concurrent engineering (Lawson et al, 1994, Loch, et al 1998).

Table B.1: Summary of stages/phases and gates (Cooper, 2000), their purpose and activities to be completed during each

Component	Purpose	Activities
Discovery Stage	Towards a defined, proactive idea generation system.	• technical research; • search new technological possibilities; • uncover unarticulated needs; and • uncover market opportunities.
Gate 1: Idea Screen	First decision to commit resources to an idea.	• Decide on idea's strategic fit; • Evaluate market attractiveness; • Investigate technical feasibility; and • Investigate definite project stoppers.
Stage 1: Scoping	Determine project's technical and marketplace merits in short time with low cost.	• Do preliminary market assessment; • Do preliminary technical assessment; and • Deliver first pass business and financial analysis as input to Gate 2.
Gate 2: Second Screen	Re-apply the "must meet" and "should meet" criteria of Gate 1 more stringently considering the improved and additional information available. Additional criteria can be added.	• Similar as in Stage 1 with expansions.
Stage 2: Building the Business Case	Clearly define the product and verify market attractiveness.	• Define target market; • Delineation of product concept; • Specify product positioning and strategy; • Specify product benefits; and • Specify essential and desired product requirements.
Gate 3: Go to Development	To complete product definition and/or project definition.	• Review Stage 2 activities for completeness, quality of work and positive product outcome, and; Designate project team.
Stage 3: Development	To deliver a lab-tested product prototype.	• Do full scale technical design; • Advance the marketing of product; and • Resolve legal aspects of product.
Gate 4: Go to Testing	Check product development and continued product attractiveness.	• Review development work for completeness and quality; • Check consistency of Gate 3 product definition; and • Review product financials.
Stage 4: Testing and Validation	Test product viability. Negative results will send the product back to Stage 3.	• Do in-house product tests; • Execute user or field product trials; • Do pilot production; • (Pre)test market; and • Revise business and financial plan.
Gate 5: Go to Launch	A go-ahead will lead to full production and market launch.	• Determine quality of testing and validation; • Evaluate final financials; and • Evaluate start-up plans.
Stage 5: Launch	To implement marketing and production launch.	• Implement marketing and production launch.
Post-Launch review	Determine project's and product's strengths and weaknesses.	• Do post-project audit.

Appendix B: Financial considerations of illustrative case study

Table B.1: Summary of cost involved in implementing the existing predictive control system

Description	Cost	Symbol
Cost of existing control system	US$1,200,000	A1
Normal % defects	5%	B1
Accuracy of predictive control system available on the market	73%	C1
Expected annual reliability per sensor	99.7%	D1
Number of inputs required (one sensor per input)	20	E1
Plates with defects historically sent to clients	1.43%	F1
Total annual revenue	US$100,000,000	G1
Loss in revenue per year	US$1,433,609	H1
Allowable payback period (years)	3	I1
Cost associated with existing control system and loss of revenue for a 3 year period	US$5,500,826	J1

Calculating the number of plates with defects historically sent to clients (F1):

$$F1 = \frac{B1 \times (1 - C1)}{D1^{E1}} \qquad (1)$$

Calculating the loss in revenue per year (H1):

$$H1 = F1 \times G1 \qquad (2)$$

Calculating the cost associated with existing control system and loss of revenue for a 3 year period (J1):

$$J1 = A1 + H1 \times I1 \qquad (3)$$

Table B.2: Summary of cost involved in implementing the existing predictive control system		
Description	**Cost**	**Symbol**
Cost of newly developed predictive control system	US$855,000	A2
Normal % defects	5%	B2
Accuracy of predictive control system developed	73%	C2
Expected annual reliability per sensor	99.7%	D2
Number of inputs required (one sensor per input)	1	E2
Plates with defects historically sent to clients	1.35%	F2
Total annual revenue	US$100,000,000	G2
Loss in revenue per year	US$1,354,062	H2
Allowable payback period (years)	3	I2
Cost associated with existing control system and loss of revenue for a 3 year period	US$4,917,187	J2

Calculating the number of plates with defects historically sent to clients (F2):

$$F2 = \frac{B2 \times (1 - C2)}{D2^{E2}} \qquad (4)$$

Calculating the loss in revenue per year (H2):

$$H2 = F2 \times G2 \qquad (5)$$

Calculating the cost associated with existing control system and loss of revenue for a 3 year period (J2):

$$J2 = A2 + H2 \times I2 \qquad (6)$$

Cost associated with developing and implementing a new predicative control system		
Description	**Cost**	**Symbol**
Stage 1	US$40,000	A3
Stage 2	US$85,000	B3
Stage 3	US$210,000	C3
Stage 4	US$80,000	D3
Stage 5	US$440,000	E3
Total development and implementation cost	US$855,000	F3

The total cost was determined by equation 7:

$$F3 = A3 + B3 + C3 + D3 + E3 \qquad (7)$$

Appendix C: Details of the case study stage investigations

During Stage 1 a principle component analysis (PCA) was performed on a data set consisting of the twenty inputs that the control system available on the market required. PCA is a vector space transformation often used in exploratory data analysis to lower the multidimensional space of data. Encouraging results were obtained in that a lower dimensional space, i.e. using less than the twenty input parameters, was obtainable that retained most of the higher dimensional space's information.

The PCA result indicated that it was probable that a predictive control system could be developed that needed less than twenty input parameters. Using less than twenty input parameters were listed as a "must meet" criterion. Options that produce models that were difficult to interpret, like artificial neural networks (ANNs), were eliminated. Developing human interpretable models was a "should meet" criterion. The encouraging results of the first stage lead to the successful passing of the second gate.

Computer programming and data mining experts further investigated the potential benefits of a newly developed predictive control system. Various modelling options, like support vector machines (SVM) and genetic programming (GP), were investigated.

On laboratory scale, during Gate 4, it was found that only one specific input parameter of the twenty measured was required to deliver the same predictive performance of the control system available on the market. The human interpretability of a predictive model based on the value of a single input parameter is trivial.

The added advantage of the new model was that it resulted in an explicit model that could be analysed. It must be remember that the predictive control system available on the market was a 'black box' system which gave the user no insight into the logic used during predictions.

Appendix D: 1st and 2nd Questionnaire

CDM questionnaire to the CDM Association (To be used to direct further research)

Chair of Life Cycle Engineering
Graduate School of Technology Management, University of Pretoria

Room 4-11, Engineering 2, Main campus, Pretoria, 0002

Tel: +27 12 420 3929
Fax: +27 12 362 5307
E-mail: alan.brent@up.ac.za
Web: http://www.up.ac.za/gstm

1. Approximately how many potential CDM projects are your company currently working on?

0	1 – 3	4 – 6	7 – 10	MORE

2. How many registered CDM projects do your company have?
(Please do omit this question if you feel this compromises the anonymity of the questionnaire)

0	1 – 2	3 – 4

3. Where are the majority of the current projects situated?
(Indicate percentage)

South Africa %	Africa %	Global %

4. Where is the priority of your future CDM focus?
(Indicate percentage)

South Africa %	Africa %	Global %

5. What aspect of the CDM do you specialize in?
(Indicate percentage)

Financial %	Technical	Regulatory %

6. Do you follow a formalised project management model or standard? (Such as PMBOK®, PRINCE2, etc.)

   YES NO

7. If yes, what specific project management model or standard is used?

…………………………………………………………………………………

…………………………………………………………………………………

8. Why is the specific project management model or standard used? **OR** Why is project management not formalised?

…………………………………………………………………………………

…………………………………………………………………………………

9. Do you see the need for a formalised project management structure?

   YES NO

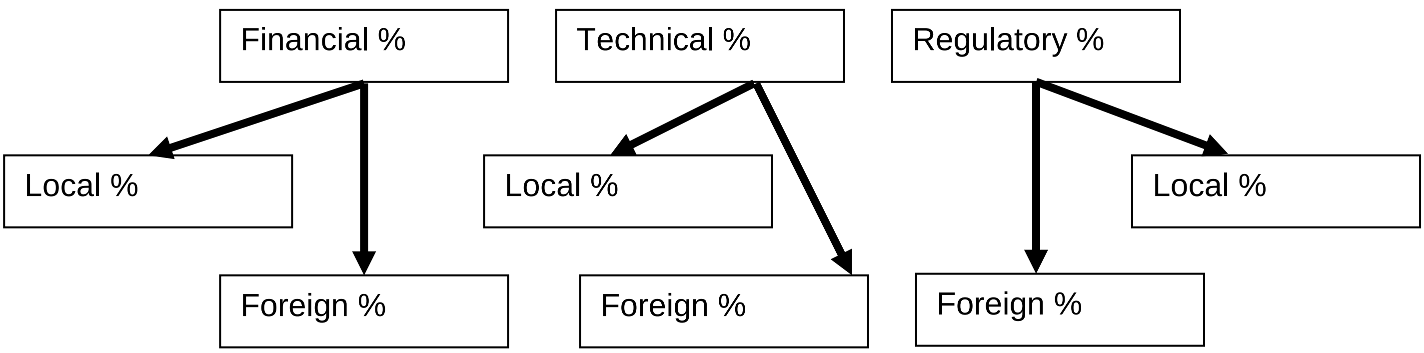
10. Do you have a person/group acting as dedicated project manager for CDM?

    YES NO

11. If applicable, does the project management manager/group succeed in facilitating the development of CDM projects?

    YES NO

12. Where do you experience bottlenecks in a CDM project?
    Are these bottlenecks caused by South African considerations/parties/influences or foreign?
    (Indicate percentage)



Questions focussed on the proposed CDM project management model:

13. Please complete the following table regarding the proposed model: (Each aspect should be scored from 1 to 10. The same score may be used more than once. A higher score denotes a higher cost, effort level, importance, or the like.)

Aspect	Phase[30]											
	1	2	3	4	5	6	7	8	9	10	11	12
Effort level: Time												
Effort level: Money												
Effort level: Amount of work												
Score importance of each phase												

14. Please provide a narrative description of what is considered, in your opinion, to be the success and failure criteria for a CDM project

…………………………………………………………………………
…………………………………………………………………………
…………………………………………………………………………
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15. Please provide comment on the proposed CDM model regarding applicability, completeness, practicality, areas that are unclear or any other comment.

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[30] These phases refer to the phases of Model β as presented to the 2nd questionnaire respondents.

Appendix E: Summary of the 1st Questionnaire

Summary of answers to questionnaire:				
No	Question	Average		Number of replies
1	Approximately how many potential CDM projects are your company currently working on?	4.3		8
2	How many registered CDM projects do your company have?	0.5		6
3	Where are the majority of the current projects situated?	South Africa:	91%	8
		Africa:	2%	
		Global:	7%	
4	Where is the priority of your future CDM focus?	South Africa:	79%	8
		Africa:	12%	
		Global:	9%	
5	What aspect of the CDM do you specialize in?	Financial:	44%	8
		Technical:	41%	
		Regulatory:	14%	
6	Do you follow a formalised project management model or standard?	38% (Yes)		8
7, 8	Commentary questions discussed later			
9	Do you see the need for a formalised project management structure?	88% (Yes)		8
10	Do you have a person/group acting as dedicated project manager for CDM?	63% (Yes)		8
11	If applicable, does the project management manager/group succeed in facilitating the development of CDM projects?	100% (Yes)		5
12	Where do you experience bottlenecks in a CDM project? Are these bottlenecks caused by South African considerations / parties / influences or foreign?	Financial – Local:	17%	7
		Financial – Foreign:	7%	
		Technical – Local:	6%	
		Technical – Foreign:	25%	
		Regulatory – Local:	28%	
		Regulatory – Foreign:	17%	

Appendix F: Complete representation of Model α

<table>
<tr><th colspan="5">Table F.1: Phase 1</th></tr>
<tr><th>Phase name</th><th colspan="4">1. Project identification and planning</th></tr>
<tr><td rowspan="2">Purpose of project phase</td><td>1</td><td colspan="3">Identify potential emission reduction projects</td></tr>
<tr><td>2</td><td colspan="3">Ascertain eligibility of projects regarding fundamental CDM criteria</td></tr>
<tr><td>Gate 1 criteria</td><td>No</td><td>Criteria</td><td>No</td><td>Yes</td></tr>
<tr><td rowspan="2">Kill/Go criteria</td><td>1</td><td>Does this project conform to the fundamentals of the CDM?</td><td>Kill</td><td>Go</td></tr>
<tr><td>2</td><td>Does the project fit the strategic business alignment of the project proponents?</td><td>Kill</td><td>Go</td></tr>
<tr><td rowspan="2">Comments</td><td>1</td><td colspan="3">Fundamentals of CDM refers to concepts like measurable emission reductions, additionality, measurable sustainable development contribution, etc.</td></tr>
<tr><td>2</td><td colspan="3">Strategic business alignment refers to project proponent's identified business visions and missions.</td></tr>
<tr><td rowspan="3">Ranking criteria</td><td>No</td><td colspan="2">Criteria</td><td>Score[31]</td></tr>
<tr><td>1</td><td colspan="2">What is the strategic importance of the proposed project?</td><td></td></tr>
<tr><td>2</td><td colspan="2">Is this project reproducible?</td><td></td></tr>
<tr><td rowspan="2">Comments</td><td>1</td><td colspan="3">If the proposed projects have benefits, like opening up new markets, then give a higher ranking score.</td></tr>
<tr><td>2</td><td colspan="3">Reproducible projects achieve higher scores since the role out of following projects are highly beneficial.</td></tr>
</table>

[31] A value of 1 – 10 will be awarded per point in the ranking phase. It is important to note that a "higher is better" scoring system will be used. Relative ranking criteria weights were not added. This could be added in the project meetings during which gates are discussed.

Table F.2: Phase 2				
Phase name	**2. Feasibility assessment**			
Purpose of project phase	1	Clarify the need for the project. (revenue / corporate responsibility / etc)		
	2	Do an initial estimate of the emission reductions		
	3	Asses what is necessary in monitoring the inputs to calculate emission reductions		
	4	Do initial assessment of project risk (financial, technical and regulatory)		
	5	Obtain initial approval from local DNA		
Gate 2 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Is there a need for this project?	Kill	Go
	2	Does the initial emission reduction warrant a CDM project?	Kill	Go
	3	Is the project risk level acceptable?	Kill	Go
	4	Are all inputs required measurable / obtainable?	Kill	Go
Comments	1	Various strategic reasons can exist for proposed emission reduction projects. Clarifying the need of these projects will help in obtaining backing from management.		
	2	If the estimated emission reduction achievable is too small then no CDM project exists. The project proponents should decide what they consider to be the lower cut off value regarding emission reductions achieved.		
	3	Projects should be stopped as soon as project risk reaches unacceptable levels.		
	4	It is foreseeable that insufficient data are available to accurately establish emission reductions. If the emissions reductions are not measurable then the project should be stopped.		
Ranking criteria	**No**	**Criteria**		**Score**
	1	Are there any perceived or real objections from the local DNA?		
	2	How attractive is the amount of CERs earned?		
Comment	1	In the development of this model it is proposed to get initial host country approval for a project at the earliest possible stage. This will help in managing project risk from the start although host country approval is according to CDM guidelines not strictly necessary at such an early stage.		
	2	The amount of carbon credit revenue earned is a direct function of the amount of CERs obtainable. All else being equal projects producing more CERs should take preference.		

Table F.3: Phase 3				
Phase name	**3. Initial design**			
Purpose of project phase	1	Do initial design for early estimates of regulatory / financial / technical requirements and iterate to determine initial best fit		
	2	Build and evaluate initial financial model		
Gate 3 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Is the project technically viable?	Kill	Go
	2	Is the project regulatory viable?	Kill	Go
	3	Does the project make financial sense?	Kill	Go
Comments	1	CDM projects necessitate real and measurable emission reductions. This entails the use of sound technical equipment. No project exists without technical viability.		
	2	CDM projects should conform to all regional, provincial/state and national regulatory requirements. Above this the proposed CDM project should also conform to CDM EB regulatory requirements. The project should be stopped if it does not conform to all regulatory requirements.		
	3	A financial model must be developed. Only financially viable projects should be investigated further.		
Ranking criteria	**No**	**Criteria**		**Score**
	1	How easy are the technical aspects?		
	2	Is the regulatory environment in place?		
	3	Is the required capital relatively low?		
Comments	1	Technically difficult projects should receive a lower score.		
	2	Projects that have all regulatory requirements in place are more desirable and must receive a higher score.		
	3	Low capital projects should be pursued more vigorously and thus receives a higher score.		

Table F.4: Phase 4				
Phase name	**4. Detailed design**			
Purpose of project phase	1	Do a detailed design for the financial / technical and non-CDM specific regulatory requirements and iterate to determine optimal case		
	2	Identify/develop the required CDM methodology		
	3	Develop the PDD		
	4	Develop all documentation required by the DNA		
Gate 4 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Does the detailed optimal design prove a bankable project?	Kill	Go
	2	Does the appropriate CDM methodology exist or can it be developed?	Kill	Go
	3	Is the CDM PDD developed and completed?	Kill	Go
	4	Is all the documentation required by the DNA developed?	Kill	Go
Comment	1	The project should be stopped if the detailed design does not provide a bankable study. All potential risks and questions that investors / financial instructions could raise must be addressed in the detailed design.		
	2	Without a CDM methodology no CDM project will be registered. If no methodology exists that is applicable to the envisaged project then a new methodology has to be developed. If no current or developed methodology is approved then the project should be stopped.		
	3	A PDD must be developed to illustrate the application of the CDM methodology to the specific proposed project.		
	4	To achieve host country approval various submissions must be prepared and submitted to the DNA and possibly other governmental departments. This phase is not completed before the required documentation is completed.		
Ranking criteria	**No**	**Criteria**		**Score**
	1	How easy are the technical aspects?		
	2	Is the regulatory environment in place?		
	3	Is the required capital relatively low?		
	4	Is there an existing appropriate CDM methodology?		
	5	Can the PDD be completed with relative ease?		
Comments	1	The importance of ranking criteria 1 – 3 was answered in the comments of the discussion of phase 3 above.		
	2	Projects that have existing applicable CDM methodology should receive a higher score since CDM methodology development can be expensive and time consuming.		
	3	Completing the PDD can be problematic even with an existing CDM methodology. Projects for which PDD development is foreseen as problematic should have a lower score.		

Table F.5: Phase 5				
Phase names	**External phases: 5. Approval, 6.Validation, 7.Registration**			
Purpose of project phase	1	To achieve project approval		
	2	To achieve project validation		
	3	To achieve project registration		
Gate 5 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Are all the necessary written approvals in place from the host party? (From DNA and other parties.)	Kill	Go
	2	Was the project validated by the selected DOE?	Kill	Go
	3	Was the project registered by the CDM EB?	Kill	Go
Comment	1	Host country approval is obligatory to achieve project registration. Without host country approval the project can not progress.		
	2	The DOE validation is required before the project will be registered. Without DOE validation the project can not progress.		
	3	CDM EB registration has to be obtained to complete the CDM registration process.		
Ranking criteria	**No**	**Criteria**		**Score**
		NA		
Comment		No ranking criteria exist. All objectives of these phases are mandatory.		

Table F.6: Phase 8				
Phase name	**8. Build and Commissioning**			
Purpose of project phase	1	To build and commission all equipment associated with the project activity		
Gate 6 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Are equipment build, commissioned and operating properly?	Kill	Go
Comment	**1**	The project activity can only start if all equipment associated with the project is functioning properly. This phase can be subdivided into the classical project management phases of non-CDM type projects.		
Ranking criteria	**No**	**Criteria**		**Score**
	1	Can the building and commissioning phase be completed quicker with acceptable increases in cost?		
Comment	1	In many projects the duration of certain phases can be reduced by incurring extra costs. The time saving actions of this phase must be ranked taking cost into account. Where ever cost effective the time decreasing options must be implemented.		

Table F.7: Phase 9				
Phase name	**9. Monitoring**			
Purpose of project phase	1	To monitor all inputs required as prescribed in the registered PDD		
Gate 7 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Are all inputs measured in accordance to the PDD and all applicable tools?	**Kill**	**Go**
Comment	1	The accurate measurement of all inputs required for monitoring the achieved emission reductions are discussed in detail in the registered PDD. It is essential to conform to the PDD instructions on measuring to ensure the issuance of CERs.		
Ranking criteria	**No**	**Criteria**		**Score**
Comment	1	Identify and rank all steps that can be taken to increase the accuracy of the monitored data while still complying with the PDD.		

Table F.8: Phase 10 and 11				
Phase name	**External phases: 10. Verification and certification, 11. Issuance of CERs**			
Purpose of project phase	1	Obtaining verification and certification of CERs from DOE		
	2	Obtain issued CERs from UNFCCC EB		
Gate 8 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Did the DOE verify and certify the CERs?	Kill	Go
	2	Did the UNFCCC EB issue the CERs?	Kill	Go
Comment	1	It is a necessity to obtain DOE verification and certification before CERs can be issued.		
	2	The UNFCCC EB is the party that will issue the obtained CERs after completion of the previously described project phases.		
Ranking criteria	**No**	**Criteria**		**Score**
	NA	NA		
Comment	1	The above mentioned objectives of the phases are mandatory for successful project completion. No ranking is applicable.		

Table F.9: Phase 12				
Phase name	**12. Distribution of CERs**			
Purpose of project phase	1	To distribute the CERs to the relevant parties		
Gate 9 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Was the CERs distributed to the relevant parties as contractually agreed upon?	**Kill**	**Go**
Comment	1	Formalized contractual agreements will provide guidance regarding the distribution of the issued CERs. Legal intervention must be sourced if the parties involved in the project are not satisfied with the issuance of the CERs. Project termination should be the last option.		
Ranking criteria	**No**	**Criteria**		**Score**
	NA	NA		
Comment	1	No ranking criteria exist in this phase.		

Table F.10: Phase 13				
Phase name	**13. Annual post mortem**			
Purpose of project phase	1	To investigate and correct any shortcomings that exist in the project activity		
Gate 10 criteria	**No**	**Criteria**	**No**	**Yes**
Kill/Go criteria	1	Can all problems be overcome?	Kill	Go
Comment	1	CDM project termination will be investigated if problems of the post mortem keep the project from producing CERs annually.		
Ranking criteria	**No**	**Criteria**		**Score**
	1	Identify and rank changes that can be made to increase the amount of CERs issued in the following year		
Comment	1	It will be attempted to solve the post mortem identified problems. By doing so it is envisaged that the amount of CERs earned will be increased.		

Appendix G: Input received from Designated National Authority (DNA)

Input from DNA

Interview date:	24 January 2009
Interviewer:	Marco Lotz
Interviewee 1:	Ndiafhi Patrick Tuwani
Title:	Deputy Director: Designated National Authority
Interviewee 2:	Olga Lindiwi Chauke
Title:	Deputy Director: Designated National Authority

Focus of discussion:

- Understanding the sustainable development (SD) criteria used in evaluating CDM projects;
- Discussion of SD criteria and application on the case studies, and;
- DNA's issues and sideline notes

Understanding the sustainable development (SD) criteria used in evaluating CDM projects

The DNA indicated that the National Environmental Management Act (NEMA) is the over arching legislative framework that regulates all environmental affairs. This said the DNA is an autonomous unit embedded in the South African Department of Mineral and Energy. The sole purpose of the DNA is to facilitate the development of CDM projects in South Africa. The evaluation of the SA CDM SD criteria is a fundamental function that the DNA performs to ascertain whether the proposed project activity will obtain host country approval or not.

The three aspects of the SD criteria were discussed. These aspects are:

- Environmental;
- Economic, and;
- Social

It also quickly became apparent that these aspects cannot always be viewed in isolation. As an example the employment of a person as a result of a CDM project has positive economic and social implications.

The DNA relies on the input from project developers to evaluate the SD criteria of a project. This input is provided by the project developers in the Project Idea Note (PIN) and the PDD. The execution and monitoring of the actions of the project developers in implementing the stated SD improvements/advances are extremely difficult. The DNA does not have a mandate to ascertain or enforce the SD advances proposed by a project developer once the project has obtained host country approval.

On Project Management:

The DNA does not involve them with the management approach followed by project developers. For this reason no input was obtainable from the DNA regarding existing management approaches followed in industry or inputs on the proposed project management model. The DNA does however provide fundamental input for the understanding of the case studies of this research.

Side notes:

- The project developers/country needs assistance from government and other (UNFCCC) for developing new methodologies;
- UNFCCC CDM timeline too long. (This is Meth Panel, Secretariat, etc.);
- Lack of DOEs leads to:
  - Long waiting time for visits and work to be finished;

  - Very expensive to get overseas DOEs for developing countries to pay in US$ or Euro
- SA government should assist project developers financially and then government gets cut of credits to reinvest in new project development;
- This is what India do. They do not assess social component of proposed project, but rather take cut of CERs obtained for social upliftment;
- EIA takes long and recent changes in CDM process leads to confusion;
- DNA can advice on % financial contribution to a specific cause, but cannot enforce it. They can also not withhold host country approval on the basis of not following DNA's advise on % financial contribution;
- DNA will from 2009 have annual questionnaire to registered projects to determine whether the originally claimed SD benefits were achieved;

Appendix H: Summary of Case study 1 (Animal waste management)

According to the PDD (ref) Kanhym is the biggest pig farm in South Africa It houses approximately 45,000 pigs at any given time. The swine are confined to enclosed feeding lots. These feeding lots are equipped with a sewer system that drains into a large, three-staged anaerobic lagoon. The swine manure is collected from the enclosed feeding lots' concrete floors into the main sewer channel which terminates in an anaerobic lagoon. The unlined and uncovered lagoon produces a mixture of greenhouse gasses, which include CH_4, N_2O and CO_2. Currently these gasses are vented to atmosphere.

The project activity entails building a new lined lagoon with an expandable membrane roof. By doing this the greenhouse gases can be captured and controlled. The digester residue will be used as fertilizer.

The project will be executed in a phased approach as follows:

- Phase 1: Combustion of methane rich gas using a flare and/or using the generated heat in a boiler system. The boiler will produce steam which will be used to maintain the temperature in the new digester;
- Phase 2: Internal combustion engines will be installed to generate electricity from the biogas if the amount of gas produced warrants the capital investment. The project developer estimated that it could be feasible to install 1MW_e generating capacity in the future. The electricity produced will be used by the farm or the surrounding communities and the waste heat from the internal combustion engine will heat the digester

The project developer states the following sustainable development[32] benefits:

- Phase 1:
  - Temporary creation of employment during the construction phase;
  - Limited permanent employment for operation purposes;
  - Training for the employed people;
  - Purchasing of South African based technology suppliers will benefit the local economy;
  - The revenue received for the CERs generated is viewed by the project developer as foreign investment;
  - The project owner presented black economic empowerment (BEE) credentials. The aim of the BEE aspect is to historical inequalities;
  - The project owner will use some of the CDM revenue for training people from the surrounding communities in information technology related fields;
  - The project developer argues that the health situation at Kanhym farm will be improved by the project by replacing the present anaerobic lagoon with a covered anaerobic lagoon;
  - The smell of the rotting manure will be improved, and;
  - The possibility of groundwater pollution by the present waste stream will be greatly reduced;
  - Installing electricity generation capacity running on renewable energy sources will contribute to the national economic development, and;
  - Will leads to energy diversification

An interview with the DNA affirmed that the DNA agreed that the proposed project would better the living conditions of the local communities from a health perspective and in reducing the smell of the surroundings.

[32] A discussion of the South African DNA's view on the CDM SD will be included in the appendixes

The DNA commented on the fact that if possible the methane would not be only flared, but also used to generate electricity. This demonstrated that the project developer wanted to use the methane to the best possible application. Generating electricity from the renewable biogas manure source was seen as the best possible scenario. The DNA granted this project host country approval.

Appendix I: Summary of Case study 2 (Energy efficiency)

Transalloys is a division of Highveld Steel and Vanadium Corporation Ltd. Transalloys is a manganese alloy smelter in the Witbank area of South Africa. The aim of this project is to reduce the amount of electricity required in the production of silicomanganese (SiMn).

The planned energy efficiency project will decrease the amount of electricity by 10-20% per ton of alloy produced. This energy saving will translate in ±0.5MWh/ton alloy product.

The project developer states the following sustainable development benefits:

- Reduces demand side electricity requirements;
- Acts as a demonstration project for cleaner production;
- Reduces the particulate matter pollution in the local environment;
- Leads to increased job security for the workers of the plant;
- Help in mitigating currency risk associated with a commodity industry like manganese alloys

The DNA commented on the SD criteria by stating that this project will do more than generate foreign revenue from CDM. It will also generate electricity that:

- Decrease coal combustion which leads to less indirect pollution;
- Generate income over and above CDM revenue

The DNA granted the Transalloys project host country approval

Appendix J: Summary of Case study 3 (Mine methane capture)

According to the PDD (ref) the Star Diamond Mine is located in an area rich in underground methane. It is believed that the methane originates from coal deposits that occur in the mined area. Methane gas is known to be transported in a series of geological faults that cut through the mining areas. Methane is a colourless and odourless explosive gas which has caused fatalities in other mines in the region in the past. Underground are point sources where the methane is emitted into the mining working areas. In 2002 a methane explosion in the Star Diamonds mine resulted in the death of two miners.

The company tried to prevent future explosions by:

- Sealing off mining areas which had methane present. This was unsuccessful as the pressure behind the sealed off areas resulted in methane leakages into the mining areas;
- Piping the methane to surface. The methane was then simply vented to atmosphere.

It was proposed that the sole purpose of this project activity is to destroy mine methane that is currently venting to atmosphere. The project developer stated that the amount of mine methane captured and piped to atmosphere was not sufficient to warrant the capital of electricity generation equipment.

Embedded unit of analysis: Beatrix

The Beatrix project is analogous to the Star Diamonds project in that the project aims to reduce mine methane emissions. (Beatrix is a gold mine in the Free State province of South Africa.) Just like in the Star Diamonds project methane will be piped to surface. This project differs from the Star Diamond project in that the project developer argues that the captured methane can be used since sufficient mine methane can be captured and controlled. Currently all mine methane is released to atmosphere as ventilation air methane.

The captured mine methane will be used to:

- Generate steam in a boiler system;
- Generate electricity using internal combustion engines;
- Generate chilling in absorption chillers, and;
- Only excess mine methane will be flared

The project developer states the following sustainable development benefits:

- The project will donate R0.20 per ton of CO_2e and 0.5% of pretax profit to the Goldfields Foundation. (The Gold Fields Foundation is the vehicle by which social responsibility investment is done by Gold Fields.);
- On a global scale, like all CDM projects, green house gas emissions will be reduced;
- Local air quality will be improved as less SO_x containing coal has to be combusted for electricity generation and steam production;
- The revenue from CERs will help to alleviate the strong financial dependence of the mine on the gold price. This will aid in securing the jobs of the miners, and;
- The technology used in the project activity will lead to a transfer of skills to the local mine employees

Summary of the DNA's view on the SD evaluation:

The findings of the DNA interview regarding the Star Diamonds and Beatrix project is summarized in Table:

Table Appendix J.1: Summary of DNA's evaluation of the sustainable development criteria

Regarding the Star Diamonds project:	Regarding the Beatrix project:
The Star Diamonds project only involves the flaring of non-renewable mine methane.	The Beatrix project involves the combustion of mine methane and the application of the liberated energy. (Electricity and chilling will be produce)
The fact that such a project will generate foreign revenue does not qualify as a sufficient economical contribution to SD since all CDM project generate foreign revenue.	Not only is foreign income generated, but also electricity and chilling which have monetary value.
No additional permanent employment would be generated by the project. The temporary employment during the construction process was also considered negligible.	During construction temporary employment will be generated. In addition it is foreseen that some permanent operators will be employed for the electricity generation and chilling activities.
Very little or no skill transfer will be achieved by this project.	Specialized equipment will be installed which will lead to skill transfer.
All CDM projects achieve reduced greenhouse gas emission reduction.	Methane combustion will lower green house gas emissions, but the electricity generated will offset the combustion of coal in power stations.
Conclusion: The DNA did not grant host country approval	Conclusion: The DNA granted host country approval