

A MANAGEMENT MODEL FOR THE SUCCESSFUL IMPLEMENTATION OF AN INTEGRATED REFINERY INFORMATION SYSTEM

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ABSTRACT

Information management plays an increasingly important role in businesses today. This role is to support the business objectives through optimised work processes and improved information availability to support faster decision-making.

Information systems were initially developed as isolated applications focussed on a specific function or business process. New business needs however requires a more integrated approach. Integrating information systems can be a costly process requiring large amounts of capital.

The process of information systems development and implementation has been studied by various researchers. Many companies however do not apply these research results and the development and implementation of information systems are often late and exceed the budgets allocated to these projects.

The purpose of this dissertation is to investigate the process of information systems development and implementation, and to recommend a practical process for information systems development and implementation for relatively small organisations.

A theoretical overview is presented of the strategic processes involved in information systems development. General project management and various theoretical models for information systems development are presented.

The application of the principles from the theoretical overview are tested by means of a case study on an integrated refinery information system (IRIS) that was recently implemented at the Natref refinery in Sasolburg. This is done by means of an empirical study that focuses on the project execution and change management aspects during the development and implementation of the IRIS project. A questionnaire was developed for each of these focus areas. The response rate for the project execution questionnaire was 87.5% and the response rate for the change management questionnaire was 84.6%.

The main conclusions from the dissertation (based on the literature study and the empirical study) are as follows:

- A high level of strategic importance was given to information systems at Natref during 1997;
- Information systems planning was done well in the beginning of the IRIS project;
- There was a general lack of management support during the execution of the IRIS project;
- The organisational design was not changed to support the implementation of the IRIS project or its associated changes in business processes;
- End user participation was not sufficient, leading to possible end user resistance during the implementation of the IRIS project;
- Sufficient effort went into the evaluation of hardware needed for the implementation of the IRIS project;
- Software selected during the development and implementation of the IRIS project was well considered; and
- Information systems services were considered fairly well during the IRIS project.

Recommendations were made based on the conclusions. The main recommendation is an information systems development and implementation model that can be used in practise by relatively small businesses. Proposals were also made regarding the facilitation of the strategic management of information systems and the change management process. Large businesses could also benefit from some of the recommendations.

SAMEVATTING

Inligtingsbestuur speel al hoe meer 'n belangrike rol in hedendaagse besighede. Hierdie rol behels die ondersteuning van besigheids-oogmerke deur die optimisering van werksprosesse en verhoogde beskikbaarheid van inligting ter ondersteuning van vinniger besluitneming.

Aanvanklik is inligtingstelsels as onafhanklike stelsels ontwikkel en dit het gefokus op 'n spesifieke funksie of besigheidsproses. Nuwerwetse besighede benodig egter stelsels wat geïntegreerd funksioneer. Integrasie van stelsels is egter 'n duur proses wat groot hoeveelhede kapitaal vereis.

Die doel van hierdie skripsie is om die ontwikkeling en implementering van inligtingstelsels te ondersoek, en om 'n prakties uitvoerbare proses te ontwikkel vir die ontwikkeling en implementering van inligtingstelsels in relatief klein organisasies.

Die proses vir die ontwikkeling en implementering van inligtingstelsels is deur menige navorsers ondersoek. Baie maatskappye pas egter nie hierdie navorsing in die ontwikkeling en implementering van inligtingstelsels toe nie. Die gevolg is dat projekte gereeld oor skedule en begroting eindig.

'n Teoretiese oorsig van die strategiese proses wat benodig word vir die ontwikkeling van inligtingstelsels is weergegee. Algemene projek bestuur en verskeie teoretiese modelle vir die ontwikkeling van inligtingstelsels word voorgehou.

Die toepassing van die beginsels vanuit die teoretiese oorsig word getoets aan die hand van 'n gevalle studie oor 'n geïntegreerde raffinadery inligtingstelsel (IRIS) wat onlangs by die Natref raffinadery in Sasolburg geïmplementeer is. Dit is gedoen deur 'n empiriese ondersoek te doen wat gefokus het op die projek uitvoering en die veranderingsbestuurs aspekte soos dit toegepas is gedurende die ontwikkeling en implementering van die IRIS projek. Daar is 'n vraelys ontwikkel vir elkeen van die aspekte. Die terugvoering wat op die onderskeie vraelyste terug ontvang is, is 87.5% en 84.6% onderskeidelik.

Die primêre gevolgtrekkings wat gemaak kan word uit die skripsie is die volgende (gebaseer op die literatuur studie en die empiriese ondersoek):

- 'n Hoë vlak van strategiese belang is gedurende 1997 aan inligtingstelsels gekoppel by Natref;
- Die beplanning van inligtingstelsels is deeglik gedoen aan die begin van die IRIS projek;
- Daar was 'n algemene gebrek aan bestuursondersteuning tydens die uitvoering van die IRIS projek;
- Die organisasie was nie herontwikkel ter ondersteuning van die uitvoering van die IRIS projek, of die verandering wat dit in die besigheidsprosesse meegebring het nie;
- Die betrokkenheid van eind-gebruikers was nie voldoende nie en gevolglik het dit moontlik gelei tot eind-gebruiker weerstand tydens die implementering van die IRIS projek;
- Die poging wat ingegaan het in die evaluering van hardeware was voldoende;
- Die sagteware wat vir gebruik in die ontwikkeling en implementering van die IRIS projek is deeglik oorweeg; en
- Die inligtingstelsel dienste was redelik goed oorweeg tydens die uitvoering van die IRIS projek.

Die aanbevelings wat gemaak is, is gebasseer op die gevolgtrekkings. Die hoof aanbeveling is 'n inligtingstelsel ontwikkelings- en implementerings model wat gebruik kan word deur relatiewe klein besighede. Daar is ook voorstelle gemaak vir die fasilitering van die strategiese bestuur van inligtingstelsels asook vir die veranderingsbestuur proses. Groter besighede kan ook baat vind by hierdie aanbevelings.

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Chapter 1: Nature and scope of the study

1.1 Introduction

Business increasingly relies on more powerful computer systems and as software becomes embedded in more industrial and consumer products, the need to effectively manage larger and more critical software development projects becomes more intensive. The information systems environment has numerous examples of costly and conspicuous failures of software development projects (Guinan *et al.*, 1998:101).

Information systems play an increasingly important role in the success of businesses throughout the world. The benefits that can be derived from the effective utilisation of information technologies include cost reduction, performance improvement, quality enhancement, and the creation of new products and services (Behling & Behling, 1996:3). It is therefore important to ensure that information systems are designed and implemented to support business processes.

In most companies, information is not available from a single source of information, but is distributed over various areas like production-, financial-, commercial-, and many other systems. It is however desirable to have information available from an integrated system that makes information readily accessible.

The development and implementation of integrated information systems require significant capital investments and therefore need to be done in a structured and well-planned manner. The success of the development and implementation of information systems determines largely the benefit that

will be gained by the use (or lost by resistance to use) of the information systems.

1.2 Problem statement

The development and implementation of information systems are plagued by late project completion, and overspending on budgets. Resistance of users, complexity of systems, and unreliability of systems can further nullify the investment made in information systems.

Factors that can lead to inefficient information systems include:

- The strategic perspective placed on information systems;
- Top management commitment and support to information systems;
- Project management during the development and implementation of information systems;
- The extent of end user participation in the development and implementation process of information systems;
- The methodology used in the implementation of information systems; and
- The quality and extent of the change management process during the implementation of information systems.

This study is specifically focussed on investigating the application of these factors in the Natref environment. The results from this dissertation will enable small businesses in the development of suitable strategies for the development, implementation and maintenance of integrated information systems.

1.3 Objectives of this study

The main objective of this study is to develop a methodology for the development and implementation of information systems in organisations that do not have the critical mass to support a full scale information management department.

The primary objective will be realised by meeting the following secondary objectives:

- To research the facilitation of strategic information management in small businesses; and
- To research the facilitation of the change management for the development and implementation of information systems.

1.4 Scope of the study

The study will mainly focus on the recently implemented integrated refinery information system (IRIS) at the Natref refinery in Sasolburg. Natref is the only inland refinery in South Africa and is situated approximately 600 km inland from its nearest port, namely Durban.

Natref is owned by two partners namely Sasol and Total SA. A more detailed description of Natref and the IRIS project can be found in Chapter 3.

1.5 Methodology

The methodology followed in this study consists of two parts namely an extensive literature study and an empirical study.

1.5.1 Literature Study

In order to establish a sound theoretical background to the problem as formulated above, an in depth analysis, evaluation and integration of the different aspects relating to the development and implementation of information systems will be conducted by paying attention to:

- The strategic process for information systems;
- General project execution methodology;
- The planning of information systems;
- The change management process for the development and implementation of information systems; and
- Methodologies for the development and implementation of information systems.

The aim of the literature study is thus to gain theoretical knowledge of project management, development and implementation of information systems, including the strategic perspective of information systems. The literature will further be used to identify ideal practices during information systems development and implementation. The knowledge gained from the literature study will be used to develop questionnaires for the empirical investigation.

As far as possible only recent literature in the field of information systems development will be used. The literature will consist of relevant textbooks, technical journals, magazine articles, publications on the internet, and IRIS project documentation.

1.5.2 Empirical study

The empirical field investigation will mainly focus on:

- Project execution in an information systems environment; and
- Change management in an information system environment.

To establish the above mentioned aspects, the empirical study will be aimed at managers directly involved in the development of the IRIS project, and end users of the information systems developed during the IRIS project. Questionnaires will be used to determine the shortcomings between the actual process followed during the execution of the IRIS project, and the ideal process, as identified during the literature study with regard to the development and implementation of information systems.

The information gathered during the literature study will be used for the development of the questionnaires. The questionnaires will consist mainly of attitude-determining questions based on a five point Likert scale.

The questionnaires will be distributed through e-mail and personal contact. The return of the questionnaires will be followed up using e-mail, telephone calls, and personal contact to ensure a high return rate. All questionnaires will be treated confidentially to ensure that facts will not be distorted.

The results will be statistically analysed using an appropriate statistical methodology. The analysed results will be used to draw conclusions and recommendations will be made regarding the development and implementation of information systems.

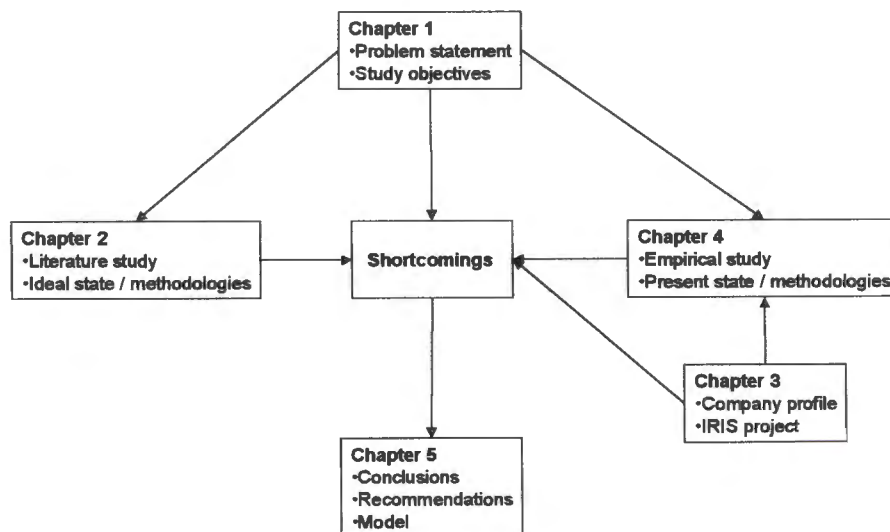
1.6 Limitations

The focus of this study is limited to relatively small businesses that do not have the critical amount of employees to support an information management division. This study is in particular applicable to the Natref refinery where the study was done. Bigger organisations may however also find benefit in some of the recommendations.

1.7 Layout

The dissertation will consist of five chapters. The relationships between the chapters are shown in figure 1.1.

Figure 1.1: Schematic layout of the study



Chapter 1 provides an overview of the study. The chapter includes the problem definition, the study objectives, the scope of the study, and the methodology to be followed in the study.

Chapter 2 entails the literature study. The literature study portrays the ideal state or methodologies for information systems development and implementation. Topics that are discussed include strategy in information management, project management and information systems development methodologies.

Chapter 3 presents an overview of Natref and present insight into the IRIS project.

Chapter 4 discusses the results from the empirical study. In this chapter the statistical analysis of the results are presented and interpreted.

Chapter 5 presents the conclusions from the study. Recommendations are made to address the shortcomings identified in the previous chapters. A model is presented for the development and implementation of information systems in relatively small organisations.

Chapter 2: Project execution and management process

2.1 Introduction

As managers experience more volatile marketplaces, global competition, shortened product life cycles, customer pressures for tailored offerings and tighter performance standards, they increasingly depend on new information systems (Feeny & Willcocks, 1998:9). The information systems (IS) components in business solutions must be constructed rapidly and effectively despite the massive changes in information technology (IT) product capability, a restructured supply industry, potential shifts in system development approaches, and new ambiguities in terms of what should be regarded as a business-side or technical specialist task (Feeny & Willcocks, 1998:9).

A critical task in utilising the opportunities in Information Systems and Information Technology is project management. O'Brien (1999:G-15) defines project management as managing the accomplishment of an information system development project according to a specific project plan, in order that a project is completed in time, within its budget, and meets the design objectives. Projects are becoming more difficult to plan and manage, with demanding customers, tight budgets and schedules, complex technology, and project teams that work concurrently in different locations (Christensen *et al.*, 1999:34). As software development projects continue to be over budget and behind schedule, researchers continue to

look for ways to improve the likelihood of project success (Guinan *et al.*, 1998:101).

It is exactly these strategic issues impacting on the successful completion of integrated information system (IS) projects that this chapter will investigate.

2.2 Management process

2.2.1 Strategic management

Different views exist on exactly what strategic management means. Robson (1994:3) argues that strategic management is not an exact science and that no organisation can apply strict rules. Rather, strategic management is about the correct reading of signs and portents of the future and placing the correct interpretation upon them in order to choose an appropriate direction for the future development of the organisation (Robson, 1994:3).

Thompson and Strickland (1998:3) identified the following five strategic management tasks:

- Forming a strategic vision of what the company's business makeup will be and where the organisation is headed – so as to provide long-term direction, delineate what kind of enterprise the company is trying to become, and infuse the organisation with a sense of purposeful action;
- Setting objectives – converting the strategic vision into specific performance outcomes for the company to achieve;
- Crafting a strategy to achieve the desired outcomes;
- Implementing and executing the chosen strategy efficiently and effectively; and

- Evaluating performance and initiating corrective adjustments in vision, long-term direction, objectives, strategy, or implementation in the light of actual experience, changing conditions, new ideas, and new opportunities.

Strategic management is important to ensure that projects undertaken are aligned to the corporate strategy that the company chooses. The undertaking of projects can be viewed as a tactical means of implementing strategy to reach the desired objectives of the company.

2.3 General project management

2.3.1 Project definition

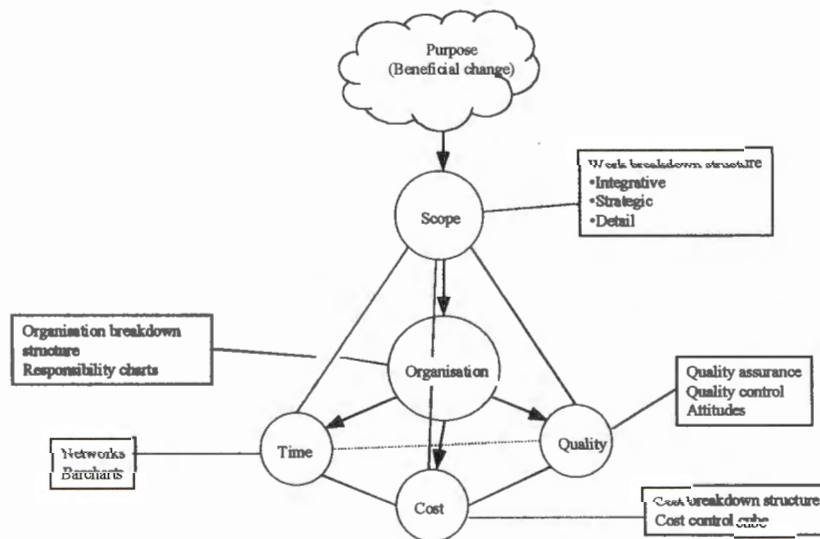
Oosthuizen *et al* (1998:33) defines a project as any undertaking with a defined starting point and objectives by which completion is signified, characterised by limited resources by which objectives are achieved. Or alternatively, a project is a set of well-defined activities in a logical order, the purpose of which is to produce predetermined results (deliverable product(s) or service(s)) for a stipulated amount of money, within a rigorously managed time frame, maximising the satisfaction of all stakeholders.

Chase *et al* (1998:48) defines a project as a series of related jobs usually directed toward some major output and requiring a significant period of time to perform.

Turner (1993:7) defines a project as an endeavour in which human, material and financial resources are organised in a novel way, to undertake a unique scope of work, of given specification, within

constraints of cost and time, so as to achieve beneficial change defined by qualitative and quantitative objectives (see figure 2.1).

Figure 2.1: A structured approach of project management



(Adapted from Turner, 1993:15)

From Figure 2.1 it is evident that five objectives need to be managed namely scope, organisation, quality, cost and time. It is also clear that each objective can influence the other objectives. The result is that there is a sixth element, inherent in project management, namely risk that needs to be managed. These six elements are also present in information systems and need to be managed to ensure successful implementation of integrated information systems.

2.3.2 Definition of project management

Before a more in depth outline of project management is given, it must first be understood exactly what project management means.

Project management theory covers planning, control, scheduling, estimation, project manager roles and many more topics (Gardner, 1997). According to Chase *et al.* (1998:48), project management can be defined as planning, directing, and controlling resources (people, equipment, material) to meet technical, cost, and time constraints of the project.

Burke (1999:3) defines project management as the application of knowledge, skills, tools and techniques to project activities in order to meet the stakeholder's needs and expectations from the project. In other words the project manager must do whatever is required to make the project happen.

Project management can therefore be viewed as the management of the six project objectives identified in paragraph 2.3.1 (scope, organisation, quality, costs, time and risks) through the application of knowledge, skills, tools and techniques to meet stakeholder's expectations.

2.3.3 Project manager responsibilities

In any project, the project manager is responsible to ensure that the project is completed successfully. Because of this responsibility, the project manager has to plan the project in detail.

The detail included in the project should identify:

- The activities to be undertaken;
- Resources needed;
- Timescales;
- Interdependencies (both within and between projects);
- Budgets;
- Critical success factors for the project; and
- Risks (Peppard, 1993:263-264).

The project manager has to develop certain qualities and skills to be able plan and execute a project. These qualities and skills are explained in the next paragraph.

2.3.4 Project manager qualities and skills

A competent IS manager is regarded as the most critical factor for project success (Jiang *et al.*,1998:39). Jiang *et al.* (1998:44) found in their research that the three highest-ranking behavioural skills needed by project managers are interviewing, directing, and managing. They also found that the lowest-ranking behavioural skills are selling, assertiveness, and non-verbal communication.

Bloom (1996:6) views the following qualities and skills as essential for IS project managers:

- Substantial, even expert, knowledge of the project's business objectives. Project managers should be conversant with the business processes and functions, and the information model the project addresses;
- Authority and willingness to commit required project resources. The project manager must be perceived at all times as acting with authority

and with a willingness to accept responsibility for decisions as to the deployment of project resources;

- Ability to advise users about the system's impact. The project manager must also be the chief spokesperson for the project with respect to how it will affect users (internal and external);
- Adequate technical competence to manage the IS project. The IS project manager must understand technical issues and how to arbitrate among alternative technical solutions. In addition, he or she must comprehend the business implications of various technologies, how to use these to the corporation's advantage and how to be unintimidated by technical staff or issues;
- Excellent political and people management skills. Closely related to advising users on project impact and deploying the project's people resources is the ability to interact effectively with and guide the project team, steering committee(s), prospective users (including external users) and others who may be interested;
- Proven ability to move the project forward in the face of obstacles. The effective project manager must be able to recognise real problems and ensure that the project's daily activities aren't disrupted unduly while these are addressed;
- Maturity to accept full project responsibility. The project manager should have the authority to make necessary decisions. Therefore, the effective project manager accepts responsibility for whatever goes wrong and shares credit for every success; and
- Stamina and a sense of humour.

Bloorn (1996:9) believes that selecting the best possible manager at the beginning of the project and establishing management commitment will get the project off to a good start. Bloom (1996:9) also realises that careful attention must be paid throughout the project to sustaining this commitment and to effectively supervising even the best project manager.

From the information above, it is clear that the project manager is an essential role player in the success of a project. It can be argued at this stage that the success of a project depends largely on the project manager's qualities and skills, and his or her abilities to use these qualities and skills during project execution. It is also evident that these qualities and skills do not relate only to technical issues, but also include strong people skills.

2.3.5 Project success

Before a project can be viewed as successful, it needs to be defined what project success means. It seems that most researchers are in agreement with the views of Pitagorsky given below.

Pitagorsky (1998:7) has the view that a successful project satisfies its clients and sponsors with an outcome that achieves objectives within time and cost constraints. It produces a quality product, end when appropriate (i.e., avoids wasting time and money), maintains and promotes harmonious relationships among project stakeholders (including performers and their management), and contributes lessons learned to the organisation.

Project success is measured in terms of:

- Project performance effectiveness (e.g., meeting time and budget constraints);
- Product quality and effectiveness (e.g., whether the project outcome actually helps to achieve the business objectives it was initiated to achieve); and

- The degree to which the project prepares the performing organisation for the future (Pitagorsky, 1998:7).

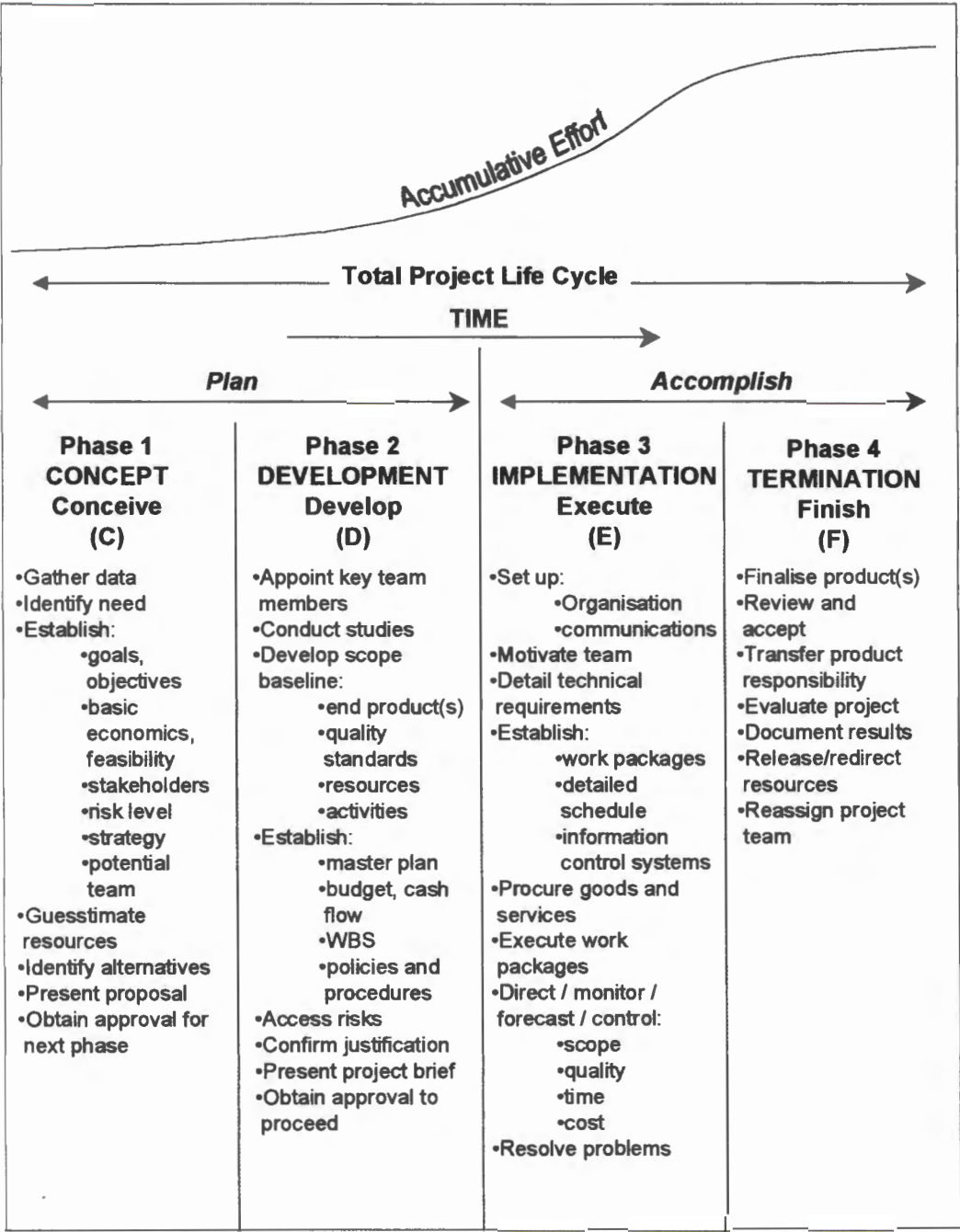
From the information above, it is evident that project success is not a once off measurement at the end of the project, but rather a process that needs to be successful, and that delivers a product that can be effectively used in the future of the organisation.

2.3.6 Project life-cycle

Before a project can be evaluated, it is important to understand the basic building blocks of projects. The discussion below is generic in nature and most projects should contain some or all of the elements described for each phase.

There is general agreement that most projects pass through a four-phase life cycle under the following headings as depicted in figure 2.2.

Figure 2.2: Generic project life-cycle



(Source: Burke, 1999:28)

From figure 2.2 it can be conducted that the four phases entails the following aspects:

- **Concept and initiation phase:** the first phase starts the project by establishing a need or opportunity for the project, facility or service. The feasibility of proceeding with projects is investigated and on acceptance moves to the next phase;
- **Design and development phase:** the second phase uses the guidelines set by the feasibility study to design the product and develop detailed schedules and plans for making or implementing the product;
- **Implementation or construction phase:** the third phase implements the project as per the baseline plan development in the previous phase;
- **Commissioning and handover phase:** the fourth phase confirms the project has been implemented or built to the design and terminates the project (Burke, 1999:24).

IS projects should contain similar phases than this generic project life cycle. It is however expected that some of the elements will differ. This generic model should therefore be taken in consideration in attempting to develop a project execution model for integrated information systems. The basic project execution models used in information systems projects will be described in paragraph 2.4.9.

2.3.7 Project cost management

Project cost management is the term which has commonly come to be used to encompass all aspects of project costs – estimating, estimate revision, cost control and cost monitoring (Whittaker, 1995:273).

The main objectives of project cost management may usefully be defined as follows:

- To establish a sound and accurate sanction estimate of the eventual project cost;
- To control the costs of the project throughout its design, construction and commissioning;
- To maintain an up-to-date estimate of project cost throughout the life of the project;
- To manage the cash flow of the project within any constraints which have been imposed; and
- To account for money spent and produce a coherent set of capital accounts (Whittaker, 1995:274).

The management of costs is one of the objectives of project management as explained in paragraphs 2.3.1 and 2.3.5. It is important in any project to stay within the allocated budget of the investment. IS projects contain a high risk of overspending due to the complexity of estimating the development time and resources needed during the development of the software. In addition to this, the possibility of end user needs and/or external environment changes during the projects are not excluded. It is therefore important to understand the objectives of cost management and to ensure strict control during the execution of IS projects.

2.3.7.1 Project cost estimate

There are several reasons why cost estimates are done. The most obvious reason is to provide a measure against which to control costs. Other reasons are to:

- Assess project viability;
- Obtain funding;

- Allocate resources;
- Estimate durations; and
- Prepare tenders (Turner, 1993:180-182).

The same estimate cannot satisfy all six purposes mentioned above. Turner (1993:182) proposes five types of estimates of varying accuracy (Table 2.1).

Table 2.1: Types of estimate: purpose and accuracy

Type of estimate	Range of accuracy (%)	Purpose	Stage of project
Proposal (Idea investigation)	± 30 to ± 50	Appraise viability to start feasibility study	Pre-proposal and initiation
Budget (Conceptual estimate)	± 20	Appraise viability to start systems design	Proposal and initiation
Sanction (Preliminary or comparative estimate)	± 10	Appraise viability to approve project, obtain funding, allocate resources	Design and appraisal
Control (Definitive estimate)	± 5	Measure progress, assign resources	Implementation planning
Tender	± 2	Prepare tender	Tender preparation

(Adapted from Turner, 1993:182)

Almost every aspect of the project must be quantified, and with this high level of information and effort, accurate quotations of $\pm 1\%$ can be

achieved. There is, however, a time and cost penalty, as costing is expensive and time consuming to produce (Burke, 1999:69).

A project cost estimate can be sub-divided into a number of different costs namely:

- Direct costs;
- Indirect costs;
- Time related costs;
- Labour costs;
- Material and equipment costs;
- Transport costs;
- Preliminary and general costs;
- Project office costs; and
- Project team costs (Burke, 1999:70).

A detailed breakdown of costs estimation and cost estimation techniques fall outside the scope of this document and will therefore not be discussed further.

2.3.7.2 Cost control and monitoring

It is important to control and monitor costs to prevent overspending. It is common to plot earned value and accrual on a time chart at each reporting period. As the project progresses they form the customarily shaped curve, called an S-curve. The shape is caused by the work of the project taking some time to accelerate at the start, and slowing at the end. It provides a visual representation of whether the project is under- or overspent as it progresses (Turner, 1993:203).

The most common mistakes of cost control include:

- The use of the predicted rate of expenditure with time as the baseline for control, and compare the actual rate of expenditure with this (Turner, 1993:198); and
- The recording of accrual and earned value only as invoices are paid (Turner, 1993:200).

The correct baseline to be used is the baseline costs of work scheduled. The costs recorded against this baseline should be the committed costs and the earned value (not costs already paid).

Using the correct baseline, committed costs and earned value enables the project manager to detect overspending or underspending, and late or early completion of work earlier. This enables the project manager to control the costs and schedule of the project more effectively.

2.3.8 Project organisational structure

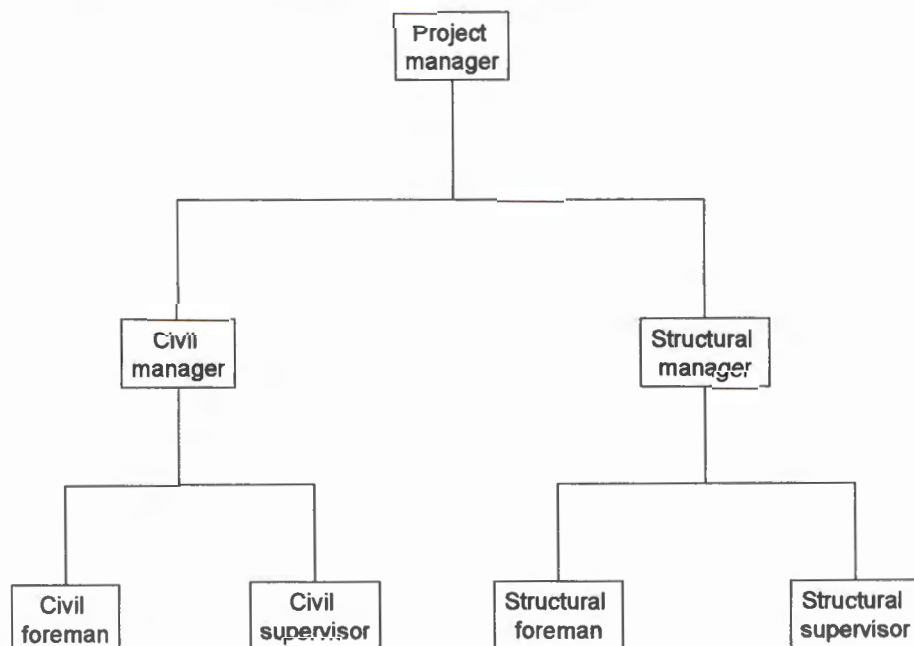
The project organisational structure identifies the relationship between the project participants, together with defining their duties, responsibilities and authority. Because of the dynamic nature of projects it is possible to have a number of organisation structures running concurrently and during the project you may well use all of the organisational structures (Burke, 1999:255).

Before a project starts, senior management must decide which of three organisational structures will be used to tie the project to the parent firm: pure project, functional project, or matrix project (Chase *et al.*, 1998:52)

2.3.8.1 Pure project

The pure project organisation structure is similar in shape to the functional organisational structure except now all departments are dedicated to the project. It has autonomy from the rest of the company, as a self-contained unit with its own technical staff and administration (see figure 2.3). This type of structure is typical of large projects (Burke, 1999:265)

Figure 2.3: Pure project organisational structure



(Source: Burke, 1999:266)

The advantages with the pure project structure include:

- The project manager has full authority over the project;
- Team members report to one boss. They do not have to worry about dividing loyalty with a functional-area manager;
- Lines of communication are shortened. Decisions are made quickly;

- Team pride, motivation, and communication are high (Chase *et al.*, 1998:53).

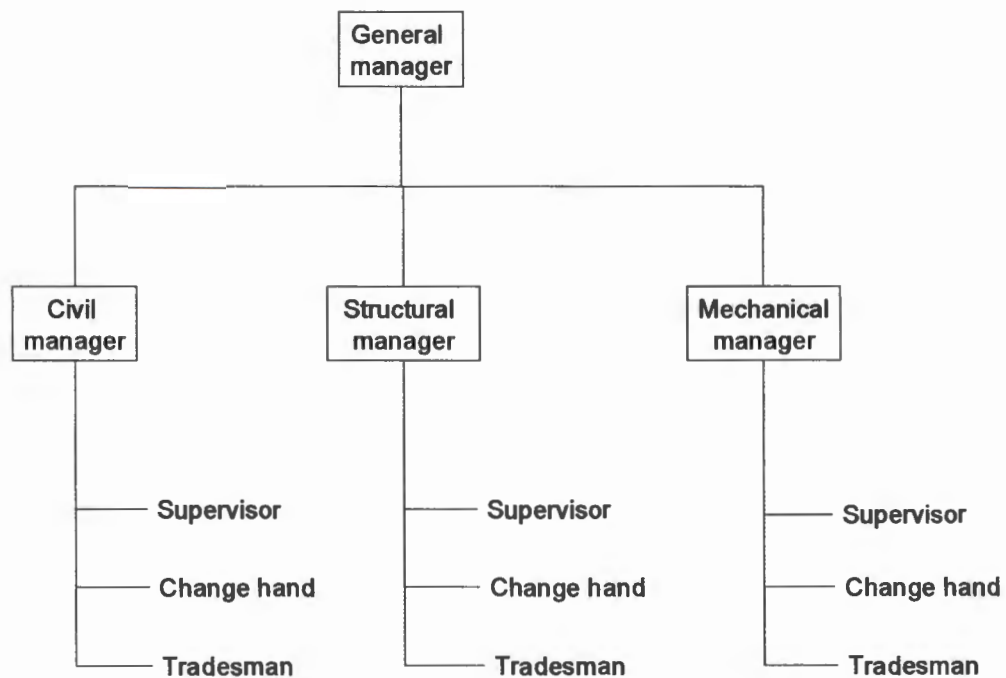
The disadvantages with the pure project structure include:

- Duplication of resources. Equipment and people are not shared across projects;
- Organisational goals and policies are ignored, as team members are often both physically and psychologically removed from headquarters;
- The organisation falls behind in its knowledge of new technology due to weakened functional divisions;
- Since project members have no functional area “home”, they worry about life-after-project, and project termination is delayed (Chase *et al.*, 1998:53).

2.3.8.2 Functional project

At the other end of the project organisation spectrum is the functional project, housing the project within a functional division (Chase *et al.*, 1998:53). This traditional organisation structure is based on the subdivision of product lines or disciplines into separate departments, together with a vertical hierarchy (Burke, 1999:259) (see figure 2.4).

Figure 2.4: Functional project organisation structure



(Source: Burke, 1999:259)

The advantages of the functional organisation structure are:

- A team member can work on several projects;
- Technical expertise is maintained within the functional area even if individuals leave the project organisation;
- The functional area is a “home” after the project is completed. Functional specialists can advance vertically;
- A critical mass of specialised functional-area experts creates synergistic solutions to a project's technical problems (Chase *et al.*, 1998:53).

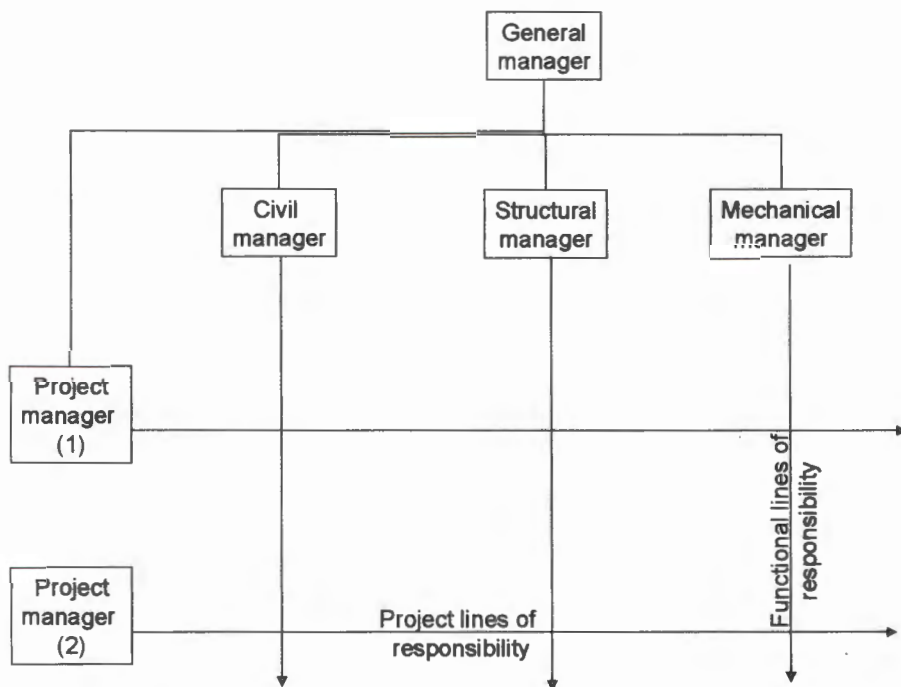
The disadvantages of the functional organisational structure are:

- Aspects of the project that are not directly related to the functional area get short-changed;
- Motivation of team members is often weak;
- Needs of the client are secondary and are responded slowly (Chase *et al.*, 1998:53).

2.3.8.3 Matrix project

This classic specialised organisational structure attempts to blend properties of functional and pure project structures (Chase *et al.*, 1998:54). The matrix structure is a temporary structure created to respond to the needs of the project where people from the functional departments are assigned to the project on a part-time or full time basis (see figure 2.5). Thus, the matrix structure is initially superimposed on the existing functional structure (Burke, 1999:261).

Figure 2.5: Matrix project organisation structure



(Source: Burke, 1999:256)

Some of the advantages associated with the matrix structure are:

- Communication between functional divisions is enhanced;
- A project manager is held responsible for successful completion of the project;
- Duplication of resources is minimised;
- Team members have a functional “home” after project completion, so they are less worried about “life-after-project” than if they were a pure project organisation, and
- Policies of the parent organisation are followed. This increases support for the project (Chase *et al.*, 1998:54).

The following disadvantages are inherent in the typical matrix organisation structure:

- There are two bosses. Often the functional manager will be listened to before the project manager. He is responsible for promotions and salary adjustments;
- It is doomed to failure unless the project manager has strong negotiation skills, and
- Sub-optimisation is a danger, as project managers hoard resources for their own project, thus harming other projects (Chase *et al.*, 1998:54).

From the above it is evident that a strong emphasis is placed on participation from areas where integrated information systems impact on. This will be further investigated in paragraphs 2.4.7.1 and 2.4.8. The structure that creates the most participation, especially when a project is cross sectional, is the matrix organisation. Communication between functional divisions is also enhanced, which supports the implementation of integrated information systems.

2.4 Management of projects in an information systems environment

2.4.1 Strategic information systems

The views of scholars regarding the role that information systems have to play in the organisation are very similar.

Strategic information systems are defined as follows:

- Any information system that can help an organisation achieve a long-term competitive advantage (Oz, 2000:50); and
- Information systems that support or shape the competitive position and strategies of an enterprise (O'Brien, 1999:63);

From the definitions above, it can be seen that strategic information systems are focussed on the long-term goals or strategies of a company and must therefore be aligned with the company's strategy and business objectives.

This view is supported by Peppard (1993:18) and O'Brien (1999:63). Peppard (1993:18) states that IS strategy is concerned primarily with aligning IS development with business needs and with seeking strategic advantage from IT. It determines requirements to meet business needs and the applications to be developed. O'Brien (1999:63) describes the strategic role of information systems as using information technology to develop products, services, and capabilities that give a company strategic advantages over the competitive forces it faces in the global marketplace.

Peppard (1993:10) further views strategic information management as information systems or information technology strategies which significantly improve information use and content in order to enhance performance and co-ordinate activities across functional and business unit lines, as well as the interactions with external entities, in pursuit of a competitive advantage.

For information strategies to be implemented successfully in support of business objectives, it must be properly planned. The remainder of this section will focus on the planning and implementation of information systems.

2.4.2 Strategic planning of information systems

Strategic information systems planning (SISP) requires significant outlays of increasingly scarce human and financial resources (Segars & Grover, 1998:139). Therefore, the process must deliver benefits beyond the resources necessary to sustain it in order to contribute positively to organisational effectiveness. Yet, quantification of the benefits of planning cannot be reduced to simple financial measures such as return on investment, payback, or internal rate of return (Segars & Grover, 1998:139).

IS planning involves developing both general and specific direction for the information systems area. Future programs and projects are determined through IS planning, which can be a direct result of strategic planning for the organisation. In general, the organisational strategic plan gives direction to all other functional areas within the organisation, including marketing, production, finance, accounting, and information systems (Stair, 1992:397).

2.4.3 The steps of IS planning

The IS planning process integrates information systems into the overall business direction.

Oz (2000:525) proposes the following steps for IS planning:

- Creating a corporate and IS mission statement;
- Articulating the vision for IT within the organisation;
- Creating IS strategic and tactical plans;
- Creating a plan for operations to achieve the mission and vision; and

- Creating a budget to ensure that resources are available to achieve the mission and vision.

O'Brien (1999:621) also makes the connection to the organisation's vision, but the process he proposes is somewhat different:

- Create business vision;
- Determine business drivers;
- Make comparative assessments;
- Develop and align strategies;
- Design IT architecture; and
- Develop tactical plans.

The process that O'Brien (1999:621) proposed gives a clearer picture of what the steps in the planning of information systems should be. The perspective that Oz (2000:525) adds to this is that part of the planning process is to ensure that consideration be given to the resources needed, including the availability of a budget. Oz (2000:525) also includes an operations level which is focussed on the use of the systems. Both authors include information systems projects as part of their tactical plans.

2.4.4 Advantages of IS planning

O'Brien (1999:619) views information systems planning as an important component of organisational planning. Information technology can play a vital role in the efficiency of a company's operations, the effectiveness of managerial decision-making, and the success of an organisation's strategic initiatives. Therefore, managing IT requires a planning process that is part of the strategic, tactical, and operational planning of the organisation.

Companies do strategic information systems planning with four main objectives in mind:

- **Business alignment.** Aligning investment in information technology with a company's business vision and strategic business goals;
- **Competitive advantage.** Exploiting information technology to create innovative and strategic business information systems for a competitive advantage;
- **Resource management.** Developing plans for the efficient and effective management of a company's information system resources, including IS personnel, hardware, software, data, and network resources; and
- **Technology architecture.** Developing technology policies and designing an information technology architecture for the organisation (O'Brien, 1999:620).

IS planning has many advantages, including:

- The development of a long term strategy;
- Better utilisation of information resources; and
- Better performance of the information systems functional area (Stair, 1992:399).

One of the primary benefits of IS planning is to develop a long-range approach or strategy for using information technology within the organisation. IS planning provides a framework for success. The expenditure of funds, the timing of projects, the use of IS personnel, major milestones, and project completion dates can be specified using IS planning (Stair, 1992:399).

One of the most important aspects of the IS plan is better communication with top-level executives and managers. Top-level executives can review

the IS plan and suggest changes, if necessary, to meet organisational objectives (Stair, 1992:399-400).

2.4.5 General objectives of IS/IT planning

The implementation of information systems must support the company goals. The goals of an organisation are broad statements of what the company wants to achieve. Objectives are specific, measurable elements of the goal.

The general objectives of IS/IT planning are:

- Use information systems for a competitive advantage and business support;
- Achieve cost effective investment for measured benefits;
- Control IS/IT expenditure and obtain incremental benefits;
- Protect existing IS/IT investment and reduce maintenance costs;
- Obtain user and IS/IT management commitment to ensure IS/IT succeed; and
- Prioritise the application of limited IS/IT resources towards meeting important business needs (Peppard, 1993:77).

From this, it is evident that information systems objectives are focussed on exploiting opportunities in support of the company strategy.

2.4.6 Management's role in IS/IT planning

Because of the strategic importance of information systems, it is important that management play a leading role in the planning process. Management must demonstrate their commitment and support in the

establishment of those information systems that are necessary to utilise opportunities and optimise business processes.

Management is therefore at the centre of the information systems planning process because it is their role to:

- Steer the IS planning process and take overall responsibility for the process;
- Identify the specific IS/IT opportunities;
- Agree priorities, approve requirements and identify benefits to be delivered; and
- Approve and plan the overall resources required, including the capital investment and operating costs (Peppard, 1993:77-78).

Management must be aware of this role and understand that their ability to demonstrate their support and commitment for information systems will largely determine the success of information management in the organisation.

2.4.7 Systems development

Systems development is the activity of creating new, or modifying existing, business systems. It refers to all aspects of the process – from identifying problems to be solved or opportunities to be exploited to the evaluation and possible refinement of the chosen solution (Stair, 1992:386).

There are different strategies for the development of an information system application. The best approach depends on the situation. Application development methodologies are based on the concept of an application development cycle of activities. The way that steps in the cycle are defined and the methods included will depend on the development

perspective employed. The organisation of steps in development and the omission of certain steps will depend on the strategy or development approach (Davis & Hamilton, 1993:156).

Good systems development is not automatic. Companies have lost millions and wasted years of effort because of inadequate systems development (Stair, 1992:387). The importance of systems development can therefore not be over emphasised.

2.4.7.1 Factors in successful systems development

Various factors can impact on the success of information systems development. It is important to know and understand these factors before they can be successfully managed.

Stair (1992:387) and Lester (1998:36) identified the factors that they view as essential for good systems development. These factors combined are as follows:

- Top management support and commitment;
- Involvement of end users at all stages (this will be discussed in greater detail in paragraph 2.4.8.3);
- Use of a proven systems development methodology;
- Clearly defined systems goals and objectives;
- A focus on the most important problems or opportunities;
- Attractive new product concepts being available for development;
- Venture teams with appropriate staffing and resources; and
- A simple and straightforward design;
- Good training programs for all involved;
- Organisational structure and processes that support the venture;

- Project management able to focus on reducing uncertainties as early as possible.
- A review schedule after project completion; and
- A well-defined and organised maintenance program.

Attention to these factors during the early stages of new product development allows managers to save significant time and money while reducing delays and risks.

2.4.7.2 Senior management support and commitment

One of the most critical success factors for successful systems development is management support and commitment. Bloom (1996:6) views it as the most critical factor that contribute to the success of IS projects. Lester (1998:36) supports this view and he argues that it forms an essential foundation of support for new products.

According to Lester (1998:36) key elements of management commitment include vision, strategy and sponsorship:

- The vision is a statement that senior management develops to describe the desired future of the organisation. It provides the driving force for major initiatives and efforts;
- Strategy answers critical questions about the future of the company, including which markets it expects to target, which core competencies will be needed, which marketing discipline it will follow, and which products the company will offer; and
- Sponsorship empowers new product development to succeed.

As information technology becomes an increasingly significant platform upon which an organisation's business is conducted, executives can no

longer delegate the full responsibility of plan development to operating managers and technology professionals. They themselves must become active participants. Strategies and policies that guide the development and deployment of information technology within an organisation must be defined, enforced, and continually monitored as one component the organisation's overall business strategy (Palombo, 1998:48).

2.4.8 Change management

Any change in an organisation causes some disruption of business processes. If this disruption is not managed correctly, it can lead to dysfunctional business processes.

The implementation of information systems is directly focussed on automation, optimisation, redesigning, or development of business processes. It therefore impacts directly on these processes and the changes must be managed carefully.

Three major change management areas exist in the information systems environment namely: software change management, changeover management and organisational change management. These change management areas are discussed below.

2.4.8.1 Software change management

At each stage of a systems development project, change requests or variations to requirements arise from business managers, users, designers and programmers. These requests occur as soon as users start evaluating prototypes of a system and continue through to the

maintenance phase of the project when the system has gone live (Bocij *et al.*, 1999:467).

The main steps in managing changed requirements are:

- Record change requests, indicating the level of importance and module effected;
- Prioritise them with the internal or external customer as must have, nice to have or later release (Priority 1,2 or 3). This will be done with reference to the project constraints of system quality, cost and timescale;
- Identify responsibility for fixing the problem, since it may lie with a software house, internal IS staff, systems integrator or hardware vendor;
- Implement changes that are recorded as high-priority; and
- Maintain a check of which high-priority errors have been fixed (Bocij *et al.*, 1999:467).

When a system is live, a more complex classification is often used to help in deciding how to escalate problems according to their severity. This could be structured as follows:

- 1 Critical problem, system not operational. This may occur due to power or server failure. Level 1 problems need to be resolved immediately, since business users cannot access the system at all.
- 2 Critical problem, making part of the system unusable or causing data corruption. These would normally need to be resolved within 12 to 24 hours depending on the nature of the problem.
- 3 Problem causing intermittent system failure or data corruption. Resolve within 48 hours.
- 4 Non-severe problem requiring modification to software until next release.

- 5 Trivial problem or suggestion which can be considered for future release (Bocij *et al.*, 1999:468).

Software quality assurance

An important part of software change management is to ensure that the product complies with the quality standards of the organisation. The organisation should therefore establish quality standards or procedures to ensure software quality.

Procedures should be followed throughout the software lifecycle to try to produce good-quality systems. These quality assurance (QA) procedures have been formalised in the British Standard BS5750 Part 1 and its European equivalent ISO9001 (TickIT). These procedures do not guarantee a quality information system, but their purpose is to ensure that all relevant parts of the software lifecycle, such as requirements capture, design and testing, are carried out consistently (Bocij *et al.*, 1999:468).

Configuration management

Another important aspect of software change management is configuration management.

Throughout the implementation phase, updated versions of the software are released to users for testing. Before software can be used by users it needs to be released as an executable, built up from compiled versions of all program code modules that make up the system. With large software systems there will be hundreds of program files written by different developers that need to be compiled and then linked. If these files are not

carefully tracked, the wrong versions of files may be used, with earlier versions causing bugs. This process of version control is part of an overall process known as configuration management, which ensures that programming and new releases occur in a systematic way (Bocij *et al.*, 1999:469).

2.4.8.2 Changeover method

Choosing the method to be used for migrating or changing from the old system to the new system is one of the most important decisions that the project management team must make during the implementation phase. Changeover can be defined as moving from the old information system to the new information system. Note that changeover is required whether the previous system is computer or paper based. The main factors that a project manager will consider are:

- Costs;
- Time;
- Quality of new system after changeover;
- Impact on customers; and
- Technical issues (Bocij *et al.*, 1999:469).

The four basic changeover methodologies, which are normally used during the implementation of new information systems, are discussed below. The methodology used depends on factors like the criticality of the system, size of the network, and the type of industry where it is implemented.

Immediate cutover or big bang method

The immediate cutover method involves moving directly from the original system to the new system at a particular point in time. On a designated date, the old system is switched off and all staff moves to using the new system. Clearly, this is a high-risk strategy since there is no fallback position if serious bugs are encountered (Bocij *et al.*, 1999:470).

Parallel running

Conversion can be done on a parallel basis, whereby both the old and the new system are operated in parallel until the project development team and end user management agree to switch completely over to the new system (O'Brien, 1996:565). This presents a lower risk than the immediate cutover method, since if the new system fails, the company can revert to the old system and customers will not greatly affected (Bocij *et al.*, 1999:472).

The cost of running two systems in parallel is high, not only in terms of maintaining two sets of software and possibly hardware, but also in the costs of the human operators repeating operations such as keying in customer orders twice. The parallel method is only appropriate when old and new systems perform similar functions and use similar software and hardware combinations (Bocij *et al.*, 1999:472).

Phased implementation

A phased implementation involves delivering different parts of the system at different times. These modules do not all come live simultaneously, but rather in sequence. Each module can be introduced as either immediate cutover or in parallel. This gives staff the opportunity to learn about the new system more gradually and problems encountered can be fixed as they are introduced.

To achieve a phased implementation requires that the architecture of the new system and the old system are designed in a modular way, and that the modules can operate independently without a high degree of coupling. For all systems, however, data exchange will be required between the different modules and this implies that common data exchange formats exist between the old and new systems (Bocij *et al.*, 1999:472).

Pilot system

In a pilot implementation, the system will be trailed in a more limited area before it is deployed more extensively. This could include deploying the system in one operating region or functional department of the company, possibly a single country, or limited number of offices. This approach is common in multinational or national companies with several offices. Such a pilot system usually acts as a trial before more extensive deployment with several offices (Bocij *et al.*, 1999:472).

Combinations of changeover methods

The different changeover methods are often used in conjunction for different stages of an implementation. The advantages and disadvantages of each of these changeover methods are summarised in table 2.2:

Table 2.2: Software changeover methodologies

Method	Main advantages	Main disadvantages
Immediate cutover	Rapid, lowest cost	High risk if serious errors in system
Parallel running	Lower risk than immediate cutover	Slower and higher cost than immediate cutover
Phased implementation	Good compromise between immediate cutover and parallel running	Difficult to achieve technically due to interdependencies between modules
Pilot system	Essential for multinational or national rollouts	Has to be used in combination with other methods

(Source: Bocij *et al.*, 1999:473)

Deployment planning

A deployment plan is necessary to get all hardware in place in time for user acceptance testing. A deployment plan is a schedule that defines all tasks that need to take place in order for changeover to occur successfully. This includes putting the entire infrastructure in place such as cabling and hardware (Bocij *et al.*, 1999:473).

2.4.8.3 Organisational change management

The implementation of a new system will always cause disruption to staff, because changes to their patterns of working will occur. The best approach to managing this change is to use education to communicate the purpose of the system to the staff, in other words, to sell the system to them. This education should target all employees in the organisation that will be affected by the change, and involves:

- Explaining why the system is being implemented;
- Explaining how staff will be affected;
- Involve users in specification, testing and review: treat them as customers. Involvement must from the beginning of the development;
- Training users in use of software; and
- Above all, listening to users and acting on what they say (Bocij *et al.*, 1999:474).

User involvement

Studies by Barki and Hartwick (1994:68), McKeen and Guimaraes (1997:138) and Hunton and Price (1997:810) found that various levels of

user participation can increase user motivation and satisfaction in the use of newly developed information systems.

Barki and Hartwick (1994:68) distinguished between user participation, user involvement, and user attitude. They found that user participation influenced both involvement and attitude. Through participation, users may be able to influence the design of a new system and satisfy their needs. They may even develop feelings of ownership. User involvement will also lead to the development of a better understanding of the new system and how it can help them in their job.

Later research done by Hunton and Price (1997:811), based on the work of Barki and Hartwick (1994), suggests that the types of activities, meaningfulness of activities, and processes through which these activities take place are essential ingredients to a successful participation formula. They found that the secret of success in user participation might reside in the individuals' perception of control. The participative process providing employees with a sense of control – even limited control – can result in positive consequences.

Research by McKeen and Guimareas (1997:138) reconfirmed that user participation is positively related to user satisfaction in systems development. The more users participated in projects, the greater their level of satisfaction. McKeen and Guimaraes (1997:138) identified the following five activities that constitute the “basic core” of participative behaviours, and that should always be performed by users:

- Be members of the project team for the feasibility studies;
- Must be interviewed to obtain information;
- Approve information requirements;
- Help to define I/O forms, screens, and report formats; and
- Be members of the project team for the installation of the system.

McKeen and Guimaraes (1997:138) also found that users could be participating in more activities and suggested that, for projects with a low need for participation (i.e., projects where task and/or system complexity are low), users should (in addition to the core set) approve the cost justification of the project, and appoint a formal “user-liaison” person to the team from IS.

For projects with high task and/or system complexity, users should also:

- Be responsible for project definition;
- Define the physical controls and security procedures;
- Define I/O forms, screens, and report formats;
- Conduct the system test;
- Lead the project team;
- Initiate the project via a formal request process;
- Develop project management schedules and progress reports;
- Approve project management schedules and progress reports; and
- Ensure that user management assesses user participation.

Users need to be much more involved in systems where task and/or system complexity is high. In these situations, it is critical that issues get identified and resolved. Many trade-offs will be made as the project progresses. Neither IS developers nor users are able to make these decisions by themselves. They must collaborate: Users must decide what the system is supposed to do; developers must decide how best to accomplish this. This symbolic relationship transpires during the evolution of the systems development process, and active user participation ensures the result. In such situations, users have a much larger role to play, with greater responsibility. Having users actually lead the project and assume many of the project management duties is very different from

simply having them approve various features of the design (McKeen and Guimaraes, 1997:139).

Documentation and training

Developing good user documentation is an important part of the implementation process. Examples include manuals of operating procedures and sample data entry display screens, forms and reports. Documentation serves as a method of communication among the people responsible for developing, implementing, and maintaining a computer-based system (O'Brien, 1999:641).

2.4.9 IS development models

Various models have been developed for the development and implementation of information systems. Three of these models are discussed below.

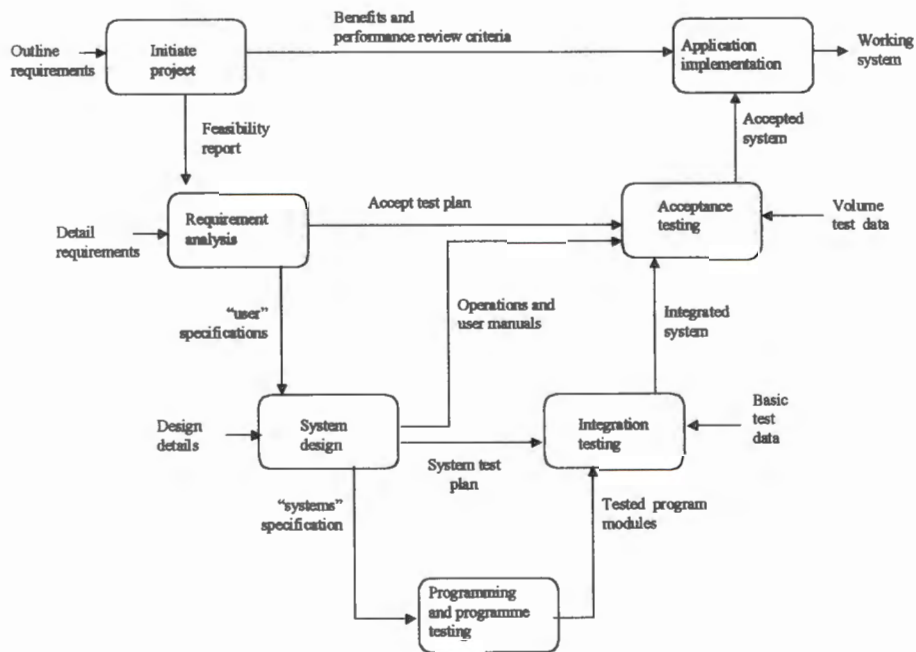
2.4.9.1 V- model of IS development

Peppard (1993:264) describes the V-model of IS development as shown in Figure 2.6. The V-model shows the general case for systems development. From each major stage a deliverable is produced which provide the basis of input to the following stage. However the real power of the V-model is the horizontal links it shows between the specifying activities, shown on the left hand side, and the testing activities, shown on the right hand side. This means that at the time of specifying or producing

something, the way in which it will be checked and the criteria to which it must conform are defined (Peppard, 1993:264-265).

The V-model is diagrammatically shown in figure 2.6.

Figure 2.6: The V-model of IS development



(Source: Peppard, 1999:264)

In essence the main stages of the V-model are:

- Project initiation;
- Requirements analysis;
- System design;
- Programming and programme testing;
- System integration and testing;
- User acceptance testing; and

- Application implementation.

Project initiation

The outcome of project initiation is the feasibility report. This should specify the objectives and scope of the project, the desired benefits and potential risks. The classification of the project in terms of the strategic grid will provide a basis against which to evaluate the expected resource, cost, dependency, technical and organisational issues. It will also specify responsibility and the criteria for success (Peppard, 1993:265).

Requirements analysis

This is concerned with clarifying the precise impact of change, who will be affected and the business tasks involved. Considerable detail may be required here describing the processes, volumes, and data structures. The main output is a statement of functional requirements and the key features of an acceptable test plan (Peppard, 1993:265).

System design

System design reviews the business requirements and examines alternative technical solutions. The major deliverable at this stage is a system specification describing the nature of the system in terms of processes, data files, hardware and security. This document can act as a basis for programming, package selection, or invitation to tender. Importantly, the system specification should provide evaluation criteria for

both the systems integration testing stage and user acceptance (Peppard, 1993:265).

Programming and programme testing

At this stage individual programme modules are written and tested (Peppard, 1993:265).

System integration and testing

The individual components of the system may work in themselves, but they may not perform as expected when combined with other system components. Software integration checks the operation of the system as a whole to ensure its technical correctness in relation to the system specification (Peppard, 1993:265).

User acceptance testing

This is a key stage in the development of an application, one where the users of the system along with the developers will need to invest a considerable amount of time and effort ensuring that when the system is implemented it will allow the realisation of the desired benefits. The accompanying documentation, including operation and user manuals, should be checked for adequacy (Peppard, 1993:266).

The impact of the system on the organisation's operations should also be evaluated in detail to help prepare for implementation (Peppard, 1993:266).

Application implementation

This can be fraught time as the new IT-based application is introduced into the work practices of the organisation. Many of the shortcomings or omissions during the development phases may begin to reveal themselves. Even without these problems the additional workload can be immense, under resourced and often underestimated (Peppard, 1993:26).

2.4.9.2 The collaborative software engineering methodology

Dean *et al.* (1997:179) state that the process of creating information systems has been plagued with excessive costs, delayed releases, and the production of faulty, bug-ridden products. Much of the blame for this has been placed on inaccurate, unstable specifications for projects with unreasonable budgets and time schedules. This is largely the result of systems developers' inability to effectively involve end users in the development of detailed, adequate specifications.

Dean *et al.* (1997:180) identified the following weaknesses in the traditional systems development lifecycle:

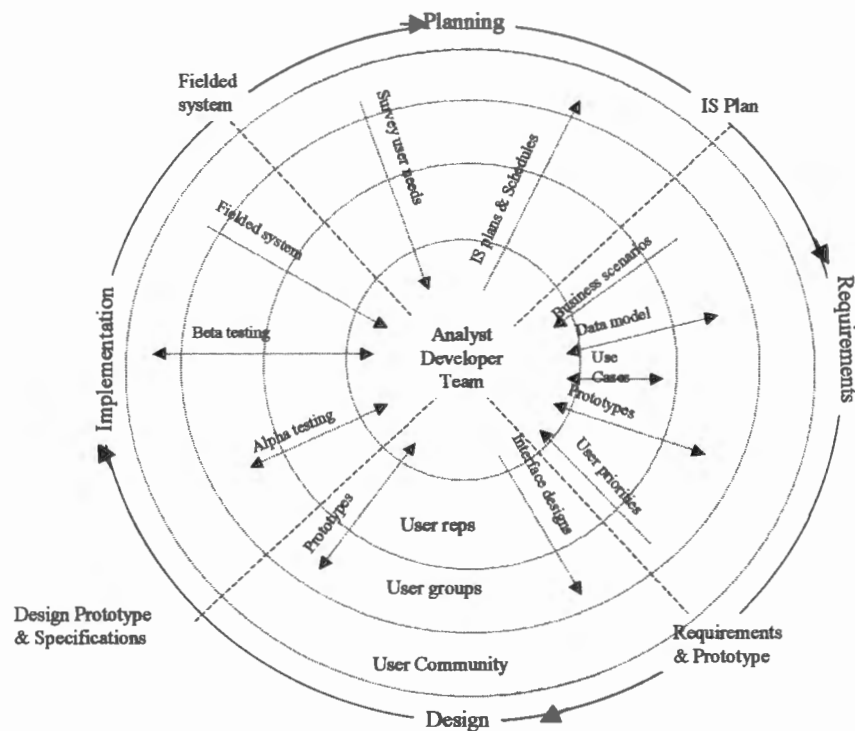
- Nothing is demonstrable until near the end of the cycle;
- It depends on correct, stable requirements;
- It delays detection of errors until implementation;
- It does not promote software reuse;
- It takes too long; and
- It is generally not practised in a formal fashion.

In addition, it does not recognise an organisation's information systems development as an ongoing activity. Instead, it is designed around a single project that has a defined beginning and end. This orientation involves end users only at the beginning and the end, does not promote integration with existing applications, inhibits data standardisation, and does little to promote long-term business process or activity analysis (Dean *et al.*, 1997:180).

The development of the collaborative software engineering methodology is focussed on addressing these problems.

Dean *et al.* (1997:184) views teamwork as essential to all successful information systems development efforts. The analyst/developer team is at the core of this methodology and three different levels of user participation extends out of the core namely: selected users, who represents the user groups; groups of users, who represents the user community; and the entire user community (see figure 2.7). Group members, referred to as subject matter experts (SME), should be influential members of the user community and should be experts in their business areas. SME groups meet regularly to generate requirements, resolve conflicting viewpoints, enhance proposed models or prototypes, and validate key deliverables.

Figure 2.7: The collaborative software engineering life cycle



(Source: Dean *et al.*, 1997:184)

Planning phase

The purpose of the planning phase is to identify user needs and to map them into information system development plans. Planning is especially critical in the collaborative software engineering methodology because it is designed to support incremental system development. An incremental system development life-cycle supporting timely fielding of information system increments/versions is used to rapidly satisfy customer requirements and to get real user feedback for future increments. Because of the need for rapid systems development, IS plans are established collaboratively by management and senior analysts/developers based on user input instead of a time consuming strategic planning process. IS

plans and proposed schedules are provided to development teams and the user community. The plans are updated based on feedback from the users and an understanding of user needs increases with successive information systems increments (Dean *et al.*, 1997:185).

Requirements phase

The purpose of the requirements phase is to guide the subject matter experts (SME). The methodology accomplishes this goal through an iterative process of making the transition from high levels of abstraction to specific details which allows SME's to bridge the gaps, the requirements and the artefact specificity gaps. The process begins with top-down decomposition of business activities followed by development of detailed scenarios and data requirements for those activities. This process increases the specificity of requirements. The scenarios and data requirements are subsequently translated into alternative system use cases that are implemented in a physical artefact – the prototype. The development and evaluation of system use cases and prototypes and therefore increase the specificity of both the requirements and the artefact. This result in higher-quality requirements than those provided by the traditional waterfall model, which does not provide a demonstrable product until near the end of the entire life cycle (Dean *et al.*, 1997:185).

Design and implementation phases

The collaborative software engineering methodology seeks to improve the speed and quality of the design and implementation phases by continuing its emphasis on SME participation and prototype development and evaluation. The methodology implements a rapid application development

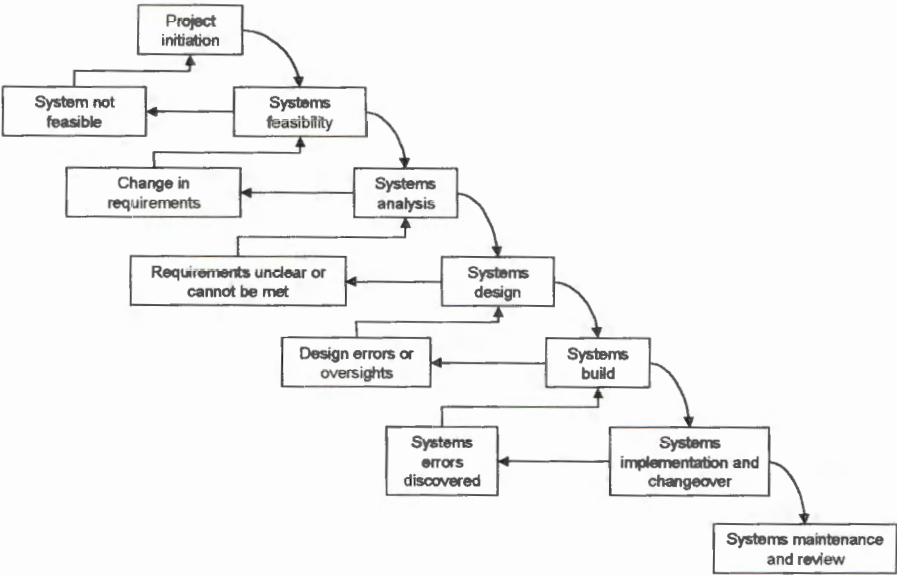
(RAD) like approach, with analysts and developers working with the SME group and its representatives to refine user interfaces and define required design specifications. Because of their involvement throughout the development process, the SME groups are also ideal participants during the implementation's alpha testing. Beta testing generally expands outward to include additional members of the user community at large. Upon completion of the implementation phase, the new system, along with its associated models and requirements/design specifications, serves as inputs to the next iteration of the cycle. In this manner, the systematic reuse of requirements, designs, and subsystems is specifically incorporated into the collaborative software engineering methodology, thereby accruing the benefits of this effective development practice (Dean *et al.*, 1997:186).

2.4.9.3 The traditional waterfall model

The traditional waterfall model outlines the series of steps that should occur when building an information system. The waterfall model is based on the standard development life cycle (SDLC).

The purpose of the waterfall model is to divide the development process up into a series of manageable parts (see figure 2.5) that relate to each other in an organised way (Bocij *et al.*, 1999:253).

Figure 2.8: The traditional waterfall model



(Adapted from Bocij *et al.*, 1999:258)

Systems Initiation

The initiation phase is the first phase of an information systems development project. Bocij *et al.* (1999:253) identified three initiation points namely: managing director or senior management, information systems department, and functional business area.

Bocij *et al.* (1999:253) is of the opinion that systems initiated by the managing director or senior management are likely to have the support for successful development. Systems initiated by the information systems department will still need high-level support, but may be initiated as part of the organisation's overall IS/IT strategy. Systems initiated by the functional business areas will be competing with all other development projects.

Systems feasibility

The feasibility assessment can be viewed as part of the initiation phase. The primary objective is to determine whether the existing system is satisfying the goals and objectives of the organisation. O'Brien (1999:93) views the goal of feasibility studies as the evaluation of alternative systems and to propose the most desirable systems for development.

Bocij *et al.* (1999:254) identified three areas of feasibility that need to be assessed namely: technical feasibility, economical feasibility, and operational and organisational feasibility. This view is supported by O'Brien (1999:93) and Stair (1992:403). Stair (1992:403) proposed that an investigation team must be formed for the feasibility studies.

The outcome of the feasibility studies will be a report recommending that the project proceeds, or that the project be reassessed.

Systems analysis

Stair (1992:404) describes system analysis as a study of the existing system. Strengths and weaknesses are uncovered. The existing system's ability to satisfy user needs is determined during this stage of systems development. System analysis involves assembling an analysis study team, collecting and analysing data, and developing a report on the existing system.

O'Brien (1999:95) differs somewhat in this view. He defines system analysis an in-depth study of end user information needs that produces

the functional requirements that are used as the basis for design of a new information system. According to O'Brien (1999:96) system analysis traditionally involves a detailed study of:

- The information needs of the organisation and end users;
- The activities, resources, and products of any present information systems; and
- The information system capabilities required to the organisation's and end user needs.

Bocij *et al.* (1999:255) agrees with this view and add that system performance standards and environment requirements such as the physical working environment, operating system and hardware must be defined.

Systems analysis in essence describes what the system should do.

Systems design

The systems design phase defines how the system will work in key areas of user interface, program modules, security and database transactions (Bocij *et al.*, 1999:255).

O'Brien (1999:98-100) divides systems design into three areas namely user interface design, data design, and process design. During user interface design, it must be simple, clean and logically organised. Data design is the detailed description of attributes and entities and the relationship between them, data elements, and integrity rules. Process design is the architecture of processing services namely user services, application services, and data services.

Systems design describes in short how the system will accomplish the objectives identified during the systems analysis phase.

Systems build

Systems build is the creation of software by programmers or developers. It involves writing the software code, building release versions of the software, constructing and populating the database and testing by programmers and end users (Bocij *et al.*, 1999:256).

The output from the build stage will be an information system that has been tested and is available for final data conversion or take-on and live operation (Bocij *et al.*, 1999:256).

Systems implementation and changeover

Systems implementation places the new or modified system into operation. This important step includes software acquisition and development, personnel hiring and training, site preparation, data preparation, installation, testing, start-up, and operation (Stair, 1992:404).

The changeover methods that can be used are immediate cutover, parallel running, phased implementation, pilot systems, or a combination thereof as described in paragraph 2.4.8.2.

Systems maintenance and review

The purpose of systems maintenance and review is to keep the system operating as efficiently, error free, and effectively as possible. (Stair, 1992:404).

Bocij *et al.* (1999:257) proposes two areas of maintenance. The first area addresses errors and oversights in the original systems development that is necessary to ensure conformation with the original specification. The second area of maintenance involves the addition of new features and facilities that extend the scope and functionality of the information system.

Maintenance occurs after the system has been signed off as suitable for users of the system (Bocij *et al.*, 1999:258).

2.5 Summary

The development and implementation of information systems must be focussed on the long-term goals or strategies of an organisation. The management of an organisation therefore has to play a leading role in the planning process for information systems. The information systems planning process involves developing both general and specific direction for the information systems area.

Various methodologies exist for the development and implementation of information systems. Although these methodologies differ from project management in other fields, the basic principles for project management have to be applied during the development and implementation of information systems. The most important success factors during the

development and implementation of information systems include clearly defined systems goals and objectives, management support and commitment, involvement of end-users at all stages of the project, and good change management.

This chapter represents the literature study that was done on the development and implementation of information systems. The knowledge gained from the literature study will be used during the empirical study as discussed in chapter 4, and for the conclusions and recommendations made in chapter 5.

Chapter 3: Company profile

3.1 Introduction

The company profile of Natref, where the empirical research will be done, will be discussed in this chapter. The description of the Natref organisation and business processes will create a better understanding of the empirical study described in the next chapter. This chapter will also serve as a basis for the recommendations in the last chapter.

The following areas in Natref will briefly be discussed:

- Historical background;
- Organisational structure;
- Vision;
- Information management; and
- Project management

3.2 Historical background

National Petroleum Refiners of South Africa (Natref) is one of the few inland refineries in the world. It is situated approximately 700 km inland from Durban.

The Natref refinery was built during the 1960's within a partnership between Sasol (52% shareholding), Total S.A. (30% shareholding) and the National Oil Company of Iran (NIOC – 17.5% shareholding) after the

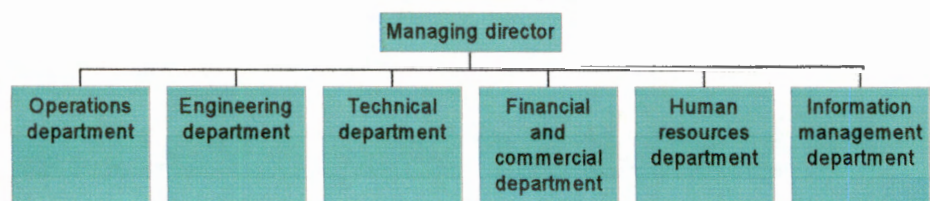
government realised the threat of the oil embargo against South Africa. With the fall of the Shaj of Iran and the international embargoes against South Africa the NIOC shares were bought out in 1989 and distributed between the current shareholders.

3.3 Organisational structure

Natref currently employs 597 people in permanent positions. Of these, 220 work 12 hour shifts and 377 work normal day shifts.

The Natref refinery is structured on a functional basis as depicted in figure 3.1. The functions are operations, engineering, technical, financial and commercial, human resources and information management.

Figure 3.1: Natref organisational structure



The organisational structure of Natref supports information management as a centralised function. The risk in this structure is that the process can be driven by the information management department, depending on the commitment to information management of other departmental heads. It could also be that projects from departmental managers that are more committed to information management get preference over information systems needs in the other departments.

To overcome this risk, an information systems forum was established. The role of the information systems forum did however change from a strategic perspective to a feedback forum on existing projects. It therefore needs to be reviewed.

3.4 Vision

During February 1995, Natref adopted a new vision, mission and strategy as shown below.

Vision: To be a pacesetter refinery!

Mission: To generate continuous growth, in the interest of all our stakeholders, through crude oil refining.

Strategy: Create enduring and beneficial stakeholder relationships
Unlock and align the energy of people .

Through: **Order:** allocate clear responsibilities and use effective structures.

Culture: create value addition through respect, empowerment, learning and teamwork.

Resources: develop and utilise the full potential of all resources.

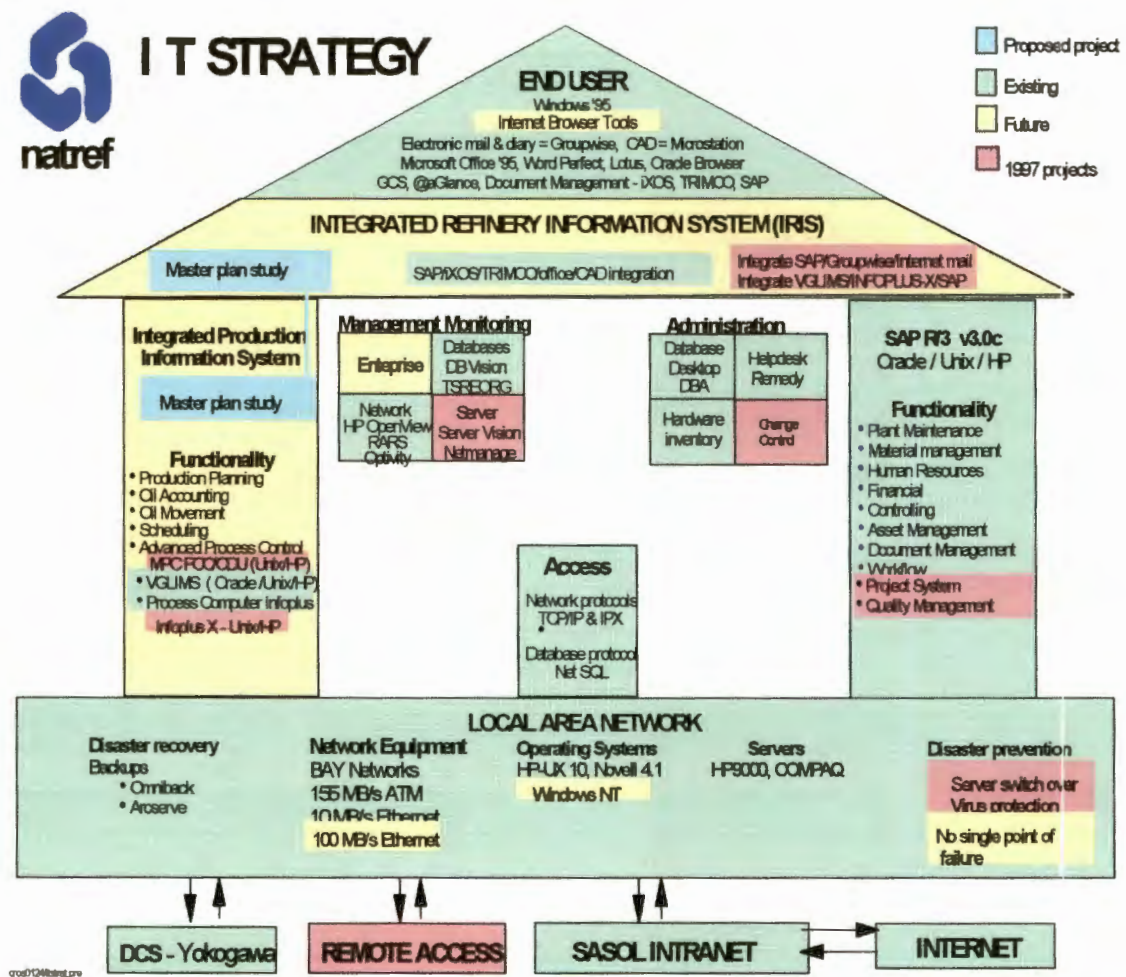
Energy focus: do the right things first, then do them right.

This vision, mission and strategy were in place throughout the development and implementation of the integrated refinery information systems (IRIS) project. The Natref vision has been revised in 2001, but the new vision are not applicable for the period of the IRIS implementation, and will therefore not be discussed.

3.5 Information management

During 1995, Natref made a strong statement regarding their commitment to utilise information systems as a strategic advantage by establishing an information strategy represented as a house (figure3.2)

Figure 3.2: Natref information systems strategy



(Source: Burger & Volkwyn, 1997)

This strategy clearly indicated the existing systems (green) and the intended future systems (yellow).

It can be seen from figure 3.2 that the foundation of the strategy, namely the local area network (LAN) is well established. It was however visualised that the LAN speed must be upgraded to 100 MB/s in the future, and to

migrate the LAN to a Windows NT platform. It was further visualised that the LAN availability will be 100% with no single point of failure.

The right wall of the strategy is supported by SAP R/3, which was in its final stages in 1997. The functionality of SAP R/3 system was focussed primarily on maintenance-, financial-, commercial-, and human resources.

The roof of the strategy is mainly focussed on the end-user systems and office automation, which was well established in 1997. These systems were however mainly isolated systems, where manual intervention and manipulation was needed to obtain information. The master plan study identified the need to integrate these systems, as shown on the bottom part of the strategy roof.

The master plan study also identified the need to re-develop the production information system, which forms the left wall of the information strategy house. The windows and the door of the house are demonstrating the systems needed for the administration, systems monitoring and access control to the system.

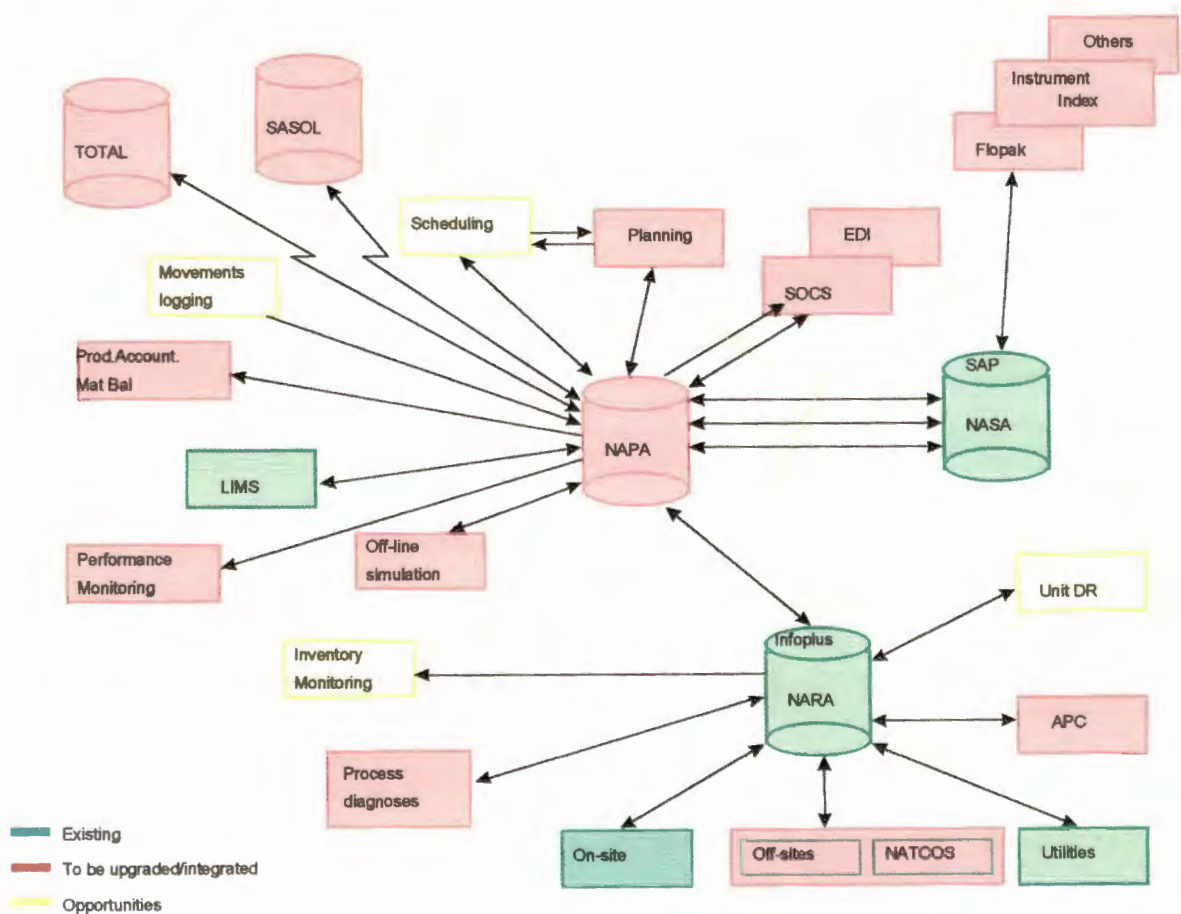
Natref visualised the creation of an Integrated Refinery Information System (IRIS) in 1995, and this need was supported by the master plan study, which was done in 1997.

Based on the above mentioned vision and systems strategy a project was launched in 1996 for the upgrading of the production information system, as well as the integration of all relevant information systems. This project became generally known in Natref as IRIS (Integrated refinery information systems).

3.5.1 Integrated refinery information system (IRIS)

An IRIS Masterplan study was completed during the first half of 1997 (Burger, 1997). This Masterplan study formed the basis of the IRIS project. From the study, a basis for information flow was proposed as shown in figure 3.3.

Figure 3.3: Information flow integration



(Source: IBM Semea *et al.*, 1997: ch. 2, 154)

The IRIS system, as shown in figure 3.3, is made up of three major application management systems namely:

- **NARA** – Natref real-time applications;
- **NAPA** – Natref production applications; and
- **NASA** – Natref support applications (IBM Semea *et al.*, 1997: ch1, p1).

The real-time environment (**NARA**) includes a data historian, direct control and data acquisition by the DCS, advanced process control (APC) systems and lastly the real-time monitoring applications which facilitate real-time optimisation of the respective refining processes. The production information environment (**NAPA**) includes a non-real-time or relational database (RDB). It also includes a data reconciliation application and several other applications like the laboratory information management system (LIMS), off-line simulation models like Distop and Profimatic, linear programming (LP) modelling, and other planning and scheduling applications, performance reporting and management facilities. The Support business environment (**NASA**) is mainly the SAP R/3 system with its respective modules and other support systems like CAD drawing and the Flopak flow measurement application. The hardware architecture is made up of the LAN, PC's, and servers (Burger, 1997).

The functional design of IRIS was approved in the second half of 1997 by the Natref Operations Committee of the Board at an estimated cost of R 3.5 million. The Board approved the implementation of the IRIS Production Management project in August 1998. The estimated cost was R 32.2 million, which would bring the total cost of the project to R 38.4 million including previous approvals and expenditure (Burger, 1999).

The approved scope of work included the following:

- A relational production management database with a relational data model;
- System applications like reporting, navigation and data query for both the relational and the real time systems;

- Specific applications – movement logging, data reconciliation, inventory management, performance accounting and crude scheduling;
- Systems integration between the core database and the specific applications as well as other data systems like InfoPlus-X, SAP and Natcos; and
- Communication to and from users.

This system, together with the existing DCS and InfoPlus-X real time systems at Natref and Natcos, form the central production information system for the refinery core business process (Burger, 1999).

Project completion was planned for July 2000. By February 2001, there was still outstanding project work. The operation of some of the components of the systems still posed further challenges that needed to be resolved. The full time project team was demobilised in July 2001 with some of the functionality that was originally intended outstanding.

Change over process

The changeover process followed was a combination of prototyping, parallel running, and phased implementation. The changeover process was delayed due to the lack of trust in the new systems because the results from the new mass balances were slightly different from the results from the previous mass balances. A burning platform had to be created from lower levels before the previous system was taken out of operation.

Project success

Although the result from the project can be viewed as successful, the project had to be reduced in scope due to cost and time limitations. The impact of the project on end-users was underestimated and it complicated the change management process.

3.6 Project management

Project management in Natref is formalised to some extent. Although Natref does not have a project execution model, it has basic procedures in place for the management of projects.

The basic steps outlined in the procedure are:

- Conceptual work:
- Basic engineering:
- Detail engineering;
- Construction and implementation; and
- Project close out.

The procedure does not contain a lot of detail regarding project management principles. The reason for this is mainly because Natref uses Sasol technology (Sastech) for the management of projects.

The use of Sastech in project management resulted in only basic project management skills being available in Natref.

3.7 Summary

Natref is an inland refinery jointly owned by Sasol and Total SA. Natref had a clear strategy and its vision was to become a pacesetter refinery in terms of world-wide standards (the vision was reviewed during the study period).

The organisational structure of Natref supports information management as a centralised function. Natref developed an information systems strategy during 1995. From this strategy, a project for the integration of the refinery information systems (IRIS) was launched in 1997. This project was successfully implemented, but the impact on end-users was underestimated and it complicated the change management process.

This background of Natref and the IRIS project will be used during the empirical study (chapter 4), conclusions, and recommendations (chapter 5)

Chapter 4: Empirical study

4.1 Introduction

The literature study in Chapter 2 highlighted the importance of project management principles in the information management environment. The role of end users and the importance of end user participation and management support in the process of information systems development were described.

To determine to what extent Natref applied information systems development principles, an empirical study was undertaken. The previous chapter described the ideal project execution environment for integrated information systems development and implementation. It is however very difficult to establish a perfect environment in the real world and there will always be shortcomings in management systems that is used during the execution and implementation of projects.

The development and implementation of information systems is different from other projects in the sense that end-user participation is extremely important throughout the whole developmental and implementation phases. It can actually be argued that the end users must be the architect of the information environment that they work in.

The empirical study will focus on identifying the shortcomings with respect to the information systems development process, and the change management processes (which included end user participation).

The goal of this empirical investigation is to achieve the objectives of this study by investigating the following:

- The application of information systems planning;
- The implementation of business change;
- The evaluation of hardware, software, and information systems services; and
- The change management process.

This chapter will explain the process of data gathering using survey questionnaires, and the results obtained from the responses to the questionnaires.

4.2 Target population

The target population used in this empirical study is those employees that were directly involved during the execution of the IRIS project. The first questionnaire (project execution questionnaire) targeted the persons involved in the execution and management of the project, and the second questionnaire targeted mainly the end users of the system. The distribution of the change management questionnaire will be shown in figure 4.1 in paragraph 4.5.2. Both questionnaires were distributed to the total population directly involved in the two specific focus areas.

4.3 Information gathering

The preparation of questionnaires during the empirical study can be viewed as critical. The rest of this section describes the development of the questionnaires used in this empirical study.

4.3.1 Preparation of the questionnaires

For study objectives to be met, the questions used in the questionnaires should be related to the issues under investigation. It was therefore necessary to conduct a literature study (Chapter 2) to become familiar with the issues relating to the development of Information systems. Two questionnaires were developed based on the most important aspects identified during the literature study. The first questionnaire focussed on the project management and technical aspects (Attachment A), and the second questionnaire focussed on the change management process (Attachment B).

4.3.2 Structuring of the project execution questionnaire

The project execution questionnaire was developed to investigate the factors affecting project execution in an information systems environment. Due to the technical and sensitivity nature of the questionnaire, it was only distributed to the project management, the end-user managers directly involved in the execution of the project, and the project team.

The project execution questionnaire was divided into the following three areas of importance:

- Planning;
- Implementing business change; and
- Evaluating hardware, software, and services.

A five-point Likert scale was used for all questions that did not have an exact answer or a yes/no answer associated with it. The main reason for the five-point scale is that most of the people working at Natref are familiar with it as it is used for the annual merit appraisals. A five-point scale also assists in forcing the individual to make a decision.

The scale used in the project execution questionnaire must be interpreted as follows:

- 1 - Not considered at all;
- 2 - Moderate consideration was given
- 3 - Average consideration was given and it was partly incorporated in the project;
- 4 - Good consideration was given and it was sufficiently incorporated in the project; and
- 5 - Was fully considered and incorporated in the project.

Space for additional comments was provided at the end of each area of importance.

4.3.3 Structuring of the change management questionnaire

The importance of change management and end-user participation was discussed in detail in chapter 2. The second questionnaire investigated the extend to which Natref applied good change management during the execution of the IRIS project. This questionnaire was distributed to all the end users in Natref, as well as the project team.

The change management questionnaire was divided into the following three areas of importance:

- Software change management;
- Change-over management; and
- Organisational change management.

Again five-point Likert scale was used for all questions that did not have an exact or a yes/no answer associated with it.

The scale used in the change management questionnaire must be interpreted as follows:

- 1 - Not at all;
- 2 - Sometimes / somewhat;
- 3 - Intermediate; and
- 4 - Mostly
- 5 - Always.

Space for additional comments was provided at the end of each area of importance.

4.4 Response to questionnaires

Of the 8 project execution questionnaires send out, 7 responses (87.5%) were received by the cut-off date. Of the 26 change management questionnaires, 22 responses (84.6%) were received by the cut-off date. Despite several telephone calls, e-mails and personal reminders, the outstanding questionnaires were not completed and returned by the cut-off date. Due to the low population numbers, a high response rate was of the utmost importance. However, conclusions will have to be made with care.

4.4.1 Statistical processing of the data

The data received from the completed questionnaires were processed using Excel spreadsheets. The standard Excel functions have been used for the calculations of the mean and standard deviation of the population. The release of the software used for the processing of the sample data is Microsoft® Excel 97 SR 2.

4.4.2 Statistical terminology

The statistical terminology mentioned in the study, can be defined as follows:

- **Population:** The population is the totality of items or things under consideration (Berenson & Levine, 1996:3).
- **Sample:** A sample is the portion of the population that is selected for analysis (Berenson & Levine, 1996:3).
- **Sample mean:** The sample mean (also called arithmetic mean) is the most commonly used average or measure of central tendency. It is calculated by summing all the observations in a batch of data and then dividing the total by the number of items involved (Berenson & Levine, 1996:106).
- **Standard deviation:** The standard deviation can be defined as the square root of the variance, where the variance is the average of the squared differences between each observation and the sample mean, divided by the number of observations minus one (Berenson & Levine, 1996:120).

4.5 Interpretation of data

Although the number of questionnaires that were sent out is only 8, it must be remembered that it included all the people involved in the management of the IRIS project. The results can therefore be viewed as sufficiently representative for the purposes of this study.

A sample mean of 4 or higher is viewed as an indication of full compliance to the issue addressed in the question. A sample mean between 3.5 and 4 is viewed as an indication that the issue in the question is moderately addressed. A sample mean of lower than 3.5 indicates that the issue has not been sufficiently addressed. It is therefore an indication of a gap between the ideal situation described in chapter 2, and the process Natref followed in the execution of the IRIS project.

The standard deviation of a sample is a measure that reflects how the numerical data are dispersed (Berenson & Levine, 1996:121). For the purposes of this study it will be used to indicate the level of agreement between the responses on any particular question. A standard deviation of 1 or less indicates a high level of agreement, and a value higher than 1 indicates disagreement of responses.

4.5.1 Project execution questionnaire

4.5.1.1 Information systems planning

Information systems planning is an important component of organisational planning as described in paragraph 2.4.3. Table 4.1 summarises the responses to the questions relating to planning.

Table 4.1: Information systems planning

Question	Average response	Standard deviation
To what extent were the following objectives considered during the planning phase of IRIS:		
Business alignment – Aligning investment in information technology with the company's business vision and strategic business goals.	4.50	0.55
Competitive advantage – Exploiting information technology to create innovative and strategic business information systems for competitive advantage.	4.33	0.52
Resource management – Developing plans for the efficient and effective management of a company's information system resources, including IS personnel, hardware, software, data, and network resources.	3.83	0.98
Technology architecture – Developing technology policies and designing an information technology architecture for the organisation.	4.50	0.55

Business alignment

From table 4.1, it can be seen that the respondents believe that the IRIS investment is aligned with the company's business vision and strategic business goals, and that it was considered during the planning phase of the project. On a 5 point scale, the sample mean is 4.50 (standard deviation = 0.55), which is an indication of a high level of agreement between the respondents.

The comments from the respondents indicates that the Masterplan study done in 1997 forms the basis for the IRIS project, and is therefore aligned with the business strategies that supports the Natref vision.

The IRIS project is therefore supporting the information systems strategy and plans. It is however important to note that the information systems strategy at NATREF was drafted in 1997, and has not been updated since. It is advisable that information systems planning should be done on a more regular basis than in this case.

Competitive advantage

Another important aspect in information systems planning is whether a competitive advantage is achieved during the execution of the plans. It is important to see if consideration to this aspect was given during the investment of approximately R 40 million.

The response to the question regarding competitive advantage had a mean of 4.33 (standard deviation = 0.52) which indicate that the respondents believe that sufficient consideration was given to this aspect (see table 4.1).

Most of the comments received on this issue refer to the Masterplan study done in 1997 which still forms the basis of the Natref information management study. Concerns were however raised regarding the view of the Natref partners on future oriented technology and it is believed that the full competitive advantage of this system could not realised for the partners as the result of their view.

Resource management

It is important to develop plans for the efficient and effective management of a company's information system resources to enable effective implementation of information systems strategies. Table 4.1 shows that the mean for the responses regarding resource management had a mean of 3.83 (standard deviation = 0.98). This indicates that although resource management was well considered during the execution of the IRIS project, not all respondents agreed that it was sufficient.

The respondents raised various concerns regarding the appointment of developers and IT personnel. Planning on the project had to be completed 80% before any appointments could be made. The developers that were appointed were inexperienced. The planned savings by using inexperienced developers and training did not realise due to the additional time spent on programming and development work. Sometimes they were also used for non-value adding activities.

Personnel instability was experienced in the IT department during the execution of the project. The result was that eventually three different managers consecutively were accountable for the IT/IS function, and the IT/IS function was only part of their portfolio's. Natref was also not successful in the transformation from a traditional information technology approach towards an information management approach.

Despite the instability in the IT department, the plans to utilise hardware, software, data and network resources was viewed as being excellent.

Technology architecture

Technology architecture is important to ensure that information system standards exist for supporting optimum performance of information systems. The responses in table 4.1 indicate that technology policies and technology architecture were well considered (mean = 4.5, standard deviation = 0.55). A further breakdown of technology architecture is given in table 4.2.

Table 4.2: Technology architecture

Question	Average response	Standard deviation
To what extent were the following architecture components considered during the planning phase of IRIS:		
Technology platform – Computer systems, system and application software, and telecommunications networks.	4.67	0.52
Data resources – Operational and specialised databases, including data warehouses, analytical databases, and external data banks	4.67	0.52
Applications portfolio – Support key business functions as well as cross-functional business processes. Include support for inter-organisational business linkages, managerial decision making, and end user computing and collaboration, and strategic initiatives for competitive advantage.	4.60	0.55
IT organisation – Organisation structure of IS function within the organisation.	2.60	1.52

From table 4.2 it can be seen the respondents believe that the technology platform (mean = 4.67; standard deviation = 0.52), data resources (mean = 4.67, standard deviation = 0.52) and applications portfolio (mean 4.60, standard deviation = 0.55) were well considered during the execution of the project. The respondents however feel that the IT organisation, with a mean of 2.60 (standard deviation = 1.52) was not well considered. The large standard deviation is due to the fact that one respondent differed from the other by giving the question a score of 5. This person is directly involved in the IT department, which can possibly indicate that the IT department could have lost touch with the rest of the organisation.

Most respondents viewed the technology architecture as very sound and sensible. One respondent described it as one of the jewels of the system.

The concerns regarding the IT department were mentioned again. The respondents felt that the IM and IT organisation was not considered timely enough. This resulted in a resource crisis and inadequate management depth. The instability of management in the IT/IS environment and the focus of managers resulted in little or no progress in this area. They also feel that very little has happened to align the IT organisation with the vision as defined in the master plan that was developed and approved by management at the start of the project.

4.5.1.2 Implementing business change

Implementing business change forms part of the change management required during the execution of an information systems project. The section of the questionnaire investigating this topic is summarised in table 4.3.

Table 4.3: Implementing business change

Question	Average response	Standard deviation
<i>Top Management support</i> – Was top management involved and committed to the change process?	2.67	1.21
<i>Organisational design</i> – Was a formal organisational change process followed during the change process?	2.00	1.26

Top management support

From table 4.3 it is clear that most of the respondents believe that there was a lack of top management support. This perception is possibly supported by the fact that one of the top management team requested to complete the questionnaire did not respond at all. The standard deviation for the question 1.21 is due to one of the respondents that differed from the others by giving the question a score of 5. This might be because the person was more involved in the development phase, than the implementation phase.

The mean for the question relating to management support is 2.67. This is of great concern due to the importance of management support as explained in paragraph 2.4.5 and paragraph 2.4.7.2. Management must

be at the centre of the information systems planning and is the most critical factor that contribute to the success of IS projects.

The comments from the respondents indicated that top- and line management gave their support verbally. These verbal commitments did however not result in effective actions to improve the change management process. It was also indicated that action was taken when problems arose. These actions were however reactive, while a more pro-active approach was needed to optimise the change management process.

Top management input into the change process and agreed change management planning actions that were assigned to them by the project steering committee was not executed. Top management only got involved when the project personnel requested them to help in resolving some crisis. Some crises re-occurred because the effectiveness of the actions taken by line management was not monitored.

The change management process was also negatively affected by managers that had other priorities that were in competition with the change management process.

Organisational design

IT increasingly changes jobs, skill needs, work, and relationships. Technical change has become synonymous with organisational change. Such change can be complex, painful, and disruptive (O'Brien, 1999:630). It is therefore important to give enough consideration to organisational design during the execution of information systems projects.

From the responses in table 4.3, it is evident that no formal process for organisational change was followed during the implementation of the IRIS project (mean = 2.00, standard deviation = 1.26).

The respondents indicated that the project team made several suggestions for organisational redesign. The idea of organisational redesign was supported by top management. No action was however taken to ensure that organisational changes were implemented in support of the changed business processes.

End user resistance to change

During the implementation of most changes in the workplace, some resistance to change can be expected. It is necessary to limit the resistance to change through focussed actions. Table 4.4 summarises the results dealing with end user resistance to change as part of the business change process.

Table 4.4: End user resistance to change

Question	Average response	Standard deviation
To what extent were the following factors considered and applied from the project execution side?		
Pre-implementation – Gather of data on workplace, personnel work, tasks, etc.	4.33	0.82
Human design – Study automated workplace and establishment of criteria for its human design.	3.60	1.52
Marketing – Develop and implement a strategy for	3.17	0.75

"selling" IRIS and the changes caused by it.		
Education – Educate workers about the demands of IRIS will make on them and the benefits it will provide.	3.00	0.63
Training – Develop and implement of a sequential, natural program of skill growth.	3.17	0.75
Documentation – Compose and distribute documents that explain how the system works.	3.17	0.75
Human communications – Establish and maintain continuing means of communication with workers.	3.00	0.63
Post-implementation – Compile evaluation of each phase into one document and review entire implementation process.	2.83	0.75

The view represented in table 4.4 is from a management and project management perspective.

According to the respondents, pre-implementation work of gathering data on the workplace, personnel work and tasks were done well (mean = 4.33, standard deviation = 0.82).

The human design factor, looking at the automated workplace and developing criteria for its design, had a mean of 3.60. From this mean it seems that good attention was given to this factor. From the standard deviation of 1.52 however, it is clear that not all respondents agree that sufficient attention was given to the human design of this system.

The rest of the aspects addressing end user resistance were only moderately addressed namely:

- Marketing (mean = 3.17, standard deviation = 0.75);
- Education (mean = 3.00, standard deviation = 0.63);
- Training (mean = 3.17, standard deviation = 0.75);

- Documentation (mean = 3.17, standard deviation = 0.75); and
- Human communications (mean = 3.00, standard deviation = 0.63)

It is also clear from the standard deviations of these aspects that there is a high level of agreement on the non-conformance of these aspects.

These aspects are very important in changing the perceptions and attitudes of end users towards the use of a new information system and can contribute to slowing the implementation and use of the system.

It is good practice to evaluate the implementation of bigger projects in order to identify the learning points from such a project. The process followed should then be reviewed and adjusted to incorporate the learning points, and to optimise the process followed. According to the respondents this was not done sufficiently (mean = 2.83, standard deviation = 0.75).

The respondents indicated that change management planning was done well at the start of the IRIS project, especially on the process of selling the process to end-users. End-users were also involved in the initial functional specifications, the technology selection, and the development of interfaces.

Communication during the development and implementation of the IRIS project was good. It did however fail in some instances due the delegation of subordinates to progress discussions. The quality of communication between the project sponsor and top management was also questioned by the respondents.

The focus during the development and implementation of the information systems changed from reducing end user resistance towards solving technical problems in specific business areas. Conflicting priorities and a

lack of commitment and from top- and line management towards the change process further contributed to the lack of reduction in end user resistance.

The respondents also felt that all the documentation that was needed for the operation and training of the IRIS processes was not available. The documentation that was completed is available as help files and training modules on the systems. Users had to rely on coaching and making their own notes during training where the documentation was not available. This training was ineffective in areas where line management support was low and the business processes complex and difficult to understand.

From the results in table 4.4, and the respondents comments, It is clear that more attention must be given to change management. This will reduce end user resistance, and increase their buy in into new systems being developed.

4.5.1.3 Hardware evaluation

Acquiring hardware is one of the major implementation activities in the implementation of information systems (O'Brien, 1999:635). A formal evaluation process reduces the possibility of buying inadequate or unnecessary computer hardware (O'Brien, 1999:637). This section in the empirical study is focussed on determining to what extent the factors of hardware evaluation were present during the implementation of the IRIS project. The results for hardware evaluation are summarised in table 4.5.

Table 4.5: Hardware evaluation

Question	Average response	Standard deviation
To what extent were the following factors considered during hardware evaluation:		
Performance – Speed, capacity, and throughput	4.25	1.50
Cost – Lease or purchase price. Cost of operations and maintenance	4.25	0.96
Reliability – Risk of malfunction and its maintenance requirements. Error control and diagnostic features	4.20	0.84
Availability – Delivery date	4.80	0.45
Compatibility – Compatibility with existing hardware and software. Compatibility with hardware and software provided by competing suppliers.	4.80	0.45
Modularity – Can it be expanded and upgraded by acquiring modular “add on” units?	4.40	1.34
Technology – In what year of its product life cycle is it? Does it use untested technology or does it run the risk of obsolescence?	4.00	1.41
Ergonomics – Has it been “human factor engineered” with the user in mind? Is it user friendly, designed to be safe, comfortable, and easy to use:	4.60	0.55
Connectivity – Can it be easily connected to wide area and local area networks of different types of computers and peripherals?	4.60	0.89
Environmental requirements – What are its electrical power, air conditioning, and other environmental requirements?	4.67	0.58

Software – Is the system and application software available that can best use this hardware?	4.50	1.00
Support – Are the services required to support and maintain it available?	3.40	1.14

The results in table 4.5 indicate that the respondents believe that most of the factors were well considered in the execution of this project. The standard deviation on the following aspects however indicates that some respondents do not agree that they were sufficiently considered:

- Performance (mean = 4.25, standard deviation = 1.50);
- Modularity (mean = 4.40, standard deviation = 1.34);
- Technology (mean = 4.00, standard deviation = 1.41);
- Software (mean = 4.50, standard deviation = 1.00); and
- Support (mean = 3.40, standard deviation = 1.14).

It can also be seen that there are concerns among the respondents about information systems services that are required for supporting and maintaining the systems. Paragraph 4.5.1.5 gives a clearer explanation of exactly what these concerns are.

The respondents indicated that support services are in place for maintaining hardware, but not as per the requirements stipulated by the project. They believe that a very structured and detailed approach was used during the evaluation of hardware. It is true that often the evaluation had to be based on information provided by the suppliers, which sometimes tended to be inaccurate.

4.5.1.4 Software evaluation

Another aspect that is a major implementation activity is software evaluation. As for hardware, a formal evaluation process reduces the risk of buying inadequate or unnecessary software. The extent of software evaluation is evaluated during this section of the questionnaire and the results are summarised in table 4.6.

Table 4.6: Software evaluation

Question	Average response	Standard deviation
To what extent were the following factors considered during software evaluation:		
Efficiency – Is the software a well-written system of computer instructions that does not use much memory capacity or CPU time?	3.25	0.96
Flexibility – Can it handle its processing assignments easily without major modification?	4.40	0.56
Security – Does it provide control procedures for errors, malfunctions, and proper use?	4.20	0.84
Language – Is it written in a programming language used by Natref’s computer programmers and users?	4.00	0.82
Documentation – Is the software well documented? Does it include helpful user instructions?	4.00	0.82
Hardware – Does existing hardware have the features required to best use the software:	4.00	0.71
Performance – Speed, capacity, and throughput	3.80	1.10
Cost – Lease or purchase price. Cost of	3.80	0.84

operations and maintenance.		
Reliability – Risk of malfunction and its maintenance requirements. Error control and diagnostic features.	4.00	0.00
Availability – Delivery date.	4.60	0.56
Compatibility – Compatibility with existing hardware and software. Compatibility with hardware and software provided by competing suppliers.	4.40	0.89
Modularity – Can it be expanded and upgraded by acquiring modular “add on” units?	4.50	1.0
Technology – In what year of its product life cycle is it? Does it use untested technology or does it run the risk of obsolescence?	4.67	0.58
Ergonomics – Has it been “human factor engineered” with the user in mind? Is it user friendly, designed to be safe, comfortable, and easy to use:	4.50	0.58
Support – Are the services required to support and maintain it available?	4.00	0.82

The table indicates that the aspects that are important during a formal software evaluation have been considered well during this project. The respondents are mostly in agreement with each other on most aspects.

It is however felt that the following aspects were only moderately considered:

- Efficiency (mean = 3.25, standard deviation = 0.96);
- Performance (mean = 3.80, standard deviation = 1.10); and
- Cost (mean = 380, standard deviation = 0.84).

The respondents did however indicate specific issues that influenced the implementation of the IRIS project. These issues are described below:

- Web technology were still relatively new when the project started and many costs were incurred in the process of sorting out the instabilities between Oracle and Microsoft to enable systems to run flawlessly. Not enough experience was available in South Africa;
- The database support is outsourced to Oracle SA. They do however not treat Natref as one of their important clients and reporting back on incidents is slow;
- The person trained and experienced for technical support for two critical applications left Natref and management decided not to fill the vacancy without considering and stating the strategy to maintain and support these applications;
- Hardware is generally well considered. Slow speed and response times for database queries came as a surprise;
- Development took too long and a number of years of opportunity benefits are already lost; and
- Complexity caused late delivery.

4.5.1.5 Information systems services

The major sources of information services are computer manufacturers, computer retailers, computer service centres, system integrators, and independent consultants (O'Brien, 1999:636). In the Natref environment, these services are mainly internally located, although some services are outsourced. The level of consideration given to information systems services is summarised in table 4.7.

Table 4.7: Summary of responses to IS services

Question	Average response	Standard deviation
To what extent were the following factors considered during IS Services evaluation:		
Performance – What has been their past performance in view of their past promises?	3.40	1.14
Systems Development – Are systems analysis and programming consultants available? What are their quality and cost?	3.40	1.14
Maintenance – Is equipment maintenance provided? What is its quality and cost?	3.80	0.84
Conversion – What system development, programming, and hardware installation services will they provide during the conversion period?	3.75	0.50
Training – Is the necessary training of personnel provided? What is its quality and cost?	4.60	0.55
Backup – Are several similar computer facilities available for backup purposes?	3.60	0.89
Accessibility – Does the vendor have local or regional office that offers sales, system development, and hardware maintenance services? Is customer hotline provided?	3.75	0.96
Business Position – Is the vendor financially strong, with good industry market prospects?	4.75	0.50
Hardware – Do they have a wide selection of compatible hardware devices and accessories?	4.75	0.50
Software – Do they offer a variety of useful system software and application packages?	4.50	1.00

From table 4.7 it is evident that good consideration was given to training (mean = 4.60, standard deviation = 0.55), business position (mean = 4.75, standard deviation = 0.50), hardware (mean = 4.75, standard deviation = 0.50) and software (mean = 4.50, standard deviation = 1.00). Less consideration was given to past performance (mean = 3.40, standard deviation = 1.14), systems development (mean = 3.40, standard deviation = 1.14), maintenance (mean = 3.80, standard deviation = 0.84), conversion (mean = 3.75, standard deviation = 0.50), and accessibility (mean = 3.75, standard deviation = 0.96). This could indicate a greater emphasis on getting the IRIS project in place and less focus on getting the support structures in place to ensure continuous support for availability of the system.

The respondents indicated that insufficient programmers were available in South Africa. Experienced Oracle developers were extremely scarce and unaffordable. One of the factors affecting their availability was the Y2K problem that coincided with the development phase of the IRIS project. Training of young graduates therefore had to be done before the project commenced. This became a major focus point during the initial stages of the project. The inexperience of these developers caused long delays. Furthermore, the evaluation and support to inexperienced developers with regard to their approach and logic was not adequate.

Vendors for the chosen mass balance and scheduling tools (OpenYield and MIMI) were limited in South Africa.

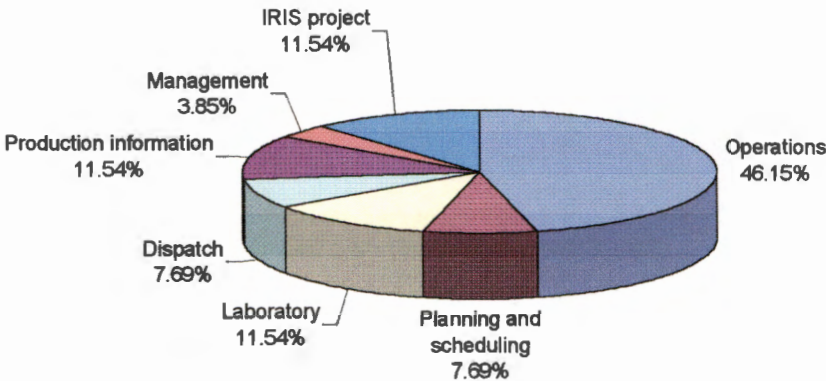
4.5.2 Change management questionnaire

The change management questionnaire was distributed to 26 individuals which included 23 end users and 3 people involved in the management of

the IRIS project. The focus of this questionnaire was more directed towards end user perception of the change management process. It did however include two areas where not all end users could respond, namely software change management and hardware change management. It was therefore necessary to include people more directly involved in these processes in order get a more representative sample.

The geographical distribution of the change management questionnaire is illustrated in Figure 4.1.

Figure 4.1: Geographical distribution of change management questionnaire



4.5.2.1 Software change management

Software change management is one of the three areas of change management that exists in the information systems environment. It is important to have systems in place to ensure that changing end user requirements are sufficiently addressed during the development of an information system. It is further necessary to maintain reliability during the implementation of an integrated information system. The software change management applied during the execution of the IRIS system was investigated in the first section of the change management questionnaire and the results are summarised in table 4.8.

Table 4.8: Software change management

Question	Average response	Standard deviation
Record change requests, indicating the level of importance and module affected.	3.43	0.98
Prioritise change requests with the internal and external customer as must have, nice to have, or later release.	4.14	0.90
Identify responsibility for fixing the problem.	3.88	0.64
Implement changes that are recorded as high priority.	4.13	0.35
Maintain a check of which high-priority errors have been fixed.	3.88	0.64
To what extent was quality assurance procedures formalised and used during the development of the IRIS project?	3.50	0.55

To what extent were the releases of software tracked and version control applied to ensure that software is released systematically and the correct releases of software are in operation?	3.33	0.82
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From the results in table 4.8 it is clear that the respondents are in agreement that the prioritisation of change requests (mean = 4.14, standard deviation = 0.90) were sufficiently done. They are also satisfied that the responsibility for fixing the problem, or executing their request were identified (mean = 3.88, standard deviation =0.64), and that changes identified as a high priority were implemented (mean = 4.13, standard deviation = 0.35).

The respondents are however not fully satisfied that the recording of requests by the end users were sufficiently done (mean = 3.43, standard deviation =0.98). The respondents are of the opinion that control over which high-priority errors were fixed, were only moderately addressed (mean = 3.88, standard deviation = 0.64) and they are not totally convinced that formal quality assurance procedures were followed during the execution of the IRIS project (mean = 3.50, standard deviation = 0.55). The tracking of software version control, especially ensuring that the correct releases are in use, were according to the respondents an area of concern (mean = 3.33, standard deviation = 0.82).

The respondents indicated that internal change procedures for updates on reports and forms were lacking. The procedures that were in place were rigorously applied during the project. After rollout, when responsibility started moving to line managers, the necessary procedures were not always followed.

4.5.2.2 Changeover method

Another change management aspect of importance in the information systems environment is the changeover method. The choice of a specific changeover method impacts on costs, time, and other aspects as described in paragraph 2.4.8.2. The second part of the change management questionnaire focussed on the changeover method and the impact thereof.

The results of the changeover section are summarised in table 4.9.

Table 4.9: Changeover method

Question	Average response	Standard deviation
To what extent was consideration given to the following factors during the IRIS changeover process:		
• Costs	3.75	0.89
• Time	3.44	1.13
• Quality of system after changeover	3.44	0.53
• Impact on customers	3.33	1.50
• Technical issues	3.71	0.49
To what extent were all tasks planned to ensure that all hardware and other infrastructure were in place for the changeover process?	3.60	1.07

It can be seen in table 4.9 that the respondents believe that the cost of changeover was considered well during this project (mean = 3.75, standard deviation = 0.89). The respondents are not fully in agreement that the time it took for the changeover was sufficiently considered as can be seen from the mean of 3.44 and the standard deviation of 1.13.

The respondents believe that the quality of changeover (mean = 3.44, standard deviation = 0.53) was not considered enough and that the technical issues (mean = 3.71, standard deviation = 0.49) identified during the changeover were not sufficiently addressed.

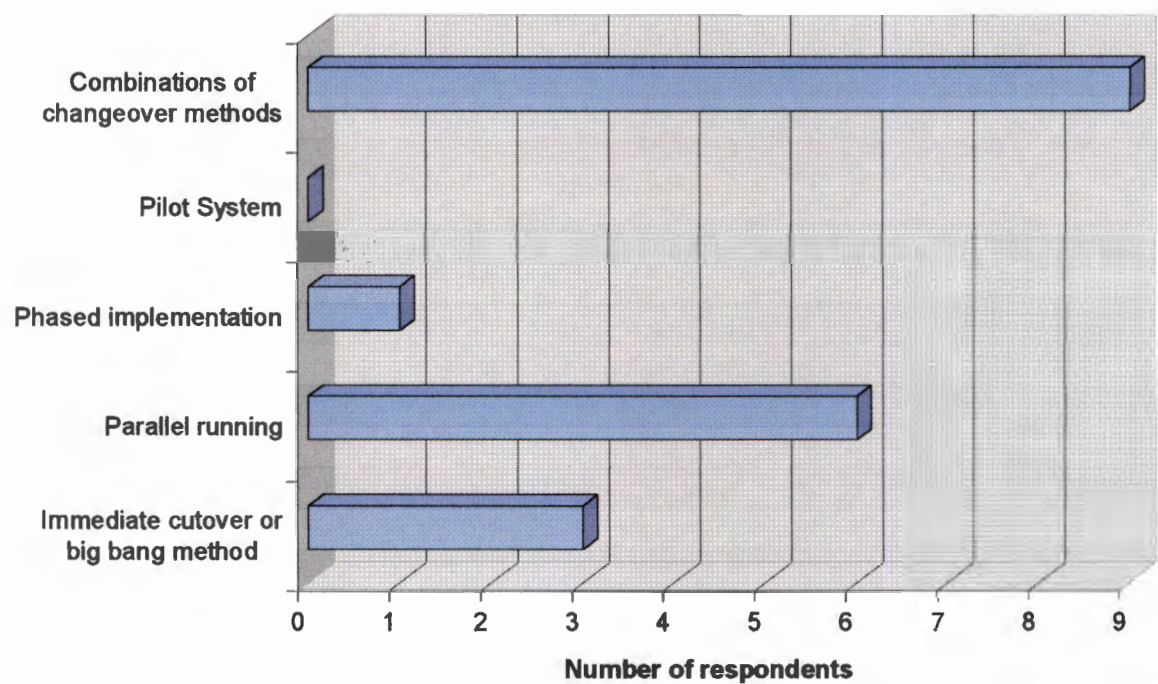
There is disagreement between the respondents with regard to the question if the impact on the customers (in this case the end users) was sufficiently considered. This disagreement can be seen in the standard deviation of 1.50. Most of the respondents however believe that the impact on them as customers was not sufficiently considered during the changeover as can be seen from the mean of 3.33 for this question.

From table 4.9 it can be derived that the respondents believe that more planning was needed to ensure that all hardware and other infrastructure were in place for the changeover process (mean = 3.60). There is some disagreement on this aspect (standard deviation = 1.07).

Factors that contributed to late deployment included a lack of commitment from line management and priority of business was never IRIS implementation.

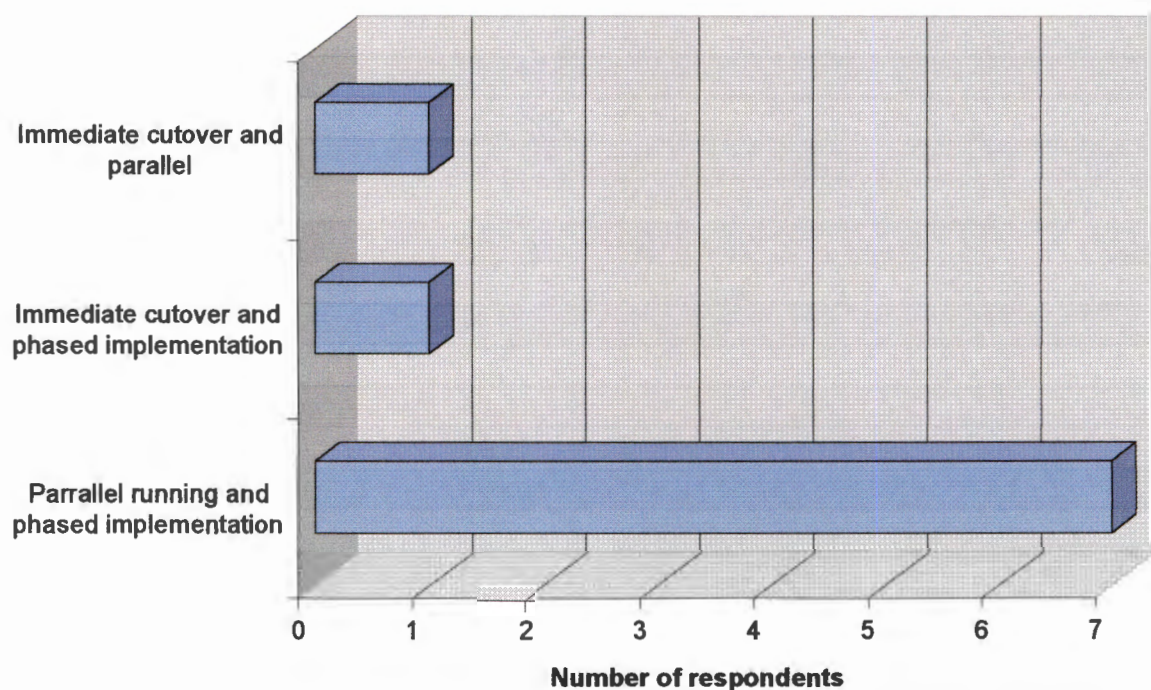
The respondents were asked in the questionnaire to indicate the method of changeover. The result from this question is illustrated in figure 4.2.

Figure 4.2: Changeover method



From figure 4.2 it is evident that most respondents felt that a combination of changeover methods was used. The breakdown of the support for different combinations is shown in figure 4.3. It must also be noted that there are 6 respondents supporting parallel running, and 3 respondents supporting immediate cutover as the method that was used for the change over.

Figure 4.3: Combinations of changeover methods



From figure 4.3 it is clear that most respondents believe that parallel running, in combination with phased implementation were used for the implementation of the IRIS project.

4.5.2.3 Organisational change management

Organisational change management is an important aspect for the successful implementation of information system projects. If done properly it will reduce end user resistance and encourage the use of a new system. The questions relating to organisational change management are summarised in table 4.10.

Table 4.10: Organisational change management

Question	Average response	Standard deviation
To what extent was the purpose of the system explained to employees?	3.36	1.00
To what extent was the effect on employees envisaged and explained to them?	3.05	1.02
To what extent were the users involved in the specification, testing and review of the IRIS project?	3.14	1.06
To what extent were the users trained in the use of the software?	3.23	0.97
To what extent were the views of the users taken into account and acted upon?	3.43	1.16

From table 4.10 it is evident that the users do not believe that organisational change management in its totality was sufficiently addressed. From the mean and standard deviation (relatively high) of each result, it can be derived that there is at least some of the respondents felt that it was sufficiently addressed. It can therefore be concluded that not all end users were reached in the organisational change management efforts.

4.5.2.4 End user involvement

As with organisational change management, end user involvement can be used to reduce end user resistance during the implementation of new information systems. It can also serve to optimise workflow and to reduce some of the tasks and complexity of the systems. The last section of the change management questionnaire investigated the end user involvement

during the implementation of the IRIS project. The results from this section are summarised in table 4.11.

Table 4.11: End user involvement

Question	Average response	Standard deviation
To what extent were the users made part of the project team for feasibility studies?	3.00	1.10
To what extent were the users involved in the approval of the information requirements	2.90	0.94
To what extent were the users involved in the definition of I/O forms, screens, and report formats?	3.10	1.14
To what extent were the users included in the project team for the installation of the IRIS systems?	2.74	1.10
To what extent were the users responsible for the project definition in their respective areas?	3.00	0.97
To what extent did the users define the physical controls and security procedures?	2.68	1.06
To what extent did the users conduct system tests?	2.60	1.10
To what extent were the users involved in the leadership of the project?	2.65	1.23
To what extent was the project initiated by users via a formal request process?	2.74	1.24
To what extent were users involved in the development of project management schedules and progress reports?	2.47	1.26
To what extent were users involved in the approval of management schedules and progress reports?	2.32	1.20

To what extent did user management ensure that users are involved in the project?	3.20	1.11
To what extent did user management assess user participation?	3.30	1.03
To what extent were project team members and users involved in the identification and resolution of critical issues?	3.57	0.98

From the results in table 4.11 it can be concluded that end user involvement was not sufficiently addressed. As for organisational change management, it seems that at least some of the end users were involved during the execution of the IRIS project.

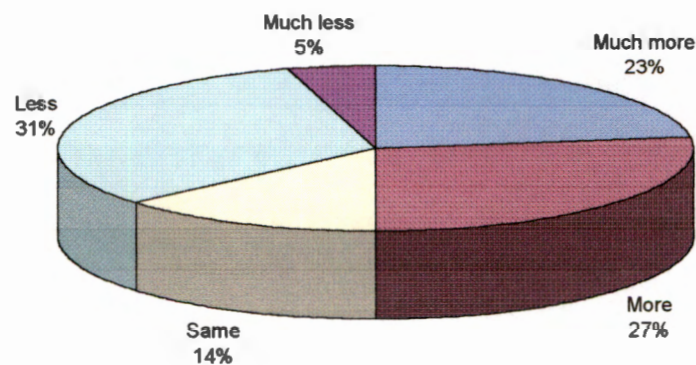
The involvement of project team members and end users in the resolution of critical issues is the only aspect that was sufficiently addressed (mean = 3.57, standard deviation = 0.98). This aspect is very important because it addresses to some extent the optimisation of the system and ensures the correct functionality in the system.

Task intensity and system complexity

In developing a new system, it is important to optimise workflow and work processes. This usually results in a reduction of task intensity and complexity of the system. These two factors were specifically investigated as part of the third section of the questionnaire.

On the question on how task intensive the result of the project, compared to the original work methods is, the respondents responded as illustrated in figure 4.4.

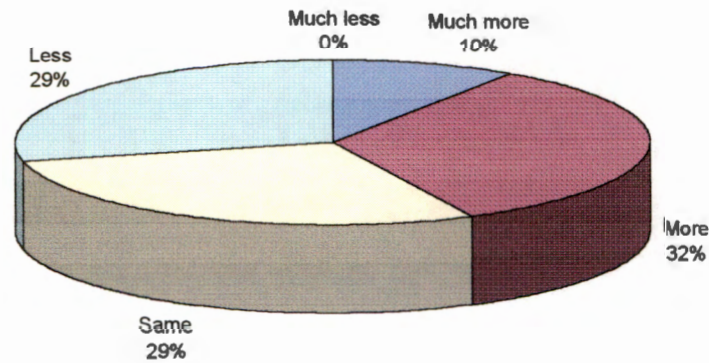
Figure 4.4: Task intensity



From figure 4.4 it is evident that the end users had mixed feelings on the task intensity of the new system. It however indicative that half the people felt that there was an increase in the task they had to execute with 23% responding that their tasks intensified. 36% of the respondents felt that their task intensity decreased with only 5% reporting a dramatic decrease in their task intensity. It must be noted that the effect on the users will differ because they are using different functionalities of the system.

Mixed feelings do also exist on whether system complexity increased or decreased. The results on the question relating to system complexity are illustrated in figure 4.5.

Figure 4.5: System complexity



None of the respondents felt that the system became much less complex. Of the respondents, 29% felt that system complexity became less, 29% felt it stayed the same and 32% felt that the system is more complex. Only 10% of the respondents felt that the system became much more complex than in the past.

From the comments from the respondents, it is clear that there was an increase of work, especially in the offsite division. The main reason for this is the decentralisation of the responsibility for data. The end users did acknowledge that IRIS is a good system and that there are definite benefits to the business. Concerns were also raised on the complexity of the system and some duplication on paper.

The availability of the project team to assist during the implementation of the project was highlighted as being excellent. This had the effect that the operators are committed and know how to use the system.

Although the result of the project is more task intensive in some divisions, preliminary data is available on a daily basis. Previously it was only available on a weekly basis. This enables management to make quicker and more informed decisions regarding the optimisation of the production units.

4.6 Summary

During this chapter, the preparation of the questionnaires for the gathering of data for the empirical study was discussed. Two questionnaires were drawn up focussing on the project management and change management processes. These questionnaires were distributed to individuals involved in the execution of the IRIS project at Natref, and the end users of the IRIS system. The responses received back on the questionnaires were 87.5% and 84.6% respectively.

The responses were statistically processed and the results of the responses were discussed. Conclusions from this study, and recommendations to address identified gaps, will be discussed in chapter 5.

Chapter 5: Conclusions and recommendations

5.1 Introduction

In this final chapter, conclusions and recommendations will be made relating to the objectives of the study. Initially the conclusions reached from the empirical study will be discussed, whereafter some recommendations will be made. These recommendations will be based on the following:

- The knowledge of experts and researchers as discussed in the literature study (Chapter 2);
- The company profile (Chapter 3); and
- Results gained from the empirical investigation on project execution and change management (Chapter 4).

Finally, a brief evaluation will be done to confirm that the objectives of this study are met.

5.2 Conclusions based on the empirical study

The starting point of information management systems is developing an information systems strategy that supports the vision and business objectives of a company. From the information management strategy, plans must be developed to put the strategy into practice. These plans would normally include projects to develop and implement information

systems. Various methodologies exist for information systems planning and project execution as described in paragraphs 2.3.6 and 2.4.9.

Management commitment and support during the strategic process, information systems planning, and project execution, is extremely important as described in paragraphs 2.2.1, 2.4.1, 2.4.2 and 2.4.7.2.

Change management is the key to the successful implementation of any information system. It is important to start the change management process with the initiation of the project, and continue with it until the project is completed.

The integration of information systems certainly makes business sense because it improves the flow of information in an organisation, and at the same time reduces costs related to licensing, developing and maintenance of software.

With this background in mind, the following conclusions can be made:

5.2.1 Information systems strategy

The first important conclusion that can be drawn from this study is that a high level of strategic importance was given to information systems at Natref during 1997. Information management was believed to be the key strategic enabler in realising Natref's pacesetter vision. This is evident from the Masterplan study done in 1997 and the results on business alignment and competitive advantage as described in paragraph 4.5.1.1.

It is however a concern that the information management strategy have not been updated since 1997. This could indicate that the strategic

importance of information systems is missing at this stage. It could lead to losing any competitive advantage that the IRIS project was focussed on.

5.2.2 Information systems planning

Information systems planning forms an integral part of the IM strategy and is focussed on business alignment, competitive advantage, resource management and technology architecture. It normally takes on a long-term approach.

It can be concluded from the results in paragraph 4.5.1.1 that information systems planning was done well in the beginning of the IRIS project. The planning however lacked in resource management. The instability in the management of the IT department, as well as the use of inexperienced developers can be viewed as the most important reasons for the lack in resource management.

5.2.3 Change management

5.2.3.1 Top management support

Any change in an organisation creates some uncertainty for employees. These changes could be organisation structures, implementation of new systems, plant modifications, and many more. It is important that the leaders in the organisation show their support by ensuring that resources are available, and demonstrate their commitment to the changes.

From paragraph 4.5.1.2, it can be concluded that there was a lack of management support during the implementation of the IRIS system.

The main reasons for the lack in support is:

- Diluted management focus;
- Changes in the management team;
- Lack of project background and skills;
- Conflicting priorities; and
- Sponsor's efforts not supported by all management team members.

From the comments received, it seems that many frustrations were caused by this lack of management support.

5.2.3.2 Organisational design

Organisations must be structured in such a way that the strategy of the company is supported by its structure. It is therefore necessary to do a formal evaluation of organisational structures to ensure that changes in the business processes are supported by the organisational structures.

It can however be concluded from paragraph 4.5.1.2 that the organisational design was not changed to support the implementation of the IRIS project or its associated changes in business processes.

This conclusion is also supported by the instability experienced in the IT department during this period.

5.2.3.3 End user participation and resistance to change

From the literature study (paragraph 2.4.8.3.), it is evident that end user participation on all levels of the project execution is necessary. Two main reasons exist for this namely:

- Participation reduces end user resistance to change, ensuring that they will be more committed to making the change a success; and
- User requirements are thoroughly considered and their work processes can therefore be optimised.

The discussion in paragraph 4.5.1.2 (table 4.4) indicated that the marketing (development and implementation of a strategy for “selling” the IRIS project and the changes caused by it), end user education and training, documentation and human communication during the execution of the IRIS project was moderately addressed. It was further indicated in paragraph 4.5.2.3 that organisational change management was insufficient during the execution of the IRIS project. From paragraph 4.5.2.4, it is evident that end user involvement was not sufficiently addressed.

It can therefore be concluded that end user participation was low and this possibly led to end user resistance during the implementation of the IRIS project. This part of the change management process can therefore be viewed as unsuccessful.

5.2.3.4 Hardware evaluation

During the implementation of any information systems project, it is important to ensure that the hardware needed for the new system is

compatible with the existing structures. It includes computer equipment, telecommunications and software compatibility. It is also important to ensure that the maintenance of this equipment be considered because availability of hardware is important. The environment where the equipment will be used can influence the availability and type of equipment needed.

From paragraph 4.5.1.3 it can be concluded that sufficient effort went into the evaluation of hardware needed for the implementation of the IRIS project. It was also addressed by the Masterplan study.

5.2.3.5 Software evaluation and software change management

The importance of evaluating software lies, as for hardware, in compatibility with existing systems. This is of critical importance when systems are integrated. Additional reasons for software evaluations include the limitation of additional licensing fees, reduction of interface development, and upgrading and maintenance of systems. Training and the costs associated with it is also important in ensuring that end users can use the new system.

It can be concluded from paragraph 4.5.1.4 that the software selected during the development and implementation of the IRIS project was well considered.

From paragraph 4.5.2.1, it can be concluded that there is some gaps in the software change management process. These gaps are the recording of change requests, software quality assurance, and the control on software releases.

5.2.3.6 Information systems services

Information systems services in general are responsible to ensure the reliability of an information system. As mentioned in paragraph 4.5.1.5 these services can be internally or externally to an organisation. It was also mentioned that these services are mainly supplied internally in Natref, although some specialised services are outsourced.

Paragraph 4.5.1.5 describes the responses to the information systems services questions included in the project execution questionnaire. From the results in this paragraph, it can be concluded that the information system services have been considered fairly well during the IRIS project.

The deficiencies in the evaluation of information systems services include:

- Lack of past experience and performance; and
- The availability of programming consultants and the quality and cost associated with them.

As mentioned earlier the use of inexperienced programmers for this project is the main contributing factor for these deficiencies. These programmers were furthermore appointed on a temporary basis, which resulted in the loss of skills, in the form of programmers, at the end of the project.

5.3 Recommendations

Throughout this study, it became evident that the implementation of information systems need to be managed from a strategic perspective, and cannot be managed as a once-off implementation of information systems. It is also evident that for the successful implementation of

information systems a structured process needs to be followed to ensure that all facets of the project are sufficiently addressed.

The following recommendations are provided solely as a guide to small refineries that need to implement or develop integrated information systems, and are particularly of interest to Natref where the case study was conducted.

5.3.1 Objectives

The primary objective of implementing information systems in a company is to ensure a competitive advantage when compared to other companies. This implies that information systems must serve to optimise and support business processes and must be innovative in nature. Therefore, the goals of implementing integrated information systems should be to:

- Identify ineffective business processes and external drivers;
- Develop a strategy to address these inefficiencies;
- Develop a plan to optimise information systems to optimise business processes;
- Implementation of the plan through specific projects; and
- Evaluating the results of the plan and projects.

5.3.2 Strategic management of information systems

Since it is of strategic importance to manage information systems, it is necessary to recommend a method of capturing the strategic issues that need to be addressed. There are two levels of significance that need to be managed namely the internal business processes and the external environment.

The first step is to put structures in place to capture the internal business processes and to evaluate them for inefficiencies. It is proposed to establish a forum where each division in the company is represented (preferably by the divisional managers). This forum will focus on present business processes and will identify opportunities for the optimisation thereof. This forum will be able to identify external and internal threats to a specific business area. In order to demonstrate top management support in this process, it is recommended that at least one representative from the top management team forms part of this forum. This will also serve as a link between this forum and top management. It is recommended that this forum meet at least four times per year to ensure continuity in the process. This forum can be viewed as the tactical IS forum

By implementing the above mentioned recommendation the following objectives will be achieved:

- Involvement of end user representatives in the information management of the company;
- A better understanding of each division's role in the optimisation of business processes;
- Identification of opportunities from each business division; and
- Top management support.

The second recommended step is to establish a strategic perspective on the internal business processes, and to include external threats or opportunities in the information systems strategy. Top management and in particular the IM manager will be vital for the success of this process. It is therefore proposed that the top management team of the company review and revise the information strategy at least once per year. It is further recommended that they consider the proposals from the lower level forum at six monthly intervals. This forum is responsible for approving initiatives

and ensuring the availability of resources to drive the initiatives. This forum can be viewed as the IM steering committee.

The result from the second recommendation will achieve the following objectives:

- Top management commitment for the continuous development and optimisation of business processes;
- An information systems strategy that is alive and aligned with changing business objectives and external environment;
- Resources will be available for continuous improvement of information systems; and
- Management support for all information systems initiatives.

5.3.3 Information systems planning

The information systems planning need to be a formalised process that is primarily driven by the IM division with assistance from other divisions. The two separate forums described in paragraph 5.3.2 forms the basis for the information systems planning.

The information system objectives from these two forums must be evaluated and IS projects identified. The projects must then be prioritised. The higher priority projects must be implemented and the amount of projects handled at any particular point is dependent on the availability of resources. A formal project execution plan must be followed to ensure the successful implementation of information systems projects as described in the next paragraph.

5.3.4 Information systems project

The success of an information systems project is largely dependent on the successful management of IS projects. It is therefore necessary to ensure that a suitable project model is followed. The resources and skills available in an organisation determine largely how IS projects will be executed in that organisation. It is normally difficult for smaller companies to retain IS resources due to the high degree of specialisation in the field, and the growing market for IS specialists. They therefore tend to move towards outsourcing with longer-term contracts for the maintenance and implementation of IS systems.

It is also important for information systems projects to be completed in the shortest possible time to ensure a competitive advantage, and to keep pace with the fast changing technology environment.

As mentioned in paragraph 3.3, Natref has a permanent workforce of 597 of which 19 people (3.2%) work in the IT division. Natref is therefore a relative small company and from the experience on the IRIS project does not have the capacity or skills to implement large projects in a short period and at low costs.

It is therefore recommended for Natref (and similar refineries or companies) to outsource as many of their IS development and maintenance as possible and to retain only a small core of specialists to protect the interest of the company. It is recommended that longer term alliances with two or three credible IS companies must be put in place to ensure that they can supply the necessary resources and support to maintain existing systems, and to implement new projects.

The project model proposed for this environment is shown in figure 5.1.

Figure 5.1: Project execution model for small businesses

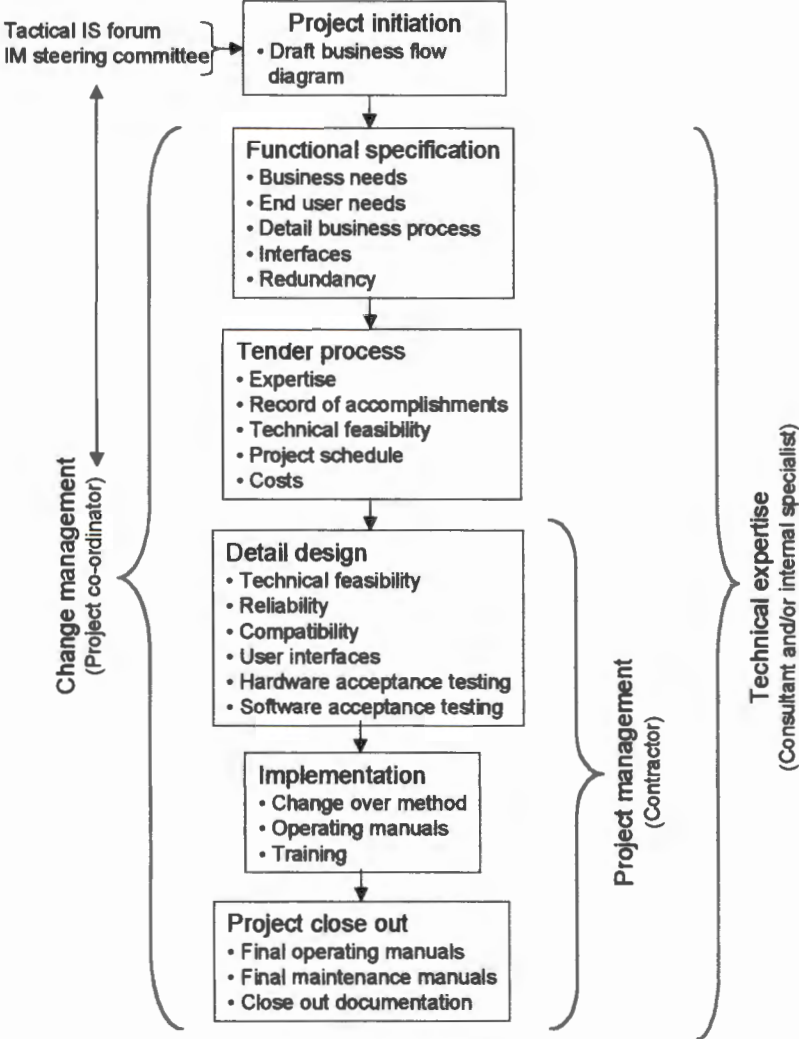


Figure 5.1 is described in the following paragraphs.

5.3.4.1 Project initiation

Projects must be initiated using the tactical IS forum and the IM steering committee. Once they have approved the priority of a project, the project must be started.

The first step will be to make limited resources available to draft an outline of the project. The outline of the project consists of a rough flow diagram indicating the proposed business process. The purpose of the outline is to appoint a consultant and/or internal specialist to assist in the next phases of the project. A project co-ordinator from the most affected business area must also be appointed at this stage of the project

Once a consultant and/or internal specialist has been assigned to the project, the project initiation is completed.

To clarify the purpose of the project co-ordinator, internal specialist, and consultant, their roles are described below.

Project co-ordinator

The project co-ordinator will be responsible for all change management processes. He/she must ensure participation of all affected parties during the development and implementation of the project. He/she will also be responsible to co-ordinate and liase with contractors to ensure that all goals relating to the project are met. He/she therefore need to be relatively senior in the company, and must know the affected business processes well.

Consultant

A consultant will not be appointed under all circumstances. The appointment of a consultant will depend on the availability of an internal specialist, and the specific expertise needed in the development of the project. The role of the consultant will be to develop the functional specification for the project and tender documents for the project. He/she will advise the refinery on the technical viability of the tender proposals. Because of this involvement, the consultant must be independent from the companies involved in the tender process.

Internal specialist

The internal specialist will perform the task of the consultant, as described above, if no consultant is appointed. In addition to this task, he/she will supply technical information regarding existing information systems and infrastructure and will look after the interest of the company from a technical and cost of software and hardware perspective.

He/she must therefore be up to date with newest technology, and the costs of technology.

5.3.4.2 Functional specification

It is proposed that all affected parties must be included during the functional specification. During this phase all the business needs, including end-user needs must be taken into consideration. It is therefore imperative that as many of the end-users as possible must be consulted.

The functional specification must outline the business processes in as much detail as possible. All interfaces must be specified and all redundancy and disaster recovery needs must be included. It must also be indicated what the companies standards are. Care must however be taken not to fix the scope to such an extent that innovations cannot be proposed by the tenders.

Consideration must be given to the change over method that will be suitable for the business processes that are changed, and it must be included in this specification.

The functional specification will be used as the basis for tendering on the information system.

5.3.4.3 Tender process

The functional specification and commercial requirements must be sent out to reliable information systems companies. The two or three companies mentioned in paragraph 5.3.4 must as far as possible be included in this process to limit the amount of companies involved in the maintenance of future systems. It may however not be possible in all cases, and prospective tenderers must be selected based on their expertise and record of accomplishment.

The tenders must be evaluated against the compliance with the functional specification, technical feasibility, project schedule, and costs.

5.3.4.4 Detail design

It is recommended that the detail design of new information systems be outsourced. This recommendation is based on the limited resources and project management expertise available in Natref. The contractor selected will be responsible for the final technical design and must do risk analysis on his proposals in conjunction with the company's representative.

All design detail must be evaluated and approved by the internal specialist for technical feasibility, reliability and compatibility. The proposed forms and user interfaces must be approved by both the project co-ordinator and end user representatives. All software and hardware must be tested for stability and functionality by the contractor, internal specialist, project co-ordinator, and end user representatives.

5.3.4.5 Project management

The contractor will be responsible for the project management for the information system that is being designed. This also includes managing any part of the project that Natref may control, as well as costs control. The project co-ordinator must keep track of progress and costs of the project to protect the interest of the company. Any project changes must be negotiated with the project co-ordinator.

5.3.4.6 Change management

Change management is the most important part of the project to ensure successful implementation of information system.

The project co-ordinator is responsible for change management. He must maintain communication to end-users and management throughout the project. He must ensure that the contractor supplies the necessary operating manuals and training for both hardware and software. He must also ensure that the implementation of hardware and software are done with minimum interruption and must co-ordinate this action with the project manager.

5.3.4.7 Project close out

The contractor must supply all documentation relating to hardware, software, operating and maintenance manuals, and close out documentation to the project co-ordinator. The project co-ordinator must ensure that the documentation is put into the Natref document control system to ensure availability.

The project co-ordinator must facilitate a session where all facets of the information system project are reviewed. All inefficiencies must be identified and proposals must be made to improve the process. The proposals must be accepted by the tactical IS forum and the IM steering committee.

5.4 Study evaluation

The primary objective of this study was to develop a methodology for the development and implementation of information systems in organisations that do not have the critical mass to support a full scale information management department. Detailed recommendations were based on

information gathered in the literature study and the results of the empirical study. In the process of achieving the primary objective, proposals were made for structures in an organisation to facilitate:

- Strategic information management in small businesses; and
- Change management for the development and implementation of information systems.

It can be concluded that the objective of the study has been accomplished and that the total result of the study can be viewed as successful and satisfactory.

5.5 Summary

This chapter concluded the empirical study as described in chapter 4. Based on the conclusions and the literature study in chapter 2, the following recommendations have been made to fill the gaps that were identified:

- The establishment of an tactical IS forum;
- The establishment of an IM steering committee;
- A formal IS planning process;
- The outsourcing of development and maintenance of information systems by small companies; and
- A project execution model for small businesses.

Although some of the recommendations would certainly be applicable to larger organisations, the model is however limited in its application to relatively small refineries and similar businesses that cannot support full time developers.

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Appendix A: Project Execution Questionnaire

The following questionnaire is designed to identify possible learning points from the IRIS project recently completed at Natref. The information supplied will be used for the completion of a management report. The main purpose of the management report is to identify learning points from the process followed during the execution of the IRIS project, and to make proposals as to project execution in the information systems environment for similar systems.

You will be required to complete only the questions that you have direct knowledge or clearly defined opinion about. Please indicate if you are not in a position to answer a particular question.

In general a 5-point scale will be used unless otherwise indicated. Please mark the applicable square with an X.

After each section or subsection space is allowed for comments.

1. Planning:

Scale:

- 1 - Not considered at all
- 2 - Moderate consideration was given
- 3 - Average consideration was given and was partly
 incorporated in project
- 4 - Good consideration was given and it was sufficiently
 incorporated in the project
- 5 - Was fully considered and incorporated in project

To what extent were the following objectives considered during the planning phase of IRIS:

- **Business alignment** – Aligning investment in information technology with the company’s business vision and strategic business goals.

1 2 3 4 5

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- **Competitive advantage** – Exploiting information technology to create innovative and strategic business information systems for competitive advantage.

1 2 3 4 5

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- **Resource management** – Developing plans for the efficient and effective management of a company’s information system resources, including IS personnel, hardware, software, data, and network resources.

1 2 3 4 5

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- **Technology architecture** – Developing technology policies and designing an information technology architecture for the organisation.

1 2 3 4 5

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Comments:

Information Technology Architecture:

Scale:

- 1 - Not considered at all
- 2 - Moderate consideration was given
- 3 - Average consideration was given and was partly incorporated in project
- 4 - Good consideration was given and it was sufficiently incorporated in the project
- 5 - Was fully considered and incorporated in project

To what extent were the following architecture components considered during the planning phase of IRIS:

- **Technology platform** – Computer systems, system and application software, and telecommunications networks.

1 2 3 4 5

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Computer systems considered:

System and application software considered:

Telecommunications networks considered:

- **Data resources** – Operational and specialised databases, including data warehouses, analytical databases, and external data banks.

1 2 3 4 5

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Data resources considered (examples: Access, Oracle):

- **Applications portfolio** – Support key business functions as well as cross-functional business processes. Include support for inter-organisational business linkages, managerial decision making, and end user computing and collaboration, and strategic initiatives for competitive advantage.

1 2 3 4 5

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- **IT organisation** – Organisation structure of IS function within the organisation.

1 2 3 4 5

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Comments:

2. Implementing Business Change

Scale:

- 1 - Not at all
- 2 - Somewhat
- 3 - Average
- 4 - Sufficient
- 5 - Fully

- **Top Management support** – Was top management involved and committed to the change process?

1 2 3 4 5

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- **Organisational design** – Was a formal organisational change process followed during the change process?

1 2 3 4 5

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End user resistance to change:

Scale:

- 1 - Not considered at all
- 2 - Moderate consideration was given
- 3 - Average consideration was given and was partly incorporated in project
- 4 - Good consideration was given and it was sufficiently incorporated in the project
- 5 - Was fully considered and incorporated in project

To what extent were the following factors considered and applied from the project execution side?

- **Pre-implementation** – Gather of data on workplace, personnel work, tasks, etc.

1 2 3 4 5

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- **Human design** – Study automated workplace and establishment of criteria for its human design.

1 2 3 4 5

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- **Marketing** – Develop and implement a strategy for “selling” IRIS and the changes caused by it.

1 2 3 4 5

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- **Education** – Educate workers about the demands of IRIS will make on them and the benefits it will provide.

1 2 3 4 5

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- **Training** – Develop and implement of a sequential, natural program of skill growth.

1 2 3 4 5

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- **Documentation** – Compose and distribute documents that explain how the system works.

1 2 3 4 5

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- **Human communications** – Establish and maintain continuing means of communication with workers.

1 2 3 4 5

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- **Post-implementation** – Compile evaluation of each phase into one document and review entire implementation process.

1 2 3 4 5

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Comments:

3. Evaluating Hardware, Software, and Services

Hardware evaluation:

Scale:

- 1 - Not considered at all
- 2 - Moderate consideration was given
- 3 - Average consideration was given and was partly incorporated in project
- 4 - Good consideration was given and it was sufficiently incorporated in the project
- 5 - Was fully considered and incorporated in project

To what extent were the following factors considered during hardware evaluation:

- **Performance** – Speed, capacity, and throughput

1 2 3 4 5

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- **Cost** – Lease or purchase price. Cost of operations and maintenance.

1 2 3 4 5

--	--	--	--	--

- **Reliability** – Risk of malfunction and its maintenance requirements.
Error control and diagnostic features.

1 2 3 4 5

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- **Availability** – Delivery date.

1 2 3 4 5

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- **Compatibility** – Compatibility with existing hardware and software. Compatibility with hardware and software provided by competing suppliers.

1 2 3 4 5

--	--	--	--	--

- **Modularity** – Can it be expanded and upgraded by acquiring modular “add on” units?

1 2 3 4 5

--	--	--	--	--

- **Technology** – In what year of its product life cycle is it? Does it use untested technology or does it run the risk of obsolescence?

1 2 3 4 5

--	--	--	--	--

- **Ergonomics** – Has it been “human factor engineered” with the user in mind? Is it user friendly, designed to be safe, comfortable, and easy to use:

1 2 3 4 5

--	--	--	--	--

- **Connectivity** – Can it be easily connected to wide area and local area networks of different types of computers and peripherals?

1 2 3 4 5

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- **Environmental requirements** – What are its electrical power, air conditioning, and other environmental requirements?

1 2 3 4 5

--	--	--	--	--

- **Software** – Is the system and application software available that can best use this hardware?

1 2 3 4 5

--	--	--	--	--

- **Support** – Are the services required to support and maintain it available?

1 2 3 4 5

--	--	--	--	--

Comments:

Software evaluation:

Scale:

- 1 - Not considered at all
- 2 - Moderate consideration was given
- 3 - Average consideration was given and was partly incorporated in project
- 4 - Good consideration was given and it was sufficiently incorporated in the project
- 5 - Was fully considered and incorporated in project

To what extent were the following factors considered during software evaluation:

- **Efficiency** – Is the software a well-written system of computer instructions that does not use much memory capacity or CPU time?

1 2 3 4 5

--	--	--	--	--

- **Flexibility** – Can it handle its processing assignments easily without major modification?

1 2 3 4 5

--	--	--	--	--

- **Security** – Does it provide control procedures for errors, malfunctions, and proper use?

1 2 3 4 5

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- **Language** – Is it written in a programming language used by Natref's computer programmers and users?

1 2 3 4 5

--	--	--	--	--

- **Documentation** – Is the software well documented? Does it include helpful user instructions?

1 2 3 4 5

--	--	--	--	--

- **Hardware** – Does existing hardware have the features required to best use the software:

1 2 3 4 5

--	--	--	--	--

- **Performance** – Speed, capacity, and throughput

1 2 3 4 5

--	--	--	--	--

- **Cost** – Lease or purchase price. Cost of operations and maintenance.

1 2 3 4 5

--	--	--	--	--

- **Reliability** – Risk of malfunction and its maintenance requirements. Error control and diagnostic features.

1 2 3 4 5

--	--	--	--	--

- **Availability** – Delivery date.

1 2 3 4 5

--	--	--	--	--

- **Compatibility** – Compatibility with existing hardware and software.
Compatibility with hardware and software provided by competing suppliers.

1 2 3 4 5

--	--	--	--	--

- **Modularity** – Can it be expanded and upgraded by acquiring modular “add on” units?

1 2 3 4 5

--	--	--	--	--

- **Technology** – In what year of its product life cycle is it? Does it use untested technology or does it run the risk of obsolescence?

1 2 3 4 5

--	--	--	--	--

- **Ergonomics** – Has it been “human factor engineered” with the user in mind? Is it user friendly, designed to be safe, comfortable, and easy to use:

1 2 3 4 5

--	--	--	--	--

- **Support** – Are the services required to support and maintain it available?

1 2 3 4 5

--	--	--	--	--

Comments:

IS Services evaluation:

Scale:

- 1 - Not considered at all
- 2 - Moderate consideration was given
- 3 - Average consideration was given and was partly incorporated in project
- 4 - Good consideration was given and it was sufficiently incorporated in the project
- 5 - Was fully considered and incorporated in project

To what extent were the following factors considered during IS Services evaluation:

- **Performance** – What has been their past performance in view of their past promises?

1 2 3 4 5

--	--	--	--	--

- **Systems Development** – Are systems analysis and programming consultants available? What are their quality and cost?

1 2 3 4 5

--	--	--	--	--

- **Maintenance** – Is equipment maintenance provided? What is its quality and cost?

1 2 3 4 5

--	--	--	--	--

- **Conversion** – What system development, programming, and hardware installation services will they provide during the conversion period?

1 2 3 4 5

--	--	--	--	--

- **Training** – Is the necessary training of personnel provided? What is its quality and cost?

1 2 3 4 5

--	--	--	--	--

- **Backup** – Are several similar computer facilities available for backup purposes?

1 2 3 4 5

--	--	--	--	--

- **Accessibility** – Does the vendor have local or regional office that offers sales, system development, and hardware maintenance services? Is customer hotline provided?

1 2 3 4 5

--	--	--	--	--

- **Business Position** – Is the vendor financially strong, with good industry market prospects?

1 2 3 4 5

--	--	--	--	--

- **Hardware** – Do they have a wide selection of compatible hardware devices and accessories?

1 2 3 4 5

--	--	--	--	--

- **Software** – Do they offer a variety of useful system software and application packages?

1 2 3 4 5

--	--	--	--	--

Comments:

Demographic Information:

Age: _____.

Position: _____.

Division: _____.

Appendix B: Change Management Questionnaire

The following questionnaire is designed to identify possible learning points from the IRIS project recently completed at Natref. The information supplied will be used for the completion of a management report. The main purpose of the management report is to identify learning points from the process followed during the execution of the IRIS project, and to make proposals as to project execution in the information systems environment for similar systems.

You will be required to complete only the questions that you have direct knowledge of or a clearly defined opinion about. Please indicate if you are not in a position to answer a particular question.

In general, a 5-point scale will be used unless otherwise indicated. Please mark the applicable square with an X.

Scale:

- | | | |
|---|---|----------------------|
| 1 | - | Not at all |
| 2 | - | Sometimes / somewhat |
| 3 | - | Intermediate |
| 4 | - | Mostly |
| 5 | - | Always |

After each section or subsection, space is allowed for comments.

Please note that the information regarding the individuals will be treated confidentially.

1. Software change management

To what extent were the following steps applied for managing of changing requirements:

- Record change requests, indicating the level of importance and module affected.

1	2	3	4	5
---	---	---	---	---

- Prioritise change requests with the internal and external customer as must have, nice to have, or later release.

1	2	3	4	5
---	---	---	---	---

- Identify responsibility for fixing the problem.

1	2	3	4	5
---	---	---	---	---

- Implement changes that are recorded as high priority.

1	2	3	4	5
---	---	---	---	---

- Maintain a check of which high-priority errors have been fixed.

1	2	3	4	5
---	---	---	---	---

1.1 **Software quality assurance**

To what extent was quality assurance procedures formalised and used during the development of the IRIS project?

1	2	3	4	5
---	---	---	---	---

1.2 Configuration management

To what extent were the releases of software tracked and version control applied to ensure that software are released systematically and the correct releases of software are in operation?

1	2	3	4	5
---	---	---	---	---

Comments:[illegible]

2. Changeover method

To what extent were consideration given to the following factors during the IRIS changeover process:

- Costs

1	2	3	4	5
---	---	---	---	---

- Time

1	2	3	4	5
---	---	---	---	---

- Quality of system after changeover

1	2	3	4	5
---	---	---	---	---

- Impact on customers

1	2	3	4	5
---	---	---	---	---

- Technical issues

1	2	3	4	5
---	---	---	---	---

What method of changeover was used for the implementation of the IRIS project?

Immediate cutover or big bang method	
Parallel running	
Phased implementation	
Pilot system	
Combinations of changeover methods (Indicate which combinations in the space provided below)	

• **Deployment planning**

To what extent were all tasks planned to ensure that all hardware and other infrastructure was in place for the changeover process?

1	2	3	4	5
---	---	---	---	---

Was a formal schedule used?

Yes	No
-----	----

Comments:

3. Organisational change management

To what extent was the purpose of the system explained to employees?

1	2	3	4	5
---	---	---	---	---

To what extent was the effect on employees envisaged and explained to them?

1	2	3	4	5
---	---	---	---	---

To what extent were the users involved in the specification, testing and review of the IRIS project?

1	2	3	4	5
---	---	---	---	---

To what extent were the users trained in the use of the software?

1	2	3	4	5
---	---	---	---	---

To what extent were the views of the users taken into account and acted upon?

1	2	3	4	5
---	---	---	---	---

3.1 *User Involvement*

To what extent were the users made part of the project team for feasibility studies?

1	2	3	4	5
---	---	---	---	---

Approximately how many users were interviewed to obtain information?

--

To what extent were the users involved in the approval of the information requirements:

1	2	3	4	5
---	---	---	---	---

To what extent were the users involved in the definition of I/O forms, screens, and report formats?

1	2	3	4	5
---	---	---	---	---

To what extent were the users included in the project team for the installation of the IRIS systems?

1	2	3	4	5
---	---	---	---	---

To what extent were the users responsible for the project definition in their respective areas?

1	2	3	4	5
---	---	---	---	---

To what extent did the users define the physical controls and security procedures?

1	2	3	4	5
---	---	---	---	---

To what extent did the users conduct system tests?

1	2	3	4	5
---	---	---	---	---

To what extent were the users involved in the leadership of the project?

1	2	3	4	5
---	---	---	---	---

To what extent was the project initiated by users via a formal request process?

1	2	3	4	5
---	---	---	---	---

To what extent were users involved in the development of project management schedules and progress reports?

1	2	3	4	5
---	---	---	---	---

To what extent were users involved in the approval of management schedules and progress reports?

1	2	3	4	5
---	---	---	---	---

To what extent did user management ensure that users are involved in the project?

1	2	3	4	5
---	---	---	---	---

To what extent did user management assess user participation?

1	2	3	4	5
---	---	---	---	---

How task intensive is the result of the project in your opinion compared to the original work methods?

Much more	More	Same	Less	Much Less
-----------	------	------	------	-----------

How complex is the system in your opinion compared to the original work methods?

Much more	More	Same	Less	Much Less
-----------	------	------	------	-----------

To what extent were project team members and users involved in the identification and resolution of critical issues?

1	2	3	4	5
---	---	---	---	---

Comments:

User satisfaction

How do you as an end user rate your satisfaction with the end product from the IRIS project?

Not satisfied at all	Poorly satisfied	Moderately satisfied	Satisfied	Very Satisfied
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Demographic information:

Name	
Division	
Position	
Age	