INFORMATION SYSTEMS/INFORMATION TECHNOLOGY SUCCESS AND EVALUATION AN EVALUATION FRAMEWORK AND GENERAL PRACTITIONER MODEL

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Abstract

The main goal for IS/IT projects is the successful and timely delivery which meets their planned performance and objectives. However, IS/IT projects frequently fail. It has been reported that, on average, IS systems are delivered one year behind schedule, only 1% of projects finish on time and within budget. This highlights the need for a model capable of determining the state of readiness of organisations prior to their implementation of an IS/IT project. This model should be able to show the way of improving organizational readiness to increase the likelihood of a successful implementation of such a project. In spite of the recognition of the main factors which can affect the success of IS/IT, tools do not exist that addresses those factors in an integrated manner. The primary aim of this research is to produce a general practitioner measurement tool that assists organisations in identifying the readiness gap before the initiation of a new IS/IT project, and suggests guidelines for improvements.

This research is also concerned with the establishment of an evaluation framework for IS/IT. This framework presents a measurement of the success of IS/IT projects at the business level. Both the evaluation framework and the general practitioner model would help organizations to predict the level of success of IS/IT projects in meeting their business objectives.

In order to achieve the aims and objectives of this research a thorough review of previous related literature from different disciplines was carried out in order to first build the IS/IT evaluation framework. The literature covered fields such as IS/IT success literature, organisational effectiveness, strategic planning, communication theories, marketing, maturity models and IS/IT measurement. The framework was

then verified and modified by an exploratory field work in nine organisations from which the general practitioner model was established.

To verify and test the model, qualitative non-experimental approach was conducted using in-depth case studies in four different organisations utilising triangulation of data collection methods that uses observation, structured interviews, unstructured interviews, historical data collection, and document review.

Chapter 1: Introduction

1.1 Introduction

In 1996, the global investment in information technology (IT) was estimated to be around US $ 11 trillions (Strassmann, 1997; Brynjolfsson & Hitt, 1998). In 1994, the annual U.S. spending alone on the development of Information Technology (IT) applications reached $250 billion (Johnson, 1995). In 1996, United Kingdom's annual expenditure on IT was estimated to be over US $ 35 billion (Willcocks, 1996). The strategic importance that IT now plays, coupled with the burgeoning costs of developing systems, has raised the stakes associated with project failure. Despite the costs involved, press reports suggest that such failures occur with alarming frequency (Betts, 1992; Cringely, 1994; Ellis, 1994; Gibbs, 1994; Kindel, 1992; Kull, 1986). While it is difficult to obtain statistics on the actual frequency of IT failures, various sources suggest that at least half of all IT projects are not as successful as they were expected to be (Gladden, 1982; Lytinen and Hirschheim,1987). On average, IS systems are delivered one year behind schedule and only 1% of projects finish on time and within budget (Stockman & Norris, 1991). According to a 1995 Standish Group research, in the United States alone, 31.1% of projects are cancelled before they finish, with a cost of $81 billion. Only 52.7% of projects are completed but with 189% of their original estimated cost. Out of those, only 42% of the originally proposed features and functions are fulfilled.

The lack of success of new information systems (IS) by failing to meet the objectives expected to be achieved continues to be a major concern for organisations (McDermott, 1987). These projects are either abandoned, significantly redirected, or even worse, they were "kept alive" in spite of their failure, where the cost of having funded them and the missed opportunities of not benefiting from their intended capabilities can represent a tremendous loss for an organisation.

Many IS/IT projects that fail are blamed mainly on poor project management practices, but it is necessary to look beyond traditional explanations of poor project management as the main cause and to consider possible organisational factors that may promote IS/IT project failure (Johnson, 1995; Strassmann, 1997). The process of planning, designing, developing and implementing of IS/IT has changed over the past decade. There is a trend towards planning and implementation of third party products instead of bespoke products. The problems resulting from this change introduce different challenges which organisations have to face. These are mainly related to organisational factors such as people, processes, IT components and environment.

Moreover, investments in IS/IT in recent years became more linked to the achievements of the organisations' business objectives, while IS/IT success was previously measured at either user or technical levels or in hard financial terms. In early studies, 'IS/IT success' is determined by its achievement of the IS/IT objectives, where measurement of success was performed on the technical level using technical attributes that focus on performance characteristics such as resource utilisation, hardware utilisation efficiency, reliability, response time, ease of terminal use, etc. (DeLone & McLean, 1992; Hamilton and Chervany, 1981; Kriebel and Raviv, 1980; Swanson, 1974). Other studies used different measures such as the extent to which the information system is used by management (Cerullo, 1980; Ginzberg, 1981; King and Rodriquez, 1978; Lucas, 1975, 1978; Zmud, 1979), or the impact of an IS on individual or organisational performance (Cerullo, 1980; Ein-Dor and Segev, 1978; Hamilton and Chervany, 1981; Kriebel, 1979; Lucas, 1975). In later studies, IS/IT success is described as the desired state of an information system mainly on the usage level using factors such as use and user satisfaction (DeLone & McLean, 1992; Gatian, 1994; Seddon, 1997; Garrity & Sanders, 1998). In some instances, the term 'IS/IT success' is used to mean the desired state of the IS/IT function, rather than the information systems, in an organisation (Hamilton & Chervany, 1981; Myers et al., 1998). In a different approach, some studies applied all-purpose hard financial measures in evaluating the value of IS/IT. They used such measures as return on investment (ROI) and cost-benefit analysis (CBA) (Brynjolfsson & Hitt 1995,1996,1998; Brynjolfsson & Yang 1996; Hitt & Brynjolfsson 1996; Dewan & Min 1997; Farbey et al.1994, 1995; Moony et al., 1996; Strassmann 1997).

In an attempt to improve the likelihood of IS/IT project success, it is essential to understand the quality of IS components and the environment it operates in, hence a number of measures of IS/IT success and IS/IT investment evaluation were developed within the IS/IT research field.

Other measures have been developed with the aim of improving organisational processes which have been generally recognised as a main factor contributing to the success of IS/IT. Examples of these are Capability Maturity Model (CMM) (Paulk et al., 1993), Trillium (Trillium, 1996), Bootstrap (Kuvaja et al., 1994), Software Process Improvement and Capability dEtermination (SPICE) (El Emam et al., 1998), IT Infrastructure Library (ITIL) (Central Computer and Telecommunications Agency, 1992), Goal/Question/Metric (GQM) paradigm (Solingen & Berghout, 1999), etc. In addition, IS/IT literature discusses other measures that assess organisational maturity in terms of IS/IT planning (Bhabuta, 1988; Earl, 1986, 1988, 1989), IT infrastructure (Weill & Broadbent, 1999), IS/IT utilisation (Hamilton & Chervancy, 1981; Nolan, 1979), and management of IS function (Hirschheim et al., 1988; Galliers, 1991).

1.2 Research problem: limitations of current IS/IT measures

The research field of IS/IT evaluation is still inconclusive, especially in measuring the success of IS/IT projects on the business level (DeLone & McLean, 1992; Ishman, 1996). Many of the evaluation measures have been criticised in the literature for suffering serious shortcomings. In fact, many researchers advocate that a major problem with IS/IT investments is the way in which they are evaluated (Farbey et al. 1994; Strassman, 1997; Willcocks, 1996). This criticism has been sounded regarding both financial-based 'hard' measures and the 'soft' non-financial measures (Brown, 1987; Brynjolfsson & Yang, 1996; DeLone & McLean, 1992; Roach, 1987).

The measures of IS/IT are mainly post-investment/project appraisals that try to assist Management in organisations to review the result of their decisions on IS/IT projects. This is to enable Management to learn from valuable lessons which should feed back in the decision-making process in the organisation regarding IS/IT issues (Krohe, 1993; Brynjolfsson & Hitt, 1998; Bryniolfsson & Yang, 1996; Strassmann, 1997). However, the huge amount of IS/IT project failure that is supported by the statistics does not provide evidence that the lessons have been learnt (Stockman & Norris, 1991; Willcocks, 1996).

To lessen the risk of a failure of IS/IT projects, organisations need to be able to more accurately predict the level of success of those projects. The earlier this prediction can be achieved, the more likely it is that changes needed to facilitate a successful system can be made. In this context, it is important to identify the 'readiness gap' (Figure 1.1) in the organisation for a particular IS/IT project. This gap is the difference between the current organisational situation in terms of IT, people, process and environment, and the situation in which the organisation need to be to successfully develop, implement, operate and maintain the intended IS/IT.

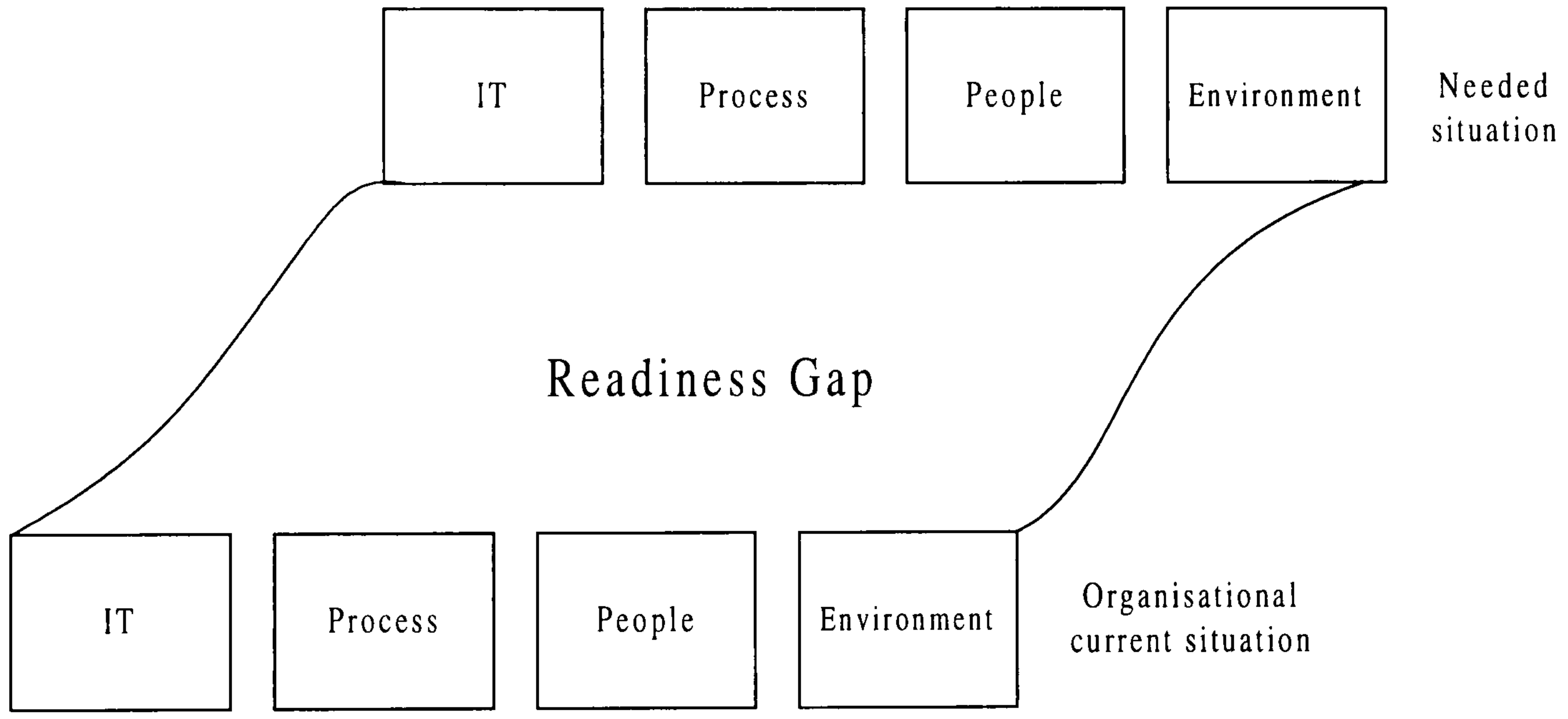

Figure 1.1 Readiness gap

It is becoming more obvious that there is a need for a tool that can assist Management in predicting the success of IS/IT projects before launching them. However, the IS/IT research field still lacks a credible measurement tool that can be used to determine the organisational state of readiness within which successful implementation of IS/IT projects can be achieved. Such a tool should also assist the organisation in building an improvement plan to bring it into the required readiness status in terms of having the adequate capabilities and environment for planning, development, operation and maintenance of information systems that would increase the likelihood of IS/IT project success. This illuminates the need for the establishment of an alternative measurement approach to increase the likelihood of successful implementation of IS/IT projects in meeting their intended objectives. Such a measurement would help to improve organisational readiness for such an IS/IT projects by revealing the needed organisational capabilities and environment for planning, development, operation and maintenance of the proposed information system(s).

1.3 Research proposition

The IS/IT measurement field is still inconclusive. It lacks an overall IS/IT measurement framework through which measures and measurement levels could be clearly identified. In order to contribute to this field, a clearer picture of the various existing measures needs to be presented, along with their relationship/impact on each other. This study fulfils this need by producing a novel evaluation framework of IS/IT measurement which bring together the various levels of an IS/IT system with overlapping measurement approaches. This framework, which is based on the adoption of the communication theory into the IS/IT field, highlights the need for a tool that can assist management in organisations to evaluate their organisational readiness gap prior to the implementation of IS/IT projects. Such a tool should assist the organisation in building an improvement plan to bring it into the required readiness status in terms of having the adequate capabilities and environment for planning, development, operation and maintenance of information systems that would increase the likelihood of IS/IT project success. The tool should follow a balanced approach between the main factors affecting IS/IT success: people, process, IT, and environment, which aims at determining the current/existing organisational status and the needed status. This alternative approach provides management with effective guidance that contributes to meeting the business objectives by achieving the Critical Success Factors (CSF) (Rockart, 1979) of the IS/IT project. CSFs could be used as a measurement of IS/IT success because it could measure attainment of objectives at different levels of deployment, i.e. project, group, unit, or organisation, and it could also be of different types of 'hard' financial or 'soft' non-financial measures (Gottschalk & Khandelwal, 2002).

1.4 Research aims and objectives

The reasons that led to undertaking a study in the area of IS/IT success measurement are various. First, the measurement of IS/IT success has been the concern of Management and researchers alike for more than three decades, but the research field of IS/IT success measurement is still inconclusive (Brynjolfsson 1993; Brynjolfsson & Hitt, 1998; Brynjolfsson & Yang, 1996; DeLone & McLean, 1992; Chan, 2000; Dewan & Min, 1997; Farbey et al., 1994; Hitt & Brynjolfsson, 1996; Moony et al., 1996; Strassmann, 1997). It still lacks a holistic and broad evaluation framework that could incorporate the different IS/IT success measurements (Brynjolfsson & Hitt, 1998; Blake, 1994; DeLone & McLean, 1992; Garrity & Sanders, 1998; Gatian, 1994). Despite the great amount of investment that is estimated by trillions of US Dollars, the majority of IS/IT projects still fail without the existence of a credible tool that is capable of pointing at areas of problems and enables organisations to measure their readiness for implementing new IS/IT projects successfully (Brynjolfsson & Hitt, 1998; Strassmann, 1997; Willcocks, 1996).

In spite of the recognition of the main factors which can affect the success of IS/IT, no encompassing tool that addresses those factors in an integrated manner has been produced. The primary aim of this research is to produce such a measurement tool that assists consultants and management in identifying the organisational readiness gap before the initiation of a new IS/IT project, and suggests guidelines for organisations to progress through to reach the ready status for successfully implementing the intended IS/IT.

In the light of the research aim, the following are the objectives of this research:

1. To enhance and build theory by reviewing a large body of literature, and by integrating diverse research fields into a holistic and integrated perspective.
2. To evaluate and classify the different approaches to IS/IT success measurement and to identify the effectiveness of the different models of IS/IT measurement as stated in the literature.
3. To propose a new way of adoption of communication theory into IS/IT field that resolves some of the shortcomings in previous attempts.
4. To propose a new evaluation framework of IS/IT measurement that overcomes some of the shortcomings that exist in the research field.
5. To assess the currently defined IS/IT success levels and to establish an alternative measurement approach to measuring success at the business level of deployment.
6. To identify the requirements for a balanced measurement approach which integrates the main factors of IS/IT success (IT, people, process, and environment).
7. To establish, using the literature as a guide, a practical and balanced general practitioner measurement model that measures the readiness status of an organisation prior to the implementation of IS/IT which will enhance the ability

of the organisation in predicting the level of success of IS/IT projects and provide effective guidance to meeting their business objectives.

8. To explore, test, validate and adapt the model through detailed case studies.
9. To produce implementation guidelines that assists consultants and management in identifying the organisational readiness gap before the initiation of a new IS/IT project.
10. To produce recommendations for future work

1.5 Research contributions

This study intends to make the following contributions:

To knowledge and theory:

- This study proposes a novel way of adoption of communication theory into IS/IT field that resolves some of the shortcomings in previous attempts.
- The study introduces a novel evaluation framework of IS/IT measurement that enables conceptualising of IS/IT measurement in a new perspective, and helps to overcome some of the shortcomings that exist in the research field.
- The study also introduces an evolutionary model for IS/IT project success at the business level.
- In addition, this study widens the understanding of the role of IS/IT in an organisational context, and the different factors that affect this role. It identifies the factors that affect the IS/IT project success and introduces an innovative view of IS/ IT success measurement. The model introduces six levels of maturity of each of the four domains: Process, IT, People, Environment. A description of characteristics of the attributes of each of the levels is provided. The attributes under those domains are: systems, staff,

skills, IS/IT head position, leadership style, culture, structure and generic work practices. The readiness gap is measured by assessing the level of the organisational situation in terms of those attributes and the needed ones for the IS/IT project to succeed. This view also advocates that the success of IS/IT should be measured on the level of deployment of the IS/IT project, and the measure of success needs to be the degree of attainment of its CSFs at a level which will contribute to IS/IT success on the organisational/business level.

To management practice:

For managers and consultants, the study provides them with a tool/model that enables them to assesses the readiness gap in their organisations. It also provides them with the steps of action and change regarding issues concerning People, Processes, IT, and the Environment in the organisation so that the IS/IT project can succeed in achieving its intended business objectives. This new approach will create new opportunities for management/consultants to propose 'better' and more focused 'business cases' for new IS/IT projects.

1.6 Research approach and methodology

In order to achieve the aims and objectives of this research , a qualitative non-experimental approach is adopted using in-depth case study with triangulation of data collection methods that uses observation, structured interviews, unstructured interviews, historical data collection, and document review. In building the evaluation framework and the readiness model, the researcher has conducted a thorough review of previous related literature from different disciplines such as IS/IT success literature, organisational effectiveness, strategic planning, communication theories, marketing, etc..

Judgment sampling involves choosing subjects who are in the best position to supply needed information. Because the use of case studies in this research aims to test and validate the model produced in the research in as close to 'real life' situations as possible. While the elements and issues addressed by the model are 'logical' and supported by the literature, it was important to experience the actual implementation of the model in a real organisational setting as much as possible, and to solicit the opinions of the people involved with IS/IT projects in organisations regarding the usefulness and practicality of the model in real situations. Organisations that fitted the required criteria, such as large and medium-size organisations, acquiring different IT infrastructures, having different outcomes of the IS/IT projects: successful, semi-successful, failure, or under development were selected. Other criteria used for selection included the nature of development of IS, whether being bespoke, or customised third party package. From the latter category, the project could be sourced differently. Some organisations have their own people work on the project development alongside the external vendor, while in others the external vendors have the full responsibility for project development.

Because this research requires studying cases with such specified criteria, purposive judgment sampling was used in this research, and similarly to choose subjects in the best position to supply needed information (Burgess, 1984; Sekaran, 1984).

1.7 Scope and limitation

The readiness model introduced in this research should be used at the time where a specific IT/IS project has been decided upon by an organisation, but before the tender or development task has been assigned to any entity, either internal or external.

Issues related to strategic information systems planning (SISP) and work systems that support the business are outside the scope of this research. Also, in spite of their importance in affecting the IS/IT operations, national environmental factors such as the national culture, legal issues, national technological infrastructure, and national economic issues (Deans & Ricks, 1991; Gallupe & Tan, 1999; Hofstede, 1991; Khalil, & Elkordy, 1997) are not included in the scope of this research. Recommendations for further research opportunities regarding those issues will be introduced in the concluding chapter.

1.8 Organisation of thesis

This thesis comprises eight chapters. After this introduction chapter, Chapter 2, is the first of two literature review chapters. It presents an overall view of the IS/IT measurement research field. It also presents the different ways within which this research field has been classified. Based on those classifications, the chapter will present the most known approaches to IS/IT measurement; the 'hard' financial and the 'soft' non-financial IS/IT measurements. It will also introduces one of the most prominent studies in the IS/IT measurement research field, DeLone & McLean (1992). Because the study builds upon communication theory, a number of communication theories are reviewed, discussed and built upon in subsequent

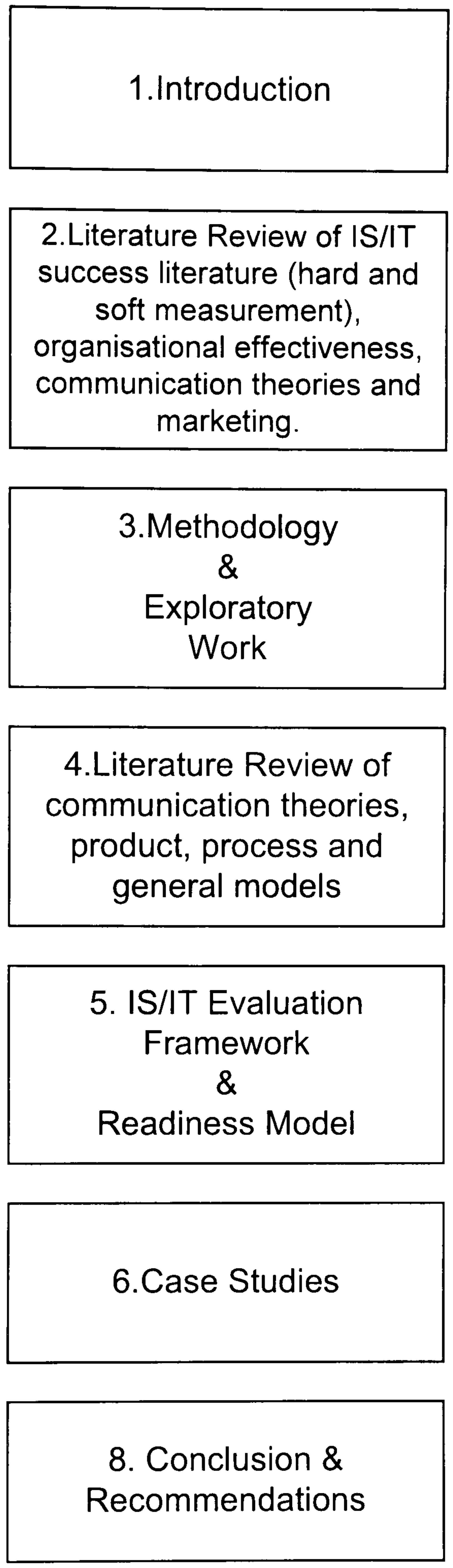

Figure 1.2 Organisation of Thesis

chapters. The chapter then introduces a novel classification of IS/IT success and measurement. This new classification serves as an introduction to the second review of literature (Chapter 4). Chapter 3 introduces the methodology and the design of this research. It also presents the exploratory work conducted following the literature review presented in Chapter 2. This exploratory work verifies and expands on issues and factors affecting IS/IT success which are introduced in the literature. Chapter 4 presents the product, process, and general models and approaches to IS/IT success measurement. Chapter 5 presents a new evaluation framework of IS/IT based on an alternative adoption of the communication theory into IS/IT field. The chapter also introduces a general, practical and much needed 'General Practitioner' model for measuring organisational readiness for the successful implementation of IS/IT projects. Chapters 6 presents the four case studies and their analysis. The case studies test and validate the Readiness/General Practitioner model introduced in Chapter 5. Chapter 7 concludes the study and recommends directions for future research. Figure 1.2 gives an overview of the structure of the thesis.

1.9 Ethical considerations

The confidentiality of the respondents, both the individuals and their organisations, have been promised and respected, since IS/IT project leaders, user managers and other respondents have given confidential information about the internal operation of the information system of their respective organisations during both exploratory work and case studies.

1.10 Summary and conclusion

The chapter has introduced the nature and intent of the research. It began with an introduction to IS/IT success and value measurement, identifying the different approaches, their importance to organisations, and limitations those approaches suffer. It then explained the aim and objectives of this study, and its significance for both research and practitioners. It then concludes by presenting thesis organisation.

Chapter 2: Review of 'Hard' and 'Soft' IS/IT Success Measurements and Communication Theory adoption

2.1 Introduction

In 1996, the global investment in information technology (IT) was estimated to be around US $ 11 trillions (Strassmann, 1997; Brynjolfsson & Hitt, 1998). Assessing the return on this large investment in IS/IT projects is of great importance to the global business community. For this reason, information system success and effectiveness as a field of research has gained in importance and attracted researchers from a variety of disciplines.

The main goal for IS/IT projects is the successful timely delivery which meets the planned performance and objectives. However, IS/IT projects frequently fail (Simpson, 1987; Barki, Rivard & Talbot, 1993). It has been reported that, on average, IS/IT systems are delivered a year behind schedule, and only 1% of projects finish on time and to budget (Stockman & Norris, 1991). According to a 1995 Standish Group research, in the United States alone, 31.1% of projects are cancelled before they finish, with a cost of $81 billion. Only 52.7% of projects are completed, but with 189% of their original estimated cost. Out of those, only 42% of the originally-proposed features and functions are fulfilled. The situation is made even worse by the lack of credible measurements of success for those completed systems.

How to measure the success of information systems (IS) has been a puzzling question since the introduction of computers into the business environment (Hoos, 1960). A great amount of research has tried to answer this question by looking at what effects information systems have on individual 'white' and 'blue' collar workers (Roach 1987,1991), management of different levels, groups of different types, and organisations of different sizes, types, and objectives. Those were looked at from different points of view, economic, financial or non-financial. Also, different levels of study were used, firm, sector or industry, entire economy or national, and international (Brynjolfsson & Yang, 1996; Strassmann, 1997).

Answering such a question first gained momentum among economists in the 1980's where they tried to find the economic 'hard' IS/IT value to business. This effort did not prove successful. Even though at the time the amount of computing power per worker was growing in the business organisations, researchers found that the productivity in those organisations did not reflect it (Brynjolfsson & Hitt, 1998; Brown, 1987; Roach, 1987). This economic research dilemma was then termed the "Productivity Paradox" which meaning was summarised by the Nobel Prize economist Robert Solow by stating in the New York Times Book Review in July, 1987, "We see computer age everywhere except in the productivity statistics". This paradox spanned over a decade and left a large body of research, and its effects have still surface in IS/IT research until recently (Krohe, 1993; Brynjolfsson & Hitt, 1998; Brynjolfsson & Yang, 1996; Strassmann, 1997). The productivity paradox drew the attention of IT/IS professionals and researchers, and prompted some voices to call for mobilisation to counter the "IT critics'" arguments; "Given the professional standing of our critics and the momentous implications if they are correct, it is the obligation of every information systems' professional to understand the issues that surround the paradox. So armed, each of us must then be prepared and willing to participate knowledgeably in the debate", wrote the MIS Quarterly editor (Blake, 1994). This mobilisation effort that had already started some years before Blake's call, encouraged other researchers to study the non-financial 'soft' value and implications of IS/IT on users and organisations. DeLone & McLean (1992), in a study that gained wide prominence and debate, tried to formulate a global outcome measure of IS/IT success employing the financial 'hard' and the non-financial 'soft' measures. This study was dependent in its theoretical basis on Mason (1978) adoption of the communication theory of Shannon & Weaver (1949) into the IS/IT research field.

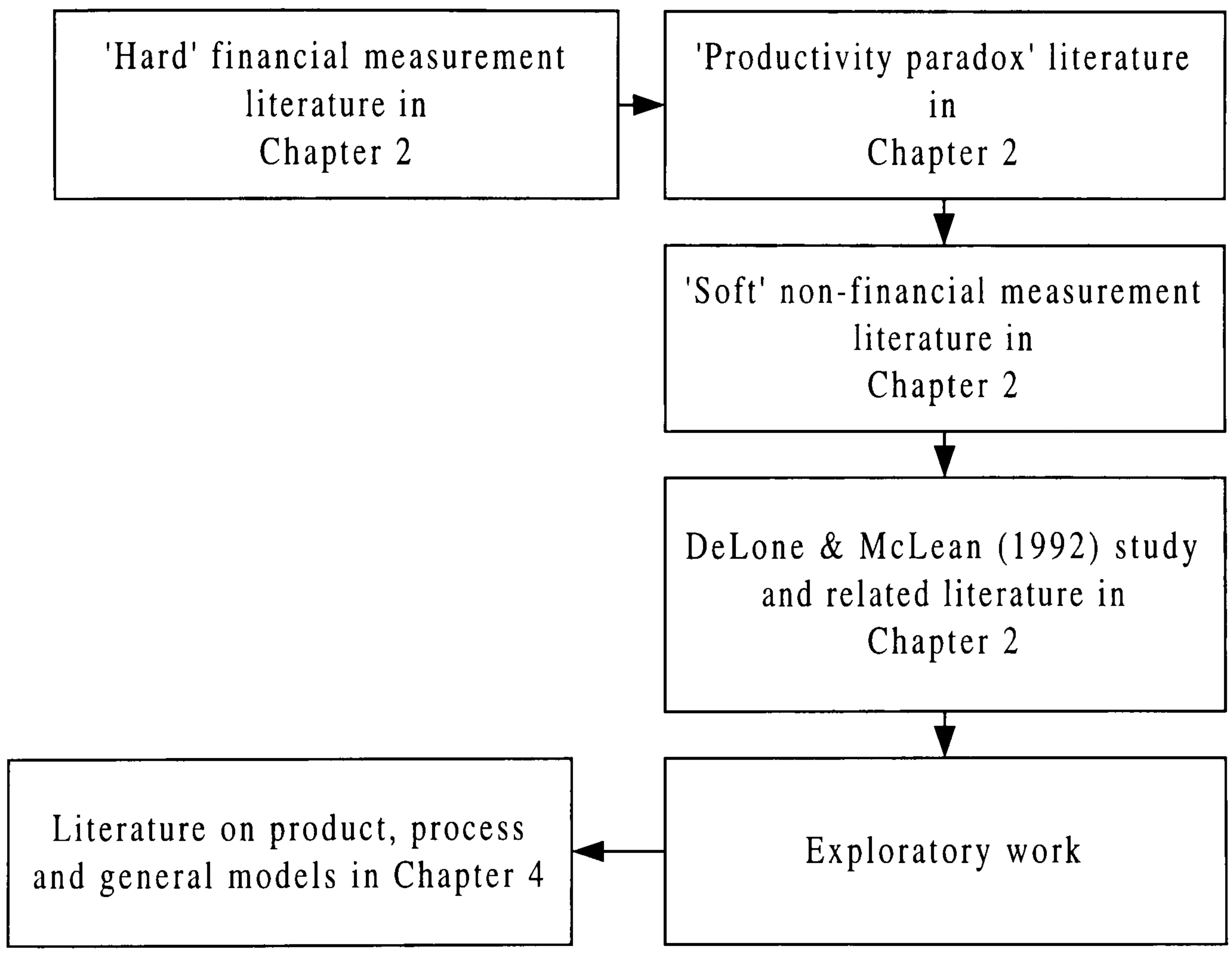

Figure 2.1 Literature review map

This chapter will introduce the literature review (Figure 2.1) in the sequence it was conducted by the researcher while studying IS/IT measurement issues that were seen to be relevant to the achievement of the research aims. In general, the researcher had first reviewed the literature concerned with the 'hard' economic value of IS/IT, which led him to encounter the 'productivity paradox' body of literature, which then led him to the studies that focused on the 'soft' non-financial measures of IS/IT that include information and system quality, usage, and user satisfaction. While reviewing this literature, the researcher was led to DeLone & McLean (1992) study. This study, and in spite of its promising approach in resolving the IS/IT measurement problem, had generated a considerable amount of debate and criticism in the IS/IT literature. This led the researcher to try to find out the reasons behind this criticism. By doing so, the researcher found it necessary to back-trace the theoretical path the study was built upon, namely Shannon & Weaver (1949) communication theory and its adoption into the IS/IT field by Mason (1978) which are the parent studies of DeLone & McLean (1992). During this literature study, shortcomings in all three hierarchies of studies were noted and solutions regarding each were introduced. Those solutions, in addition to the exploratory work done during this research, led to the introduction of a new framework of IS/IT success measurement. Introducing this framework presented the researcher with an opportunity to recognise that IS/IT measures which exist and are used in the IS/IT field are post-project/post-implementation measures that do not contribute considerably to the success of the following projects. The researcher then conducted a further review of the literature, which is presented in Chapter 4, and introduced an alternative pre-project/pre-implementation measurement approach/model that would measure the readiness of an organisation for a predetermined project. This approach/model would help management and consultants to locate and strengthen weak areas in the organisation that otherwise would contribute to the failure of the IS/IT project.

This chapter will introduce the literature reviewed before conducting the exploratory work. It will first introduce definitions of information systems/ information technology (IS/IT) effectiveness and success as presented in the literature. Then it will introduce the literature concerned with measuring 'soft' non-financial aspects of

IS/IT such as technical success of IS/IT, system use and user satisfaction, and 'hard' financial impacts of IS/IT on organisations. During the presentation of the latter type, a review of some of the 'productivity paradox' literature will be presented. This section will then present limitations of both 'hard' and 'soft' measures of IS/IT. The chapter will then introduce a detailed presentation of Delone & McLean (1992) study that tried to combine both the 'hard' and 'soft' measures in a comprehensive measurement model. Because Delone & McLean (1992) was built upon a communication theory, a number of communication theories will be reviewed to be discussed and built upon in the course of the research. This chapter will end with a summary of the content of the chapter and a conclusion.

2.2 Information systems/ information technology (IS/IT)

2.2.1 Definitions of IS/IT

The terms "Information systems" (IS) and "Information technology" (IT) are used interchangeably in the literature (Al-Gahani, 1998). One can find different definitions for both terms, some of which are overlapping. Information Technology (IT) can be defined in various ways. One of the most common definitions among economists is that of the U.S. Bureau of Economics Analysis category (BEA) "Office, Computing and Accounting Machinery (OCAM) which consists primarily of computers". According to BEA, "Information Processing Equipment (IPE)" includes communications equipment, scientific and engineering instruments, photocopiers and related equipment, besides software and related services which are sometimes included in the IT capital (Brynjolfsson & Yang, 1996). Other definitions of IT provided by the Institute for Development Policy and Management at the University of Manchester (IDPM, 2002) are "computers and telecommunications" or "electronic means by which to accept, store, process, output and transmit information". Other definitions exist but they are mainly variations of the above stated definitions, e.g. "IT is a term that encompasses all forms of technology used to create, store, exchange, and use information in its various forms" (TechTarget, 2002). Information Systems (IS) have been described as consisting of hardware, software, communication networks, data or information, people or participants, and procedures or work processes (Gasser, 1986; Strassmann, 1997).

Since the terms IS and IT are used interchangeably and in an overlapping fashion in the literature (Al-Gahani, 1998), in this research we will adopt the widely accepted term IS/IT to refer to information systems-related issues.

Another definition of information system indicates that it is a system in which human participants perform a business process (or part/multiple) using information, hardware, and software to capture, transmit, store, retrieve, manipulate, or/and display information for internal or external customers (Alter, 1996, 1999). Hardware refers to the devices and other physical equipment involved in processing information, such as computers, workstations, physical networks, and data storage and transmission devices. Software refers to the computer programs that interpret participant inputs and control the hardware. Software includes operating systems and end user application software (Bonner, 1995; Alter, 1996; Kendall & Kendall, 1992; Delone & Mclean, 1992). Participants in an information system are the people who do the work. Human participants in this system typically play essential roles such as entering, processing, or using the information in the system. On the other hand, the term 'user' refers to the internal or external customers that use the output of the information system. 'Secondary customers' are people who receive some benefits from the information system even if they do not receive and use its outputs directly (Alter, 1996). In the IS/IT literature the term 'user' is used loosely to mean both the participant and the internal and external customers. This might be because in many of the systems, employees play both roles. Nevertheless, both roles are not bound together and often participants and users are different.

2.2.2 IS/IT Success

The term "IS success" is variously described as improved productivity (Bailey and Pearson, 1983), changes in organisational effectiveness, utility in decision making (Ives et al., 1983), and higher relative value or net utility of a means of inquiry (Swanson, 1982). In early studies, the term "IS effectiveness" was considered to refer to the result of comparing IS performance to its predefined objectives (Hamilton and Chervany, 1981), while, "IS success" is determined by its achievement of those objectives, where the measurement was performed on the technical level using technical attributes that focus on performance characteristics such as resource utilisation, hardware utilisation efficiency, reliability, response time, ease of terminal use, etc. (DeLone & McLean, 1992; Hamilton and Chervany, 1981; Kriebel and Raviv, 1980; Swanson, 1974). Other studies used different measures of success, such as the extent to which the information system is used by management (Cerullo, 1980; Ginzberg, 1981; King and Rodriquez, 1978; Lucas, 1975, 1978; Zmud, 1979), or the impact of an IS on individual or organisational performance (Cerullo, 1980; Ein-Dor and Segev, 1978; Hamilton and Chervany, 1981; Kriebel, 1979; Lucas, 1975). In later studies, the difference between the two terms (effectiveness and success) blurred. IS success and IS effectiveness describe the desired state of an information system mainly on the usage level, using factors such as use and user satisfaction

(DeLone & McLean, 1992; Gatian, 1994; Seddon, 1997; Garrity & Sanders, 1998). Both studies that use the term success and those that use the term effectiveness cite each other, which indicate that both understand the terms to be synonymous (DeLone & McLean, 1992; Gatian, 1994; Bonner,1995; Ballantine et al., 1996; Munshi, 1996; Seddon, 1997; Garrity & Sanders, 1998; Grover et al., 1996; Woodroof & Kasper, 1998). In some instances, IS success or IS effectiveness is used to mean the desired state of the IS function, rather than the information system in an organisation (Hamilton & Chervany, 1981; Myers et al., 1998).

In a different approach, some studies tried to apply all-purpose hard financial measures in capturing the 'value' of IS to the business. They used such measures as return on investment (ROI) and cost-benefit analysis (CBA) (Brynjolfsson & Hitt 1995,1996,1998; Brynjolfsson & Yang 1996; Hitt & Brynjolfsson 1996; Dewan & Min 1997; Farbey et al.,1994, 1995; Moony et al., 1996; Strassmann 1997).

This study further expands IS/IT success measurement to describe the desired state of IS/IT, at the business level, in contributing to the achievement of the business objectives i.e. in-terms of achieving the Critical Success Factors (CSFs) (Rockart, 1979) of a specific IT/IS project.

2.2.3 Measures of IS/IT Success

The IS/IT research field has developed a number of measures of IS/IT success and IS/IT investment evaluation. Those measures are mainly product-based which are concerned with measuring 'soft' aspects such as technical success of IS/IT (Baroudi & Orlikowski, 1988; DeLone & McLean, 1992; Garrity & Sanders, 1995), system use and user satisfaction (Igbaria & Zviran, 1991; DeLone & McLean, 1992; Gatian, 1994; Grover et al., 1996; Garrity & Sanders, 1998; Woodroof & Kasper, 1998), and 'hard' financial impacts of IS/IT on organisations (Brynjolfsson & Hitt 1995,1996,1998; Brynjolfsson & Yang, 1996; Hitt & Brynjolfsson, 1996; Dewan & Min, 1997; Farbey et al., 1994, 1995; Moony et al., 1996; Strassmann, 1997).

A product-based measurement, is mainly concerned with assessing the different features of the IS/IT as a product. A different approach is a process-based measurement which is concerned with measuring the process that creates the IS product, assuming that successful process produces successful IS/IT product. Process-based measurements have been developed with the aim of improving organisational processes which have been generally recognised as a main factor contributing to the success of IS/IT. Examples of these are Capability Maturity Model (CMM) (Paulk et al., 1993), Trillium (Trillium, 1996), Bootstrap (Kuvaja et al., 1994), SPICE (Software Process Improvement and Capability dEtermination) (El Emam et al., 1998), IT Infrastructure Library (ITIL) (Central Computer and Telecommunications Agency, 1992), Goal/Question/Metric (GQM) paradigm (Solingen & Berghout, 1999), etc.

In addition, IS/IT literature discusses multi-approach (include both product and process) measures that assess organisational maturity in terms of IS/IT planning (Bhabuta, 1988; Earl, 1986, 1988, 1989), IT infrastructure (Weill & Broadbent, 1999), IS/IT utilisation (Nolan, 1979), and management of IS/IT function (Hirschheim et al., 1988; Galliers & Sutherland, 1991).

Process-based measurements and the multi-approach general measurements will be presented in Chapter 4 after the presentation of the exploratory work in Chapter 3.

In the following sections, a review of the 'hard' financial and 'soft' non-financial measures will be presented.

2.2.4 Product-Economic-financial 'hard' measurement

Evaluation of an IS/IT investment is becoming the concern of senior management in many organisations because, for many organisations, IS/IT represents the single largest capital expenditure. Still, many organisations are uncertain how to measure the impact of those investments (Farbey et al., 1992). Some of the financial economic measurement methods used for evaluating IS/IT investment are Return-on-investment (ROI) (Radcliffe, 1982), Cost-benefit analysis (CBA) (King & Schrems, 1978), Multi-objective multi-criteria methods (MOMC) (Chandler, 1982; Vaid-Raizda, 1983), Return-on-management (ROM) (Strassman, 1985, 1990, 1997), and Information economics (Parker et al., 1987).

a. Return-on-investment (ROI)

Return-On-Investment (ROI) approaches (Radcliffe, 1982) include a number of formal investment appraisal techniques. A simple example is the payback method, which calculates the time taken before the investment is recouped. But perhaps the best known of the ROI methods are those based on evaluating the current value of estimated future cash flows. Of those, the most widely used is the internal rate of return (IRR), which estimates the internal rate of return of the project. This could be used by the financial management of the organisation to decide whether the project should go ahead.

ROI methods have formal techniques, and the calculations are carried out on the basis of inputs from the project. Although those methods appear to overcome the problem of risk by the means of setting an appropriate hurdle rate, in practice they have not been successful with projects that have uncertainty in their projections, nor with projects with uncertain lifetimes, which are frequent difficulties with IT projects. In practice, some of the IT projects which seemed to have provided the best returns in terms of competitive advantage would not have satisfied the current ROI criteria for success (Farbey et al., 1992).

b. Cost-benefit analysis (CBA)

Cost-benefit analysis (CBA) (King & Schrems, 1978) is an approach that attempts to find (or compute) a money value for each element contributing to the cost and benefit of a development project. The approach originated as an attempt to deal with the problem that some elements regarded as benefits or costs have no obvious market value or price. The classic example is: What value is attached to a system which could result in the saving of one extra life?

In CBA, elements which have no obvious market value or price will be assigned a money value based on some notion of valuation. The resulting cost-benefit values can be projected in the form of notional cash flows on a year-by-year basis and the projected outcomes for alternative schemes or designs fed into a decision model based on one of the standard ROI methods. The main weakness of classic CBA (Stern, 1976) is the artificial nature of some of the surrogate measures. In practice, the recommendations coming from CBA are often overturned by decision makers who cannot accept the values selected by the analysts. The approach is used in circumstances where ROI methods are generally appropriate but where there are costs and benefits that are difficult to quantify (Farbey et al., 1992).

c. Multi-objective multi-criteria methods (MOMC)

Multi-objective multi-criteria methods (MOMC) (Chandler, 1982; Vaid-Raizda, 1983) are an alternative to CBA, which start from the assumption that there are measures of utility other than money value. Decision makers can appraise the relative value of different desired outcomes in terms of their preferences: they have the capability of ranking goals by applying a preference weight to each one. The approach recognises that in any organisation different stakeholders may have very different ideas on the value that the various elements of a project will deliver. The approach permits an exploration of these different viewpoints and exposes potential conflict at the decision making, rather than at the post-implementation stage of a project.

The MOMC approach can be assisted by one of a number of computer-based decision support systems that help the decision-making group to do the calculations and carry out sensitivity and robustness tests.

The approach is best used where there are a number of possible objectives to serve a number of different units or persons in the organisation. It is of particular value at the stage at which strategy is being decided. It is also useful where there are a number of design alternatives and there is difficulty in choosing between them because they do not all provide the same outcome (Farbey et al., 1992).

d. Return-on-management (ROM)

Return on management (ROM) (Strassman, 1985, 1990, 1997) is the value attributable to an information system as an incremental change to an already established level of management productivity. The method is to express the outcome of the introduction of a new system as the change to the value added by management stemming from the introduction of a new system. ROM is defined as the residual value after deducting from total revenue the cost and value added by each resource, including capital, but excluding management and the cost of management. The return on the new system is the difference between the ROM computed before the introduction of the new system and the ROM computed after the system has been implemented. The values computed are money values derived from the standard accounting and non-financial data held by an organisation.

At the strategy formulation phase, changes in ROM must be based on an estimate of revenue after the change is implemented and estimates of changes to resource costs and contributions. The difficulty of making such estimates suggests that the ROM method of evaluation is better suited to post-evaluation of information systems projects (Farbey et al., 1992).

e. Information economics

Information economics (Parker et al., 1987) seeks to be comprehensive and to be the one and only method needed to deal with the IT evaluation problem. In practice, the method is a variation on CBA, tailored to cope with the particular uncertainties and intangibles found in IS projects. It retains ROI calculations for those benefits and costs which can be directly ascertained through a conventional cost-benefit process, but for the decision process puts forward a more complex report based on a ranking and scoring technique for intangibles and risks. The ROI outcome is itself given a score, enabling executives to provide a relative evaluation of tangibles against intangibles. In other words, it seeks to identify, measure and rank the economic impact of all relevant changes on organisational performance thought to be brought about by the introduction of new systems.

Information economics extends normal CBA by three processes. The first is value linking, which looks for the consequential impact of a primary change spreading through different functions. The second process is value acceleration, which attempts to define the value of future systems which are dependent on the introduction of the system in question. Hence, the value of a primary system is seen to be enhanced if it is also seen as the platform on which later systems can be built. The third process is job enrichment, which provides an evaluation of the additional value to the organisation of the enhanced skills and understanding which its staff may gain from the use of IT.

Information economics therefore attempts to bridge the quantitative/qualitative divide and has the capability to recognise costs of such elements as strategic and technological uncertainty and organisational risk. However, it is time-consuming to carry out and requires substantial expertise and resources. It may be unnecessarily complex for well-defined transaction-processing systems with clear costs and benefits (Farbey et al., 1992).

2.2.5 Critique of economic-financial 'hard' measurements

The economic-financial 'hard' measurement approach concerned itself with measuring the impact of IS/IT in 'hard' economic financial terms, either on high levels of effects (economy and sector), or on organisational and project levels. In fact, IS/IT impact could not be differentiated from impacts caused by other factors on those levels, which was the cause of the economic dilemma of the "Productivity Paradox" (Brynjolfsson & Hitt, 1995,1996,1998; Brynjolfsson & Yang, 1996; Hitt & Brynjolfsson, 1996; Dewan & Min, 1997).

I. Productivity Paradox literature

When reviewing the IS/IT success literature, one would encounter the term 'productivity paradox' repeatedly. It not only describes a state of knowledge of researchers regarding IT productivity in the business environment, but also a stream of research that has addressed this paradox and tried to solve it.

In the late-1950s and early-1960s (Brynjolfsson, 1993; Strassmann, 1997), the time when IT/IS started to be used in business organisations in a serious manner, the accepted wisdom was that computers deliver superior quality of goods and work, and lead to improved profitability and productivity (Strassmann, 1997). This view continued with no considerable challenge until the middle of the 1980s (Brown, 1986; Brynjolfsson & Yang, 1996; Brynjolfsson & Hitt, 1998; Roach, 1987; Strassmann, 1997). It was clearly reported that although the amount of computing power per white-collar worker in the service industry was growing in the 1970s and 1980s, the productivity in that sector did not reflect it (Roach, 1987; Brynjolfsson & Hitt, 1998). In 1990, Gary Loveman conducted a study on large U.S. and European manufacturing companies. His study concluded that by investing in computers those companies involved themselves in the least attractive returns (Krohe, 1993; Loveman, 1994).

Soon after, the amount of studies on IT productivity started to accumulate. Roach's (1991) study focused on information workers' productivity and concluded that it had not increased by the use of computers (Roach, 1991; Brynjolfsson & Hitt, 1998). In two years, 1990 and 1991, about a dozen studies on IT impact on the manufacturing and service sectors were produced (Brynjolfsson, 1993). In general, the outcome of those studies was to state that the service sectors in the U.S. had spent about a trillion

U.S. dollars on IT over the 1980s and received almost no return of improved productivity, while the manufacturing sector did better in the same period. The significance of those results is that the service sector was the most IT-intensive of the two sectors (Brynjolfsson 1993; Blake 1994; Brynjolfsson & Yang 1996; Strassmann 1997; Brynjolfsson & Hitt 1998).

Lowering the Microscope

The economical financial researchers, when stating the need to measure new forms of value such as capabilities of knowledge (Brynjolfsson & Yang, 1996), and that one way to start thinking about the sources of variation is to divide the benefits of IS/IT because what occurs inside the 'black box' of the organisation has a substantial influence on the productivity of IS/IT (Brynjolfsson & Hitt 1998), do indeed indicate the need to go to lower levels to be able to measure the impact of IS/IT which has been recognised by 'hard' IS/IT value researchers (Farbey et al.,1994, 1995). This is further emphasised by Moony et al.(1996) where they thought that the singular focus on firm level output variables, while important, provides only limited understanding of how value is created using IS/IT. This has prompted some researchers to go to the organisation and project levels in looking for IS/IT 'hard' benefits. Moony et al. (1996) point out that because of the failure of traditional productivity gains from IS/IT, there is a growing consensus that a better understanding of IS/IT impacts requires a shift from output focused to process-oriented research. This opinion was also supported, according to Moony et al.(1996), by other researchers (Bakos, 1987; Gordon, 1989; Banker et al., 1990; Banker and Kauffman, 1991; National Research Council 1994). By going to the process levels looking for IS/IT 'hard' benefits in their research, Moony et al. (1996) concluded that what they have achieved in their framework is "a lowering of the microscope" to bring about a closer linkage between the level at which the technology is deployed, the level at which the impact occurs, and the level at which it is measured. Different from the Moony et al. (1996) approach, Farbey et al. (1994) looked for benefits in different areas in the organisation as a pragmatic solution for IT investment evaluation and they conducted "a great benefit hunt". The hunt was performed through introducing three models of strategic, organisational, and technological areas where benefits could be looked for. Farbey et al. (1994) argued that the problem of IS/IT investment evaluation was inherently difficult because of the unpredictability of the impact and the impossibility of attributing the end result solely to the investment in IS/IT. The study concluded by recognising that collecting models of composite sort that were introduced in the study will not make the benefits of IS/IT investment any more predictable or attributable but those models would only provide their users with a rough outline of likely places to look.

II. Explanation of productivity paradox

The productivity paradox drew the attention of IT/IS professionals and researchers and prompted some voices to call for mobilisation to counter the IS/IT critics arguments;

> *"Given the professional standing of our critics and the momentous implications if they are correct, it is the obligation of every information systems' professional to understand the issues that surround the paradox. So armed, each of us must then be prepared and willing to participate knowledgeably in the debate."*

Thus wrote the MIS Quarterly editor (Blake, 1994). In reality, the counter-studies had started earlier and mainly at MIT (Brynjolfsson, 1993), and by a commission assembled at the U.S. National Research Council in U.S.A. (Blake, 1994).

Subsequent studies appeared; some were more decisive than others in explaining the productivity paradox (Brynjolfsson & Yang, 1996; Hitt & Brynjolfsson, 1996). While some researchers were confronting the productivity paradox argument on the economic and financial front, others were trying to study the non-financial value and implications of IT/IS. DeLone & McLean (1992) tried to formulate a global outcome measure of IS/IT success employing the financial and the non-financial measures. Mainly, the explanation of the productivity paradox concentrated around the following four arguments:

1. Management role in paradox

Although the large magnitude of the productivity paradox was diagnosed in the service sector by Steven Roach (Roach, 1987, 1991; Krohe, 1993; Strassmann, 1997), we find him, the firm believer in the paradox claims, laying blame on the managers of the U.S. service sector whose industry was protected by regulations and lack of foreign competition. This, according to Roach, made them unwise in their investment in IS/IT. Top management's biggest fault was to look to IT/IS as a solution to the problems, not as a tool to be used in solving them. On this theme, Strassmann (1996) entitle was "Computers Don't Make Money, People Do". In addition, studies have shown different cases of organisations that made identical spending on IS/IT but had different effects on those organisations. This, according to Strassmann (1997), shows that it is not the computers' fault, but how a firm manages them that makes the difference. Also managers are accused of prioritising political issues over the benefit organisational goal. Some research found that redistribution of power plays an important role in IT/IS implementation (Munshi, 1996). Another problem is the inability of management to use the outcome of IT/IS. This results in adverse effects, for example the application of the old management principle, "Get all readily available information before making a decision", will lead to chaos and information overload with today's IT/IS power and capabilities (Brynjolfsson, 1993; Kohre, 1993).

2. Management contribution in solving paradox

Management should give more weight to planning, training, reorganising, and restructuring. Without doing so in a serious manner, computers in the business environment become at their best, electronic pencils (Bowen, 1986).

Planning:

Management should focus on long-term strategies and not tactical issues. The prices of computers and technology are becoming predictable, which makes planning possible (Bird, 1994). It was shown that planning for IS/IT integration in mergers, for example, contributed to its success (Weber & Pliskin, 1996). It was also found that linking business strategy to IS/IT strategy contributes to the success of the IT function within the organisation (Brown et al. 1995; Kivijarvi & Saarinen, 1995; Kaplan & Norton 1996; Watson et al., 1998).

Training:

The most important asset in any enterprise is the people that make it run. Bearing this in mind, organisations should place greater emphasis on people rather than on technologies, where training should have more attention (Strassmann 1997). It was found that cutting training or providing it in an inadequate manner resulted in IS/IT personnel lacking appropriate skills and attitudes, which was the cause of having problems in dependability of delivering reliable and acceptable IS/IT service quality (Watson et al., 1998).

Reorganising and restructuring:

It is vital to restructure work processes to accommodate the change that IS/IT brings in the organisation. Without doing so, work becomes something where you "force people to learn a whole set of skills essentially to produce the same old documents" (Kohre, 1993). The Garner Group reports that "Seventy percent of IT projects have not delivered their expected benefits because they have failed to integrate the results into work processes" (Strassmann, 1997).

It is also essential to reorganise the firm structure to reap the maximum benefits of IT: "The failure of IT to transform the work place is because the work place was not transformed - that a changed environment is a precondition not a result" (Kohre, 1993).

3. Role of information systems professionals in paradox

Not only top management actions contribute to the productivity paradox, so do the actions and attitudes of IT/IS professionals within organisations as IT/IS personnel (Watson et al., 1998) or in the IT industry as sales force (Bird, 1994). Internally, IT/IS staff should deal with other organisations' departments and entities as a service-provider rendering a service for a client. Watson et al. (1998) acknowledge that IS/IT service personnel must communicate honestly with clients so that clients' expectations and ISIT function's promises coincide. Bird (1994) reflected senior managers' views that IT/IS personnel should come down from their ivory tower, when quoting senior managers: "The IT staff know about it and we don't... so we find it difficult to challenge their recommendations", and "Computer staff have been keen to develop a mystique". Bird (1994) also found that IT/IS departments should not oppose changes just because they are seen as a threat to their power and one of the biggest challenges for companies during the comming years is to integrate their IS/IT staff with the rest of the business, but she thought that the IS/IT people are resisting it because they want to keep hold of their power, Bird quoted a senior manager, "They should beware – if they are not careful they could find their jobs have been outsourced" .To eliminate the unhealthy tension that exists between IT/IS departments and the rest of the firm's entities, top management should commit to raise the IT/IS service quality and practise reinforcement. This has proved to give positive results (Watson et al. 1998).

As for the opinions of IT/IS professionals, two heads of prestigious IS/IT consultant firms who work in acadaemia, in their book (Andriole & Fox 1990), criticise the way IT/IS professionals design, develop, and maintain IS/IT. Also, with the way they deal with IS/IT users. The authors ask questions relating to the responsibilities of IT/IS professionals: "Why is it that information systems don't work very well? Why is it that orders of magnitude more time and efforts are spent modifying systems than in building them? Why is there always enough money to program but seldom enough to document? Why do users dislike us so much?"

As for the IS/IT industry practices, one can sense a general disapproval from the business community. The IS/IT industry does not concern itself with companies' needs but with how to make a sale. An example given by Strassmann (1997) states that the IBM sales force used an unproved rationale (Grosch's Law) to persuade organisations to acquire more computing capacity than they needed. This and similar types of acts prompted a senior executive of a giant electronics firm, who was quoted by Bird (1994), to say, "The IT industry has more of the image of a second-hand car salesman than the motor industry these days". But the solution as seen by business organisations is not to expect the IT industry to change its practices, but for managers to identify their exact needs. "The idea that Bill Gates will ever listen to his customers is just a fantasy", and "The answer is for managers to put their own houses in order" were said by senior managers who were also quoted by Bird (1994).

4. Lack of suitable measurement

It could be said that the most important contributor to the productivity paradox is mismeasurement . This could be put in three categories:

1. Lack of accurate data input to the measurement process.
2. Inaccurate measurement of the value of IT/IS outputs.
3. Not accounting for lags between investment and results.

These categories are now addressed in turn:

1. Lack of accurate data sets. Brynjolfsson (1993) states regarding previous research studies that all authors make the point of emphasizing the limitations of their respective data sets. Also, a study by Ray Panko in 1991 showed, with evidence, the weakness in the U.S. economy-wide productivity data produced by the U.S. Bureau of Labor statistics which were relied upon by many studies (Blake 1994). The data on IS/IT spending are neither current nor comprehensive, and lack precision. This appears in the measurement of IS/IT stock used, which is overestimated in U.S. government statistics, that leads to underestimation of the productivity. This also means that much of the productivity improvements that U.S. government statistics gave to IT-producing industries should be given to IT-using industries (Brynjolfsson, 1993;Hitt & Brynjolfsson, 1996). Further, much of the data used to prove the productivity paradox were old data, which gave a picture of what was happening in

the 70s and 80s, where IS/IT investments were averaging 1% of revenues in most organisations (Krohe, 1993;Blake, 1994)

2. Inaccurate measurement of output. The measurements used to prove the productivity paradox were not sensitive to many of the values that IS/IT produced. The measurements could not capture the value or variety of products in the production industry or the improvements in the service industry. The convenience in using 24-hour ATMs in banking, or improvements in handling emergency phone services like 911 or 999, are examples of values that were unaccounted for. Other unmeasured improvements are greater and better quality, convenience, reliability, timeliness, safety, flexibility, and variety, all of which are non-financial values of IT/IS (Brynjolfsson, 1993; Blake, 1994; Hitt & Brynjolfsson, 1996; Chan, 2000). Put elegantly by Brynjolfsson & Yang (1996),

> *"This literature (productivity paradox literature) highlights how difficult and perhaps inappropriate it would be to translate the benefits of information technology into quantifiable measures of output. Intangibles such as better responsiveness to customers and increased coordination with suppliers do not always increase the amount or even intrinsic quality of output, but they do help make sure it arrives at the right time, at the right place...we need to spend more effort measuring new forms of value such as capabilities for knowledge creation rather than refining measures of productivity that are rooted in an Industrial Age mindset".*

Krohe (1993) explains mismeasurement as "like measuring air pressure with a ruler".

The literature shows that mismeasurement has the biggest impact in producing the productivity paradox. Brynjolfsson (1993) aknowleges that the closer one examines the data behind the studies of IS/IT performance, the more it looks like mismeasurement is at the core of the 'Productivity Paradox'. Brynjolfsson & Yang (1996) also explain that productivity measurement is not an exact science; they thought the tools used in that regard are "blunt", and the conclusions, they claim, are not definitive. They also advocate that researchers should take the opportunity to rethink how to measure IS/IT productivity and output. Similarly, Krohe (1993) emphasises that the issue ultimately is a question of measurement and the actual argument has nothing to do with the merits of the case, he thinks that either people do not know how to measure IS/IT effects or they measure them wrongly. He argues that there is no productivity paradox but a "measurement paradox".

3. Time lags and media role. The other reason for the mismeasurement problems is the lag between the time IS/IT is put to use and the effects it causes. It was actually too soon to tell whether IS/IT is productive when the studies were done. A general purpose industry tool such as IS/IT might take longer than anticipated to show its effects (Blake, 1994; Kivijarvi & Saarinen, 1995). Also, because of its unusual complexity, mastering IS/IT needs more time and experience from both users and managers. This has its basis in theory. The learning-by-using models state that the optimal investment strategy sets short-term marginal costs greater than short-term marginal benefits (Brynjolfsson, 1993).

The media also played a role in the premature announcement of the productivity paradox and likewise of its solution and "productivity payoff" (Brynjolfsson & Yang, 1996).

2.2.6 Product-Non-financial 'soft' measurement

This type of measurement tools, are mainly concerned with assessing the different features of IS/IT such as system use, user satisfaction, and system quality. These are reviewed in the following sections.

1. System Use

The use of IS/IT by users is one of the most frequently reported measures of the success of IS/IT. Several researchers (Lucas, 1973; Schultz and Slevin, 1975; Ein-Dor and Segev, 1978; Ives, Hamilton and Davis, 1980; Hamilton and Chervany, 1981) have proposed system use as the success measure for IS/IT success. Some researchers proposed that different measures of IS/IT success are interdependent and so they could choose system use as the primary measure for success in their research (Ein-Dor and Segev, 1978). System use was also used in other research as an integral part of IS/IT success framework in the context of organisations (Lucas, 1973). Bonner (1995) used system use to explain the failure of an information system in a manufacturing company. Schultz and Slevin (1975) incorporated system use as a success measurement in the MIS model that they introduced.

System use can be measured from several perspectives. It is clear that the actual system use as a measurement of IS/IT success is acceptable only for voluntary not obligatory use (Maish, 1979; Lucas, 1978; Zmud, 1979; Bonner, 1995; Gatian, 1995). Some studies used actual voluntary use, as opposed to management reported use, where they recorded the amount of user connect time (Swanson, 1974; Lucas, 1973,1978; Ginzberg, 1981).

2. User satisfaction

When the use of an information system is obligatory, system use loses its value as a measurement of IS/IT success and user satisfaction has been used instead. User satisfaction is considered to be the most widely used success measure in the IS/IT research field, where it has been advocated as a surrogate measure for IS/IT success (Igbaria & Zviran, 1991; DeLone & McLean, 1992; Gatian, 1994; Grover et al., 1996; Garrity & Sanders, 1998; Woodroof & Kasper, 1998). The reason is that many researchers accept the psychological expectancy theory which states that attitudes (i.e. satisfaction) and behaviour (i.e. productivity) are linked. This means that satisfied users will be more productive (Gatian, 1994).

While the results of user satisfaction research have provided a solid foundation for evaluating responses of individuals regarding IS/IT, the lack of a theoretical framework for placing this measure within the greater context of overall IS/IT success caused some researchers to call for the need for introducing such a framework (Grover, 1995; Malone, 1990).

3. System Quality

When measuring information system quality, some researchers have looked at resource utilisation and investment utilisation (Kriebel and Raviv, 1980), hardware utilisation efficiency (Alloway, 1980), reliability, response time, ease of terminal use (Swanson, 1974), content of the database, aggregation of details, human factors, and system accuracy (Emery, 1971). Hamilton and Chervany's (1981) list of system quality measures is probably the most well known: data currency, response time, turnaround time, data accuracy, reliability, completeness, system flexibility and ease of use. Some researchers combined a soft systemic approach with multiple perspectives (technical, organisational, personal) to provide a view of IS/IT quality that is broader than traditional approaches to software and hardware quality. Some researchers called for including user quality, where research methods used involve case study and action research (Bonner, 1995; Fiedler et al., 1997).

In general, the literature seems to agree that information systems are made up of three main interacting components: Information Technology, People, and Processes.

1. Information Technology (IT)

Even though it is not completely agreed upon in the research field of IS/IT which of IS or IT contains the other, and the terms IS and IT are used interchangeably in the literature (Al-Gahani, 1998), in this research we will adopt the most agreed upon view in the IT/IS research field. IT is the hardware and software used within information systems. Hardware refers to the devices and other physical equipment involved in processing information, such as computers, workstations, physical networks, and data storage and transmission devices. Software refers to the computer programs that interpret participant inputs and control the hardware. Software includes operating systems and end user application software (Al-Gahani, 1998; Alter, 1996; Bonner, 1995; Kendall & Kendall, 1992; Delone & McLean, 1992;).

2. Process

Davenport and Short (1990, p. 12) define a business process as "a set of logically related tasks performed to achieve a defined business outcome". Similarly, Hinterhuber (1995, p. 65) defines it as "a set of integrated and coordinated activities required for producing products or offering services". A business process has structure, inputs, outputs, customers (internal and external) and owners (Davenport and Short, 1990; Hinterhuber, 1995), and is built up by integrating fragmented functions that contribute to its operations and internal and external flows (Hammer, 1990). The process structure describes the process components and their various interactions. A process takes inputs and produces outputs that are the result of series of work activities and transformations. Process customers, both internal and external, are the recipients of process outcomes. An internal customer is a recipient of the product or service within the boundaries of the organisation. An external customer is a recipient of the product or service outside the boundaries of the organisation. Process owners are those who are in charge of its operations (Morris and Brandon, 1993).

Business processes can be classified into four groups: core which is central to business operations; support; management, which is concerned with organising and controlling business resources, and business network processes which are externally focused (Willcocks and Smith, 1994). There is also a big body of literature that addresses the process maturity in organisations. Mostly, those are consultancy and certification models such as the Capability Maturity Model (CMM) (Paulk et al., 1993), Trillium (Trillium, 1996), Bootstrap (Kuvaja et al., 1994), SPICE (Software Process Improvement and Capability dEtermination) (El Emam et al., 1998), SPICE (Structured Process Improvement for Construction Enterprises) (Construct IT, 2000), TickIT (TickIT, 1997), IT Infrastructure Library (ITIL) (Central Computer and Telecommunications Agency, 1992), and standards such as the ISO 9000 series (ISO, 1987a, 1987b, 1987c).Those will be reviewed in the next chapter.

3. People

People in an information system are of three types: Participants, Users, and IT professionals (Alter, 1996; Kendall & Kendall, 1992).

A. Participants & Users

Participants are the people that play essential roles in an information system such as entering, processing, or using the information in the system (Alter, 1996; Kendall & Kendall, 1992), while Users are those that use the output of the information system (DeLone & McLean, 1992). Often, a participant is also a user of a system's output but this is not always the case.

B. IS/IT professionals

These are analysts and programmers or programmer-analysts combined in one role, database administrators who control the definition of items in the database and monitor its performance and security, technical writers who produce documentation along with computer operators, system or project manager who could also be called team leader who is responsible for the system development and/or maintenance, user support staff in the IS function who are responsible for training users and participants, and technical support and network specialists who are responsible for hardware, networks and system software installation and maintenance (Alter, 1996; Kendall & Kendall,1992).

<u>4. IS/IT infrastructure</u>

In some studies, the term 'IT infrastructure' is used in a broad sense. It is viewed as a system of physical assets (hardware, software, and data), intellectual assets (technical skills, business skills and training), and their links (shared services, standards and policies, management support roles and sources) (Davenport, 1993; Luftman et al., 1993; Ross, 1998; Mitchell and Zmud, 1995). The IS/IT infrastructure that fails to serve the business process and business information needs is considered to be deficient, and contributes to the likelihood of failure of the organisation (Duncan, 1995; Mitchell & Zmud, 1995).

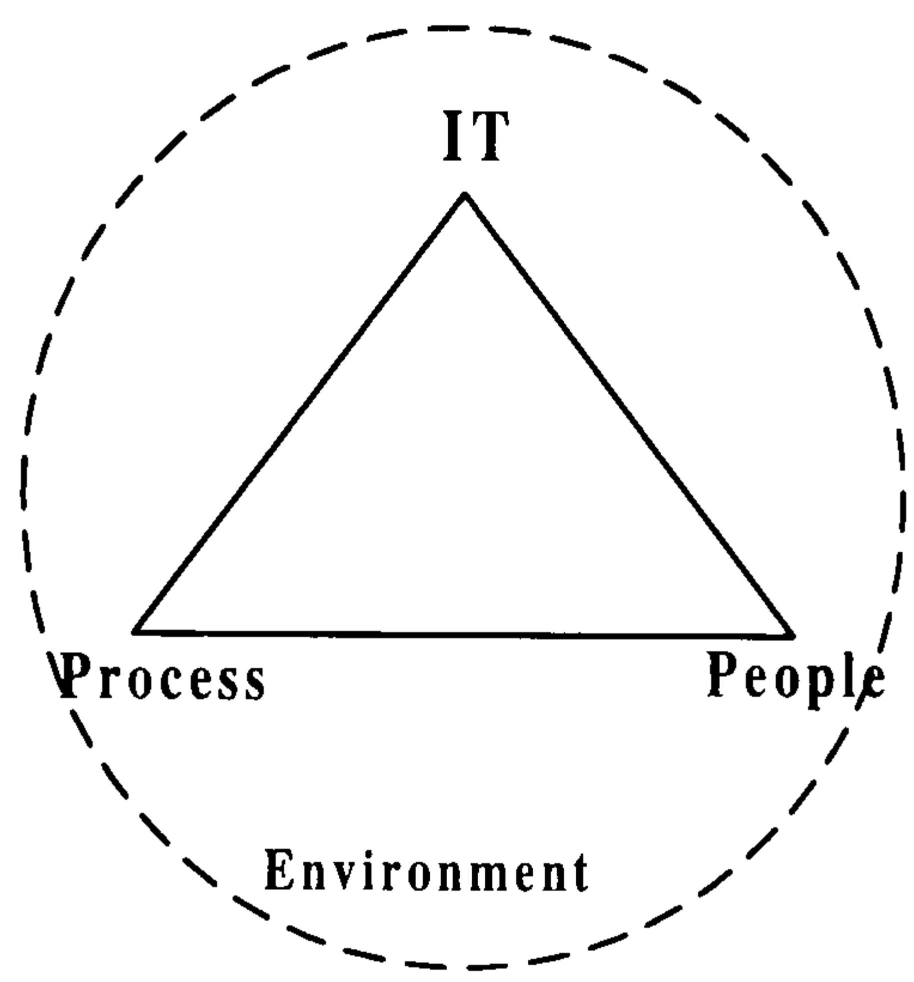

Figure 2.2 Interaction of IT, People, Process, and Environment

Searching the literature that covers IS/IT infrastructure would provide a suitable way to illustrate the interaction between IT, People, and Process (Figure 2.2). Weill & Broadbent (1999) propose a three-layer structure of IT infrastructure. In the first layer are the IT components like computers and communications networks. The second layer contains people with knowledge and expertise who are responsible for making and running shared IT services. This is where business applications use shared IT services to perform business processes operations. The third layer represents a set of IT services that are shared organisational-wide, such as distributed databases and data interchange (EDI) services. Similar to Weill & Broadbent (1999), Kayworth et al. (1997) propose a conceptual framework of IS/IT infrastructure that consists of physical assets, intellectual assets, IS/IT standards, and shared IT services. Physical assets consist of computer processors, operating systems, databases, telecommunications devices, and programming languages. Intellectual assets represent the human infrastructure that includes IS/IT-related knowledge, skills, and expertise. This model focuses on reconciling various IS/IT infrastructure components to provide shared IS/IT services to support the organisational processes.

Other models of IS/IT infrastructure illustrate the interaction of the three main components when dealing with information systems (Al-Mashari & Zairi, 2000; Malhotra, 1996; Ross, 1998). Malhotra (1996) model, in particular, has the advantage of being useful in guiding the design and development of information systems to support various organisational processes. The Ross (1998) model is comprehensive, in terms of defining the linking between organisational processes and IS/IT components, as well as describing their contexts of interaction, and making reference to the importance of several management tools.

Other studies explained that, IS/IT and people, enable process improvements and reengineering activities, and without them it would be difficult or even impossible to move, for example, from a sequential structure of processes into a parallel one. This would allow exchange of information and coordination, which would give the benefit of reducing problems that result from delays and process disruptions. (Davenport, 1993; Hammer, 1990; Linden, 1993).

5. Environment

Many studies have tried to identify the internal environmental factors within organisations that contribute positively to IS/IT successful implementation and influence its performance. Those factors were identified as user participation and involvement with IS/IT function in the development of IS/IT (Conarth & Mignen, 1990; Kim, & Lee 1986; Montazemi, 1988; Tait & Vessey, 1988), top management support and leadership (Cerullo, 1980; DeLone, 1988; Doll, 1985), and organisational culture issues, particularly people's relationship within the organisation (Burn et al.,1997; Leidner, 1998; Nelson & Clark, 1994).

Many researchers have examined the influence of organisational structure on IS/IT success and performance (Cheney & Dickson, 1982; Raymond, 1985; Cheney et al., 1986; Sanders & Courtney, 1985). Sanders & Courtney (1985) and Cheney et al. (1986) examined the impact of organisational environment and structure on IS/IT success. They suggested that there exists a relationship between the success of IS/IT implementation and the organisational structure. Also, reducing the number of levels in an organisation's hierarchies could be achieved by the use of IS/IT which enhances the decision-making process (Hammer & Champy, 1993). In addition, some researchers (Linden, 1993; Teng et al., 1994) advocated that Business Process Reengineering (BPR), when combined with IS/IT use, helps to eliminate intermediaries at different levels of organisational structure, and enhances the exchange of information required in any process. Human mediation is a component that can be supported by IS/IT-based processes as in the use of teleconferencing technology and Internet, which help in overcoming the geographic limitations imposed on business information exchange over long distances. Other studies (Cheney & Dickson, 1982; Raymond, 1985) suggested that IS function's position within the organisational structure influences the success of IS/IT implementation and use.

Leidner (1998) argued that organisational sub-unit culture affects the success of IS/IT implementation. The study proposed that the successful implementation and use of Knowledge Management System (KMS) has been affected by the type of sub-unit culture it is implemented in. Burn et al. (1997) and Nelson & Clark (1994) advocate that organisational culture which is influenced by national culture affects the successful implementation of IS/IT. Burn,et al. (1997) studied the effects of organisational culture on the success of Group Support System (GSS) in a number of

Hong Kong organisations. They found that the national culture that affects organisational culture had a negative effect on the success of GSS in those organisations. Similar to Burn et al. (1997), Nelson & Clark (1994) argued that organisational culture is influenced by national culture and they developed a model based on previous studies that presents this and the influence of organisational culture on IS/IT implementation.

6. IS/IT Function Head

The role of the IS/IT head has been found to be important for the success of IS/IT planning, development, implementation and operation in the organisation (Applegate and Elam,1992; Broadbent et al., 1994; CSC, 1996; Feeny et al., 1992; Watson, 1990).

Changes in both the technology and challenges that face organisations continue to change the role of the IS/IT executive. Computer Sciences Corporation (CSC, 1996) has suggested six IS/IT leadership roles which are required to execute IS/IT function agenda:

1. Chief Architect: The chief architect designs future possibilities for the business. The primary work of the chief architect is to design and evolve the IS/IT infrastructure so that it will expand the range of future possibilities for the business. The infrastructure should provide not just today's technical services, such as networking, databases and desktop operating systems, but an increasing range of business-level services, such as workflow, portfolio management, scheduling, and specific business components or objects.
2. Change Leader: The change leader orchestrates resources to achieve optimal implementation of the future. The essential role of the change leader is to

orchestrate all those resources that will be needed to execute the change programme. This includes providing new IS/IT tools, but it also involves putting in place teams of people who can redesign roles, jobs and workflow, who can change beliefs about the company and the work people do, and who understand human nature and can develop incentive systems to coax people into new and different behaviours.

3. Product Developer: The product developer helps define the company's place in the emerging digital economy. For example, a product developer might recognise the potential for performing key business processes (perhaps order fulfilment, purchasing or delivering customer support) over electronic linkages such as the Internet. The product developer must 'sell' the idea to a business partner, and together they can set up and evaluate business experiments, which are initially operated out of IS/IT. Whether the new methods are adopted or not, the company will learn from the experiments and so move closer to commercial success in emerging digital markets.
4. Technology Provocateur: The technology provocateur embeds IT into the business strategy. The technology provocateur works with senior business executives to bring IS/IT and realities of the IS/IT marketplace to bear on the formation of strategy for the business. The technology provocateur is a senior business executive who understands both the business and IS/IT at a deep enough level to integrate the two perspectives in discussions about the future course of the business. Technology provocateurs have a wealth of experience in IS disciplines, so they understand at a fundamental level the capabilities of IS/IT and how IS/IT has impacts on the business.

5. Coach: The coach teaches people to acquire the skill sets they will need for the future. Coaches have two basic responsibilities: teaching people how to learn, so that they can become self-sufficient, and providing team leaders with staff able to do the IS/IT-related work of the business. A mechanism that assists both is the centre of excellence, a small group of people with a particular competence or skill, with a coach responsible for their growth and development. Coaches are solid practitioners of the competence that they will be coaching, but need not be the best at it in the company.
6. Chief Operating Strategist: The chief operating strategist invents the future with senior management. The chief operating strategist is the top IS/IT executive who is focused on the future agenda of the IS/IT organisation. The strategist has parallel responsibilities related to helping the business design the future, and then delivering it. The most important, and least understood, parts of the role have to do with the interpretation of new technologies and the IS/IT marketplace, and the bringing of this understanding into the development of the digital business strategy for the organisation.

Factors affecting Head of IS/IT

A number of factors have been found to affect the performance of the head of the IS/IT function. The number of years the IS/IT function head has worked in the current organisation have been found to affect his/her performance. It has been argued that new, externally hired leaders will be more change-oriented than leaders who have been in the organisation for several years (Applegate and Elam, 1992). Also, the IS/IT function leader's performance is affected by the number of years s/he has been in the current position. It has been argued that newly appointed leaders will be more change oriented than leaders who have been in the position for many years (Applegate and Elam,1992).

The extent to which the IS/IT head personally uses technology and his/her technical background also affect the performance of the IS/IT function leader. It has also been argued that the Chief Information Officer (CIO) with greater personal IS/IT familiarity and use will spend more time in technologically-oriented leadership roles (Broadbent et al., 1994).

The support by top management and the relationship between the IS/IT function head and the CEO would have an impact on the success of IS/IT in the organisation. It has been argued that the CIO's relationship with the CEO and other executives in the organisation who represent user groups will have an impact on IS/IT leadership roles and affect the success of IS/IT (Watson, 1990). For example, the extent to which the CIO is involved in strategic planning may be dependent on trust between the CEO and the CIO. Also, the relationship between IS/IT function staff and leadership on one hand and user personnel and their leadership would affect their acceptance and use of IS/IT (Feeny et al., 1992).

The rank and position of the IS/IT head also affects his/her role. If there are several management layers between top management and the IS/IT head, then it can be argued that the latter's role is more managerial and less strategically oriented (Watson, 1990).

Those internal environmental factors have been addressed in different ways by the other researchers (Bhabuta, 1988; Earl, 1989; Hirschheim et al., 1988; Galliers &

Sutherland, 1991; Nolan, 1979;Weill & Broadbent, 1999). Those studies (evolutionary maturity models) are presented in detail in chapter 4.

2.2.7 Limitations of 'Hard' and 'Soft' IS/IT Measures

The research field of IS/IT evaluation is still inconclusive, especially in measuring the success of IS/IT projects at the business level (DeLone & McLean, 1992; Ishman, 1996). Many of the evaluation measures have been criticised for not being able to provide value to the organisation. In fact, many researchers advocate that a major problem with IS/IT investments is the way in which they are evaluated (Farbey et al. 1994; Strassman, 1997; Willcocks, 1996). This criticism has been sounded regarding both the 'hard' financial-based measures and the soft non-financial measures.

The all-purpose hard financial measures do suffer from limitations in capturing the actual value of IS/IT in organisations (Brynjolfsson & Yang 1996; Hitt & Brynjolfsson 1996; Farbey et al.,1994). Farbey et al. (1994) explain:

> *"We argued that the problem (of IT investment evaluation) was inherently difficult because of the unpredictability of the impact and the impossibility of attributing the end result solely to the investment in IT".*

The currently used IS/IT success 'soft' non-financial measures also suffer from many limitations. On the technical level, a technically sound IS does not guarantee that it would be accepted or used by the user, or that it would meet its planned objectives (Ballantine et al., 1996; Hamilton & Chervancy, 1981). On the usage level, system use has been criticised for being suitable only for voluntary use (Zmud, 1979) which is not common in today's work environment (Bonner, 1995; Gatian 1995). In addition, interfering factors, such as the individual user's work life, might affect the measurement of System Use. This makes system use more suitable for controlled laboratory settings than the real world (DeLone & McLean, 1992). User satisfaction has also been criticised, among other things, for not being a suitable surrogate for IS success. It is not necessarily the case that satisfied individuals would lead to a successful system which meets its objectives. In addition, there were no conclusive answers regarding whose satisfaction should be considered and with regard to what aspect of the IS. As the respondents change, so might the satisfaction with the IS (Ballantine et al., 1996; Delone & McLean, 1992). Moreover, usage measures have been applied only on the individual level (Ishman, 1996).

2.2.8 DeLone and McLean's Study

Because DeLone and McLean (1992) introduced an IS/IT measurement model that combines both 'soft' and 'hard' measurements, and because of its prominence by being the basis for a large amount of subsequent IS/IT success measurement research (Bonner, 1995; Ballantine et al., 1996; Seddon, 1997; Garrity & Sanders, 1998) in addition to its importance to our research, their work will be covered in detail.

2.2.8.1 Theoretical path of development of DeLone & McLean (1992)

This review will present the path of development of the DeLone and McLean (1992) model (Figure 2.3), based on the initial work of Shannon and Weaver (1949), and that of Mason (1978), in its adoption into the information systems' research field. It was Mason's work that laid the foundations for the model and its incorporation into the IS/IT success research field. The study has synthesised and classified the previous research in the field and identified the different categories of measures used previous to its publication. The model (Figure 2.3) became the focus of further theoretical research especially in measuring IS/IT success. In fact, the model itself became the subject of research more than a tool of measurement.

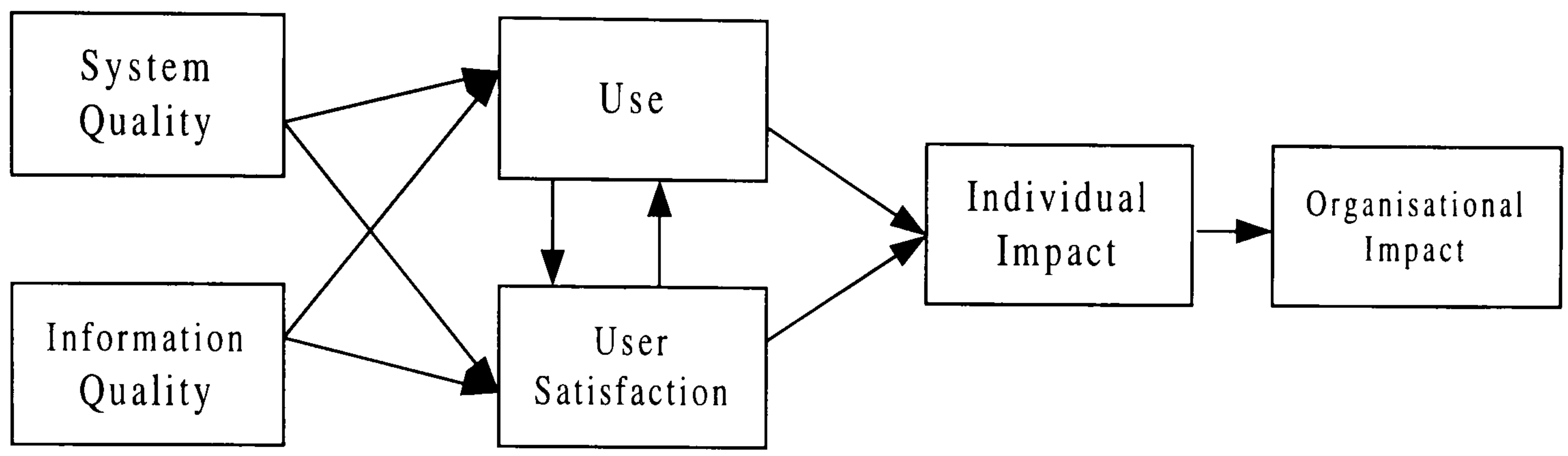

Figure 2.3 DeLone & McLean model of IS Success,
DeLone and McLean (1992)

Because of their relevance to the research findings and to DeLone & McLean study, we will next review communication theories introduced by the literature including the communication theory of Shannon & Weaver (1949), the basis of the DeLone & McLean model and introduce the difference between Shannon & Weaver's and Schramm's communication theories.

1. Communication theory of Lasswell (1948, 1960)

Lasswell (1948) described communication as "A convenient way to describe an act of communication is to ask the following questions: Who - Says What - In Which Channel - To Whom - With What Effect?"

He noted that these questions are the central issues in a number of communication research fields - control analysis (who), content analysis (says what), media analysis (in which channel), audience analysis (to whom), and effect analysis (with what effect). In addition, he stated that the communication process in society performs three functions. The first is the surveillance of the environment that discloses the threats and opportunities which affect the value position of the components that are parts within it. The second is the correlation of the components of society in making a response to the environment. The third is the transmission of the social inheritance.

2. Communication theory of Schramm (1954, 1971)

Schramm (1954) claims that "when we communicate we are trying to establish a 'commonness' with someone". All communication involves at least three elements: source, message, and receiver. The source encodes the message and transmits it, and the receiver decodes it. Both the encoding and decoding are grounded in the particular "fields of experience" of sender and receiver. If decoding matches the encoding, then a commonness with someone has been established. A distortion might occur at any point in the process which prevents the achievement of commonness. The source tries to encode the message in signs which will "make it easy for the destination to tune in the message".

Schramm states that it is "misleading to think of the communication process as starting somewhere and ending somewhere". This is because we are constantly receiving and decoding signs from the environment where we interpret these signs and encode something as a result. Schramm added feedback to his model which tells us how our messages are being interpreted.

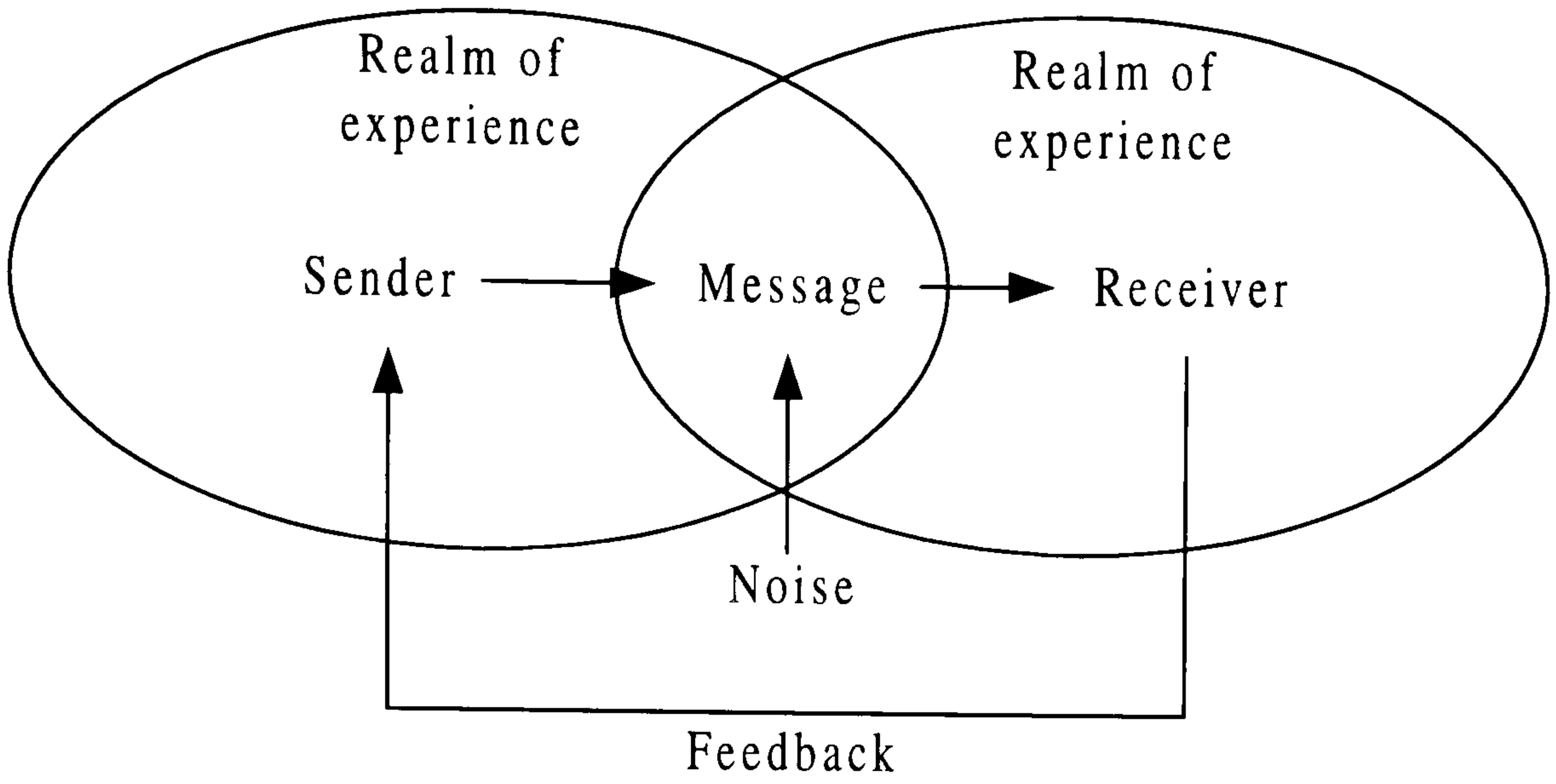

Figure 2.4 Schramm Communication Theory,
Schramm (1971)

Schramm (1971) updated his earlier work (Figure 2.4). He stated that "human communication seemed a simpler thing in 1952 than it does in 1970". He also noted that "communication had now come to be thought of as: a relationship, an act of sharing, rather than something which someone does to someone else". Schramm advocated the end of what he called "The Bullet Theory of Communication". He stated that communication had been seen as a magic bullet that "transferred ideas or feelings or knowledge or motivations from one mind to another". Schramm has also acknowledged that "it is now necessary to think of the communication process as two separate acts, one performed by a communicator, one by a receiver". He redefined communication as "the sharing of an orientation towards a set of informational signs". Information in turn was broadly defined as "any content that reduces uncertainty or the alternative number of possibilities in a situation" (p.13).

Schramm (1971) claims that all communication, whether interpersonal or mediated, involved three elements and two kinds of action. The elements are the communicator, the message, and the receiver. Schramm observed that "the message exists as a sign or collection of signs with no meaning of their own except that which cultural learning enables a receiver to read into them". He saw that the first act of the communication process is the construction by the communicator of the "signs which he hopes will call forth the desired responses". The second act is performed by the receiver in a way that "A receiver selects among the stimuli available to him, selects from the content of the message he chooses, interprets it and disposes of it as he is moved to do". He concluded that "communication is something people do; it has no life of its own, and there is no meaning in a message other than that which people put into it. The study of communication, therefore, is the study of people in relationship."

In Schramm's new model of communication (Figure 2.4), person A encodes a message and transmits the message to person B. B comes to the message in an active way. B encodes a response, transmits this message to A who also interacts with the message. Both A and B operate within certain frames of reference, by which Schramm means their "fund of usable experience" (p.31). Where they can communicate efficiently, the two frames overlap. The final element in the revised model is termed "social situation and relationships". Schramm claims that all communication necessarily functions within a broader framework of social relations which he identifies as comprising four elements: the physical /spatial relationship between sender and receiver, the situational context, role expectations, and social norms.

3. Communication theory of Berlo (1960)

Berlo (1960) states that communication is a process and it is necessary to "arrest the dynamic of the process" (p.25) to make it accessible. Berlo lists six "ingredients" of the communication process: the communication source, the encoder, the message, the channel, the decoder, and the communication receiver. Berlo claims that encoding and decoding functions are separable from source and receiver functions. Communication sources have a "purpose" (p.32) or "intend to affect behaviour" (p.73), and a "central nervous system" which enables communication. The source instructs encoders to encode. Examples of encoders are the speech mechanism, the writing mechanism, typewriters, typists and printers. Messages include words and the manner in which they are arranged. Examples of channels are sound waves and light waves. He cites the hearing mechanism and the eye as examples of decoders. The receiver is whoever responds to the decoded message. Berlo states that the concepts of source, encoder, decoder and receiver should "not be viewed as separate things or entities or people. They are the names of behaviour which have to be performed for communication to occur" (p.37).

4. Communication theory of Shannon & Weaver (1949)

Shannon & Weaver (1949) describes communication as a process which starts when an information source selects a desired message out of a set of possible messages. The transmitter changes this message into the signal which is then sent over the communication channel from the transmitter to the receiver. The receiver then changes the transmitted signal back into a message, where the message meaning is understood and an effect resulted (Figure 2.5).

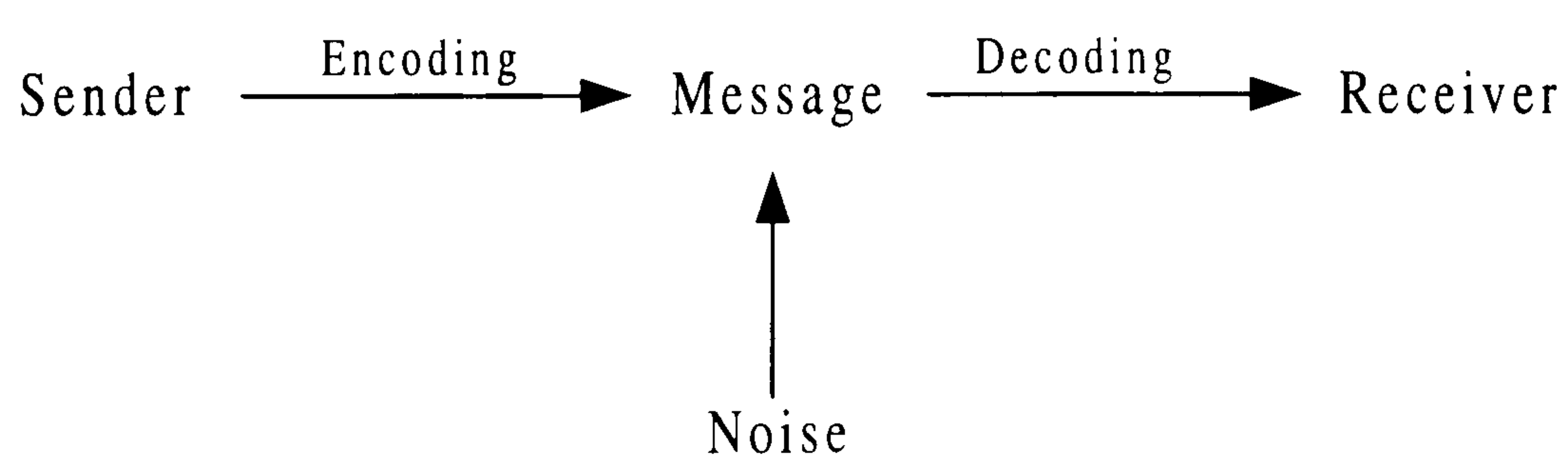

Figure 2.5 Shannon & Weaver Communication Theory,
Shannon & Weaver (1949)

Weaver, in Shannon & Weaver (1949), starts by defining communication as "all of the procedures by which one mind may affect another. This, of course, involves not only written and oral speech...and in fact all human behaviour. In some connections it may be desirable to use a still broader definition of communication, namely one which would include the procedures by means of which one mechanism... affects another mechanism."(p.3). Weaver presented communication problems in communication theory as being on three levels: "Level A. How accurately can the symbols of communication be transmitted? (The technical problem.). Level B. How precisely do the transmitted symbols convey the desired meaning? (The semantic problem.). Level C. How effectively does the received meaning affect conduct in the desired way? (The effectiveness problem.)".

Level A is concerned with the accuracy of the transfer of sets of symbols from the sender to the receiver. It starts as "The information source selects a desired message out of a set of possible messages. The selected messages may consist of written or spoken word, or pictures, music, etc.", then "The transmitter changes this message into the signal which is actually sent over the communication channel from the transmitter to the receiver... the receiver is a sort of inverse transmitter, changing the transmitted signal back into a message, and handing this message on to the destination."

In the process of transmission, unintended signals called noise are added to the message. Weaver introduced some questions regarding level A, and left the answers for Shannon to introduce them in mathematical terminology along with the mathematical proof of the communication theory. Weaver's questions were: "How does one measure amount of information?.. How does one measure the capacity of a communication channel?.. What are the characteristics of an efficient coding process?.. What are the general characteristics of noise? How does it affect the accuracy of the message?"

Level B, the semantic level, is the level where " the information source selects a desired message out of a set of possible messages". It then becomes "concerned with the identity, or satisfactorily close approximation, in the interpretation of meaning by the receiver, as compared with the intended meaning of the sender. This is a very deep and involved situation, even when one deals only with the relatively simpler problems of communicating through speech".

Level C, the effectiveness level, is "concerned with the success with which the meaning conveyed to the receiver leads to the desired conduct on his part. It may seem at first glance undesirably narrow to imply that the purpose of all communication is to influence the conduct of the receiver. But with any reasonably broad definition of conduct, it is clear the communication either affects conduct, or is without any discernible and probable effect at all." Weaver points out that "The effectiveness problem is closely interrelated with the semantic problem, and overlaps it in a rather vague way; and there is in fact overlap between all of the suggested categories of problems.

Difference between Shannon & Weaver's and Schramm's communication theories

Schramm (1954) communication model is basically a modification of the Shannon-Weaver model and incorporates some of its components and technical aspects of communication. Some similarities between the two models are revealed by Weaver's comment in Shannon & Weaver (1949) that "the function of the transmitter is to encode, and that of the receiver to decode, the message". However, since Schramm was interested in the instructional role of communication, the primary concerns of his model are meaning and the communication of meaningful symbols, whereas the Shannon-Weaver model has little to say about meaning.

The two models differ in additional ways:
The first is in Schramm's incorporation of feedback. Feedback is a response from the destination or receiver back to the source or sender, or a subsequent response from the source back to the destination.

Another important difference between the two communication models is Schramm's incorporation of the sender's and receiver's field of experience, or scope of knowledge, experience and culture. Just as important is Schramm's idea that, for meaning to be transferred from sender to receiver, the two fields must overlap, that is, the sender and receiver must share some knowledge, experience or culture that pertain to the transmitted message and its meaning.

In his 1971 modified model, Schramm introduced the notion that communication is more of a relation between the sender and receiver than being a message-bullet sent by the sender to the receiver and vice versa.

<u>Shannon & Weaver (1949) adoption into IS/IT research</u>

Shannon in Shannon & Weaver (1949) covered the mathematical aspects of the first level (Level A). Mason (1978) adapted Weaver's work to the information systems' field, where he states that "communication is the process by which one system, P, (e.g., a mind) affects another receiving system, R. The affected system, R, is the receiver" (p.220). System P, according to Mason, consists of the hardware, software, people, data, and media, all of which are controlled by rules and procedures. Mason adopted Weaver's three levels of communication and called them technical, semantic, and influence levels, respectively. He defined the output of the technical level as "the number of physical units of media or data handled or transmitted during a time period" (p.222). The productivity of this level could be measured, according to Mason, by comparing the output to the resources spent. The semantic level output is defined as "the number of units of meaning handled or transmitted by the producing unit during a given time" (p.222), where it is measured from the "point-of-view" or perspective of the information user. The influence level output, according to Mason, has " a pragmatic impact on the receiver. It produces practical results, which have some ultimate value to the receiver. These results and their values constitute the influence level" (p.225). Mason asserted that there is a hierarchy of events happening at the receiving end, and those might be used to identify approaches of output measurements at this level. The output of the levels, according to Mason, can be measured in the following terms of: "The number of individual signs accurately transmitted from P to R through the channel. The amount of meaning flowing from P to R. The amount of affect change in R occurring as a result of receiving signs from P. This includes the value the received information has for R such as, for example, improved profitability." Mason (1978) produced a framework of classes of output of an information system (Figure 2.6) where he presented levels of communication and their notions of output.

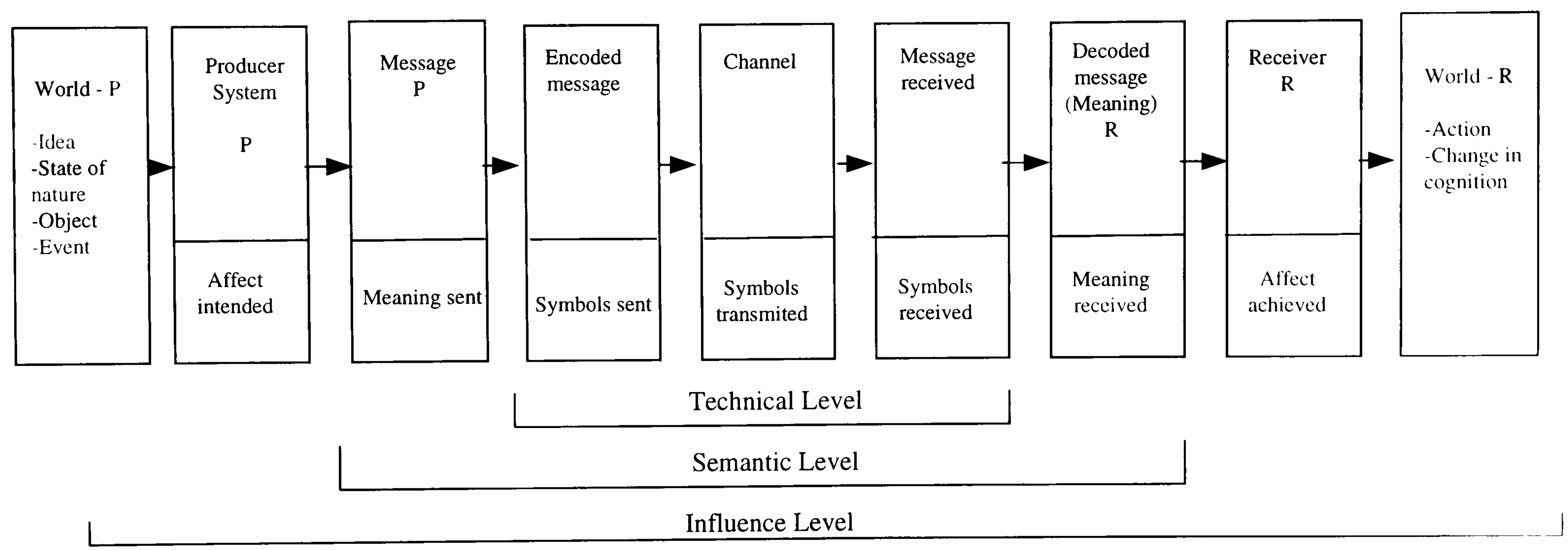

Figure 2.6 Mason Classes of output of information systems, Mason (1978)

2.2.8.2 DeLone & McLean work on IS/IT success

DeLone & McLean (1992) accepted that "The concept of levels of output from communication theory demonstrates the serial nature of information (i.e., a form of communication)… In this sense, information flows through a series of stages from its production through its use or consumption to its influence on individual and/or organisational performance".

DeLone & McLean suggested that Mason's adoption of communication theory to accommodate information systems' measurements implied the need for separate success measures for each level of the information. Building on that, DeLone & McLean came up with a total of "six distinct categories or aspects of information systems.". Those were: System Quality, Information Quality, Use, User Satisfaction, Individual Impact, and Organisational Impact (Figure 2.3).

1. DeLone & McLean's Taxonomy

After presenting their theoretical base, DeLone & McLean went on to produce a taxonomy of research and a model of IS/IT success or effectiveness. In order to organise the IS/IT effectiveness research literature, DeLone & McLean reviewed 180 references in the IS/IT field, Both conceptual and empirical studies are cited and seven IS/IT journals, from the period January 1981 to January 1988, were selected as reflecting the mainstream of IS research during this formative period. These studies were categorised into the six categories of the success model.

2. DeLone & McLean's Model

DeLone & McLean (1992) wanted to produce a model so that the six categories of the taxonomy and the structure of the model allow a reasonably coherent organisation of at least a large sample of the previous literature, while, at the same time providing a logic as to how these categories interact. DeLone & McLean also emphasized the features of the model,

> *"In addition to its explanatory value, a model should also have some predictive value...the whole reason for attempting to define the dependent variable in MIS success studies is so that the operative independent variables can be identified and thus used to predict future MIS success." (p.87).*

The model shown in Figure 2.3 presents IS/IT success as a process construct that, according to DeLone & McLean must include both temporal and causal influences. The six categories were arranged in a way to depict this. The System Quality and Information Quality singularly and jointly affect both Use and User Satisfaction. Additionally, the amount of Use can affect the degree of User Satisfaction - positively or negatively - as well as the reverse being true. Use and User Satisfaction are direct antecedents of Individual Impact that eventually should show as an Organisational Impact.

DeLone & McLean suggested that it is going to be problematic to select arbitrarily measures from each of the six categories of the model to form an overall success measurement instrument. Instead, they suggested furthering the research by systematically combining individual measures from IS/IT success categories to develop a comprehensive measurement instrument. At the same time, they suggested that consideration should be given to the contingency variables, such as the independent variables being researched and to the environment, the technology used, the task and individual characteristics of the system being studied. DeLone & McLean stated that "It is unlikely that any single, overarching measure of IS/IT success will emerge; and so multiple measures will be necessary, at least in the foreseeable future".

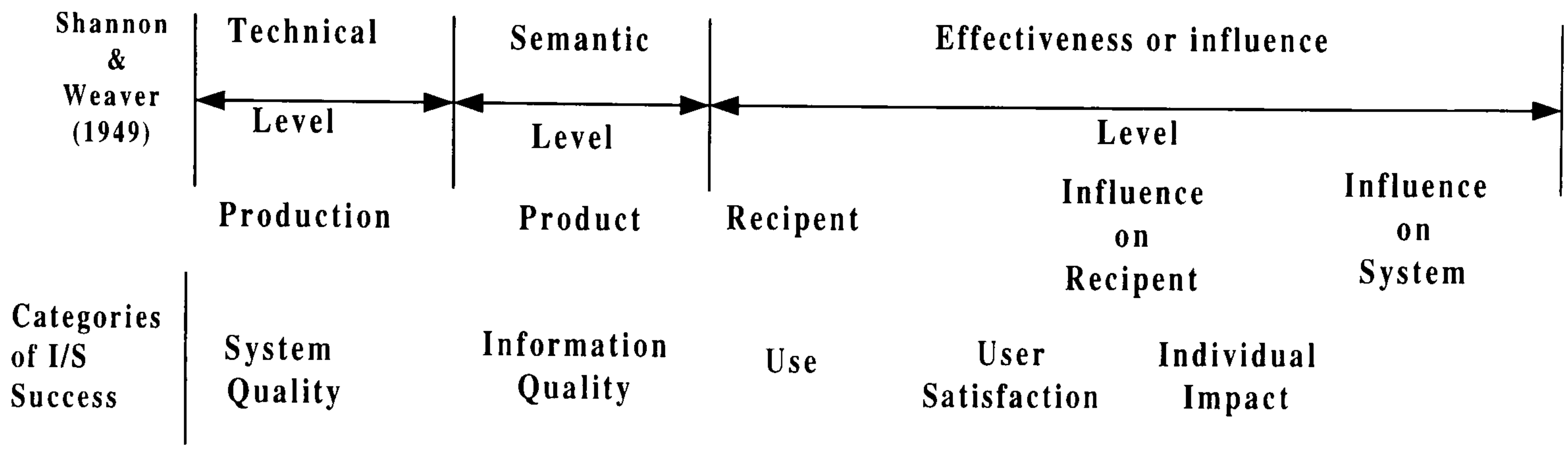

Figure 2.7 DeLone & McLean's Categories of IS success,
DeLone & MacLean (1992)

3. Critique of theoretical base of DeLone & McLean's Model

Mason's framework (Figure 2.6) presented "The classes of output of an information system." The framework is derived from Shannon & Weaver's communication levels.

Matching this framework with DeLone & McLean's introduction, Figure 2.7 reveals an interesting difference. Mason presented the three levels of communication as the influence/effectiveness level, including the semantic level, which in turn includes the technical level, i.e. the levels of communication act in a nested fashion. They start in an inward direction until they reach the middle, then unfold again in the outward direction. This makes what started last finish first, and vice versa, whereas DeLone & McLean presented the levels in a serial fashion, making the technical level the first to start and finish, then the semantic level, then the influence level. Altering the framework from representing the actual nature of the communication process led to the loss of valuable observations that might otherwise have been recognised. Investigating the IS success literature, one can find reserved opinions concerning the formation of the model, the interaction of the dimensions, the causal interdependencies among the dimensions, and/or the process positions of the dimensions. Ballantine et al. (1996) expressed confusion about the DeLone & McLean model, questioning whether it was a model, a taxonomy, or a framework. Seddon (1997) cited Seddon and Kiew (1994) and Fraser and Salter (1995) as coming to a conclusion that "D&M tried to do too much in their model, and that as a result, it is both confusing and misspecified" (p.240). Seddon (1997) also stated that "when a reader looks at the D&M model, his/her efforts to make sense of different parts of the model will frequently cause slippage from one meaning for a box or arrow to another. The result is a level of muddled thinking" (p.242). Seddon (1997) also finds confusion between the use of the model for prediction and for evaluation.

The literature also criticised some specific features of the model. For example, Ballantine et al. (1996) indicated that "Information systems quality does not exist in the absence of their relevance to individual users and organisations...In discussing IS success, DeLone and McLean do not distinguish between data and information...the model they present measures information quality at the technical level of the system, which explicitly ignores the user" (p.7). Those critical opinions are an indication of the confusion caused by the model's inability to present the causal relations of the dimensions and categories in the light and context of the information system rather than the information. Seddon (1997) complained about the ill-presentation of the causal relationships: "After working with this model for some years, it has become apparent that the inclusion of both variance and process interpretations in their

(DeLone and McLean) model leads to so many potentially confusing meanings that the value of the model is diminished...it's actually a combination of three models" (p.251). Bonner (1995) also expressed reservations about the causal relations within the model: "The assumption is that information systems can have a positive impact at the individual level and that this will result in improved overall performance. However, evidence from the case suggests that this is not necessarily so". Moreover, researchers in both the IS/IT success and effectiveness and organisational effectiveness fields have doubted impact measures' value as an indicator of effectiveness. This becomes obvious in the view that other effects, beside the individual impact shape the success of an organisation (Cameron 1986; Bonner 1995).

DeLone and McLean's model has been changed and modified by others to reflect the expectation that it should test for the influence of the information system and not the information. Seddon (1997) added four new dimensions to the model to precede the User Satisfaction dimension, namely "Perceived Usefulness, Net Benefit to Individuals, Net Benefit to Organisation, and Net Benefit to Society" (p.250), all pertaining to the category "IS Use" (p.243). Bonner (1995) suggested that the System Quality dimension should include user quality, but added, "Unfortunately, DeLone and McLean's model does not appear to consider user quality as an element of system quality" (p.220). Bonner also suggested that another dimension should be added to the model, which he called "Information Awareness" (p.218). Myers et al. (1998) added two dimensions, "Group Impact" and "Service Quality", along with two contingency factors, "External Environment" and "Organisational Environment". Ballantine et al. (1996) introduced a three-dimensional model which uses some aspects of DeLone & McLean's model but changes it in a major way, focusing on information systems rather than information. Ishman (1996) broke DeLone & McLean's model into four levels which he called Individual Level, Dyad Level, Group Level, and Organisational Level. Similar to Myers et al.(1998), he also added a "Group Impact" dimension that precedes the Organisational Impact dimension in the DeLone & McLean model. Woodroof and Kasper (1998) use the Garrity & Sanders (1995) expanded model of DeLone & McLean and extend it further. In addition to the four dimensions added by Garrity & Sanders (1995), which are Task Support Satisfaction, Quality of Work Life Satisfaction, Interface Satisfaction, and Decision Making Satisfaction, Woodroof and Kasper expanded each of those new dimensions into four parts, Process User Satisfaction and Dissatisfaction, and Outcome User Satisfaction and Dissatisfaction. Pitt et al., (1995) also added a new dimension for IS function service quality.

From all of the above examples, one observes the amount of reservations voiced by the IS research community regarding the DeLone & McLean model. These concerns were manifested by complaints about the weakness of the model and by the significant modifications and changes made to it. A possible common underlying reason for this level of criticism of their work could be the unconscious dissatisfaction with the way the adoption of communication theory, as the theoretical base, was conducted. The adoption made by Mason, and subsequently by DeLone & MacLean, was based on tracing the information system's output (the information) as the message, while the criticism, and especially the amendments made to the model by the research field, show that what was expected to be measured is the information system itself and not its output. The DeLone & McLean model does not provide the basis for a suitable practical explanation in regard to the information system's effects that allow subsequently for the creation of a 'success' measurement.

After conducting this literature study, the researcher had a list of investigations of variables and issues that are related to IS/IT success measurements. This list was investigated in an exploratory study in organisations in a Middle Eastern country and the investigation was done through interviews with their IS/IT managers. The next chapter will first introduce the research methodology applied by this research, followed by presentation of the exploratory work.

2.3 Summary and Conclusion

This chapter introduced the literature reviewed during the course of the research before conducting the exploratory work. It first introduced definitions of information systems/ information technology (IS/IT) and of IS/IT success as it is presented in the literature. Then it introduced the literature concerned with measures that are of the product-oriented measurement type. These are concerned with measuring 'soft' non-financial aspects of IS/IT such as technical success of IS/IT, system use and user satisfaction, or 'hard' financial impacts of IS/IT on organisations. During the presentation of the latter type, a review of some of the 'productivity paradox' literature was presented. This section then presented limitations of both 'hard' and 'soft' measures of IS/IT. A detailed presentation of Delone & McLean (1992) study which tried to combine both the 'hard' and 'soft' measures in a comprehensive measurement model was next introduced. Because Delone & McLean (1992) was built upon a communication theory, a number of communication theories were also reviewed.

Chapter 3: Research Methodology and Exploratory work

3.1 Introduction

Research can be defined as a systematic and organised effort to investigate a specific problem that needs a solution. It consists of a series of steps designed and followed, with the goal of finding answers to issues of concern. It is the entire process by which people attempt to solve problems (Sekaran 1984). The methodology the research follows must consist of defined logical rules and procedures if the finding of the research is to be accepted (Neumann 1997).

The hallmarks of scientific research, according to Sekaran (1984), are: sense of purpose, rigour, testability, replicability, accuracy, objectivity, generalisability, and parsimony. Scientific research is dependent on the concepts of theory and empirical research. Two approaches for research are the inductive and deductive. The inductive approach is where theory comes after research. The deductive approach is where theory comes before research. The inductive approach is based on starting from the particular moving to the general. In the deductive approach the researcher starts with a general view and moves to the particular (Neuman 1997).

This chapter will introduce the design of this research and the logic behind its selection. It will also introduce the different design issues in some detail.
The chapter will also present the exploratory work conducted in nine organisations and the outcome resulted. Overall, the chapter will walk-through the methodology path the research followed until completion.

3.2 Research design

Research design relates to the purpose of the study, the type of investigation, the setting of the study, what sampling design should be used, and how the data are to be collected and analysed (Sekaran 1984).There are different types of research design that are used for various research purposes. Those types can be generally classified into three categories:

- Historical design
- Experimental design
- Non-experimental design

3.2.1 Historical research design

Using this type of research, the researcher examines aspects of social life in a past historical time or across different cultures. S/he combines theory with data collection which uses a mix of evidence including existing statistics, documents (books, newspapers, etc.), observations, and interviews (Sproull, 1988; Neuman, 1997).

3.2.2 Experimental research design

Experimental research design is a type of research where the researcher deliberately controls and manipulates the independent variables to affect the dependent variables in a desired way so that effects could then be measured and analysed. Experimental designs are set up to study cause/effect relationships among variables. Causal studies usually have varying degrees of artificial constraints imposed on them which interrupt the natural sequence of events.

Experimental design can be of two types, classic/true experimental and quasi-experimental. The classic experimental is used where the researcher has more control over variables, while the quasi-experimental is used in situations where the classical design is difficult or inappropriate (Rummel & Ballaine, 1963; Sekaran, 1984; Sproull, 1988; Neuman, 1997).

3.2.3 Non-experimental research design

In research where a definitive cause and effect relationship between variables is not necessary or not possible to be established, then a non-experimental correlational research is performed. Since there often exist multiple factors that influence each other rather than one variable causing another, the researcher might become more interested in finding those factors that are associated with the research problem than establishing causality. The non-experimental research design is used when control over variables is not possible (Sekaran, 1984; Sproull, 1988).

Although research methodology is the general principle behind research, and research method is the actual technique implemented in the practice of data collection, methodology and method cannot be separated (Sproull, 1988; Neuman, 1997). Non-experimental research design can be categorised in two types, quantitative and qualitative.

1) Quantitative research

Quantitative research is used mainly to test a theory by testing individual hypotheses. Those hypotheses are attempts to establish relationships between variable or concepts. Concepts in quantitative research are described by distinct variables. The primary data collection methods used are survey methods such as questionnaire and structured interview, which are quantifiable. Research analysis is performed by using statistics, tables, or charts, and link what they express to the hypotheses (Balian,1982; Neuman, 1997).

Survey methods

The choice of data collection methods depends on many factors, such as the resources available to the researcher, the time span of the research, the accuracy required in the study, the expertise of the researcher, and cost associated with each method. Also, in the global environment, survey research has proved to be very practical, taking into consideration future research; it allows research to be replicated in cross-cultural studies which usually span many nations. In such a context, the survey questionnaire, as an example, is a very valuable method of data collection considering the cost and difficulties other methods may endure. It provides a means for cross-cultural comparison.

Questionnaire

A questionnaire is a prewritten set of questions for respondents to record their answers. It is an efficient data collection technique when the researcher knows exactly what is required and how to measure the variables under study. Questionnaires can be administered personally or sent by mail. The personally administered questionnaire is used when the survey is confined to a local area. The main advantage of mailed questionnaire is its convenience when a wide geographic area needs to be covered. Questionnaires allow researchers to obtain data fairly easily, responses are easily coded, and they are not expensive. Their main disadvantage is their lack of depth and flexible adaptation to the divergent circumstances of respondents. In addition, this type of survey method has another disadvantage which is the probability of inaccurate data caused by subjects, bias, lying, or omitting information (Sekaran 1984; Sproull 1988; Neuman 1997).

Structured interview

Structured interview is conducted when the exact information needed from the respondent is known. The interviewer refers to a list of questions during the course of the interview. The structured interview could be face-to-face or by telephone. It allows the interviewer to ensure the proper understanding of the questions by respondents through verbal and nonverbal feedback or reactions. The structured interview has an advantage in the global setting. Due to the variations in language skills between respondents, the presence of the researcher to ensure proper understanding of the questions is sometimes essential. The main disadvantages of the interview method are its high cost compared with the questionnaire and the need for the researcher to conduct the interview personally, which limit the number of responses. As in the questionnaire method, this method has another disadvantage which is again the probability of inaccurate data caused by respondents' bias or omitting information (Balian 1982; Sekaran 1984; Sproull 1988; Neuman 1997).

2) Qualitative research

Qualitative research differs from quantitative research by its way of generating information. It concentrates on a particular situation where depth is more important than generalisation. In qualitative research, research questions are posed rather than hypothesized. Concepts take the form of themes, and data take the form of words of participants from interviews and participation. Many methods are associated with qualitative research such as participant observation and unstructured interviews (Sproull 1988; Neuman 1997).

Unstructured interview

Unlike the structured interview, the researcher conducting an unstructured interview does not have a sequence of questions to ask the interviewee. The main objective is to have some issues and variables surface, which will call for in-depth follow-up investigation. Using this method, the researcher first starts by asking broad, open-ended questions, then as the themes formulate, more focused questions are asked. The main disadvantages of this method are its time consumption, high cost, and the difficulty in transcribing and analysing data. As in other survey methods explained earlier, the disadvantage of subjects' bias or omitting information could lead to distorted data (Balian 1982; Sekaran 1984; Sproull 1988; Neuman 1997).

Case Study

Case study is a widely used research method in management research which includes Information Systems research field (Belcher and Watson, 1993; Cross et al., 1997). Yin (1989) defines case study as "An empirical enquiry that investigates a contemporary phenomenon within its real life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used." Leidner and Jarvenpaa (1993) also indicate that "Case study research is appropriate in situations where the research question involves a 'how', 'why', or exploratory 'what' question, where the investigator has no control over actual behavioural events."

Case study method is suitable in tracking a singular phenomenon as a case. It is considered as an umbrella for a family of research methods that focuse an inquiry around a single instance. It typically involves the use of multiple data collection techniques such as documents, archival records, interviews, direct observation, participant observation, and physical artefacts. This is performed for a set period of time (Cohen and Manson, 1994; Leidner and Jarvenpaa, 1993; Yin, 1989). Case study is commonly used for developing generalisations to theoretical propositions. It is a particularly powerful technique to answer 'how' and 'why' questions.

The researcher, when using case study, should investigate the research problem through the eyes of the subjects being investigated which could be based on a predefined model (Leidner and Jarvenpaa, 1993).
Case study research approach is especially appropriate in new topics areas (Belcher and Watson, 1993; Cross et al., 1997), and can be used for both theory testing and theory generation (Bryman, 1995; Yin, 1989).

Triangulation

Triangulation or multimethod approach refers to the technique of integrating qualitative and quantitative data collection and analysis methods into one framework. It could be looked on as measuring an object or a relationship from different angles or viewpoints. The main reason for using triangulation is that measurement improves when diverse indicators are used. Having different measurements of a variable from diverse methods implies greater validity. Also, in a single research, measuring different variables might need the use of different methods (Sekaran, 1984; Neuman, 1997).

3) Sampling

There are two major sampling types: probability and non-probability sampling. In the probability sampling, elements have a known chance of being selected as subjects in the research. In non-probability sampling, elements don't have a predetermined chance of being selected. Time, type of information needed, availability and generalisability are the main determinants for selecting a sampling technique. If generalisability is the important issue then probability sampling should be used. In the instances where time rather than generalisability is the important issue, non-probability sampling is used. Also, when the information needed in the research could be obtained from specific targets, then non-probability sampling is used. The same also applies when the only available sources of information are specific elements.

Probability sampling has different techniques, some of which are listed below:

- Simple random sampling
- Complex probability sampling
- Stratified random sampling
- Cluster sampling

Non-probability sampling also has many techniques:

- Convenience sampling
- Purposive judgment sampling
- Snowball sampling
- Quota sampling

Judgment sampling involves choosing subjects who are in the best position to supply needed information. It is used when a limited category of people have the required criteria such as a specific educational background, or they have the required information where they are expected to have expert knowledge. In such cases, probability sampling is purposeless and not useful (Burgess, 1984; Sekaran, 1984).

3.3 Selecting research approach

Selecting the most appropriate research approach to achieve the research aim depends on the specific research questions. Neuman (1997) explains "It takes skill, practice, and creativity to match a research question to an appropriate data collection technique".

In making the choice of research approach to answer research questions best, the following points suggested in similar ways by Balian (1982), Sproull (1988), and Neuman (1997) have been taken as a guide:

1. Determine what type of data required (opinions, attitudes, perceptions, hard data, etc.)
2. Determine the depth or generalisation needed.
3. Determine what resources are available (time, money, etc.)
4. Determine the degree of control and ability to manipulate variables.

In this research, because the researcher does not have the ability to control or manipulate variables affecting IS/IT project success, experimental research design is excluded.

3.4 Research Methodology

3.4.1 Choice of research methods

This research has adopted the triangulation approach by employing the multiple research methods of observation, historical data and document review, along with structured, semi-structured, and unstructured interviews. The main reason for using triangulation is that measurement improves when diverse indicators are used, i.e.

having different measurements of a variable from diverse methods implies greater validity. Also, in a single research, measuring different variables might need the use of different methods (Sekaran 1984; Neuman 1997).

Because this research was initiated by exploring factors that affect IS/IT success in organisations, open-ended interviews with the senior technical persons have been used. This method was chosen because it allows the respondents to express their views freely in the manner they choose. It is also a good tool for data collection when in-depth understanding of a specific point is wanted (Neuman 1997). The unstructured interviewing step took place after the literature search step in which measures and models of IS/IT success were reviewed and an initial success model was formed. The main objective of this step was to explore the issues concerning the measurement of IS/IT success and to identify gaps and factors stated in the literature concerning IS/IT success in organisations.

To solicit the opinions of the people involved with IS/IT projects in organisations regarding the usefulness and practicality of the research model in real situations, purposive judgment sampling technique is used in sampling the subjects of the exploratory interviews and of each of the case studies, where informed people regarding the IS/IT project under study were chosen.

In the global environment, qualitative research has proved to be fruitful and practical. In such a context, the qualitative case study approach, as an example, is a very valuable method of data collection considering the possible limitations of other methods. Because of the variations in language and communication skills between respondents in studies conducted in the global setting, case study methods, such as face-to-face interviews along with observation, have an advantage over other methods such as questionnaires. It allows the presence of the researcher to ensure proper understanding of the questions. This becomes more obvious in the setting of this study; the subjects of the study are from different countries with different native languages. English, however, is the common language among them, but there exist variations in their level of understanding of English. As a consequence, the research method chosen for this study was case study research that implies triangulation of methods.

3.4.2 Steps of Study

The steps of the research process were as follows (Figure 3.1):

1. Review of IS/IT success literature (hard and soft measurement), organisational effectiveness, Shannon & Weaver's communication theory, and marketing (Chapter 2).
2. Preliminary research problem identification that was resulted in forming questions to be explored in the exploratory work (Chapter 2).
3. Exploratory work conducted in nine organisation (Chapter 3)
4. Initial findings on IS/IT success (Chapter 3).
5. Review of more literature (communication theories, strategic planning, product, process and general models) (Chapter 4).
6. Establishment of the IS/IT evaluation framework and readiness/General Practitioner model(Chapter 5).
7. Conducting detailed case studies in four organisations to test and modify the readiness/General Practitioner model resulting from the previous step. Those case studies are presented in Chapter 6.

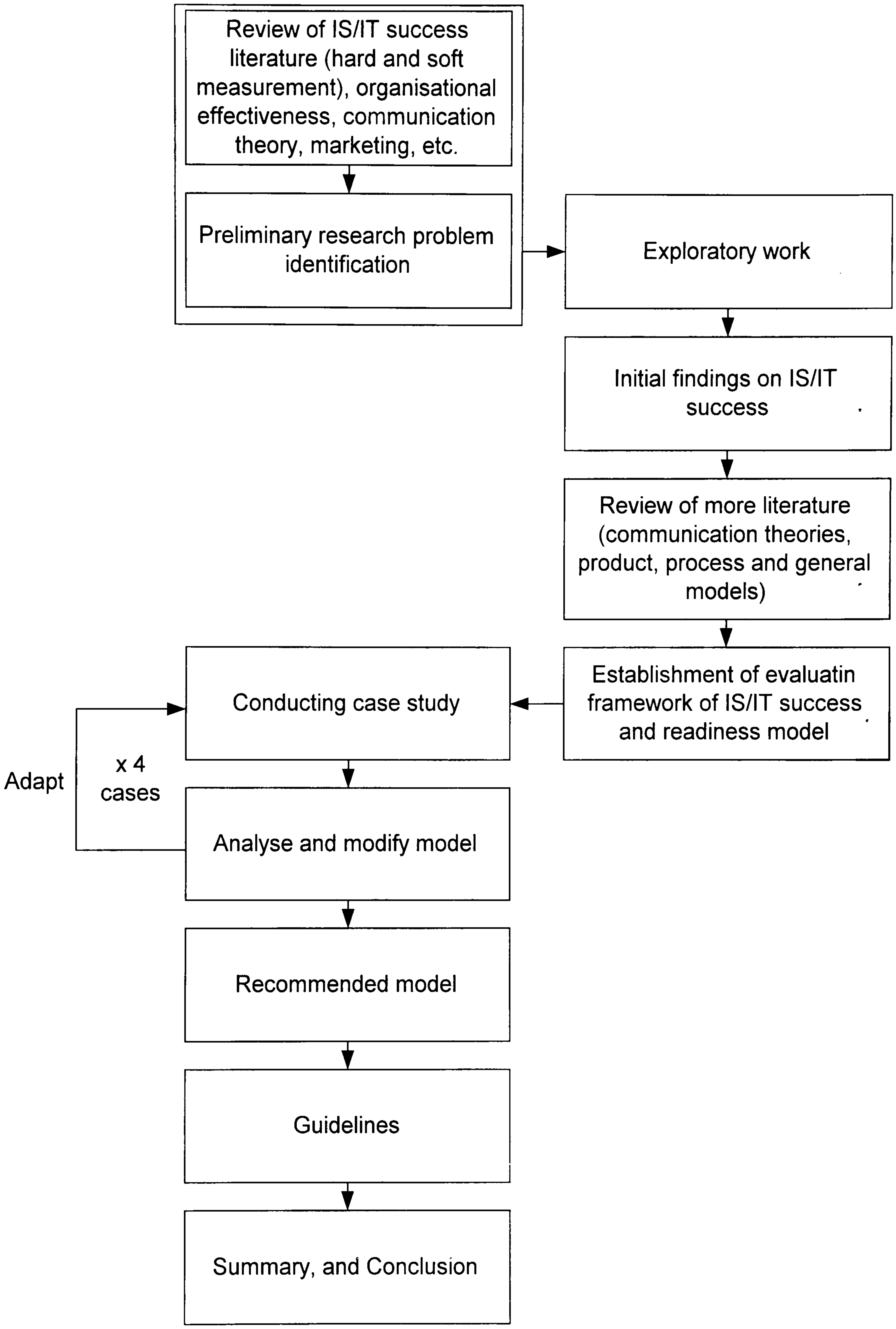

Figure 3.1 Research Design

8. After each case study, analysis of the case study is performed followed by modification of the model (Chapter 6).
9. Presenting the final recommended model that resulted from the three previous steps (Chapter 5).
10. Establish guidelines for model use (Chapter 6).
11. Presenting Summary and Conclusion of the research (Chapter 7).

3.4.3 Exploratory Work

The exploratory work took place after the initial literature search, during which measures and models of IS/IT success were reviewed and an initial list of factors affecting IS/IT success was formed. The main objective of this stage was to explore the issues concerning the measurement of IS/IT success and to identify the gaps and factors stated in the literature concerning IS/IT success in organisations. It also helped in forming the IS/IT evaluation framework and set the foundation for establishing an IS/IT readiness/General Practitioner model. This exploratory work has allowed for better planning of the subsequent case studies which tested and validated the readiness model.

The exploratory study was conducted by interviewing IS/IT managers in nine organisations. The main objective was to explore the factors that affect IS/IT success, using a draft of an IS/IT success model inspired by the literature reviewed. This study also aimed to explore the issues concerning the possibilities to conduct the intended case studies i.e. accessibility privileges and the type and status of IS/IT projects within those organisations.

The questions were put to the managers in a discussion-like environment since it was thought by the researcher to be the most suitable way for soliciting answers from people that are not used to dealing with researchers, and security issues are a priority in their minds.

The literature review presented many factors that affect the success of IS/IT. Those factors include IS/IT planning, information technology (hardware, software, networks), vendor support, IS/IT staff skills and expertise, user technical knowledge and skills, organisational culture and relationships between IS/IT function and users, quality of work processes etc. In addition the literature presented different approaches of measurements, 'hard' and 'soft'. It also presented the debate that was manifested by the 'productivity paradox' arguments. Those issues were the subject of verification in the exploratory study to find out what role they play in the practical world and whether other related issues exist.

Eight of the ten questions used in the study were designed to have an agreement or disagreement regarding the importance of issues/factors concerning IS/IT success in the organisation and to solicit additional information on those issues. Partial agreement/disagreement was also noted. An additional two questions had open-ended answers.

The questions and the answers of the nine IS/IT managers are presented in Tables 3.1, 3.2 and 3.3 where the responses of the IS/IT managers to the first eight questions are shown in columns M1 to M9 as: 'A' for agree, 'D' for disagree, and 'P' for partly agree. A summary of additional comments made by the IS/IT managers is presented in Table 3.2, and Questions 9 and 10 with answers are presented in Table 3.3.

Question	M1	M2	M3	M4	M5	M6	M7	M8	M9
Q1. Do you think that IS/IT **planning** is important for the success of IS/IT in the organisation?	A	A	A	A	A	A	A	A	A
Q2. Do you think that acquiring the latest **technologies in hardware, software, and networks** is important for IS/IT success in the organisation?	A	A	A	P	A	A	P	A	A
Q3. Do you think that **vendor support** is important for IS/IT success in the organisation?	A	A	A	A	A	A	A	A	A
Q4. Do you think that having all the needed **technical expertise** in-house is important for IS/IT success in the organisation?	A	A	D	P	P	P	D	P	P
Q5. Do you think that the **users' technical knowledge and skill** are important for IS/IT success?	A	A	A	A	A	A	A	A	A
Q6. Do you think that **good relationship between users and IS/IT people** is important for IS/IT success?	A	A	A	A	A	A	A	A	A
Q7. Do you think that it is important for the success of IS/IT to include in the system design a new design/redesign of **work processes** and procedures?	A	A	A	A	A	A	A	P	A
Q8. Do you think that you can measure the success of IS/IT by **economical measures on organisational level?**	D	P	D	D	D	D	P	D	D

Table 3.1: Answers of exploratory questions 1 - 8

Table 3.2: Comments on exploratory questions 1 - 8

Comments on Q1.

- It is necessary, but top management in our organisation or in the country in general do not give that much regard to long-term planning.
- We just do the feasibility study in development life-cycle. It is of-course better to have real planning.
- Most of the time, and maybe all of the time, we see what bigger banks do and we try to do like them. Of-course we choose what we think we need.
- We had a consultant who did a study, you can say it is some type of planning for 3-5 years, but ended in the drawers because of organisational politics.
- The new management want to start to do things according to planning from now on.

Comments on Q2 and Q3

- You can buy the latest and most advanced technology, but that does not mean all of your systems are successful. It needs more than technology to have a successful system.

- If you have a fairly new technology then you can get-by if everything else is OK, but not with very old technology.
- New technology is important but not everything. If you have bad vender support, which is the case in this country, then what is the use of new technology?
- New technology and vendor support should go hand in hand. If one company has an excellent product and bad support, and another has a good (not excellent) product but with a good support, I would go with the second one.

Comments on Q4

- IS/IT expert is very difficult to find in the local market.
- If you have bad vendor support, you need to compensate by good IT staff, which costs you money and other bureaucracy problems to bring them in the country.
- Even the vendors do not have good staff in the country, they have to bring them from abroad.

Comments on Q5

- Most of our users have to be trained which was difficult. They come from work and educational environment background where they never used computers.
- In the beginning users were afraid that computers would replace them, but after they saw that this did not happen, they now ask to be trained.
- Some users had some computer background, but most of them did not and many of those gave us a lot of trouble because we needed their expertise in their area of speciality to test the system but they could not help us because it took them a long time to learn to use computers.

Comments on Q6

- We mostly have problems, most of the users do not understand the technology, and they expect us to do everything for them.
- Some users are very understanding but many make a lot of trouble. They want to show top management that we and the computers cannot do the job, but top management know how to deal with them, they tell to go and learn more about computers.
- Of-course it is important to have good relation so you do not waste time and money.
- If you don't have good relations with users they will always try to find some problems. We are building good relations with the encouragement of top management.

Comments on Q7

- We pay attention to this issue but not as much as we should. That is why sometimes we have problems because we did not do it properly.
- It is important, but we do not have the expertise that we need in process design. Some of us read some manuals and books but that is not enough.
- Our experts have long years in designing manual processes and when they try to design computer-based work processes they come-out not efficient.
- We had a consultant who installed some systems for us, they did BPR. I don't think they did it properly, now we can see some problems. Next time we need to bring "real" experts just for that.

Comments for Q8 • No, it is very difficult, maybe only by cost reduction. • No, you could have a good system but if other departments do not do a good job then you have unsatisfactory outcome for the whole business. • No monetary indicator should be used. If the system does what it is supposed to do then it is the management job to utilise it to make profit.

Continue Table 3.2

Q9. What would be a good **measure(s) of success** of IS/IT systems? Or how do you explain to top management when they ask if a system is successful or not? • Cause customer satisfaction. • Put you in step with technology advances. • Provide better internal and external services. • Support business expansion. • Better forms of outputs and reporting. • Help in the decision-making. • Provide better storage and retrieval capability. • Provide competitive advantage. • Lower cost than old system. • If it does what it was first developed to do when setting the requirements. Q10. What **additional issues/factors** you think are important to IS/IT success? • Customer and user satisfaction with the system. • Top management involvement, for example between the user and IS/IT unit. • Top management knowledge about technology issues and support for the IS/IT department. • Educated, knowledgeable users.

Table 3.3: Answers to exploratory questions 9 and 10

3.4.4 Exploratory work findings

Exploratory work resulted in the findings presented in Table 3.4. Those were then utilised in establishing the evaluation framework and the readiness/General Practitioner model.

Result 1. IS/IT **planning** is important for the success of IS/IT in the organisation.
Result 2. Acquiring the newest **technologies in hardware, software, and networks** is important for IS/IT success in the organisation.
Result 3. **Vendor support** is important for IS/IT success in the organisation.
Result 4. Having the needed **technical expertise** available (in-house or externally) is important for IS/IT success in the organisation.
Result 5. **Users' technical knowledge and skill** are important for IS/IT success.
Result 6. **Good relationship between users and IS/IT people** is important for IS/IT success.
Result 7. It is important for the success of IS/IT to include in the system design a new design/redesign of **work processes** and procedures.
Result 8. Generally, success of IS/IT cannot be measured by **economic measures on organisational level.**
Results 9 and 10: See Table 3.3.

Table 3.4: Exploratory work findings

3.4.5 Development of evaluation framework and model

The evaluation framework was established following the literature review presented in Chapter 2 and the findings of the exploratory work. The framework constructs have been derived mainly from IS/IT research, management, communication, marketing, and organisational effectiveness literature. This was accomplished to fulfil the need for a better understanding of the various existing IS/IT success measures and their relationships with and impact they have on each other. The evaluation framework also helps in providing better understanding of the different levels of measurement that are based on adoption of the well-established communication theory. Guided by this evaluation framework and literature, including prior models in the IS/IT field, and the exploratory interviews conducted with IS/IT managers, a draft of the readiness model was then constructed.

Later, the readiness model was tested and validated by conducting four case studies in four different organisations representing different sizes and sectors in a Middle Eastern country. The model went through iterative modifications during and at the end of the case studies.

3.4.6 Case studies selection

Sampling is the process of selecting a sufficient number of elements from a population. The reason sampling is done is because in many situations it would be practically impossible to collect data from the entire population. Even were it possible, the large amount of resources needed such as time, cost, and other human resources makes it largely problematic. In some instances, sampling leads to more reliable data because of the error possibility involved with fatigue (Sudman, 1976; Burguess, 1984; Sekaran, 1984).

The use of case studies in this research aims to test and validate the readiness model in as close to 'real life situations' as possible. While the elements and issues addressed by the model are 'logical' and supported by the literature, it was important to experience the actual implementation of the model in real organisational setting as much as possible. In addition, to solicit the opinions of the people involved with IS/IT projects in organisations regarding the usefulness and practicality of the model in real situations.

In this research, organisations selected as case studies were based in the Middle East, and are characterised under different issues, sizes, sectors, and status of IS/IT project. They fall under private and government sectors, and are in oil, banking, service, and retail. They are also characterised as large and medium-size organisations. In addition, the organisations acquired different IT infrastructures. Some of those projects development were 'in-house', while others had customised third party packages, where the organisation had contracted with external vendors. From the tatter category, the project could be sourced differently. Some organisations have their own people work on the project development alongside the external vendor, while in others the external vendors have the full responsibility for project development.

The accessibility issue was important. During the exploratory study that was commenced months earlier, an account of the candidate organisations with their different status was noted, and permission to conduct the studies was solicited. Five of the nine organisation that participated in the exploratory study gave their initial agreement. At the time the researcher was ready to start the case studies, the IS manager who granted the permission at one of the organisations went on a long leave, and her deputy was reluctant to honour the agreement in the absence of the manager.

Even though the organisations characterised different situations, no claim is made by the researcher that they are representative of particular populations. Nevertheless, the diversity of situation would add more rigour to the testing and validation of the model and enrich the experience gained from those studies (Yin, 1989).

The four case studies were conducted in four different organisations: a governmental public service institution (ServIns), a major Middle Eastern oil company (Oilco), A joint public-private owned bank (Bank), and an electronics and electrical products' vendor (Eleco).

The case of the service organisation demonstrated an IS/IT project failure. The organisation contracted with an external vendor to develop a "full solution" systems based on the relational data base management system developed and marketed by the international company. Two and a half years after the start of the project, and the spending of millions of U.S. dollars, the project was terminated and considered by both parties (the organisation and vendor) to be a failure.

The case of the oil company is a failed IS/IT project that the organisation is trying to rescue. The project was supposed to be developed by the branch of an international company to customise their own developed package and build a database of the entire oil operation's data of the company that was accumulated for many years from manual and PC-based systems. The project failed in delivering the required outcome and the oil company was stuck with an unfinished technical system that even when finished is unusable and unacceptable by the target user. The oil company went into great effort to resolve the problems and shortcomings but with limited success.

The case of the electronics retail company demonstrates a bespoke IS/IT project with limited success. The largest electronics retailer in the country had two previous third party packages for its spare parts and workshop unit, which is considered by

Management to be the most money-generating unit. The company had purchased the first package from a local automobile dealership company with its source-code. After two years of operating and constantly trying to customise the package in-house, the company recognised that the package did not serve its needs. A third-party package was then purchased from a regional branch of an international company based in another country in the Middle East region. The vendors customisation of the package was acceptable in the initial implementation stage, but as the company's experience with the use of the IS/IT grew and new needs emerged, the vendor was not able to fulfil the timely needs and requests, and the company started to recognise that the package was in its way losing its cost-effectiveness. A decision then was made to abandon the use of the package and build an in-house IS. It took the company close to a year to build the bespoke IS utilising a very small DP department with three staff members, one of them was a programmer with previous experience. Even though Management consider the system to be 70% success, user reservations and observed difficulty in using the system indicate differently. Expansion of the new system is planned so that it could be deployed at the three remote branches of the spare parts and workshop unit using a Wide Area Network (WAN).

The case of the semi-government bank demonstrates an on-going project that the research followed considerable stages of its development cycle. The researcher interviewed bank's Management at post planning stage when performing the exploratory work and after requirement specification and at an advanced stage of vendors' customisation of third-party packages purchased by the bank from international vendor.

The project was meant to be “a total solution” for the bank’s operations. The bank’s Management tried to compensate for the internal lack of skill and knowledge by seeking professional advice from external consultants at different stages of the project. So far, the project is proceeding according to plan, but the model forecasted the that some problems would occur if appropriate and corrective steps are not taken, such as extensive training and recruiting/exchanging of IS/IT function and user staff in addition to a culture reforming programme.

3.4.7 Methodology of case studies

All but one of the case studies were of historical account. This means that for the model to be tested and validated data needed to be collected regarding the organisational situation both pre- and post- IS/IT projects. This could be accomplished in two ways, either by a longitudinal study that tracks the progress of the projects and records the organisational situation before and after the implementation of the project to be mapped on the model to determine the gap. Also, an account of the nature of the problems occurring during and after the project should be made. The opinions and experiences of the people involved regarding issues addressed in the model should also be noted. Noting the nature of the problems and the alignment with the prediction of the model would allow for model validation. This method is difficult to use for a study with a set of time constraints as is the case with this PhD research. It is also difficult to come across situations in which projects are in the planning stage. With only one of the case studies, the researcher therefore, was able to follow it longitudinally. While conducting the exploratory work in the early stages of the research, he came across such a situation and chose to continue to follow its progress as one of the four in-depth case studies conducted. In this study, the researcher tracked the gradual progress of the project and the problems which occurred during the different phases of the project and how Management dealt with them, and noted their correspondence with the model predictions for those situations. The project is not finished yet, but valuable data have been gathered.

The other methodology used, considering the time constraint, was to study three major projects in three organisations, projects which have ended either by implementation or termination in the advanced project phases. In the three cases, a historical account of the pre-project organisational situation and a study of the current organisational situation as the post-project organisational state, were used to identify the readiness gaps in those organisations. Noting the readiness gap, and problems and weaknesses with the resulting information systems, along with the accounts, experiences, and opinions of the people involved, would allow for model validation.

Interviews, observations, and documents related to IS/IT projects were the main sources used for data collection during the case studies investigation. Structured. semi-structured, and open-ended interviews were conducted on-site.

Key informants in each company selected were contacted to schedule interview times. Most of the interviews were taped-recorded to ensure accuracy of written data and to enable better collection of evidence and analysis. Because of reservations expressed by some informants regarding tape-recording, notes were taken. Time of interviews varied, depending on the availability of the informant and the time slot they had. The time for a single interview varied between one and two and half hours with short breaks. Because of the particularities of each project and the availability of the people, the numbers of interviewees varied from one company to another, ranging from three to four. For each company, multiple on-site visits were needed to finish interviewing. Those ranged from four to ten visits. Follow-up was also made to seek clarifications or more information.

Details are now given of the methodology followed in the case studies:
First, conducting interviews (with more than one person) to understand the general issues surrounding the project (pre-project and current), establish the historical background of the project, establish the situation pre-project in terms of the four factors: environment, people, IT, and process. Also, obtain and read all available documentation regarding the project both pre and current.

Second, after the interview(s), each of the project leaders was given a copy of the model to be used as guidelines for identifying the organisational situation. This was done in the project leader's own time to be discussed in the next meeting with the researcher. The process part of the model was given to the project leader in the following meeting to be discussed separately at a subsequent meeting because of its time consumption demand on time.

Third, in the meeting, the project leader's notes on the organisational situation were discussed and ambiguities were resolved. This was done with the background of the knowledge accumulated by the researcher from the previous experiences and meetings in the organisation.

Fourth, the model/instrument was then completed once again by the researcher alone, in the light of all the previous steps. This coincided with changing/modifying the model/instrument as a result of the knowledge and experience attained during the course of the case study. This was followed by writing a full report on the case study.

Fifth, if during the previous step, any data were found to require more clarification by the researcher, an additional follow-up telephone conversation with the project leader was made. This had led in a few instances to conducting an additional interview where telephone conversation was not adequate.

After conducting all of the four cases studies, the model went through one last overall modification. Following this modification, all cases were re-evaluated according to the new resulting model/instrument.

In addition to the project manager, other respondents were interviewed depending on the particularities of the project and the availability of the staff at the organisations (see Table 3.5). Those interviews were conducted with such people as top management (Bank, Eleco, ServInst), user manager (Bank, Oilco, Eleco), technical senior staff (Bank: IS/IT function head, Eleco: IS/IT function head, ServInst: two senior managers in IS/IT function, Oilco: DBA). In the Oilco, interviews were also conducted with the head of the 'Implementation Team'.

Position	Organisation	Title
Project Manager	Bank, Eleco, Oilco, ServInst	Project Manager
Top management	Bank, Eleco, ServInst	Deputy CEO
User manager	Bank, Eleco, Oilco	Group Manager
Technical senior staff	Bank Eleco Oilco ServInst	- IS/IT function head - IS/IT function head - Implementation Manager - DBA - two senior managers in IS/IT function

Table 3.5: Types of respondents in case studies

Qualitative Data Collection and Model Development

Model Development

In order to contribute to the resolution the shortcomings in the existing IS/IT measurements this research will produce a measurement model, which depends on capturing the knowledge, experience, and standards existing in the field that is being researched, and the literature containing models that addressed the issues concerned was researched. A suitable structure was chosen and elements from those models were extracted/adopted, combined and/or modified, and arranged according to this particular structure chosen for the new model. This is because the model is of the normative measurements type. Normative measurement is also called "conformance measurement". This approach attempts to answer the question: How does the performance compare against an external standard of a theoretically ideal product/system or process (King, 1983).

The structure depends on the notion that in order to have a successful IS, the system quality of this IS product must be adequate. Earlier review of the literature confirms that an information system is made of three components: IT, People, and Process. These are affected by environmental factors, some of which are frequently cited in the literature, such as management support and attitude towards IS, structural positioning of IS function, and culture (Alter, 1996; Davenport, 1993; Hammer, 1990; Linden, 1993; Kendall & Kendall, 1992).

A model that could predict the success of IS must be able to depict the organisational situations (both the existing/current situation and the needed/expected situation for IS to succeed) in terms of the four previously stated issues: IT, People, Process, and

Environment (Management style/Leadership, Structure, and Culture). Such a model would incorporate maturity-levelling technique to measure the gap between the current and the needed situations in terms of those issues.

Since the information system and the environment it operates in span the organisation in general, four of the components that were described in the Seven "Ss" used by McKinsey & Company (Pascale and Athos, 1981) which was also used in the Galliers & Sutherland (1991) model are suitable to be adopted in our model's structure. These components are: Structure, Systems, Staff, and Skill. Other structure components were adopted from the literature and were verified by exploratory study as being influential factors for IS/IT success. Those are: culture, leadership style, and position of IS/IT head. These structure components are suitable to serve as attributes that represent the domains: IT, people, process, and environment. The attributes were classified and refined to result in the formation of the four domains used in predicting the success of IT/IS projects at pre-implementation stage.

The model represents six levels/stages of maturity in terms of IS project readiness. The rationale behind the model is that in order for IS/IT to succeed in an organisation, the potential IS/IT components (IT, people, processes), and the environment available in the organisation need to be at adequate level of readiness. The literature (for example, Galliers & Sutherland, 1991) indicates that Decision Support Systems (DSS) or Executive Information Systems (EIS), for example, are extremely unlikely to be effective without the right kind of basic operational information systems or databases in place. Also, an organisation that tries to overcome the large backlog and heavy maintenance load of its IS/IT is unlikely to be able to develop substantial strategic information systems, without developing its staff skills and planning approaches. This means that the organisation needs to be at adequate level of readiness in regard to the IS/IT components and environment for the development, implementation, and operation of IS/IT to be successful. The structure that need to be adopted in the model needs to represent those components and organisational environment elements formed in maturity-like levels.

By presenting the current/existing and the needed/ expected organisational situation in terms of the structure of the model, the readiness gap could be identified and the route of progress in the maturity steps becomes clear.
What is usually expressed by other maturity models (CMM, Galliers & Sutherland model, P-CMM, etc.) applies with this model in that progress through the maturity levels cannot be accomplished by skipping levels. Progress can be accomplished only when organisations move through the levels in sequential order. An exception to this rule could be applied to the first two levels, and only when management had previous experience (Galliers & Sutherland, 1991).

Furthermore, it is not necessary that all of the four factors of the structure be on the same level for IS to be successful. It could be that the needed situation is different for the success of different types of information systems, which means that it might be that different types of information systems require different sets of combinations in different industries/sectors. This opens the opportunity for further research, and highlights the importance of the thorough investigation of both the current and the needed situations.

In building the model, several product and process normative models were reviewed for selection of useful elements. It is worth noting that when selecting elements from the process normative models, the selection was made of the assumed product outputs from the execution of the processes described in those models. The model went through several revisions during the time it was applied in four case studies. Those spanned four different organisations representing four different sectors.

The model is not meant to be sector-specific, rather it is a general model that could be applied in different sectors. We do not much benefit in applying it in small organisations that do not have an IS function and do not plan to have one. The model is meant to be a General Practitioner IS Consultant Tool (GPISCT) that points to the likely area of problem when an IS project is decided upon for implementation. In many cases the model would specifically and precisely point out the problem (as it would likely be the case with the position of the head of IT) and suggest a solution. In other cases/instances, there would be a need for an industry-specific expert to examine the problem further and suggest industry-specific solutions (as it would likely be the case in Process-related problems).

Data Collection and Model Refinement

For the model to be useful, qualitative in-depth investigation of the organisation's situation is needed. Experience gained from applying the model indicates that questionnaires could be used as part of the in-depth investigation, not as a substitute.

When applying the model, it was apparent that some of what used to be considered characteristics of higher maturity in some of the maturity models reviewed are not any more, and became normal occurrences at lower maturity levels; for example, the existence of networks, servers, e-mail, databases, and Internet utilisation; also, the skills that are related to them. While this was the case with mainly IT-related characteristics where they tend to slip down the ladder of maturity over time, People and Environment issues tend to stay constant. As for the Process issue, it seemed that there exists a relationship between IT and Process, which is supported by the need for revision of processes when introducing a new technology. Those revisions had most of the times led to business process reengineering or modification. Even though this did not seem to affect our general-purpose process instrument, it would affect the industry-specific investigation and solutions. The previous points illustrate the need for such normative models to be revised and updated periodically and continuously.

Also, there was a difference found between the government and private sectors. The model (and other maturity models as well) suggests that at the higher levels of maturity, an external interest starts to formulate. This would be true of the private sector but not the government sector, which most of the time has no external competition of value.

For specific attributes that were expected to be closely related, these were found not to be in some cases. Considering Skill and Staff, while a staff title (system analyst, for example) should imply certain skills, it was found that was not the case. This could be noticed only in an in-depth qualitative investigation.
This was true in regard to the problem of foreign, and especially Western, consultants in developing countries. Even though the individual consultant might be considered to have adequate skill for the job to be rendered in his/her original country, those skills, due to cultural issues, were either not adequate enough or misplaced in respect to their job in the developing country. This was found to be a source of repeated complaints in the cases studied and interviews conducted.

It was noticed that the organisation which has ISO 9002 certification had conformed to level 3 of the process part of the model, a result supported by the literature (Paulk, 1995)

3.5 Conclusion

The chapter presented the research design and methodology that was adopted by the study. It first introduced the different types of research design, which can be generally classified into three categories: historical, experimental, and non-experimental design. It presented the quantitative and qualitative research approaches. It also presented different data collection methods such as in-depth case study, observation, structured interviews, unstructured interviews, historical data collection, and document review. It also introduced triangulation and sampling techniques.

The chapter then presented the research design and methodology applied by this research. It then introduced steps applied in this research and presented the exploratory work done. The chapter concluded by presenting the methodology by which the readiness/General Practitioner model was developed and tested.

Chapter 4: Product and Process based IS/IT Measurement

4.1 Introduction

This chapter starts by presenting different classification studies of the IS/IT measurement literature that exist in the IS/IT research field which introduce different classification approaches. The chapter then presents general measurement classifications; goal-centred, normative, comparative and improvement measurement approaches. This is followed by introducing a novel classification that will distinguish between several approaches of measurement using two main dimensions. The first dimension is the product versus process which would measure the success of an IS/IT as a product or a process. A product-based measurement, is mainly concerned with assessing the different features of the IS/IT as a product while a process-based measurement is concerned with measuring the process that creates the IS/IT product, assuming that successful process produces successful IS/IT product. The second dimension is the goal-centred versus normative/conformance dimension both with or with no improvement. A distinction has also been made between normative measurement approaches; this is the distinction between maturity and non-maturity-based approaches in the measurements.

This study is also concerned with the cross relationship between the two dimensions i.e. product-normative and product-goal-centred approaches with or with no improvement. The study is also concerned with process normative measurements that target improvement. A critical review of all these approaches and limitations is then presented in the last section of this chapter.

4.2 Literature classification of IS/IT evaluation approaches

During the literature review phase of this research, five different classifications of the IS/IT have been found. These studies contributed to the understanding of the field of research and set the ground of this novel classification approach.

1. Dimensions of IS effectiveness criteria

Munshi (1996) proposed that IS/IT success literature should be classified according to "three dimensions" of measurement; Scope, Measurement and Social Paradigm (Figure 4.1). The Scope describes how broadly the concept of effectiveness is to be applied to application, firm, industry/sector, economy, and society levels. Each of these levels uses a different set of measures. Some of the levels could be sub-divided into lower levels, as with the application level, where it could be a single application or an entire class of applications in single or multiple implementations.

Dimensions of IS/IT effectiveness

Scope	**Measurement**	**Social Paradigm**
• Application level - single application - entire class • Firm level • Industry/sector • Economy level • Society level	• Type of data to be collected • Method of collection • Manner of their interpretation	• Neohumanism • Social Relativism • Radical Structuralism • Functionalism

Figure 4.1: Classification Criteria of IS/IT Effectiveness Studies in Munshi (1996)

The measurement introduced by Munshi addresses the type of data to be collected, the method of collection, and the manner of its interpretation. This measurement is performed by direct observations of business variables and psychometric measures of attitude and behavioural variables. The latter are of two types: those that measure attitudes and user perception, as in user satisfaction studies, and those that elicit opinions to gather information about, for example, IS utilisation and performance. The social paradigm addresses the argument that not all activities of business enterprises are interpretable as if they were rational organisations seeking to maximise owner's wealth; other paradigms of business organisation exist. These are Neohumanism, Social Relativism, Radical Structuralism, and Functionalism.

2. "Construct space for IS effectiveness"

Grover et al. (1996) produced another categorisation framework for IS/IT success research which they called " the construct space for IS effectiveness". They categorised the IS/IT success research by the evaluation criteria it uses (Figure 2.2); Normative, Comparative, or Improvement. The normative measurement is also called "conformance measurement". This approach attempts to answer the question: "How does the performance compare against a theoretically ideal product/system or process (King, 1983)?" The comparative measurement is also called "benchmarking". This approach attempts to answer the question: "How much does this product/system or process compare against a similar product/system or process in a similar environment (Earl, 1989)?" The improvement measurement is concerned with assessing the degree to which the current product/system or process was adapted to the changes in requirements and environment in the workplace and organisation (Lorange & Vancil, 1976).

Evaluation criteria
- Normative
- Comparative
- Improvement

Organisational

Class I - Process: Infusion measures
Class II - Response: Market measures
Class III- Impact: Economic measures

Individual

Class IV - Process: Usage measures
Class V - Response: Perceptual measures
Class VI - Impact: Productivity measures

Figure 4.2: Classification of Evaluation Criteria for Effectiveness Studies in Grover et al. (1996)

Within each approach, two units of analysis have been used: a micro unit which represents the individual user, and a macro unit that represents the organisation. For each of the units three types of evaluation measures were proposed: Process, Response, and Impact. The process evaluation is used to determine "the effective utilisation of IS resources", while the response type "assesses the reaction of the individual or the organisation to the IS service or product", and the impact evaluation, is "associated with the direct effects of IS implementation on individual or organisation", and is the most difficult to assess. When integrating all of the above categories, Grover et al. (1996) came up with six classes of IS/IT success measures. The first three are Infusion, Market, and Economic measures, which are concerned with the organisation's evaluation type categories: Process, Response, and Impact, respectively. The remaining three classes of measures are Usage, Perceptual, and Productivity, which are also concerned with each of those categories at the user level.

As a means of validating the proposed classification framework of IS/IT success research, Grover et al. (1996) produced a taxonomy of literature that conforms to the framework. They reviewed articles published over the period from 1980 to 1994 from eight "important IS publications". The review resulted in classifying approximately 83 research studies into the taxonomy.

3. System type and stakeholder relationship

Seddon et al. (1998) attempted to answer "What measures are appropriate in a particular context?" To do that, the study introduced a two-dimensional matrix (Table 4.1). The first dimension was the 'Type of System' studied. The second was the 'Stakeholder', in whose interest the IS has been evaluated. 'The Type of System dimension' was concerned with an aspect of IT use (e.g., a single algorithm or form of user interface). Under this dimension, five categories of studies were classified: a single IT application (e.g., spreadsheet), a type of IT application (e.g., Group Decision Support Systems-GDSS), all IT applications used by an organisation, an aspect of a system development methodology, and the IT function of an organisation. Those categories intersected in a taxonomy with five types of stakeholder categories: an independent observer, an individual user, a group of users, management or owners of an organisation, and a country or mankind. The authors classified into this taxonomy 186 empirical studies from three leading IS/IT journals from 1988 to 1996. Table 2.3 contains an example of the studies for each category.

4-6

Type of System/ Stakeholder	1.Aspect of IT use (e.g., a single algorithm or form of user interface)	2.Single IT application (e.g., spreadsheet)	3.Type of IT application (e.g., GDSS)	4.All IT applications used by an organisation	5.Aspect of system development methodology	6. IT function of organisation
1.Independent observer	Study type (1,1) Ang et al. (1993)	Study type (2,1) Chan et al. (1993)	Study type (3,1) Clemons and Weber (1996)	Study type (4,1) Kraemer et al. (1993)	Study type (5,1) Agarwal and Tanniru (1990)	Study type (6,1) Watson et al. (1991)
2.Individual user	Study type (1,2) Clifford et al. (1992)	Study type (2,2) Chin and Newsted (1995)	Study type (3,2) Todd, P. and Benbasat (1992)	Study type (4,2) Belcher and Watson (1993)	Study type (5,2) Barki and Hartwick (1994)	Study type (6,2) Beath (1991)
3.Group of users	Study type (1,3) Dean et al. (1994)	Study type (2,3) Alavi (1994)	Study type (3,3) Chidambaram, (1996)	Study type (4,3) Byrd (1992)	Study type (5,3) Cats-Baril, and Jelassi (1994)	Study type (6,3) Lederer and (1996)
4.Management or owners of organisation	Study type (1,4) Dos Santos et al. (1993)	Study type (2,4) Robertson (1989)	Study type (3,4) Gill (1996)	Study type (4,4) Floyd and Woolridge (1990)	Study type (5,4) Brynjolfsson, (1996)	Study type (6,4) Boynton et al. (1994)
5.Country or mankind	Study type (1,5) Banker and Kauffman (1991)	Study type (2,5) Amoroso and Cheney (1991)	Study type (3,5) Robey et al. (1993)	Study type (4,5) Deephouse et al. (1995)	Study type (5,5) Deephouse et al. (1995)	Study type (6,5) Premkunar and King (1992)

Table 4.1: Measures of IS effectiveness classification, Seddon et al. (1998).

4. Research methodologies in measuring IS/IT success

Chan (2000) conducted a classification and analysis of IS/IT success research. The study reviewed the IS success literature in four of the leading IS/IT publications for eight years starting in 1993 to the end of 1998. The review resulted in choosing 98 articles that studied "IT Value/Impact" as the main purpose of the research. Four classification criteria were used: the Research method used in the studies, Qualitative and/or Quantitative measures (methodology), Financial and/or Non-financial measures, and Level of analysis (Figure 4.3). The research method criteria varied between using secondary data analysis, case study, survey and/or historical analysis. The author used the term "hard" for the financial and, "soft" for the non-financial measures. The level of analysis was individual, group, organisation, industry, national, and international.

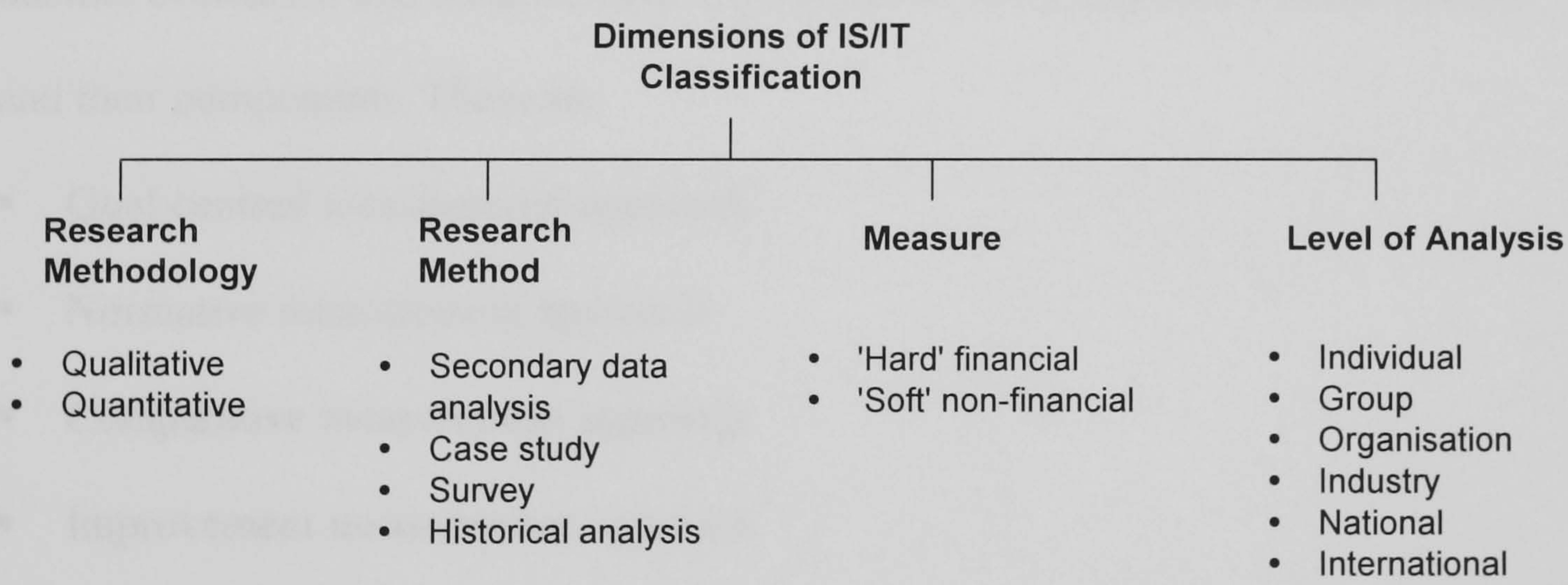

Figure 4.3: Classification Criteria of IS/IT Success Studies in Chan (2000)

5. IT and productivity relationship

Brynjolfsson & Yang (1996) reviewed, classified, and analysed the literature that deals with the relationship between information technology (IT) and productivity. Classification tables of the literature were produced. The classification had two main categories: Aggregate level and Micro level. Both levels were sub-divided into studies concerning the services sector, and the Manufacturing sector (Table 4.2).

Level of studies	**Sector**
Aggregate Level Studies (Industry level)	**Manufacturing**
	Services
Micro-Level Studies (Firms level)	**Manufacturing**
	Services

Table 4.2: IT and Productivity classification,
Brynjolfsson & Yang (1996)

4.3 Other General evaluation approaches of IS/IT

An examination of literature within the information systems field reveals four distinct evaluation and measurement approaches for assessing information systems and their components. These are

- Goal-centred measurement approach
- Normative measurement approach
- Comparative measurement approach
- Improvement measurement approach

4.3.1 Goal-centred measurement approach

Goal-centred measurement is also called "measurement against purpose" (Steiner, 1979). This approach aims to assess the degree of attainment in relation to targets (Venkatraman & Ramanujam, 1987; King, 1988; Segars & Grover, 1998). It attempts to answer the question: "To what extent are the objectives or goals are fulfilled?" This approach was used in different evaluative research fields. It was used widely in the IS planning research field and particularly in measuring strategic planning success (Venkatraman & Ramanujam, 1987). It was also used in the information systems success and effectiveness field (Hamilton & Chervancy, 1981). Additionally, the goal-centred approach is considered as the basis of theoretical developments of scholarly approaches to organisational effectiveness. The most known application of this approach in the organisational effectiveness field is the goal model where other newer models in this field can be considered fully or partly as alternative modifications of the goal model of effectiveness. Those include the system resource, internal processes, multiple constituencies, competing values, legitimacy, fault-driven, and high performing models (Cameron & Whetten, 1981;Cameron, 1986; Meyer & Gupta, 1994).

The popularity of this approach stems from its intuitive nature and relative ease of use(Venkatraman & Ramanujam, 1987).

4.3.2 Normative measurement approach

Normative measurement is also called "conformance measurement". It aims to compare the performance of a product/system or process to some external standard rather than the specific objectives or goals of the organisation. This approach attempts to answer the question: "How does the performance compare against a theoretically ideal product/system or process? (King, 1983)."

This approach is used when a standard of best performance or practice is identified by research or experts (Segars & Grover, 1998). In practice, this approach has been widely used for industry specific process measurement and certification as in the Capability Maturity Model (CMM) and ISO standards. There exists a distinction between two normative measurement approaches, that is the maturity and non-maturity based measures. The maturity concept is based on the notion that a distinction could be made in regard to levels of maturity of organisations based on pre-set characteristics.

4.3.3 Comparative measurement approach

Comparative measurement is also called "benchmarking", where comparison is performed regarding the success of a particular product/system or process with a similar product/system or process. This approach attempts to answer the question: How much does this product/system or process compare against a similar product/system or process in a similar environment? (Earl, 1989).
Implementing this approach might be difficult and in many times impossible, since it requires access to accurate data for systems or processes in other organisations.

4.3.4 Improvement measurement approach

This approach is concerned with assessing how much the current product/system or process has adapted to the changes in requirements and environment in the workplace and organisation (Lorange & Vancil, 1976). This approach is targeted at improvement, which aims to implement better methods and working practices to increase IS quality, either by improving the quality of the IS product itself or by improving the process that creates the IS, on the assumption that an improved process produces higher quality products. This makes this approach more of an assessment to how well the planning and requirement specifications were performed than an assessment of the product/system or process itself (Venkatraman & Ramanujam, 1987). In practice, this approach is not performed separately but combined with any of the other measurement approaches, mainly with the normative, which is often represented in maturity-based models.

4.4 A novel approach to classifying literature

This study, focuses on the Goal-centred, Normative, and Improvement measurement approaches because of their practicality (Table 4.3).
It distinguishes between several approaches to measurement using two main dimensions. The first dimension is the product versus process. To measure the success of an IS as a product, one can focus on the quality of that IS product itself. This could be measured by a product-oriented measurement, which is mainly concerned with assessing the different features of the IS. An alternative approach is to measure the process that creates the IS product, assuming that successful process produces successful IS product. This could be achieved by a process-oriented measurement.

The second dimension is the goal-centred versus normative/conformance. Approaches targeted at measurement of improvement are covered under the two dimensions. Those approaches that are targeted at improvement aim to implement better methods and working practices to increase IS quality either by improving the IS product itself or by improving the process that creates the IS.

There also exists yet another distinction between normative measurement approaches; this is the distinction between maturity and non-maturity-based models. The maturity concept is based on the notion that a distinction could be made in regard of levels of maturity of organisations based on pre-set characteristics.

This thesis, is chiefly concerned with one cross relationships between the two dimensions of both the product-normative and product-goal-centred approaches with or with no improvement and those that do not. The thesis is also concerned with process normative measurements that target improvement. For those listed categories, we will cover both the maturity and non-maturity approaches will be covered (Table 4.3).

	Normative	Goal-centred
Product	With improvement - Maturity - Non-maturity With no improvement	With improvement Do not include improvement
Process	With improvement - Maturity - Non-maturity	With improvement

Table 4.3: Thesis Classification of IS/IT Measurement Models and Measures

In the following sections, we will review product and process based, and general models of IS/IT measurement that were studied by the researcher after conducting the exploratory work. This literature was mainly studied in the course of building the readiness model which will be introduced in the next chapter.

Prior to introducing the reviewed models, we will present the type of approaches and categories of the respective models.

4.5 Product Goal-centred approaches

4.5.1 Product Goal-centred with Improvement approach

The aim of this measurement approach is to try to solve problems or reach goals by gathering relevant information, deciding on the best course of action, and implementing the solution.

Product goal-centred with improvement approaches are used in the software industry. These types of approaches take internal sources as reference for the improvement activities. Usually this means that the business strategy and business goals of the organisation form the bases for the improvement efforts. The business goals are translated into improvement goals for the organisation, and these are next translated into measurement goals. A measurement programme is used to fulfil the measurement goals, and based on the outcome of the measurement programme, decisions can be taken and improvements can be implemented to reach the improvement goals.

Most product goal-centred with improvement methods used in the software engineering domain build upon the Goal/Question/Metric paradigm (GQM) (Basili and Rombach, 1988). It offers a structured approach to translate high-level measurement goals into questions that need to be answered to reach the goals, which in turn lead to the metrics needed to answer the questions.
Below, we give an overview of GQM as an example of product goal-centred with improvement approaches. It is important to note that GQM could be used as a process goal-centred approach because of its flexible nature.

Goal/Question/Metric (GQM)

Most Product goal-centred with improvement approaches are based on the Quality Improvement Paradigm (QIP) and the Goal/Question/Metric (GQM) paradigm, developed by Basili and Rombach (1988). The Quality Improvement Paradigm consists of six major steps, (Table 4.4). It aims to provide a basis for organisational learning and improvement by facilitating learning from experience in projects and feeding this experience back to the organisation. Each new project is regarded as an experiment, and available results of every foregoing and ongoing experiment should be packaged and reused.

1) Characterize the current project environment.
2) Set up goals and refine them into quantifiable questions and metrics for successful project performance and improvement over previous project performances.
3) Choose the appropriate software project execution model for this project and supporting methods and tools.
4) Execute the chosen processes and construct the products, collect the prescribed data, validate them, and provide feedback in real-time.
5) Analyse the data to evaluate the current practices, determine the problems, record the findings, and make recommendations for improvement.
6) Proceed to step 1 to start the next project, armed with the experience gained from this and previous projects.

Table 4.4: Quality Improvement Paradigm,
Basili and Rombach (1988)

The QIP has a continuous character which is implemented by two feedback cycles: the project feedback cycle and the corporate feedback cycle. The project feedback cycle provides new projects with information about foregoing projects. The corporate feedback cycle provides knowledge to the complete organisation by comparing individual projects with the aggregated project data (Solingen and Berghout,1999). The GQM paradigm is a method which helps determine which measures should be taken to support reaching certain measurement goals, and can be used to implement step 2 of the quality improvement paradigm. Based on the measurement goals, questions are formulated that need to be answered. Next, the questions lead to metrics that need to be measured. The information gathered provides the answers to the questions. This leads to a tree or a hierarchy of goals, questions, and metrics (Figure 4.4).

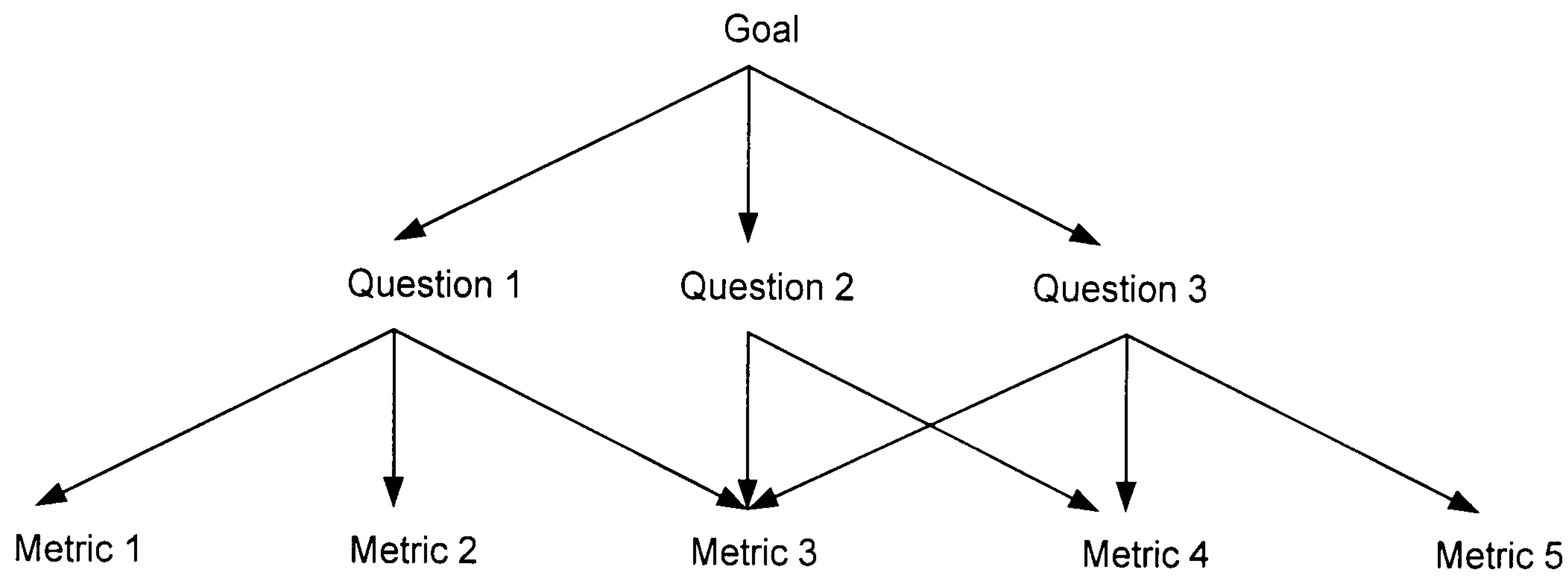

Figure 4.4 Goal/Question/Metric (GQM) tree,
Basili and Rombach (1988)

The method provides templates which can be used to formulate the goals. The following example originates from research into the causes and effects of interrupts on software development work (Solingen et al., 1998; Solingen and Berghout, 1999). The following measurement goal was defined:

analyse:	Interrupts and their effects
for the purpose of:	Understanding
with respect to:	Impact on schedule
	Cost/benefit of interrupts
from the viewpoint of:	Project team
in the following context:	Project X

Next, questions were formulated that needed to be answered to reach the goal, for example:

- What is the influence of interrupts on the work that was interrupted?
- What factors influence treatment and effort for handling an interrupt?
- Is prevention of interrupts possible?

These questions formed the basis for selecting metrics that should provide answers to these questions. Examples of such metrics were:

- Number of interrupts for current work.
- Number of interrupts that are treated immediately.
- Number of interrupts that are planned.
- Number of interrupts per day.

Based on these measurements, it was discovered that more interrupts occurred than was expected, and that the department spent about 20% of its total time in handling interrupts. Based on these and other outcomes, action points were defined and implemented to, for example, reduce the number of personal visits in favour of e-mail communication.

GQM has been applied in measurement programmes quite often (Basili et al. 1996; Birk et al. 1998a,b; Fuggetta et al., 1998; Latum et al., 1998). These case studies resulted in a number of proposed extensions of or additions to the Goal/Question/Metric method. For example, Panfilis et al. (1997) report on two extensions they made: they found it necessary to rigorously define measures in terms of entities, attributes, units, and counting rules; and they subjected the initial GQM plan to an independent review. Both Fuggetta et al. (1998) and Latum et al. (1998) stressed the necessity of being able to characterise the process structure. This agrees with the recommendations of Pfleeger and McGowan (1990) to take the maturity of the process into account when selecting measures. Solingen et al. (1995) describe an extension of GQM (model-based GQM) that includes explicit models of the software process and products. They then define metrics according to both the standard GQM method, as well as from the perspective of the process and product models. Both sets of metrics are mutually checked for consistency and completeness.

Though many researchers stress the necessity of deriving metrics from specific improvement and measurement goals, some do not favour this approach. Hetzel (1993), for example, advocates an approach in which a basic set of measurements is defined that is to be measured during every project. The underlying principle behind his measurement software engineering model is that the primary role of measurement is to support engineering activities. It should stimulate questions and provide insight about the software process and products.

The GQM paradigm (Solingen & Berghout, 1999) tackles the problem of collecting measurement data without knowing how to use it. It introduces a structured approach to the introduction of a metrics programme. First the objectives are set for the development processes and the products. These objectives are refined in a number of questions, which are then detailed in a metric that is intended to provide answers to the questions posed.

GQM-based measurement was developed to be used in the context of the Quality Improvement Paradigm (QIP) (Solingen & Berghout, 1999). The QIP is an application of the positivist scientific method adopted into the software engineering field. The application of QIP is defined as an iterative process that repeatedly performs QIP steps.

4.5.2 Product Goal-centred with No-improvement approach

This approach aims to measure the degree to which a product/system has attained the objectives or goals that it was built to achieve. It attempts to answer the question: "To what extent are the objectives or goals fulfilled by the product/system?" One of the most used measures of this category is Critical Success Factors (CSFs).

Critical Success Factors (CSFs)

CSFs are the few key areas where things must go right for the business to succeed (Rockart,1979). It is very important to identify them when the aim is to understand the business. CSFs could be defined as being the limited number of areas which, if they are satisfactory, will ensure achievement of objectives and goals of the organisation Rockart (1979). They are areas in the workplace where it is critical they work correctly for the objectives and goals to be achieved (Thiagarajan & Zairi, 1998). As a result, the CSFs are areas of activity that should receive constant and careful attention from management. The unit or group managers in the organisation need to be aware as to what the CSFs are of each of the objectives they are concerned with. The status of performance for each CSF should be continually measured, and this measurement outcome should be made available in the organisation (Alshawi & Aouad, 1995).

Objectives are the targets that are set by the organisation in order to fulfil its vision and goals. They should be unambiguous, measurable, relevant, achievable, and consistent with any higher level objectives and organisational goals.

Usually, the organisational high-level goals' strategic objectives are cascaded down through the organisation where each unit, function, process, group, or project team develops its own objectives depending on the high-level ones. The lower-level objectives are usually tactical, and those which trigger information systems' needs and determine their requirements (Figure 4.5).

CSFs should be identified only after the identification of objectives. If specific CSFs are achieved, then it becomes likely that the objectives associated with them would be achieved. There tend to be a structured relationship between objectives and CSFs, as there exit levels of objectives, likewise there exist levels of CSFs (Figure 4.5)

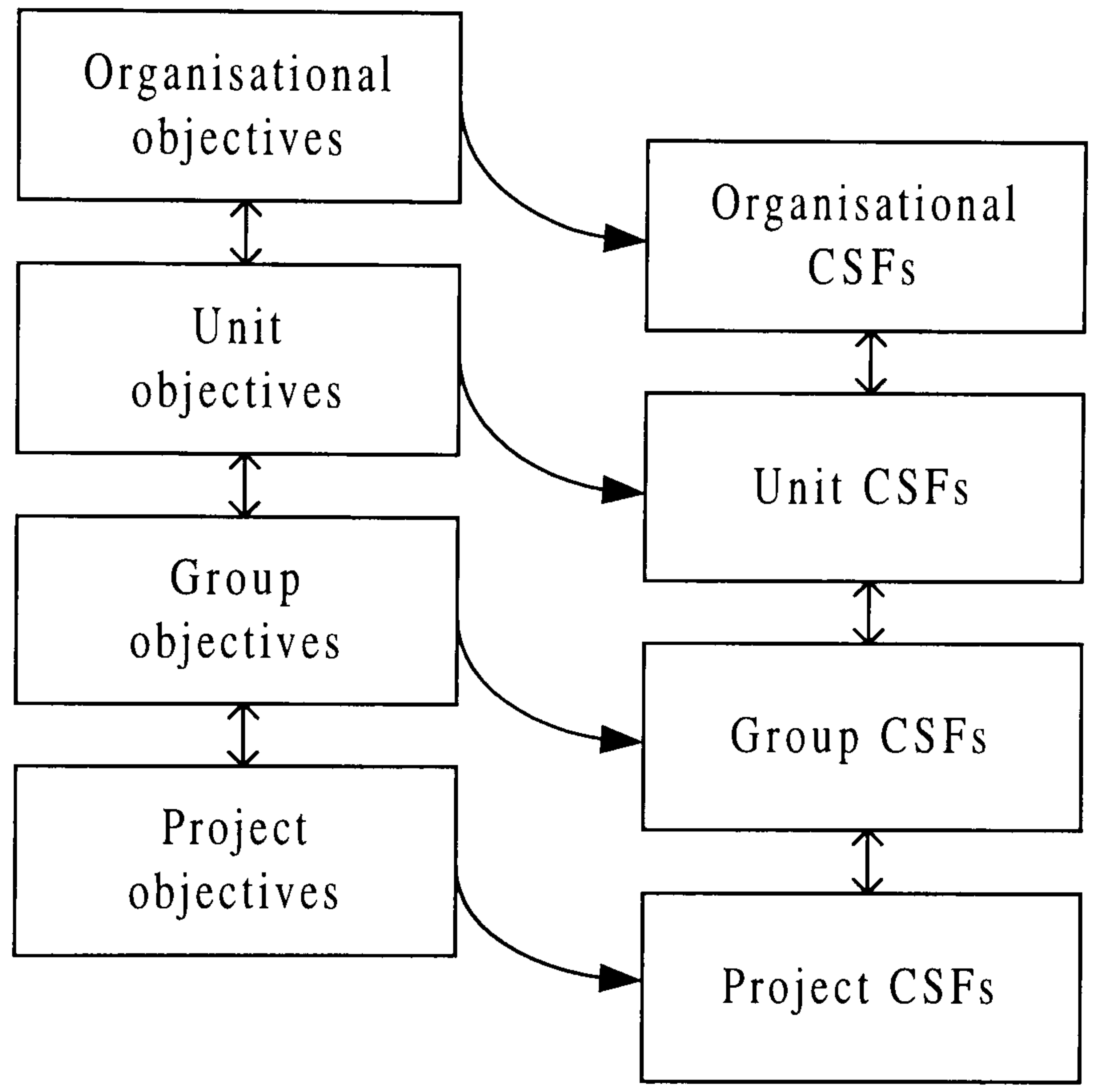

Figure 4.5: Levels of objectives and CSFs

There might be some common CSFs associated to similar organisations, units, groups, or products/systems. Those could be thought of as generic CSFs, which could give this type of measurement a normative flavour.

Performance with CSFs approach could be measured by whatever means, economic/financial or otherwise, management determine as appropriate.

The CSF approach appears to be widely used in the IS/IT research field. A considerable stream of research has focused on CSFs at the industry and organisational levels (Belassi and Tukel, 1996; Boynton and Zmud, 1984; Day and Wensley, 1988; Yang, 1998), while others applied the CSF approach at the individual level (Magal et al., 1988; Williams and Ramaprasad, 1996). In addition, the CSF approach has been used for different purposes, for example Munro and Wheeler (1980) used CSFs to determine the information requirements for management control; Meadors and Mezger(1984) applied it to develop a list of priorities for required features of an end-user language; Shank et al. (1985) used it to identify corporate information needs in developing a corporate IS/IT plan.

The literature reveals different CSFs applicable to IS/IT success. Leitheiser and Wetherbe (1985) investigated IS/IT function successes, failures, and CSF. In research based on case studies, Sumner (1985a; 1985b) identified several CSFs applicable to IS/IT function. Brancheau et al. (1985) investigated information systems from the viewpoints of the end users and asked them to identify CSFs of IS/IT success.

Determination of CSFs

To determine the CSFs a number of techniques exist. Prominent among them are structured interviewing (Bullen and Rockart, 1981), focus groups, the Delphi technique (Brancheau et al., 1996) and the group interview (Khandelwal, 1992). Each of these techniques has its respective strengths and weaknesses. In the structured interviewing technique interviews are carried out by an analyst to zero-in on the CSFs of individual managers. Two, or sometimes three, interviews are required to obtain the CSFs of a particular manager. The focus group technique involves a group of managers who collectively discuss and decide upon their group CSFs guided by an experienced facilitator. This approach obviously is much more effort effective, as it employs group synergy and takes significantly less time. The Delphi technique involves a number of iterations through the same set of managers, and while this makes it a slow and somewhat inefficient process, it is an ideal technique when little initial information about the CSFs is available. Finally, the group interview approach is similar to the focus group approach except that it starts with a number of prepared CSF constructs and proceeds quickly to identifying the CSFs.

4.6 Product Normative approaches

This method provides an external prescription against which organisations can assess their products/systems. Those are analytical in nature and consist of two main sub-approaches, those with improvement and those that do not present any improvement activities.

4.6.1 Product Normative with No-Improvement approach

This measurement approach represents the most widely used measurement methods. It includes product standards like ISO 9126. It also include the 'hard' financial/economic/monetary impact measurements such as the high-level productivity measures and the low level project financial measures. This approach also includes the 'soft' non-financial measures such as System Quality, Usage, and User Satisfaction measures (Chan 2000).

Some studies tried to consolidate both the 'hard' and 'soft' approaches in one model. One such model, and the most prominent, is DeLone & McLean (1992), which is covered in detail in chapter 2 of this thesis.

1) ISO 9126

ISO 9126 (ISO/IEC 1995a, ISO/IEC 1995b) is a standard for software product quality which defines a tree of quality attributes, including measures to quantify those quality attributes (Figure 4.6). The "best practices" include such practices as software configuration management, inspection, testing, etc.. ISO 9126 was specified for software products to overcome the problem of disagreement on definition of quality between software developers and users. For developers, quality of a software product means functionality and absence of defects after the product has been released. Often, however, these are not the characteristics that determine the quality of the software as far as users are concerned.

For this reason, the ISO 9126 standard defines six characteristics, and the appendix to the standard defines a number of sub-characteristics for each characteristic. Metrics in ISO 9126, typically give rise to quantifiable measures mapped on to scales. The rating levels' definition determines what ranges of values on those scales count as satisfactory or unsatisfactory. Since quality refers to given needs, which vary from one evaluation to another, no general levels for rating are possible. They must be defined for each specific evaluation. Similarly, the assessment criteria definition involves preparing a procedure for summarising the results of the evaluation and takes as input management criteria specific to a particular environment which may influence the relative importance of different quality characteristics and sub-characteristics. This definition, also, is therefore specific to the particular evaluation.

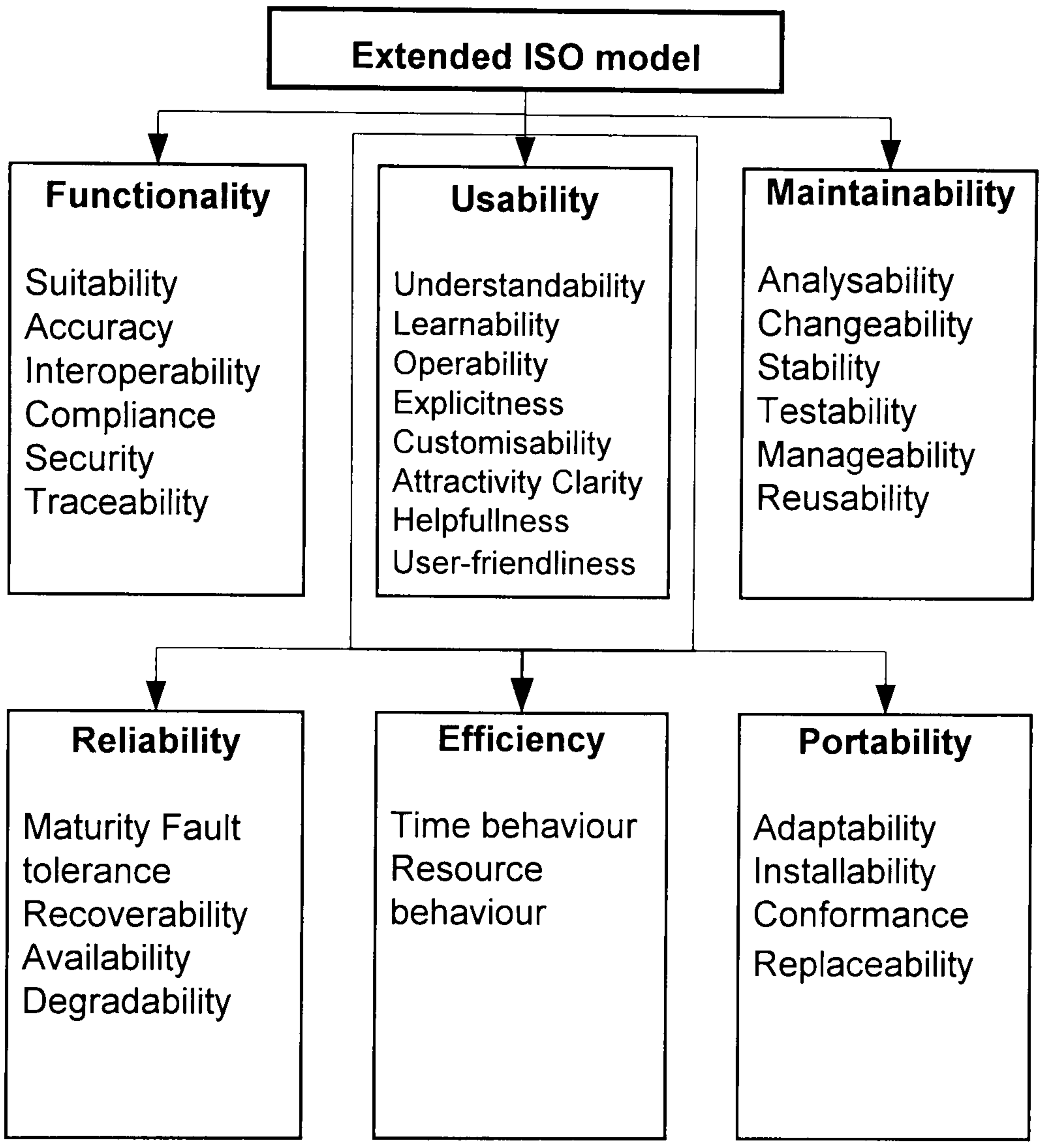

Figure 4.6: Quality characteristics of software products

2) EFQM

The EFQM excellence model (European Foundation for Quality Management, 2001) is meant to be a practical non-prescriptive framework to be used as a self-assessment tool to help organisations establish an appropriate management system regardless of the organisation's sector, size, structure or maturity. The EFQM model does this by measuring where organisations are on the path to excellence, where excellence is defined as the outstanding practice in managing the organisation and achieving results. The model is based on nine criteria that can be used to assess an organisation's progress on the premise that: "Excellent results with respect to Performance, Customers, People and Society are achieved through Leadership driving Policy and Strategy, People, Partnerships and Resources and Processes."

Five of these criteria are Enablers and four are Results. Enabler criteria are concerned with how the organisation undertakes key activities; Results criteria are concerned with what results are being achieved (Figure 4.7).

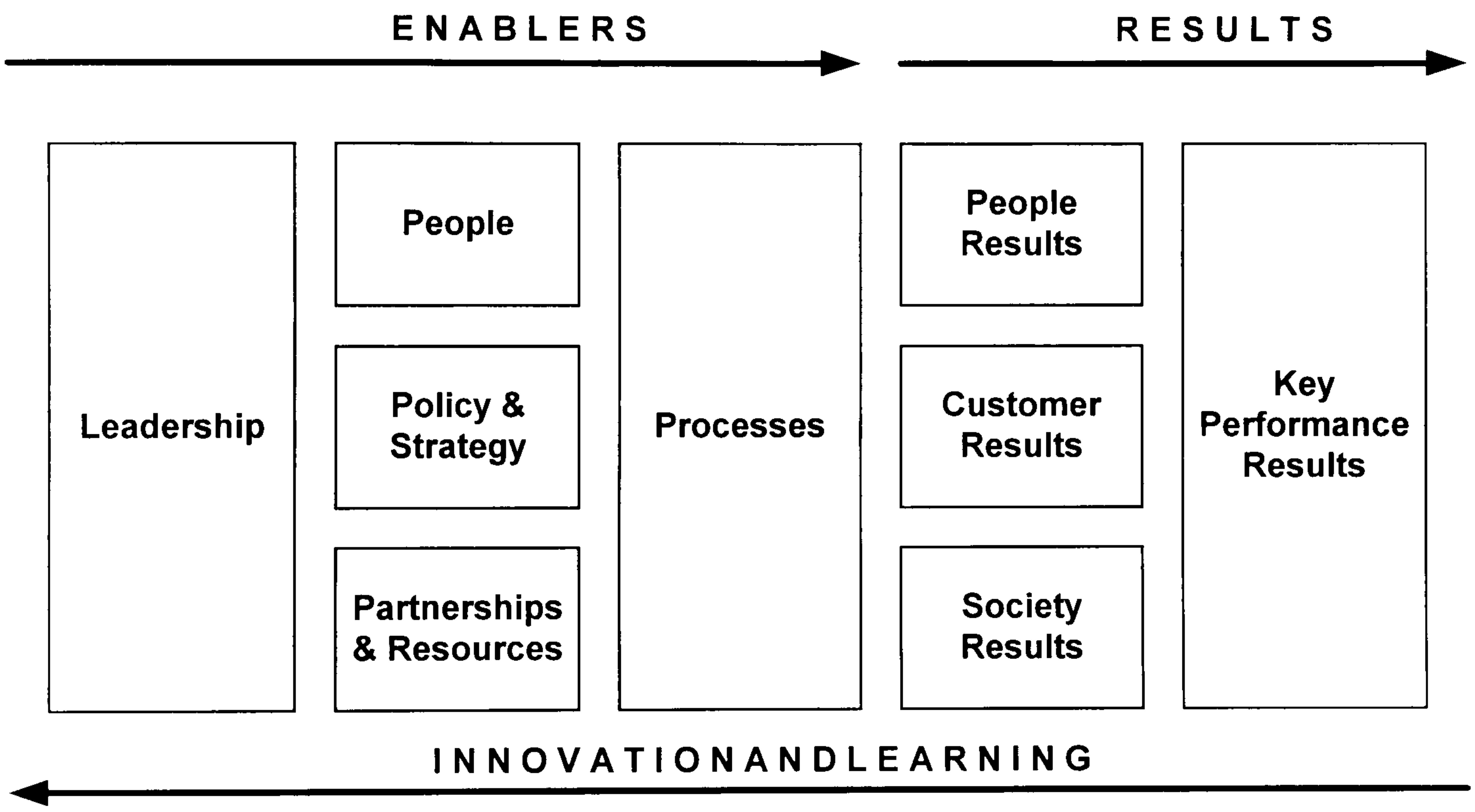

Figure 4.7: EFQM Excellence Model,
European Foundation for Quality Management (2001)

In Figure 4.7, the arrows emphasize the dynamic nature of the model. They show innovation and learning help to improve enablers which in turn lead to improved results. At the heart of the model lies the RADAR logic. The elements of RADAR (Results, Approach, Deployment, Assessment and Review) are used when assessing enabler criteria and the Results element is used when assessing results criteria.

The EFQM concepts (Figure 4.8) are Results Orientation, Customer Focus, Leadership & Constancy of Purpose, Management by Processes & Facts, People Development & Involvement, Continuous Learning, Innovation & Improvement, Partnership Development, and Public Responsibility.

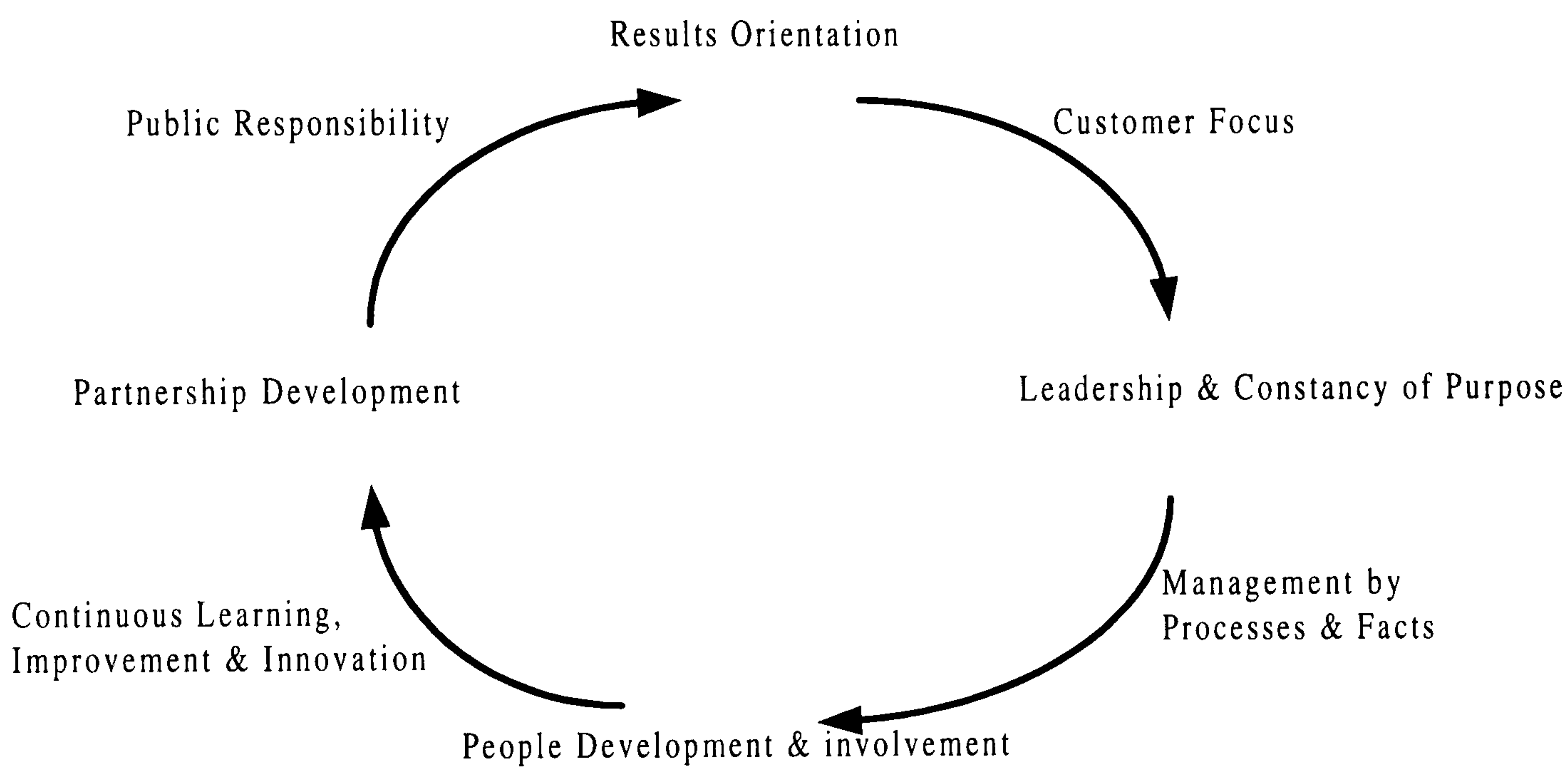

Figure 4.8: Fundamental Concepts of Excellence,
European Foundation for Quality Management (2001)

The model supplies a table (Table 4.5) that can help management to conduct a simple evaluation, to answer the question, "where are we now in relation to these concepts?" Since EFQM specifies nine key areas, this makes a partially normative process-based assessment approach.

	FUNDAMENTAL CONCEPT	START UP	ON THE WAY	MATURE
1	Results Orientation	All relevant stakeholders are identified	Stakeholder needs are assessed in a structured way	Transparent mechanisms exist to balance stakeholder expectations
2	Customer Focus	Customer satisfaction assessed	Goals and targets are linked to customer needs and expectations. Loyalty issues are researched	Business drivers of customer satisfaction needs and loyalty issues are understood, measured are applied
3	Leadership and Constancy of Purpose	Vision and Mission are defined	Policy, People and Processes are aligned. A leadership "model" exists	Shared Values and ethical role models exist at all organisational levels
4	Management by Processes and Facts	Processes to achieve desired results are defined	Comparative data and information is used to set challenging goals	Process capability is fully understood and used to drive performance improvements
5	People Development and Involvement	People accept ownership and responsibility to solve problems	People are innovative and creative in furthering organisational objectives	People are empowered to act and openly share knowledge and experience
6	Continuous Learning, Innovation and Improvement	Improvement opportunities are identified and acted on	Continuous improvement is an accepted objective for every individual	Successful innovation and improvement is widespread and integrated
7	Partnership Development	A process exists for selecting and managing suppliers	Supplier improvement and achievements are recognised and key external partners have been identified	The organisation and its key partners are interdependent. Plans and policies are co-developed on the basis of shared knowledge
8	Public Responsibility	Legal and regulatory requirements are understood and met	There is active involvement in "society"	Societal expectations are measured and applied

Table 4.5: EFQM evaluation

4.6.2 Product Normative with Improvement approach

An example of this approach is ITIL (IT Infrastructure Library) (Central Computer and Telecommunications Agency, 1992).

1) ITIL

ITIL consists of a collection of handbook manuals dealing with the practice of IT service management. It also gives detailed guidelines for many of the processes that play a role in the delivery of IT services, which makes it, beside being a product-based measurement, a normative process-based assessment method.

The IT Infrastructure Library consists mainly of a set of best practices aimed at IT service providers, but is suitable also for software maintenance providers as well. According to the Central Computer and Telecommunications Agency (1992), the primary objective of the IT Infrastructure Library is "to establish best practices and a standard of IT service quality that customers should demand and providers should seek to supply." ITIL was originally developed by the British government through their Central Computer & Telecommunications Agency (CCTA). Nowadays, ITIL is being maintained by the Netherlands IT Examinations Institute (EXIN). No academic literature was found that studied ITIL in any form.

2) Research Maturity Models

During the 1970s, a few models were developed that introduced information systems and their past and expected roles in evolutionary and maturity stages based on a centralised, integrated concept derived from the mainframe-computer environment (Gibson and Nolan, 1974; Nolan, 1979). This work was built upon by other researchers during the 1980s (Bhabuta, 1988; Earl, 1986, 1988, 1989; Hamilton & Chervancy, 1981; Hirschheim et al., 1988) and was still published until the late 1990s (Galliers & Sutherland, 1991; Galliers, 1999; Weill & Broadbent, 1999).

1. Nolan Model

The most famous of the evolutionary maturity models is that of Nolan (1979). Based on analyses of the actual use of IS/IT in a number of large US organisations, Nolan proposed an evolutionary model containing initially four "stages of growth" (Figure 4.9) where he later added two more stages (Figure 4.10). These are summarized below:

- Initiation stage, where batch off-line processing was used to automate clerical work. The aim was to reduce cost where the nature of the systems was operational. At this stage, top management support is lacking.

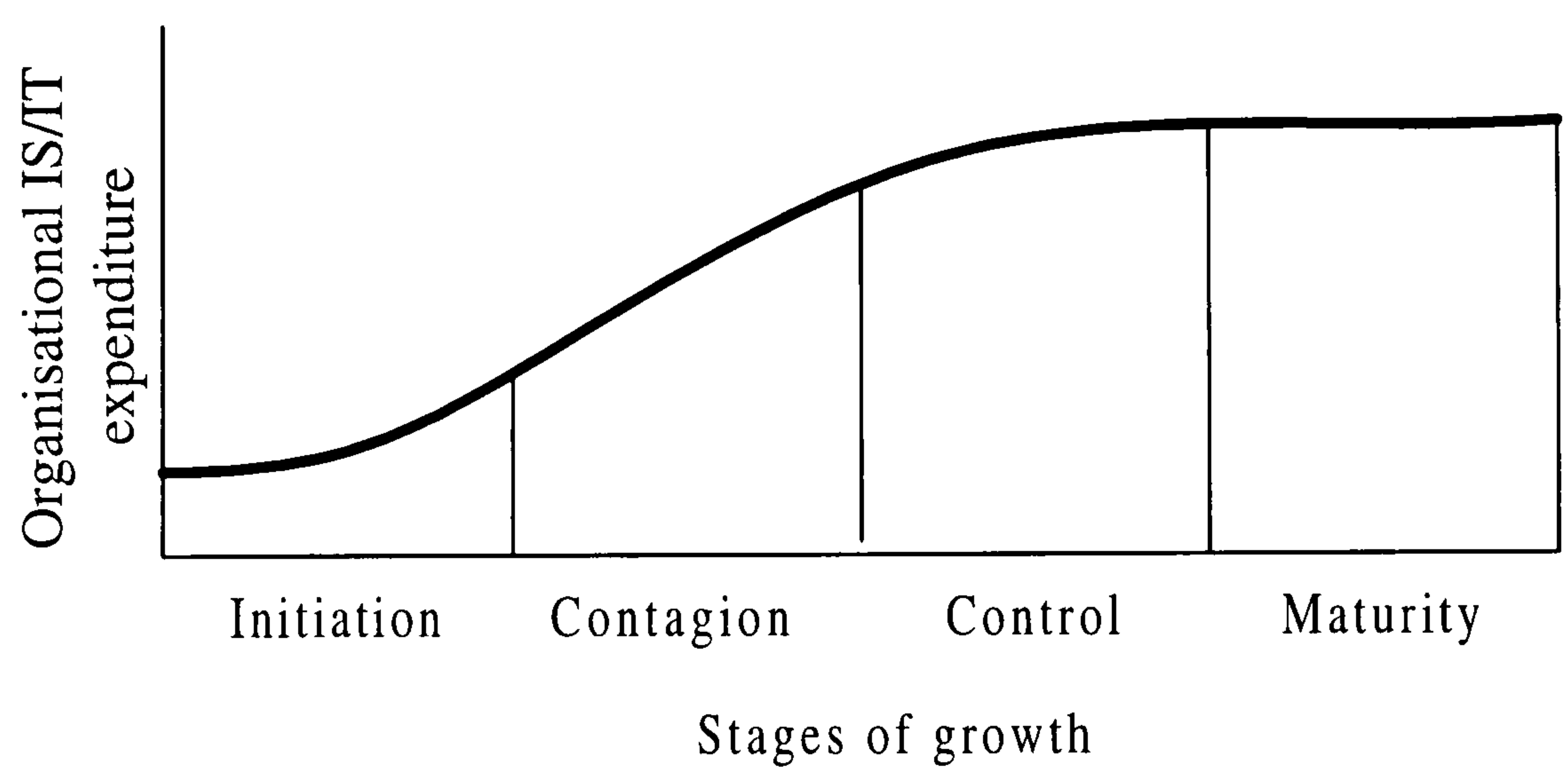

Figure 4.9: Four stages of IS/IT growth, Gibson & Nolan (1974)

- Contagion stage, where the organisation would face increased growth in IS/IT applications because of high user demand and expectations. The systems start to have on-line features. Because of this expenditure, the organisational IS/IT cost accumulates where there is little control over it. Later in this stage, a recognition of the problem of lack of control starts to surface and a drive towards centralisation starts to formulate.

- Control stage where the drive for controlling the IS/IT spending is operationalised by going towards centralisation. The IS/IT projects are expected to justify themselves by producing promised return. In order to control IS/IT within the organisation, standard methodologies and procedures are put in place. These often resulted in delays and maybe cost overrun, which lead to user complains.

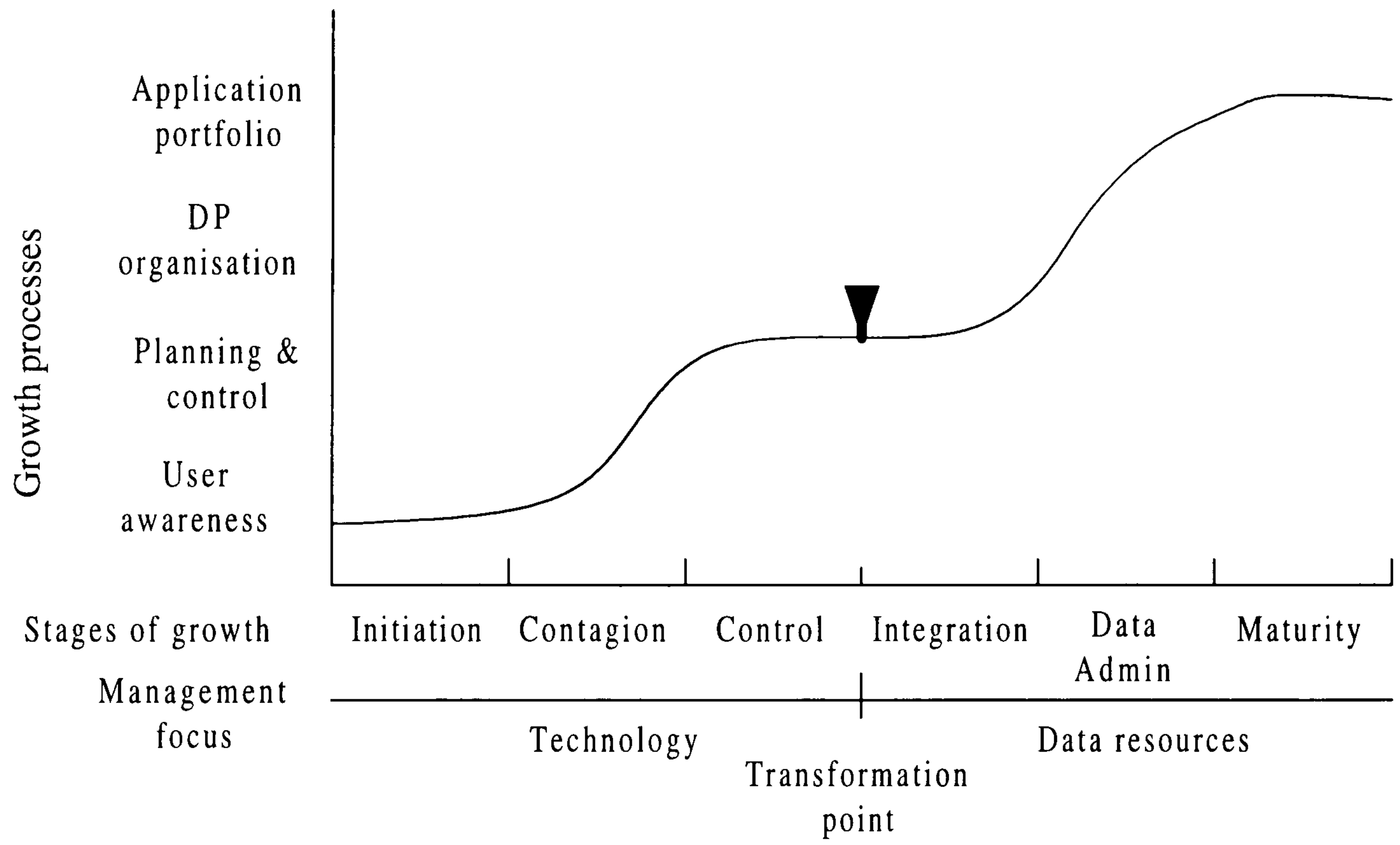

Figure 4.10: Six stages of IS/IT growth,
Nolan (1979)

- Integration stage, where integrating the current systems becomes the issue and management accepts to allocate a considerable budget for this cause. The means of systems' integration is mainly the implementation of database environment. The ownership of the systems starts to be in the user's hands and the role of the IS/IT department which could be called Data Processing (DP) is more than solving problems, rather to provide services.

- Data administration stage, where the need for information rather than data processing is what IS/IT projects are based upon. As the integration between systems is in place using database capabilities, information sharing among users becomes common and users become aware of its value.
- Maturity stage, where IS/IT planning and development are aligned with the organisational business and strategic planning.

The model suggests that in the first three stages, the concern of IS/IT management is on the technological aspects of the IS/IT operation. At the integration stage onwards, the concerns become focused on IS/IT resource management and utilisation.

The model presented five characteristics that can be used in the assessment of the organisational maturity with respect to IS/IT usage. These are:

- The type of systems the organisation acquires from both processing nature as batch, online, or database, and application type as being financial and accounting, operational systems, or management information systems (MIS).
- IS/IT expenditure as a proportion of the sales revenue, where the maturity stage could be identified primarily by assessing the size of organisational spending rate on data processing. This expenditure would take the (S) shape over time.
- The user awareness characteristics that start with being reactive towards IS/IT function unit initiatives at the first and second stages, then accepting and providing support for change, then entering into a partnership at maturity.
- The control approach that starts by having an internal approach to shift after the third stage to be of an external nature.

Literature criticism of Nolan model

The model faced criticism mainly because it could not prove its claims to represent reality, either as a means of describing the phases through which organisations pass when utilising IT, or to predict these changes (Benbasat et al., 1954; King and Kraemer, 1984). King and Kraemer (1984) found that the empirical evidence for the stages is inconsistent and many of the model's assumptions are not practical, but they acknowledged the model's simplicity is behind its popularity with practitioners, researchers, and IS managers since its introduction. Drury (1983) found that the model stages did not map on the organisations' status in the real world especially at the later stages, where he attributed this limitation to the simplicity of the model. But he accepted that individual organisations can use the model in assessing how effectively they are coping with the increasing importance of IS/IT. Friedman (1994), in analysing critiques of the Nolan model, suggested that while evolution through the early stages of the model could be observed, the arrival of strategic systems in the 1980s introduced a new stage which changed the concept of how IS/IT evolves to maturity in practice. Wiseman (1985), criticised that the influence Nolan's model had where the study suggested that it inhibited the strategic use of IS/IT until the mid-1980s.

2. Earl Model

Earl (1989) argued that organisations will pass through a number of different learning curves with respect to different information technologies. Also different units of an organisation may be at different stages of IS/IT maturity.

Earl's model is concerned with the stages of IS/IT planning maturity which organisations progress through. The Earl (1983) model has been revised many times

(Earl, 1986, 1988, 1989). Earl introduced the changing agenda for information systems planning by concentrating attention on what is seen as the primary task of the process: its major objective, the driving forces of the planning process (in terms of those involved), the methodological emphasis, and the context within which the planning takes place. Following research on current information systems planning practice, Galliers adds to this an "ad hoc" stage of planning a factor concerning the focus of the planning effort, where he argues that "the focus has tended to change over the years from a predominantly isolated, Information Systems function orientation, through an organisational focus, to a competitive, environmental focus" (Galliers, 1999).

3. Bhabuta model

Bhabuta (1988) was based on Gluck et al. (1980) and McFarlan et al. (1982, 1983) and is a model which attempts to map the progress towards formal strategic planning of information systems.

The notion behind Bhabuta's model is that strategies based on productivity improvements along with the information systems that enable them become the dominant paradigm in future competitive markets (Bhabuta, 1988). His model is more focused than the Nolan or Earl models. It brings together elements from such aspects as strategy formulation, information systems, and the mechanisms by which the IS/IT function is managed. The value systems associated with each phase of the model are also identified. Bhabuta does not assume that the categories in the model are distinct nor that it is absolute. Bhabuta argues that as organisation become more mature in the utilisation of IS/IT, and Management become more sophisticated with respect to IS/IT use, some of the characteristics that are typically associated with advanced organisations will show at the less advanced organisations.

4. Hirschheim et al. model

Hirschheim et al. (1988) build on Nolan's model. The study followed the evolution and management of the IS/IT function in a number of organisations. It found that those whose management accepted information systems as vital to their business, progress through three stages in their management of the IS/IT function. Those are delivery, reorientation and reorganisation.

- The delivery stage is concerned with IS/IT issues that are mainly internal for improving the ability to deliver and support the IS/IT. The main objective of the IS/IT function in this stage is to achieve top management's acceptance because top management carry concerns regarding the IS/IT function along with dissatisfaction with the quality of the available IS/IT and the huge costs the organisation is bearing. This situation results in hiring a new manager for the IS/IT function who carries previous experience. This new manager will focus on internal issues of the IS/IT function.
- In the reorientation stage, the focus becomes on the external environment, and on using IS/IT for competitive advantage. This results in change of focus that occurs from the delivery of IS/IT services to the exploitation of IS/IT for competitive advantage and one of the internal IS/IT senior managers becomes the head of IS/IT function whose main task is then bringing about the required change.
- In the reorganisation stage, the reorganisation occurs by making the IS/IT manager an IS/IT director. The manager's task becomes managing the

interactions and relationships between the IS/IT function and users. At this stage, units in the organisation would differ with respect to their IS/IT usage characteristics and technical capabilities. The organisational IS/IT capabilities at this stage are distributed between the central IS/IT function and the different organisational units.

5. Galliers and Sutherland model

Galliers & Sutherland (1991) argue that a gap has been left by earlier models (Nolan, Earl, Bhabuta, and Hirschheim), where they lack the organisational and management focus for the DP manager in his/her attempt to create a successful IS/IT function. Those earlier models described how an organisation could place itself within a particular stage of IT planning or utilising maturity, rather than describing what needs to be done in order to progress through to the more mature stages of growth. The model arranged and combined elements from previous models (technical, managerial and organisational), according to a new structure describing the important elements of organisation in general, and the kinds of activities and organisational structures needed for an organisation to move through "IT growth stages".

6. Weill & Broadbent Model

Weill & Broadbent (1999) propose a three-layer structure of IT infrastructure. At the first layer are the IT components like computers and communications networks. The second layer contains people with knowledge and expertise who are responsible for making and running shared IS/IT services. This is where business applications use shared IS/IT services to perform business processes operations. The third layer represents a set of IS/IT services that are shared organisation-wide, such as distributed databases and data interchange (EDI) services. Weill & Broadbent (1999) identify five core IS/IT infrastructure services in an organisation, such as the management of corporate communication networks, management of group-wide or organisation-wide messaging services, recommendation of IS/IT standards, security and disaster with recovery planning, and technology advice and support. They also presented twenty additional IS/IT services, such as management and negotiating with suppliers and outsourcers, developing a common systems development environment, technology education services, and developing multimedia services such as videoconferencing.

Weill & Broadbent (1999) present four views of IS/IT infrastructure which they represent levels of maturity in respect to IS/IT infrastructure. Those are:

1. *None view* that implies that the organisation at this level has no organisation-wide IS/IT infrastructure. The organisation usually has independent units which invest independently in IS/IT.
2. *Utility view* implies that expenditure on IS/IT infrastructure is seen as a way of saving cost by providing necessary and unavoidable services. Management concern and thrust at this level is to minimize the expense of IS/IT.
3. *Dependent view* implies that IS/IT infrastructure investments are in response to specific business strategies. This implies that IT/IS planning had followed business planning.
4. *Enabling view* implies that IS/IT infrastructure investment relates to long-term requirements for flexibility to achieve strategic objectives. The flexibility enables future unspecified occurring business strategies to be implemented rapidly to provide the organisation with competitive advantage.

The model used different criteria for classifying the level of organisational maturity such as:

- The level of the organisational IS/IT investment relative to the competitor organisations within the environment of operation, and the extent to which this investment was in IS/IT infrastructure.
- The organisational approach in justifying investment in IS/IT at organisation board level.
- How much of the entities (internal and external) can the IT/IS infrastructure can link and with what quality of services (reach and range) and to what extent those services are offered organisation-wide.

4.7 Process Measurement Approach

The process-based measurement approaches aim at measuring the activities, methodologies, practices, and/or tools an organisation should implement and/or use in order to produce a product or service (Zahran, 1997). By measuring the process that creates the product, process improvements and/or trouble shooting activities should occur. Those approaches assume that an improved process produces higher quality products.

Process-base measurement approaches are mainly rooted in the software industry where extensive effort was made to introduce software improvement models. Some of those are SEI's Capability Maturity Model (CMM) (Paulk et al., 1993), Structured Process Improvement for Construction Enterprises (Construct IT, 2000),Trillium (Trillium, 1996), Bootstrap (Kuvaja et al., 1994), Software Process Improvement and Capability dEtermination (SPICE) (El Emam et al., 1998), IT

Infrastructure Library (ITIL) (Central Computer and Telecommunications Agency, 1992), Goal/Question/Metric (GQM) paradigm (Solingen & Berghout, 1999), etc. .

Three main types of approaches fall under the category of process approaches: goal-centred, normative with improvement maturity, and normative with improvement non-maturity.

4.7.1 Process Goal-centred Measurement

An example of this approach is Goal/Question/Metric (GQM). As it is a product goal- centred measurement, GQM has the ability to measure processes with a goal-centred approach. Also, the same applies to the IT Infrastructure Library (ITIL) model which has introduced a measurement model of IT service quality processes. Both GQM and ITIL models were introduced earlier in Section 4.5.1.

4.7.2 Process Normative Improvement Maturity approach

The notion of process-based with improvement measurement approaches implies a reference framework which prescribes the activities, methodologies, practices, and/or tools an organisation should implement and/or use. These approaches structure the framework in Levels of maturity in order to facilitate implementation. There are two ways to apply maturity levels to a framework (Zahran, 1997):

- Staged-view model: The staged-view model comprises a number of maturity levels, and each process or process area is tied to a certain level. At each level, an organisation implements the processes attached to that level. A staged model measures the maturity of a complete organisation. The underlying logic of staged-view models is that the processes on a certain level form the foundation for the next levels. So, skipping processes or levels is generally not advised, because all processes at and below a certain level are needed for the next level. The SW-CMM (Paulk et al., 1993; SEI, 1995) is an example of a staged-view model with five maturity levels, ranging from level 1, the initial level, to level 5, continuous improvement.

- Continuous-view model: In a continuous-view model the processes themselves can be rated along a maturity scale. So the model measures the maturity of individual processes instead of the maturity of an organisation. In a continuous-view model, as opposed to a staged-view model, it is possible for one process to be implemented at a low level of maturity and another process at a high level of maturity. The SPICE (ISO 15504) (El Emam et al., 1998) model is an example of a continuous-view model. The maturity (capability) of individual processes can range from Level 0, (incomplete) to Level 5 (optimising).

Often, an assessment method accompanies the process improvement framework to facilitate the comparison of organisational practices with the practices as prescribed by the framework. Generally, three types of assessment are distinguished (Zahran, 1997):

- Self-assessment: In this case, the assessment is performed by the organisation itself, and mainly by its own personnel. The main objective in this case is to identify the organisation's own process capability and initiate a plan for process improvement.
- Second-party assessment: In this case, external assessors perform the assessment and the objective is to evaluate the organisation's capability to fulfil specific contract requirements.

- Third-party assessment: In this case, an independent third-party organisation performs the assessment. The main objective in this case is to verify the organisation's ability to enter contracts or produce software products, and sometimes to provide the fulfilment of certification according to a selected standard.

The last two variants are also known as "capability determination".

There are a number of process-based normative assessment approaches such as Capability Maturity Model (CMM) (Paulk et al., 1993), People Capability Maturity Model (People-CMM) (SEI, 2001), Personal Software Process (PSP) (Humphrey, 1995), Team Software Process (TSP) (Humphrey et al., 1999), Structured Process Improvement for Construction Enterprises (Construct IT, 2000),Trillium (Trillium, 1996), Bootstrap (Kuvaja et al., 1994), Software Process Improvement and Capability dEtermination (SPICE) (El Emam et al., 1998), and TickIT (TickIT, 1997).

1. Capability Maturity Model (CMM)

SEI's CMM provides a practical normative process-based approach for the assessment and improvement of software organisation processes.

History of SW-CMM: staged capability model

The most well known method for assessment of the software development processes is the Capability Maturity Model (CMM) (Paulk et al., 1993). Capability models began with the SW-CMM, which is usually called CMM, created by the SEI of Carnegie Mellon University. Version 1.0 was released in 1991. This was in response to problems in the software development industry (Gibbs, 1994) of late, poor-quality, and overrun software projects in addition to being requested by the U.S Department of Defence so that it could characterize each software developing organisation that is a potential contractor to DoD's software products. It was Humphrey (1990) who brought CMM from research into the way in which software developing organisations organise their processes in practice. A detailed description of the model and publications regarding its philosophy and practical use can be found at the web site of the SEI.

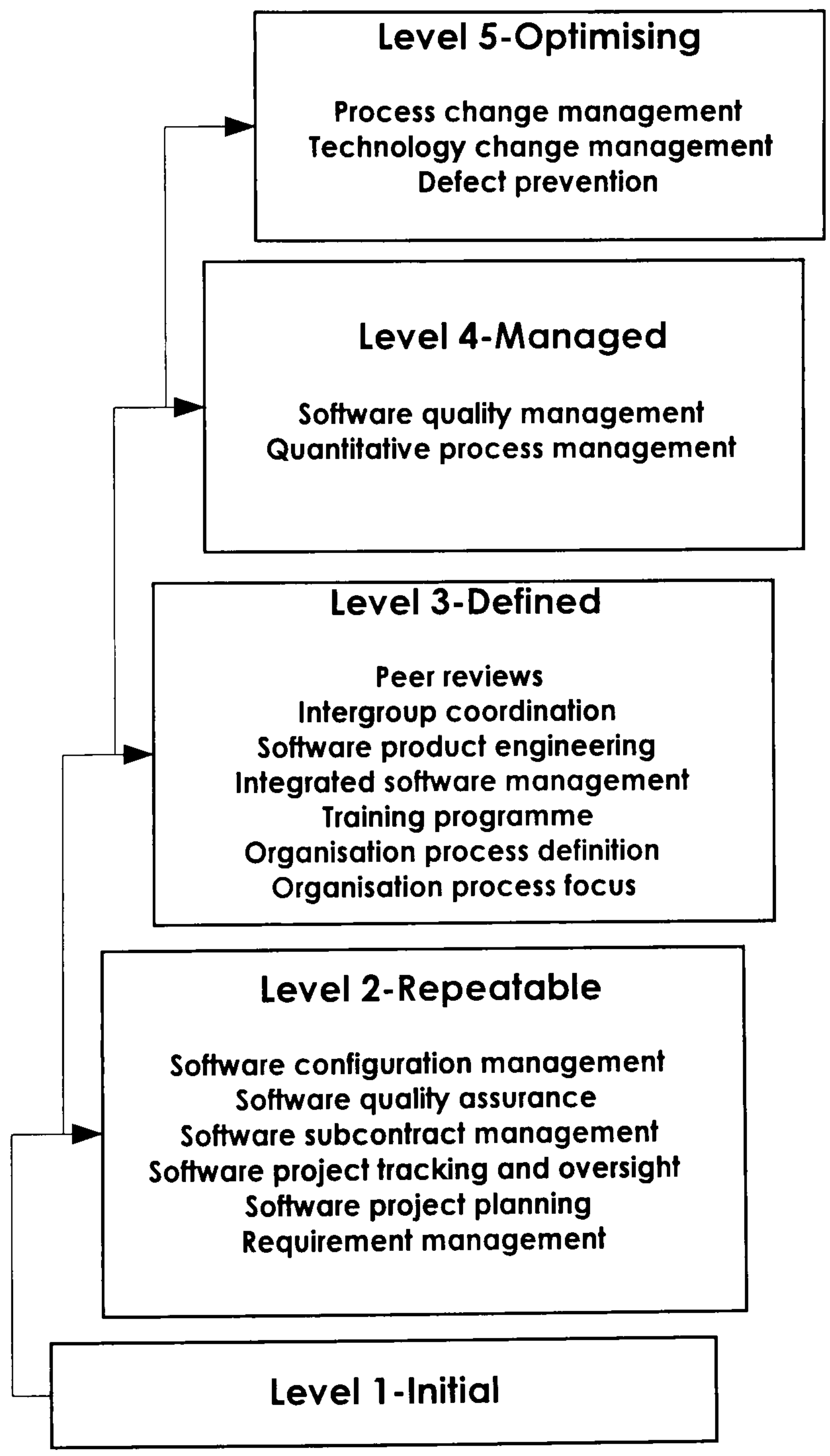

Figure 4.11: SW-CMM Key Process Areas,
Paulk et al. (1993)

The SW-CMM established a five level ladder of process maturity for organisations to climb. An organisation improves a few key aspects of its processes called key process areas (KPAs) at a time, receives a new level number for its efforts, and then improves additional areas required for the next level. SW-CMM levels, starting at level 2, consist of such key process areas (KPAs). A KPA has one or more goals that describe what should be achieved in that KPA. The KPAs are where SW-CMM advises an organisation to improve in order to be elevated to the next level of maturity. Activities that help implement the goals in order to fulfil the KPA requirement are also supplied by SW-CMM. This CMM approach is called a 'staged' view. Figure 4.11 shows the SW-CMM architecture, demonstrating this levelling approach.

2. SE-CMM: continuous capability model

In December 1993, a group was separated from the INCOSE SECAM (International Council on Systems Engineering - Systems Engineering Capability Assessment Model) working group. This group included eight organisations that agreed to provide full-time authors for a systems engineering capability maturity model (SE-CMM 1995) to be released in one year's time.

This group, later called EPIC (Enterprise Process Improvement Collaboration), used the Software Engineering Institute (SEI) of Carnegie Mellon University for project management and administrative support. Thus, EPIC products were released as SEI documents. Version 1.0 of the SE-CMM was released in December 1994, and an associated appraisal method was released in March 1995. Version 1.1 of both was released in February and June 1996, respectively.

The SE-CMM (Bate, 1995) is based on adaptation of the SEI's SW-CMM. This model uses an architecture called the 'continuous' view, derived from a draft of the international Software Process Improvement Capability dEtermination (SPICE) (El Emam et al., 1998) project guidelines. The model is divided into areas for improvement called process areas. Process content is evaluated by assessing compliance with a set of base practices that constitute a process area. Process maturity is evaluated by applying a generic scale of levels to each process area separately.

Processes must comply with all process content elements (base practices) for the process area to be evaluated at the first capability level of maturity. For example, an operational concept is determined, in any manner, and no two people may need to do it the same way.

Each subsequent level is achieved by incorporating the process maturity elements (Generic Practices) associated with the level. Essentially, generic practices address in what manner the process content is performed. For example, eventually there is a plan and a process for defining operational concepts, and people are trained to define operational concepts in the manner that the organisation has measured to be most effective.

The model allows the organisation to determine the capability or maturity of each process area separately and does not prescribe an order in which the process areas should be implemented. The continuous-view consists mainly of a generic non-industry-specific measurement (Generic Practices), which makes it suitable for use as an integrated part of a larger general model that addresses organisational Processes, People, IT, and Environment.

CMMI

SEI also introduced the CMMI (Capability Maturity Model Integration). This model integrates different flavours of the model. The CMMI project (SEI, 1999) is integrating models of both architectures, namely the staged-view SW-CMM and the continuous-view SE-CMM. CMMI has stated that it will provide a choice of either staged or continuous views for several choices of content.

Comparison of Staged-View and Continuous-View Architectures

This section shows, in brief, that the staged- and continuous-view architectures are implemented differently, but there are similarities in the concepts behind the levels. Appendix-A contains detailed comparison of both architectures.

a. Staged-view Architecture

SW-CMM (Paulk et al., 1993) looks at the organisation's maturity in a single collective view, shown in Figure 4.11. Compliance with a KPA in a staged-view model is binary (the organisation's processes comply or they do not). The organisation increases its maturity by complying with additional KPAs. The order of complying with KPAs is fixed by the model. The initial level in the staged-view model is Level 1, which indicates that the organisation does not fully comply with the Level 2 KPAs.

At the lowest maturity level of the model, an organisation is in the Initial phase. It develops software, but development is done in an ad-hoc manner where a different approach is used for different software products. In many cases, budget and time estimates are not met. The quality of the products is unpredictable as it is based on individuals' effort, knowledge and experience.

The organisation has to introduce basic management activities to rise to the second level of SW-CMM, the Repeatable stage. At this stage, more uniformity is brought into the software development process in such a way that the organisation is capable of producing products in similar ways with similar quality. Quality assurance and configuration management are important for the transition from stage 1 to stage 2 in SW-CMM.

As the organisation rises to the third level, the Defined, it should become capable of describing and managing its software development processes according to standards. As the organisation becomes familiar with the main parts of its standardized development processes, it then can control them.
In order for the organisation to achieve the Managed level, it needs to quantify data regarding the software development processes. This data should be analysed and used in establishing estimates for planning and changes.

The highest maturity level of SW-CMM is the Optimising level. At this level, the organisation continuously improve its processes. This includes seeking and eliminating root causes of product and process defects, as well as incorporating new technology as appropriate. The organisation should be capable of adopting its development processes according to the needs dictated by the characteristics of the product to be developed.

b. Continuous-view Architecture

In the SE-CMM, a continuous model, an organisation first achieves Level 1 in a process area by performing all of the process area's base practices in any manner. Not performing the base practices will earn the organisation a Level 0, the initial level in continuous-view models, in that process area. To improve the capability of a process area beyond Level 1, an organisation complies with additional generic practices in the way it performs the base practices.

For each level of the SE-CMM, these generic practices are based on the same principles as the corresponding level in the SW-CMM. SE-CMM Level 2 generic practices, for example, address project management discipline, as applied to a process area. This means that an organisation can achieve Level 2 in “Verify and Validate System”, for example, if its projects perform all the process area’s base practices and allocate adequate resources to perform the validation and verification activities. The organisation needs also to perform all of Level 2 generic practices such as assigning responsibilities for preparing for and performing the necessary tests and analyses, and documenting the project’s test and other verification processes etc..

If these project processes are tailored from an organisational standard set of test processes, using organisationally approved tailoring guidelines, and if the organisation uses well-defined data and performs appropriate reviews including peer reviews where needed according to Level 3 generic practices, then the organisation achieves Level 3 in “Verify and Validate System”, and so on for the rest of the levels regarding all of the 18 process areas. In this manner, the organisation earns a level between 0 and 5 in each of 18 process areas.

C. Staging and Equivalent Staging for Continuous-view Models

"Staging" is a concept by which a continuous-view model can be made to behave like a staged-view model (Bate, 1995; SEI, 1999). A capability level profile is a list of process areas and their corresponding capability levels. The profile may be an achievement profile when it represents the organisation's progress for each process area while climbing up the capability levels. Or, the profile may be a target profile when it represents an objective of process improvement. A target staging concept defines an order in which process areas of a continuous model are to be addressed and associated requirements (generic practices) on capability levels to be achieved. Achieving those capability level ratings in that subset of process areas and associated generic practices earns the organisation an overall Maturity Level rating. Equivalent staging is a target staging that is defined so that the results of the target staging can be equivalent to the maturity levels of the staged representation. Such staging permits benchmarking of progress between organisations, enterprises, and projects, regardless of the CMM representation view used (SEI, 1999).

3. People-CMM

In addition to the CMM, SEI has also developed People-CMM (also known as P-CMM)(SEI, 2001). The aim of this framework is to develop and manage the knowledge, experience and motivation of employees in the organisation. Just as in CMM, the maturity of the organisation with regard to human resource management is charted and improvement priorities are indicated.

The P-CMM, is an adaptation of SW-CMM concepts focused on developing the organisation's human capabilities, especially the talent in software and information systems development. The motivation for the P-CMM is to "radically improve the ability of software organisations to attract, develop, motivate, organise, and retain the talent needed to steadily improve software development capability."

The strategic objectives pursued in the P-CMM are to:

- Improve the capability of software organisations by increasing the capability of their staff,

- Ensure that software development capability is an attribute of the organisation rather than of a few individuals,
- Align the motivation of the staff with those of the organisation, and
- Retain assets (i.e., people with extensive skills and capabilities) within the organisation.

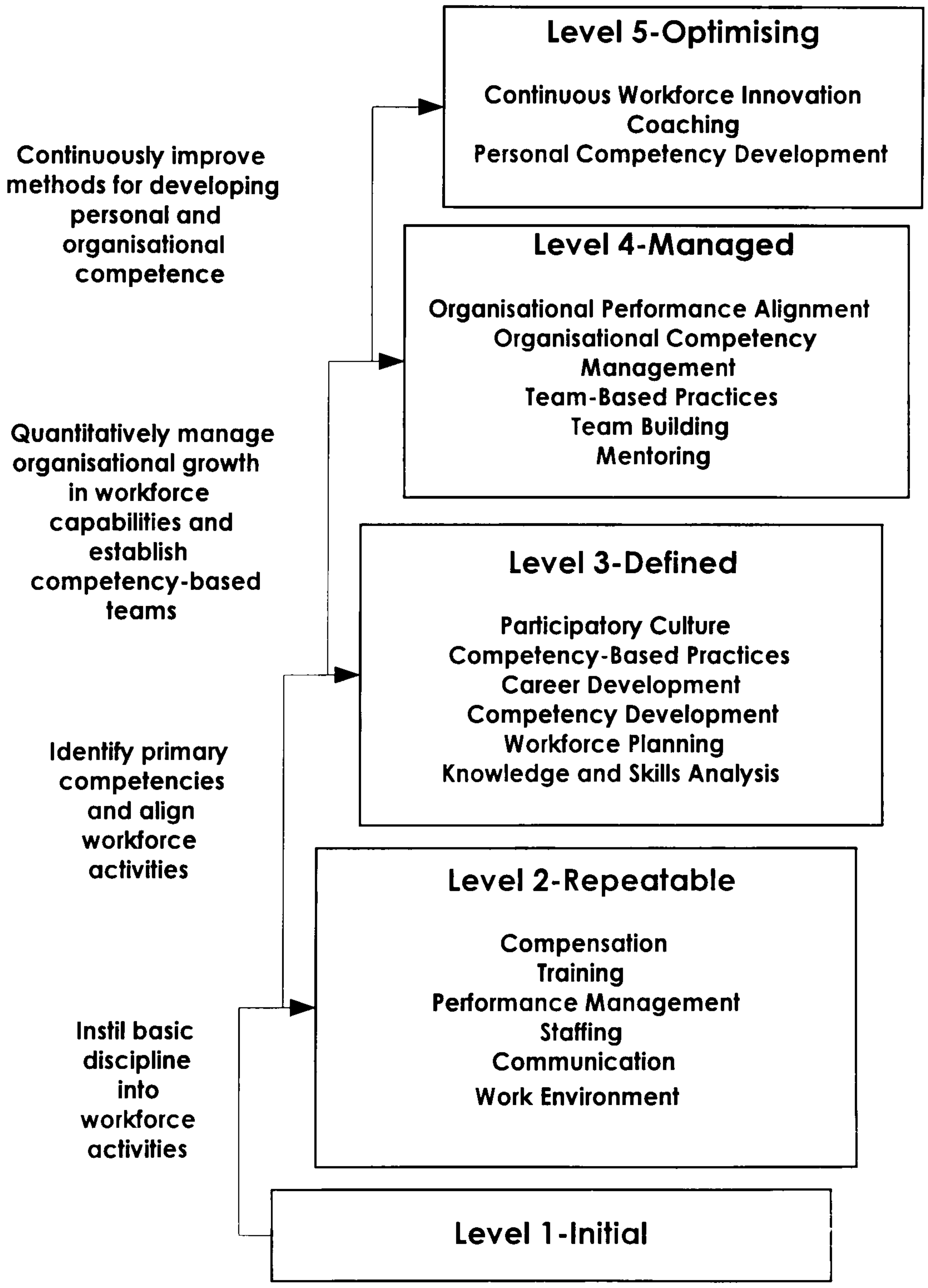

Figure 4.12: P-CMM Key Process Areas,
SEI (2001)

Category / Maturity Levels	Developing Capabilities	Building Teams and Culture	Motivating and Managing Performance	Shaping the Workforce
5.Optimising	Continuous Capability Improvement	Optimise Integration of Processes	Organisational Performance Alignment	Continuous Workforce Innovation
4.Managed	Mentoring Competency-based Assets	Empowered Workgroups Competency Integration	Quantitative Performance	Capability Management
3.Defined	Competency Development Competency Analysis	Workgroup Development Participatory Culture	Competency-based Practices Career Development	Workforce Planning
2.Repeatable	Training and Development Compensation	Coordination and Communication	Compensation Performance Management Work Environment	Staffing
1.Initial				

Table 4.6: P-CMM Key Process Areas Assigned to Process Categories, SEI (2001)

As shown in Table 4.6, the P-CMM includes the following activities in the KPAs:

- Staffing (includes recruiting, selection and planning)
- Managing performance
- Training
- Compensation
- Work environment

- Career development
- Organisational and individual competence
- Mentoring and coaching
- Team and culture development

As in SW-CMM, People-CMM (Figure 4.12) consists of five maturity levels now described where Level 1 is the "Initial level", and the four remaining levels are characterised as follows:

- Level 2 focuses on introducing basic discipline into workforce activities providing key process areas within work environment, communication, staffing, performance management, training, and compensation.
- Level 3 is the focus on the identification of organisation's competencies and using its people's management activities to enhance them. The key process areas at this level are: knowledge and skills analysis, workforce planning, competency development, career development, competency-based practices, and participatory culture.
- Level 4 introduces a quantitative management view on improving people management capabilities and in establishing teams based on competence. Key process areas at this level are: mentoring, team building, team-based practices, organisational competency management, and organisational performance alignment.
- Level 5 covers issues that address continuous improvement of methods for competence development at an organisational and an individual level. Key process areas at this level are: personal competency development, coaching, and continuous workforce innovation.

Figure 4.12 depicts the key process areas within each maturity level and lists activities to be performed to progress between levels. Table 4.6 lists the key process areas assigned to process categories. There are four of these categories: developing capabilities, building teams and culture, motivating and managing performance, and shaping the workforce.

4. Personal Software Process (PSP)

In addition to activities designed to improve the software development process and the software product, increasing consideration has been given to improving the capacities of individual software developers. Personal Software Process (PSP), in particular, focuses on this. PSP was also developed by the originator of CMM (Humphrey, 1995). The purpose of PSP is to make individual software developers aware of their own software development process, in order to improve the quality of that process, its predictability, and the quality of the result. PSP is introduced on the basis of a training course, which offers the opportunity to learn and apply PSP.

PSP was based on the notion that improved personal process discipline can help to increase the effectiveness of individual software engineers. It was also felt that as the individual software developer's performance improves, the performance of the teams he/she is part of would also be more likely to improve. The original drive for developing the PSP came from reservations raised regarding CMM. Many viewed CMM as being designed for large organisations, and did not see how it would be applied to individual work or to small project teams. As a result, PSP was developed to adapt 12 of the 18 CMM key process areas (version 1.1) to improve the work of individual software developers.

PSP is a self-improvement process designed to help individual engineers to control, manage, and improve the way they work. It is a structured framework of forms, guidelines, and procedures for developing software. If properly applied, PSP provides the individual software engineer with historical data that helps in scheduling task and meeting them, which makes the software engineering work predictable and more efficient.

Relationship between PSP and CMM

Industrial organisations are generally interested in the personal process because they see it as an efficient way to bring process improvement benefits to small project and organisations. Other groups see it as a way to avoid much of the cost and the organisational disruption of a major improvement effort. While PSP can greatly facilitate process improvement in both large and small organisations or even at an individual level, it should not be viewed as a replacement for an organisational process improvement effort. The two, in fact, are complementary. However, organisations near the CMM maturity level 2 - the repeatable level, or above, are likely to be most successful in introducing the PSP. In contrast with the CMM, the PSP does not provide for an assessment technique to identify the PSP maturity level.

5. Team Software Process (TSP)

Humphrey et al. (1999) describes Team Software Process (TSP). This third people's model introduced by SEI is meant to be at an intermediate level (after CMM for the entire software development organisation and PSP for the individual software engineer) in which the processes are mapped and improved. It is claimed that these three methods combined can reinforce each other (Humphrey et al., 1999).

When organisations started process improvement from the initial level of any CMM model, the PSP leads software developers to how to address their tasks in a professional way. Once software developing teams are well acquainted with PSP, they need to start focusing on applying Team Software Process to their projects. TSP guides developing teams in launching, planning, and managing their projects. Perhaps most important, TSP shows managers how to provide leadership in guiding and training/coaching their teams to produce successful projects.

Team Software Process (TSP) builds upon CMM and PSP to guide software developer teams in their work. It guides them to be a self-directed team that contains effective individuals. It also guides managers to support their teams and maintain a supportive environment for high team performance. TSP has five objectives:

- To establish self-directed teams that plan and keep track of their work progress, establish goals, and control their plans and processes.
- To guide managers how to train/coach and motivate their teams and how to perform at their best.
- To speed software process improvement.
- To provide improvement guidance to the more mature organisations.
- To facilitate an educational system of industrial-grade team skills.

The chief advantage of TSP is that it guides software developers to produce quality products within the pre-planned costs in reasonable time schedules. TSP guides teams through the four typical phases of a project. These projects may start or end on any phase, or they can run from beginning to end. This is illustrated in Figure 4.13.

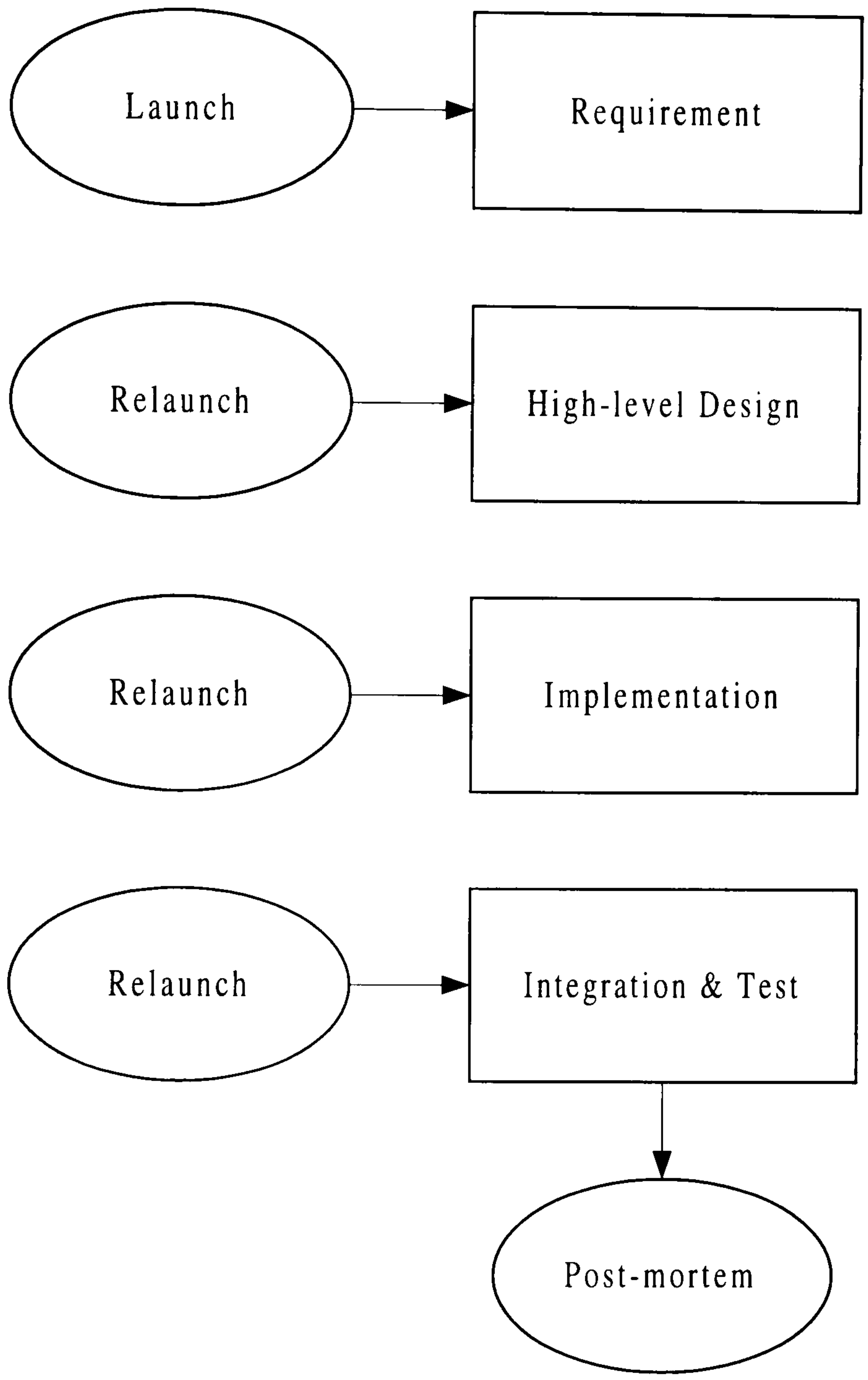

Figure 4.13: TSP structure,
Humphrey et al. (1999)

Before each phase, the team goes through a complete launch or relaunch, where they plan and organise their work. If team members are well acquainted with PSP, it would be adequate to have a four-day launch workshop which offers guidance to complete a project phase. In this workshop, TSP teams produce

- Written team goals
- Team roles' definition
- Process development plan

- Team quality plan
- Project support plan
- Overall development plan and schedule
- Detailed next-phase plans for team members
- Project risk assessment
- Project status report

For each of the subsequent phases, a two-day relaunch workshop is needed to provide the team with guidance. These launches/relaunches are part of the project. In the final launch step, the project team conducts a review of the plans and risks and conducts weekly meetings. The team also produces periodical status reports for project stakeholders.

The CMM, PSP, and TSP provide an integrated three-dimensional framework (Humphrey, 1998a, b, c) for process improvement. CMM has 18 key process areas, and the PSP and TSP guide engineers in addressing almost all of them. These methods not only help engineers be more effective, but also provide the in-depth understanding needed to accelerate organisational process improvement.

6. Bootstrap

Bootstrap (Kuvaja et al., 1994) is a normative process-based assessment approach for the improvement of the software organisations' processes. It was developed by the ESPRIT project sponsored by the European Commission from 1990 to 1993. The aim of that project was to develop a useful method for software quality improvement to be European-cultured for the European market rather than the U.S.-cultured CMM, ISO and others. Bootstrap Institute operates the method. One of the major differences between CMM and Bootstrap is the emphasis that Bootstrap places on the strength and weakness profile of an organisation in contrast to the maturity levels of CMM. A software-developing organisation does not need to master all processes to achieve a higher level. All processes are analysed to see if the organisation implements them adequately.

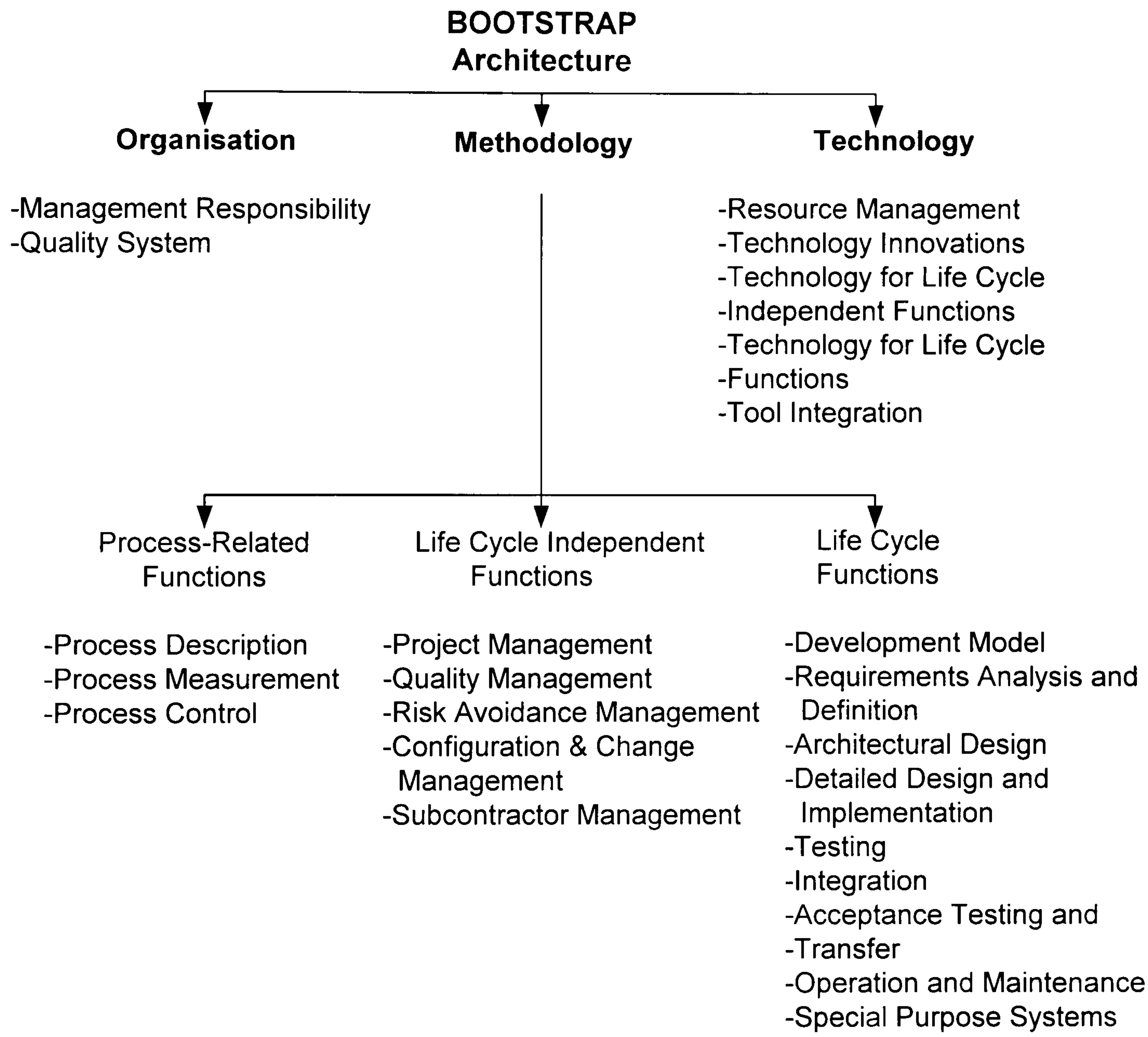

Figure 4.14: BOOTSTRAP architecture

Apart from the primary development processes such as requirement analysis, design, implementation and testing, Bootstrap also investigates supporting processes (Figure 4.14). Examples of these are project management, quality management, configuration management and in particular, the generic management-practices such as the relationship with customers and users, human resource management and process improvement.

A major difference between CMM and Bootstrap is that CMM requires all processes at a given level and below to be implemented to achieve that level, while a Bootstrap level is achieved based on the average of multiple processes in an organisation. For example, if an organisation implements all but one of level 2 processes and implements some of level 3 processes, a Bootstrap assessment may measure level 2, while CMM assessment will be level 1.

Assessments using Bootstrap have been conducted in many European countries and elsewhere. For analysis purposes, a database that contains the data of those assessments is gathered anonymously by the Bootstrap Institute.

7. Trillium

Trillium (Trillium, 1996) model is used by Bell Canada to assess the product development and support capability of prospective and existing suppliers of telecommunications or IT-based products. Trillium can also be used as a reference benchmark in an internal capability improvement programme.

The goal of the model is to provide a means to initiate and guide a continuous improvement programme. The model is used in a variety of ways: to benchmark an organisation's product development and support process capability against best practices in the industry. It could be used for self-assessment to help identify opportunities for improvement within a product development organisation, and in pre-contractual negotiations, to assist in selecting a supplier.

There are five maturity levels and eight capability areas within the Trillium model. Each capability area contains practices at multiple Trillium levels. For example, Management spans levels 2 to 4, while Quality System spans levels 2 to 5. To achieve a Trillium level, an organisation must satisfy a minimum of 90% of the criteria in each of the eight capability areas at that level. Levels 3, 4 and 5 require the achievement of all lower Trillium levels (i.e., levels cannot be skipped).

The model and its accompanying tools are not in themselves a product development process or life-cycle model. Rather, the Trillium model provides key industry practices which can be used to improve an existing process or life-cycle. Trillium is the result of a partnering project between Bell Canada, Northern Telecom, and Bell-Northern Research. The model is based on SEI's Capability Maturity Model (CMM) v1.1 and covers ISO 9000 series, among other standards.

8. SPICE and TickIT

An adaption of ISO 9000 standards specifically into the software industry resulted in the SPICE (Software Process Improvement and Capability dEtermination) (ISO 15504) (El Emam et al., 1998) and TickIT (TickIT, 1997) models. SPICE is a worldwide collaborative effort to support the development of a new international standard for software process assessment. Using this model, it is possible to report assessment results on a scale of capability from 0 to 5, with each level reflecting specific and incrementally significant issues in managing and improving software development and acquisition. A comprehensive series of user trials was incorporated into the SPICE plans.

Several authors have compared the Software CMM with the SPICE model (Garcia, 1997; Paulk et al., 1996). Paulk et al. (1996) mention as the advantage of a staged architecture is that it focuses on the "vital few" areas that typically block process performance at a particular stage in the organisation's life. The maturity levels prioritise general software problems. The advantage of a continuous model is that it provides a more detailed overview of the maturity of an organisation by measuring the maturity of individual processes.

Like SPICE, TickIT (TickIT, 1997) is a certification scheme but developed for the European market. It was developed by the British Department of Trade and Industry (DTI) and the British Computer Society (BCS) to apply ISO9001. The aim of developing this scheme was to create a detailed method for organisation, procedures and rules for a Software Sector Certification Scheme (SSCS) which would cover the assessment and certification of an organisation's software quality management scheme.

4.7.3 Process Normative Improvement Non-maturity approaches

Although ISO 9000 standards could be used for product measurement, the focus of ISO 9000-2000 is towards measuring Quality Management System processes. For this reason, ISO 9000 standards are included under this approach.

ISO 9000 series standards

The ISO 9000 standards are a set of international quality management system standards and guidelines. Since their initial publication in 1987, they have earned a global reputation as the basis for establishing quality management systems. Appendix-C contains a detailed review of the ISO 9000 standards.

Comparisons between CMM and ISO 9000

Unlike the CMM, ISO 9000-1 or ISO 9000-3 versions were not intended to be used as measurement tools specific for the software industry. However, many organisations used them to benchmark their software activities. The 1997 version of ISO 9000-3 offers clear evidence of this if read with insight (McManus, 2000). Some studies tried to compare the ISO 9000 with CMM (MacMillan, 2000; McManus, 2000; Paulk, 1995). Paulk (1995) was found to be, by far, the most comprehensive of those studies. Mark Paulk is a senior member of the technical staff at the SEI, where he is product manager for version 2 of the CMM. He was also the project leader for the CMM version 1.1 development. Below is a review of this study that compares ISO 9000:1994 version with SW-CMM.

Paulk (1995), which is reviewed in detail in Appendix-D, notices that there is a strong correlation between ISO 9001 and the CMM, although some issues in ISO 9001 are not covered in the CMM, and vice versa. He notices also that the level of detail differs significantly. For example, Section 4 in ISO 9001 is about five pages long; Sections 5, 6, and 7 in ISO 9000-3 comprise about 11 pages; and the CMM is more than 500 pages. To make a judgment, he argues, requires determining the exact correspondence, given the different levels of abstraction.

As to whether software process improvement should be based on the CMM or ISO 9001, the short answer is that an organisation may want to consider both, given the significant degree of overlap. A market may require ISO 9001 certification; addressing the concerns of the CMM would help organisations prepare for an ISO 9001 audit. Conversely, level 1 organisations would certainly profit from addressing the concerns of ISO 9001. Although either document can be used alone to structure a process-improvement programme, the more detailed guidance and software specificity provided by the CMM suggests that it is the better choice, although admittedly this answer may be biased.

Paulk concludes the study by advocating that

> "Organisations should focus on improvement to build a competitive advantage, not on achieving a score whether that is a maturity level or a certificate. The SEI advocates addressing continuous process improvement as encompassed by the CMM, but even then there is a need to address the larger business context in the spirit of Total Quality Management."

4.8 Limitations of current IS/IT Measures

To recapitulate what was presented in Chapter 2 regarding the limitations of the 'hard' and 'soft' IS/IT measures, that the research field of IS/IT evaluation is still inconclusive, especially in measuring the success of IS/IT projects at the business level both in 'hard' financial or 'soft' non-financial terms (DeLone & McLean, 1992; Ishman, 1996). Many of the evaluation measures have been criticised for not being able to provide value to the organisation. In fact, many researchers advocate that a major problem with IS/IT investments is the way in which they are evaluated (Farbey et al. 1994; Strassman, 1997; Willcocks, 1996). This criticism has been sounded regarding both the financial-based measures and the non-financial measures.

The all-purpose hard financial measures do suffer from limitations in capturing the actual value of IS/IT in organisations (Brynjolfsson & Yang 1996; Hitt & Brynjolfsson 1996; Farbey et al.,1994). Farbey et al. (1994) explain:

> *"We argued that the problem (of IT investment evaluation) was inherently difficult because of the unpredictability of the impact and the impossibility of attributing the end result solely to the investment in IT".*

The currently used IS success 'soft' non-financial measures also suffer from many limitations. On the technical level, a technically sound IS does not guarantee that it would be accepted or used by the user, or that it would meet its planned objectives (Ballantine et al., 1996; Hamilton & Chervancy, 1981). On the usage level, system use has been criticised for being suitable only for voluntary use (Zmud, 1979) which is not common in today's work environment (Bonner, 1995; Gaitian 1995). In addition, interfering factors, such as the individual user's work life, might affect the measurement of System Use. This makes system use more suitable for controlled laboratory settings than the real world (DeLone & McLean, 1992). User satisfaction has also been criticised, among other things, for not being a suitable surrogate for IS success. It is not necessarily the case that satisfied individuals would lead to a successful system which meets its objectives. In addition, there were no conclusive answers regarding whose satisfaction should be considered and with regard to what aspect of the IS. As the respondents change, so might the satisfaction with the IS (Ballantine et al., 1996; Delone & McLean, 1992). Moreover, usage measures have been applied only on the individual level (Ishman, 1996).

The process-based and multi-approach measures/models suffer from many limitations. For example, they only cover specific types of maturity such as organisational processes for a specific industry mainly the software industry, or they are used to assess only a specific aspect of IS/IT such as IS planning (Bhabuta, 1988;

Earl, 1989), IT infrastructure (Weill & Broadbent, 1999), IS/IT utilisation (Hamilton & Chervancy, 1981; Nolan, 1979), or management of IS function (Hirschheim et al., 1988; Galliers & Sutherland, 1991).

Those measures/models, which are of product normative and process normative types, suffer from yet another limitation. Even though they collectively describe many elements that are related to technical, people, process, and environmental issues that are relevant to the use, planning, development, and maintenance of information systems as well as elements that describe environmental issues related to management style, structure, and culture in the organisation, those measures/models do not provide the desperately needed assistance in predicting the outcome or level of success of an IS/IT project, prior to its implementation. As the process of planning, designing, developing and implementing of IS has changed over the past decade, there is a trend towards planning and implementation of third party products instead of bespoke products. The problems resulting from this change introduce different challenges which organisations have to face. These are mainly related to organisational factors such as people and processes as well as problems related to their integration with existing systems. Moreover, investments in IS in recent years became more linked to the achievements of the organisations' business objectives, while IS success was previously measured at either user or technical levels, and when it was measured on the business level, it was done in hard-financial terms only (Brynjolfsson & Yang 1996; DeLone & McLean, 1992; Hitt & Brynjolfsson 1996; Farbey et al.,1994).

The measures of IS/IT, until this time, have been mainly post-investment/project appraisals that try to assist Management in organisations to review the result of their decisions on IS/IT projects. This is to enable Management to learn from valuable lessons which should feed back in the decision-making process in the organisation regarding future IS/IT implementation. However, the huge amount of IS/IT project failure that is supported by the statistics does not provide evidence that the lessons have been learnt.

To lessen the risk of failure of an IS/IT project, organisations need to be able to predict more accurately the outcome of those projects. The earlier this prediction can be achieved, the more likely it is that changes needed to facilitate a successful system can be made. This calls for a pre-project/pre-implementation measure that can help management and consultant in this regard. In the next chapter, this study will present a novel measurement approach which adopts a balanced approach between the product-based and process-based measurement approaches and will be combined by adopting both the normative and goal-centred approaches.

The next chapter will discuss the various aspects and relationships of the models and presents the readiness/GP model of this research.

4.9 Summary and Conclusion

This chapter presented the process measurement approaches to IS/IT. During the presentation of the various approaches, examples of models of measurement within each approach were introduced.

Three main types of approaches fall under the category of process approaches: goal-centred, normative with improvement maturity, and normative with improvement non-maturity. The chapter first presented the process-based goal-centred measurement approaches. It then presented process-based normative improvement maturity approaches which included SEI's maturity models such as the Capability Maturity Models of SW-CMM and SE-CMM, People-CMM (P-CMM), Personal Software Process (PSP), and Team Software Process (TSP). The chapter then presented other models such as Trillium, Bootstrap, Software Process Improvement and Capability determination (SPICE). Process normative improvement non-maturity approach was the last of the main process measurement approaches that was presented. This approach included the ISO 9000 series standard. The chapter also discusses the relationships and comparisons between some models such as those between PSP, TSP and CMM; and between SPICE and CMM; and between ISO 9000 and CMM, which included the mapping between clauses in ISO 9001 with the CMM key process areas.

Chapter 5: Evaluation Framework and General Practitioner Model

5.1 Introduction

The method of adoption of Shannon & Weaver (1949) communication theory into the IS/IT research field was a cause of weakness in the theoretical base that was built upon by subsequent research concerned with the measurements of IS/IT success. This was particularly apparent in the shortcomings in DeLone & McLean (1992) model as was presented in detail in Chapter 2. The shortcomings in Shannon & Weaver (1949) were reflected in the theory's adoption into the IS/IT field. In addition, the shortcomings of the way the theory was adopted into the IS/IT research field by Mason (1978) has also contributed to the problem. All of those shortcomings in the communication theory itself and its adoption contributed to the problems in IS/IT success measurements.

Shannon & Weaver (1949) communication theory reflected communication as a bullet where the message travels from the source to the receiver in one direction. It does not give regard to the feedback from the receiver to the sender in the opposite direction. It also does not give regard to the interpretation environment that influences the interpretation of the sender and the receiver of both the original message sent and the feedback. Those two points resulted in ignoring the user participation and involvement in the process of development and implementation of IS/IT products, where user feedback in the form of participation is essential to the IS/IT success (Crowston and Kammerer, 1998; Garrity, 1994). Those shortcomings also resulted in ignoring the influencing environmental factors such as the culture in which the IS/IT product is developed and implemented (Garrity & Sanders, 1998).

In addition, the communication theory of Shannon & Weaver was adopted by Mason (1978) and DeLone & MacLean (1992) in a way that was reflected in the weakness of the theoretical base of IS/IT success measurements that built on those studies. Considering the sender of the message as the information system instead of management and the message to be the information instead of the information system in addition to the shortcomings in misallocating user satisfaction to correspond to the appropriate level of measurement by considering it as an impact measure in the influence level instead of being a perception measure in the semantic level, all these have contributed to the problems that showed in the measurement models that built upon Shannon & Weaver (1949) communication theory, Mason (1978), and DeLone & McLean (1992).

Two other issues compound the above mentioned shortcomings. First, the ultimate success measures of IS/IT have been taken to be normative measures which are dominated by financial-economic hard measures. This consideration of the preset normative measures contributed to the creation of the productivity paradox because those measures were developed to assess other than IS/IT products' success. In addition, having the technical and usage measures, such as the measurement of system use and user satisfaction, to be on the individual level only (Bonner, 1995; Ishman, 1996; Delone & McLean, 1992), had contributed to missing important aspects of IS/IT from the big and complex picture that represents the whole organisation where information systems live and interact with other components. This chapter will introduce a new framework of IS/IT that would overcome the shortcomings in the understanding of IS/IT projects which is presented in terms of a new theoretical adoption. This new adoption is based on both the Shannon & Weaver

(1949) theory of communication and Schramm's (1954, 1971) modification of it. This framework would enhance the understanding of IS/IT success measurement and be a base for future research in this area. In addition, this chapter will introduce an approach for measuring organisational readiness for successful implementation of a predetermined information system. This approach is hoped to increase the likelihood of the success of IS/IT at the business level, and will give organisations the ability to measure the readiness gap and predict the level of success of an IS/IT project. The approach should also provide management with effective guidance that contributes to meeting their business objectives and achieving their Critical Success Factors (CSF). The chapter will conclude by summarizing the important points covered in the chapter.

5.2 New evaluation framework of information systems

From Mason (1978) and DeLone & MacLean (1992), this research recognises that IS/IT project's understanding could be based on communication concepts. Nevertheless, this research also recognises that examples presented in Chapter 2 of the criticism of the IS/IT research field regarding DeLone and MacLean's model, where one can observe that these criticisms actually implied an imbedded unconscious dissatisfaction with the way the adoption of communication theory was conducted into the IS/IT field.

To recall what was presented in Chapter 2 regarding the DeLone and MacLean model, the research field's concerns and complaints were manifested by the significant modifications, changes, and amendments made to the model.

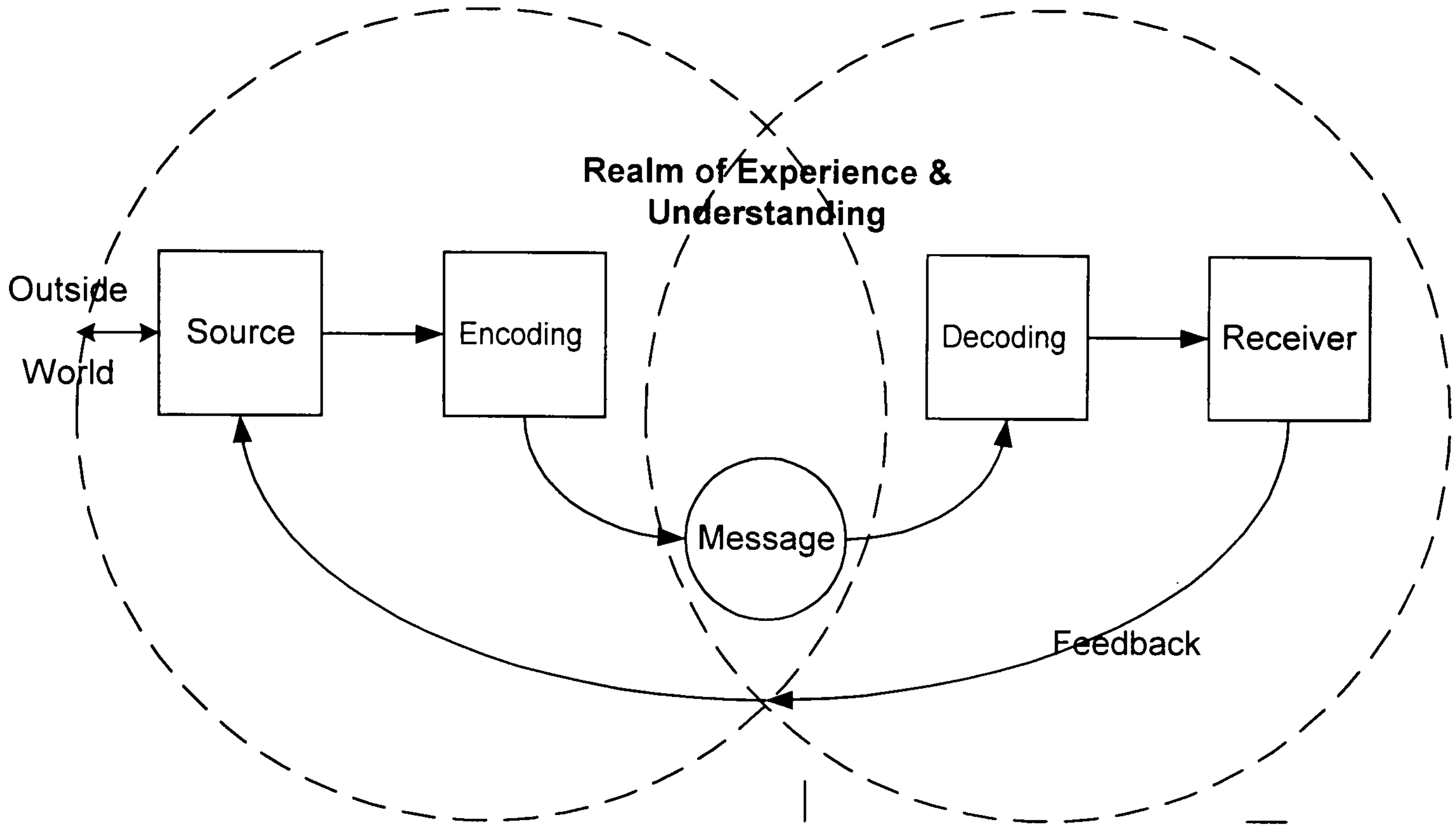

Figure 5.1: Communication theory as understood by this research

The theoretical adoption of Shannon & Weaver (1949) communication theory conducted by Mason and subsequently by DeLone & MacLean was based on tracing the information system's output (information) as the message, while the research field's criticism, and especially the amendments made to the model, show that what the research field had expected is a measurement model of the information system and not of its output. This resulted in an overwhelming notion that the DeLone & McLean model does not provide the basis for a suitable practical explanation in regard to the information system's effects that allow subsequently for the creation of an effective IS/IT success measurement. Therefore, this research advocates that shortcoming in the understanding of IS/IT projects can be largely overcome if a framework is developed to embrace the various effects and subsequent measurements within the grater context of the overall IS/IT success. This evaluation framework can be presented in terms of a new theoretical adoption that is based on both the Shannon & Weaver (1949) theory of communication and Schramm's (1954, 1971) modification of it (see Figure 5.1).

This attempt has been manifested in the introduction of a new evaluation framework of IS/IT. This new evaluation framework (see Figure 5.2 in the next page) accepts the notion of levels of measurement presented by Shannon & Weaver (1949) and Mason (1978). It mainly represents a new way of adopting communication theory into IS/IT field using the communication theory of Schramm (1971) that modified Shannon & Weaver's theory.

The evaluation framework in Figure 5.2, presents the producing sender as being the Management in the organisation, and the receiver as being the User. The technical level in the framework shown in Figure 5.2 is the IS/IT development and implementation, and its output is the implemented information system. Weaver in Shannon & Weaver (1949) defines communication as "all of the procedures by which one mind may affect another." He goes on to say that "This, of course, involves not only written and oral speech...but in fact all human behavior. In some connections it may be desirable to use a still broader definition of communication, namely one which would include the procedures by means of which one mechanism... affects another mechanism"(p.3). This definition of communication includes the communication process presented in the framework of Figure 5.2.

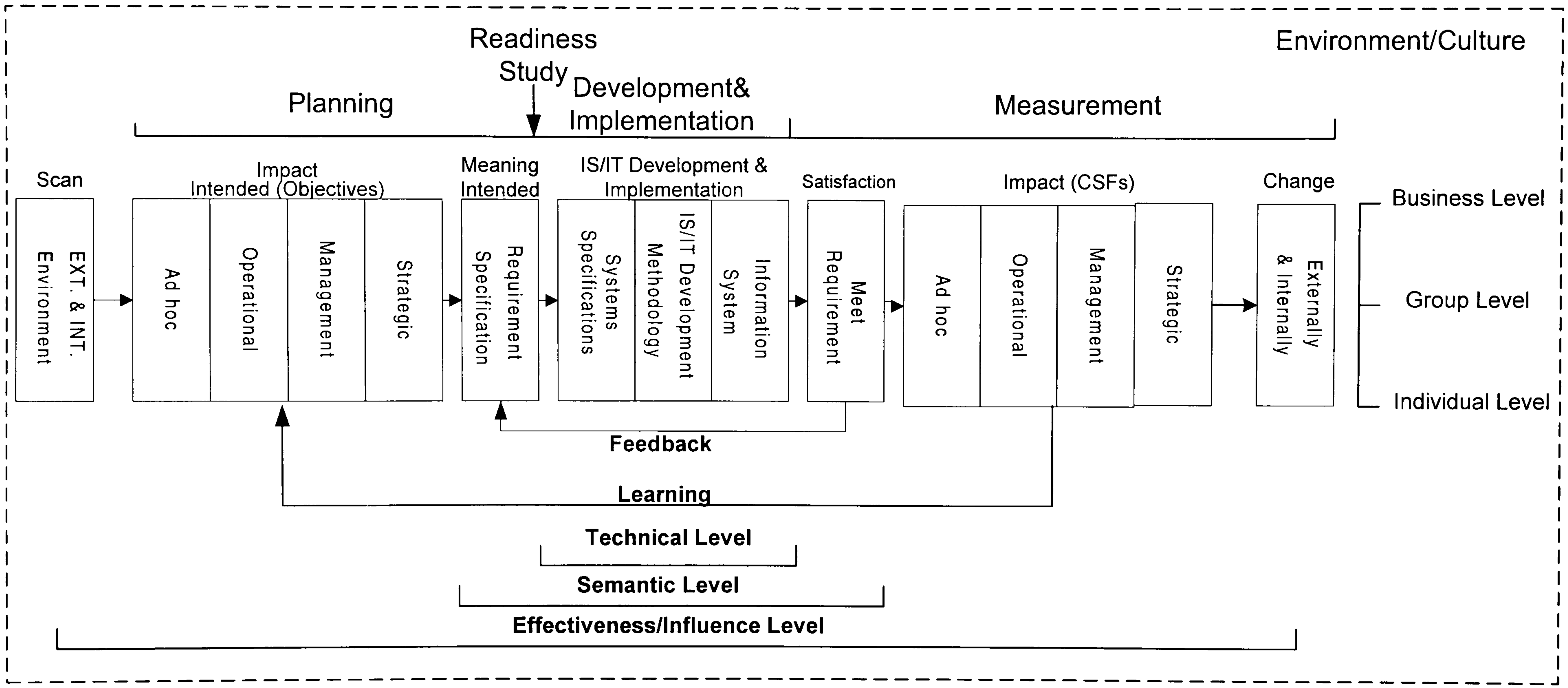

Figure 5.2 New Evaluation Framework of IS/IT

The evaluation framework presents a management communication via the IS/IT function unit which uses an IS development methodology that produces an information system, in order to cause a desired impact on a specific level or area within the organisation. The framework presents three phases: Planning, Development, and Measurement. The measurement phase starts when the first output is received at the end of the technical level, and at that point the development phase ends.

1) Planning and Development Phases

Figure 5.2 starts by showing that the initiation of an IS/IT project is an effect intended by management or on their behalf and with their approval on the specific level or area of the organisation in response to conducting an environment scanning of the external and internal environment (Choudhury & Sampler, 1997; Earl, 1989) as part of specific planning or strategic information systems planning (SISP) activities. This scanning or "driving force", as it is called by Earl (1989), starts by mimicking the technological "state of play" in the external environment in an ad hoc way, and intentions (Bhabuta, 1988; Earl, 1986, 1988, 1989; Hirschheim et al., 1988; Galliers & Sutherland, 1991). The scope of the intended effect varies according to the maturity of the organisation. These intentions include operational, managerial, or strategic. As the organisation matures from the ad hoc stage, the scanning goes internal for implementing and tuning operational IS/IT with operational-based and management-based objectives. With further organisational maturity, scanning goes external again to achieve competitive advantage with a strategic view. Having this evolution in the maturity of the environmental scanning entails an evolutionary theme in the level of objectives and CSFs that the planned IS/IT needs to achieve. As the maturity of the organisation increases, so does the level of IS/IT objectives and CSFs (Gottschalk & Khandelwal, 2002).

This step represents the start of the influence level of communication. To achieve the intended impact, the requirements of the system should be formulated. Those requirements are the intentions that management wants to convey to the individual user and/or participant. This step represents the beginning of the semantic level of communication. Shannon & Weaver (1949) state that at the semantic level, " the information source selects a desired message out of a set of possible messages". At this point, especially if the IS/IT project is not an outcome of a SISP, a need would arise to conduct a measurement study to determine organisational readiness for the implementation of the information system. This readiness measurement is to help ensure that the next steps leading to IS development are not performed unless the information system has a good chance for success. Following this readiness study, if the organisation is found to be ready for the information system implementation, the requirements are then passed to the IS/IT function unit in the technical level, otherwise, activities that resolve the shortcomings in the organisational readiness should be implemented first, and then requirements are passed to the IS/IT function unit for internal or external contracting. A new approach for measuring organisational readiness will be introduced in detail later in the chapter. It is noteworthy that the readiness study might result in the need to implement some activities to fulfil the readiness gap. Those activities might increase the level of the intended objectives of the project which in tern affect the requirements specification of the IS. This loop is not shown in the framework for simplification reasons.

Up to this point in the communication process, the activities are performed by management or on its behalf. The formulation of the message which is represented by the formulation of the requirements of the information system means that the intent of effect by management is imbedded, as a message, in the information system product. A possible message carried in the information system is for the user to change his/her work-life, productivity, efficiency, etc. The symbols that the message is comprised of are: the specific processes, specific hardware and software, and specific participants that would lead to this effect. One specific choice of combination of the message symbols (IS components: process, IT, people/participants) would convey a certain meaning, while a different combination of symbols (IS components: process, IT, people/participants) would convey another. Embedding the message in the product has been introduced by marketing communication theory (Duncan & Moriarty, 1998). Duncan & Moriarty (1998) summarise the adoption of the communication theory into marketing as: "The source is the company, the message the product, the channel the distribution system, noise the clutter of competitive products and claims, the receiver the customer, and feedback the information received through customer service, sales, and marketing research"(p.2). A representation of the adoption of communication theory into marketing is shown in Figure 5.3.

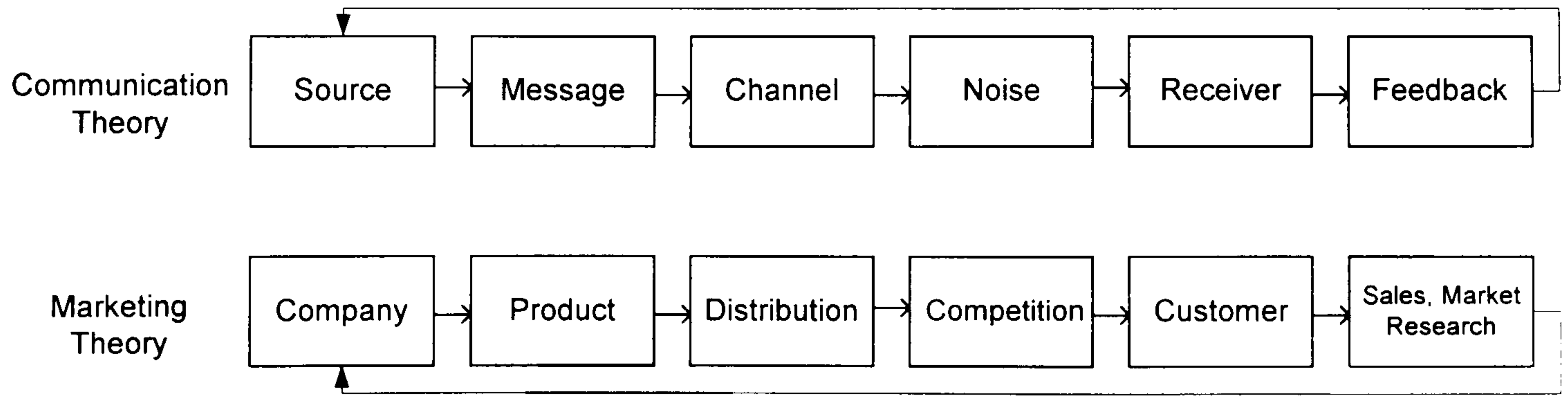

Figure 5.3: Parallel Communication and Marketing Theories,
Adapted from Duncan & Moriarty (1998)

Returning to the framework in Figure 5.2, at this point, the Planning phase has ended and the Development phase is beginning, where the IS/IT function performs a set of activities: producing technical specifications, applying an IS/IT development methodology to deliver an information system that consists of Processes, IT components (hardware, software and networks), and People (Alter 1999). This could be a bespoke development or an outsourced operation performed under the supervision and coordination of the organisational IS/IT function. Starting from this step, the Measurement phase starts and success measurement could be performed for each level separately from the other levels. There is considerable agreement in the literature on this point (Shannon & Weaver, 1949; Mason, 1978, DeLone & McLean, 1992; Bonner, 1995; Ballantine et al., 1996; Seddon, 1997; Myers et al., 1998).

2) Measurement Phase

The output measures for the technical level are concerned with the technical quality of the information system as an output of this level. Measurement of the success at the semantic level is from the receiver's perspective. Shannon & Weaver stated, "The semantic problems are concerned with the identity, or satisfactorily close approximation, in the interpretation of meaning by the receiver, as compared with the intended meaning of the sender" (Shannon & Weaver 1949). Perception is not a precise tool of measurement because of the human and environmental factors (e.g., individual characteristics, expectations, etc.) that could affect the receiver's point of view, but comprehension of meaning could be conveyed only by the receiver of the message. Mason (1978) explains the semantic level output measure by "a unit of meaning is derived by looking at data from the point-of-view of the receiver or information system user". User satisfaction with the system is a measure of the success in transforming the intended input into comprehensible and satisfactory requirements. User satisfaction is a semantic level measurement, unlike its presentation by DeLone & McLean (1992) as part of the influence level (Figure 2.7).

As stated in Chapter 2, Schramm, in his model of communication incorporated feedback. Feedback is a response from the destination or receiver back to the source or sender, or a subsequent response from the source back to the destination. User participation and feedback into the development and maintenance activities contribute mainly to the requirements specification step (Crowston and Kammerer, 1998; Garrity, 1994). The feedback arrow in Figure 5.2 represents these user activities.

User satisfaction is considered to be the most used success measure in the IS research field, where it is advocated as a surrogate measure for IS success and effectiveness (Igbaria & Zviran, 1991; DeLone & McLean, 1992; Gatian, 1994; Grover et al., 1996; Garrity & Sanders, 1998; Woodroof & Kasper, 1998). The reason being that many researchers accept the psychological expectancy theory which states that attitudes (i.e. satisfaction) and behaviour (i.e. productivity) are linked. This means that satisfied users will be more productive (Gatian, 1994).

While the results of user satisfaction research have provided a solid foundation for evaluating responses of individuals regarding information systems, the lack of a theoretical framework for placing this measure within the greater context of overall IS success and effectiveness caused some researchers to call for the need for introducing such a framework (Malone, 1990; Grover, 1995). The framework introduced in this research contributes to the resolution of this problem by showing user satisfaction as the test of success of the semantic level.

5.2.1 Measurement of Impacts

The success measure of the influence level output is the degree of impact or change in behaviour achieved that corresponds with the level of intended impact: "The effectiveness problems are concerned with the success with which the meaning conveyed to the receiver leads to the desired conduct on his part" (Shannon & Weaver, 1949). The evaluation framework points out that even if a specified level is targeted for influence (e.g. the operational level), the impact could still emerge on the other higher levels as an emergent property.

The degree of impact differs according to the different levels of influence. The greater the difference (distance) between the level of intended effect and the level of measurement, the less possible it is to isolate the effect of the information system from other interfering internal and external factors, and the less measurable is the magnitude of the effect the IS/IT accomplishes. DeLone & McLean (1992) state, "MIS academic researchers have tended to avoid performance measures (except in laboratory studies) because of the difficulty of isolating the effect of the I/S effort from other effects which influence organisational performance." This has been echoed in similar terms by many researchers in the IS/IT field (Farbey et al., 1994; Gatian, 1994; Grover et al.,1996; Moony et al., 1995; Garrity & Sanders, 1998; Woodroof & Kasper, 1998). This evaluation framework attempts to resolve this problem by specifying that the measurement of effect of the information system should be the CSFs on the level of intended effect. If the CSFs are fulfilled, then the information system has accomplished its objectives even if those effects do not show on other levels because of other factors' interference. Information systems objectives are not some general normative measures; rather, they are goal-centred to the purpose of the message which makes CSFs a suitable vehicle for measurement of objectives. Since the objective of the deployment of IS/IT could be of different levels (ad hoc, operational, management, strategic) or on different levels of the organisation (project, group, unit, whole organisation), CSF measurement could be used because it could measure attainment of those objectives at the different levels of deployment (Figure 5.4) (Gottschalk & Khandelwal, 2002). Also, CSFs are a suitable measurement because they could be of different types 'hard' financial or 'soft' non-financial measures.

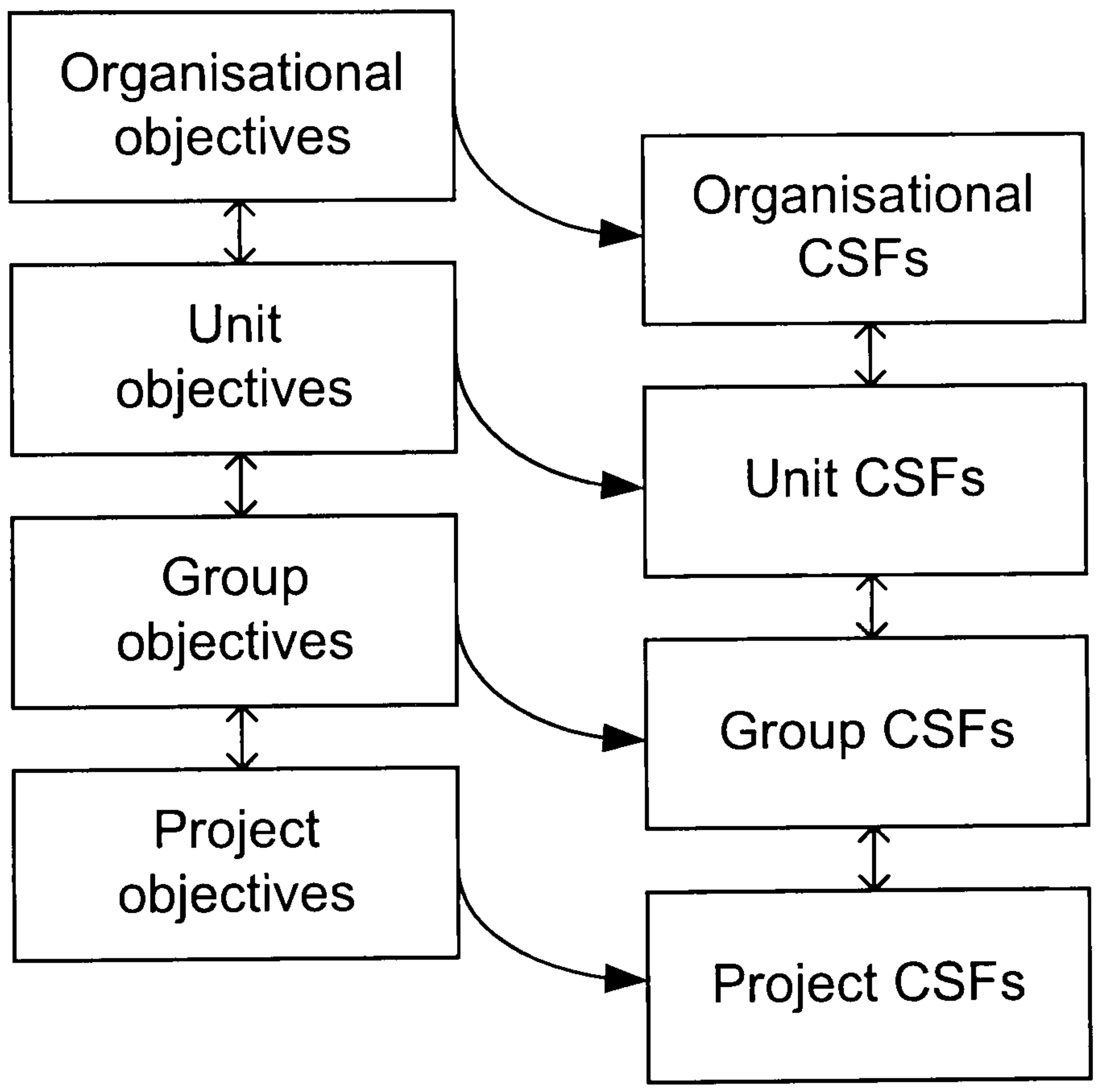

Figure 5.4: Levels of objectives and CSFs

In Figure 5.2, learning is accomplished when the experience from previous projects is accumulated by feeding them back into the planning activities. This is represented by the Learning arrow.

IS Measurement could be performed on different levels in the organisation, the individual, group, or the organisation-wide (business). This will have an effect on the technical level as it would on the semantic and the influence/impact levels. On the technical level, the type of hardware, software and networks would be different, for example, at the individual level: stand-alone terminals or PC with a stand-alone spreadsheet package; on the group level: having LAN with NT-based applications; at organisation-wide level: having WAN/Internet with servers and applications. At the semantic level, satisfaction would be taken from an individual user, a group, or all of the users in the organisation.

As stated in Chapter 2, an important difference between Shannon & Weaver's and Schramm's communication models is the latter's incorporation of the sender's and receiver's field of experience, or scope of knowledge, experience and culture. Just as important is Schramm's idea that, for meaning to be transferred from sender to receiver, the two fields must overlap, that is, the sender and receiver must share some knowledge, experience or culture that pertain to the transmitted message and its meaning.

In his 1971 modified model, Schramm introduced the notion that communication is more of a relation between the sender and receiver than being a message-bullet sent by the sender to the receiver and vice versa. He acknowledged that audiences are not passive and defenceless any more. He stated that "Human communication seemed a simpler thing in 1952 than it does in 1970". He also noted that "communication had now come to be thought of as: a relationship, an act of sharing, rather than something which someone does to someone else". These comments hold true in the current IS/IT planning, development, and implementation in the current organisational environment where Management, IS/IT function and Users interact. It is also true that "it is now necessary to think of the communication process as two separate acts, one performed by a communicator and one by a receiver", where User now is an active partner in the entire process of IS/IT planning, development, and measurement. The situation is not as it used to be, where users were passive recipients of whatever IS/IT people and management decided to throw at them. It has become common to find the following terms in the IS/IT literature as being factors of IS/IT success: user participation, user involvement, user-centric design/development, end-user development approach, etc. (Crowston & Kammerer, 1998; Garrity, 1994; Igbaria & Zviran, 1991; Lynch & Gregor, 2001; Spreitzer & Theimer, 1993).

In the new evaluation framework (Figure 5.2), the activities of planning, development, and measurement are conducted in an atmosphere of common understanding and culture. In order to form the message's symbols (information system components), there needs to be a realm of understanding between management (sender) and the user (receiver) that consists of the organisational environment which includes the organisational Culture that could be enforced by User Participation in the development of the IS (message) (Crowston and Kammerer, 1998; Garrity, 1994). The Culture also varies as the maturity of the organisation increases. It will evolve from User Participation to having User Involvement (Earl, 1989) that would be enforced by the IS/IT function by conducting user awareness activities and training programmes (Lynch and Gregor, 2001). The realm of culture and experience is represented by the environment box that surrounds all of the framework's activities.

As presented above, measurements are mainly post implementation events, which help in the learning process for subsequent IS/IT projects. Nevertheless, as indicated in the evaluation framework, there is a need for organisational readiness measurement prior to IS development and implementation. This is because many IS/IT projects are either not being an outcome of any type of strategic planning or they are an outcome of unreliable ones (Segars & Grover, 1998). This readiness measurement is to help ensure that the development and implementation of IS are not performed unless the IS has the adequate organisational processes, resources and environment for its successful implementation. In the coming sections, this research will introduce a measurement approach and model for conducting such a readiness study that would help in pointing out the weakness areas in the organisation which would inhibit the success of an IS/IT project in order to increase the likelihood of its successful implementation.

5.3 Limitations of Process-based and General Models

The normative process-based models and general models, presented in the literature review in Chapter 4, suffer from many limitations. For example, they cover only specific types of maturity such as organisational processes for a specific industry, mainly the software industry, or they are used to assess only a specific aspect of IS/IT such as IS planning (Bhabuta, 1988; Earl, 1989), IT infrastructure (Weill & Broadbent, 1999), IS/IT utilisation (Nolan, 1979), or management of the IS/IT function (Hirschheim et al., 1988; Galliers & Sutherland, 1991).

Those models (Product Normative and Process Normative) suffer from yet another limitation. They collectively describe many elements that are related to technical, people, process, and environmental issues that are relevant to the use, planning, development, and maintenance of information systems. Also, they include elements that describe environmental issues related to management style, structure and culture in the organisation. However, those models do not provide the desperately needed assistance for management in measuring the readiness of their organisation for an IS/IT project, prior to its implementation, by pointing out the weakness areas, as a collective measures, in the organisation which would inhibit the success of such a project or increase the likelihood of its successful implementation. The measurement of readiness study needs to be performed on the business level following specification of the requirement of the planned information system. Such a study should be an adequate indication for management as to how to improve the state of organisational readiness for such a project.

5.4 Requirements for New Model of Organisational Readiness Measurement

In the following section, this study will introduce the requirements of an alternative approach that would increase the likelihood of the success of IS/IT at the business level, and will give organisations the ability to determine the level of organisational readiness for an IS/IT project. This approach should also provide management with effective guidance that contributes to meeting their business objectives and achieving the specified Critical Success Factors (CSFs) (Rockart, 1979). The requirements should set up the foundation for developing a balanced measurement approach which aims at presenting the current/existing organisational status and the expected status for the successful implementation of a predefined IS/IT project.

In order to produce such a model, a suitable structure should be established, and elements from the descriptions of the models reviewed in Chapter 4 are to be extracted, combined and/or modified accordingly. The structure should embrace the main components of IS: IT, people, processes and the organisational environment it 'lives in' such as management support and attitude towards IS/IT, structural positioning of the IS/IT function, and culture (Figure5.5). This structure should lead to the development of a measurement model that is able to measure the organisational state of readiness for a predefined IS/IT project in terms of organisational IT, people, processes, and Environment factors.

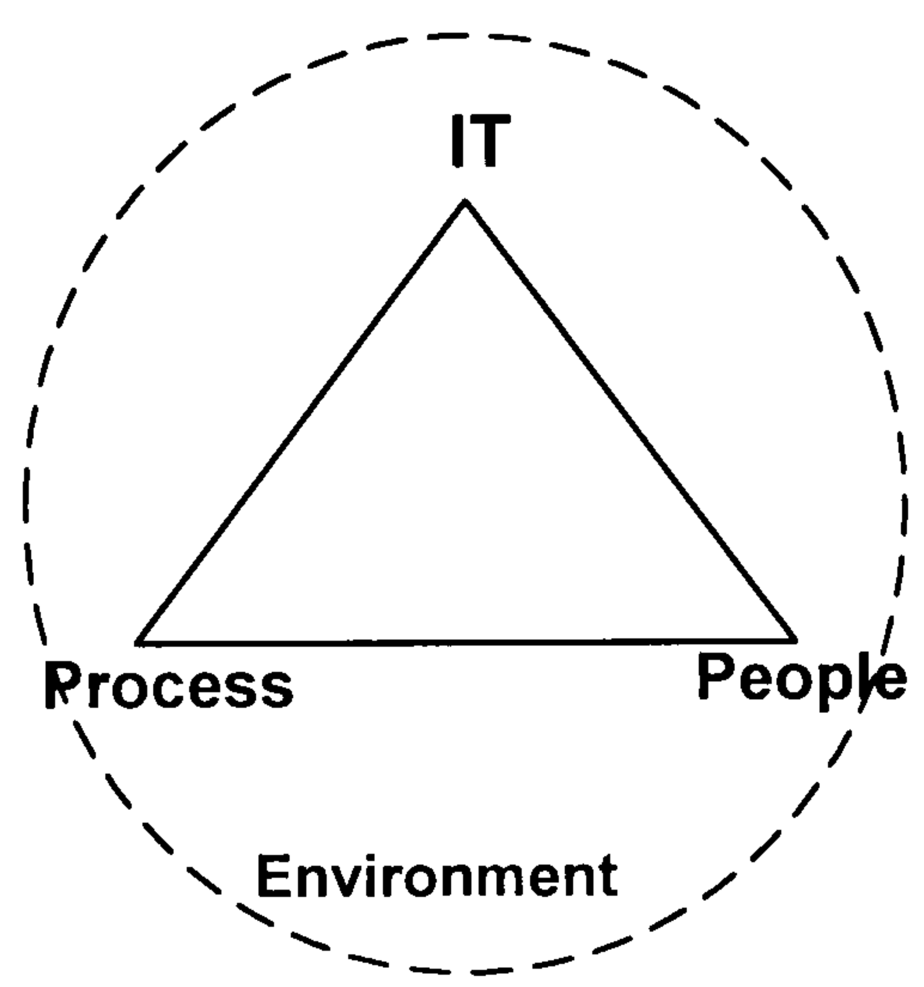

Figure 5.5 Domains of Readiness

The model should be used at the time when a specific IT/IS project has been decided upon by an organisation, but before the tender or development task has been assigned to any entity, either internal or external.

The rationale behind the model is that in order for IS/IT to succeed in an organisation, the potential IS/IT components (IT, people, processes), and the environment available in the organisation need to be at adequate level of readiness. The literature (for example, Galliers & Sutherland, 1991) indicates that Decision Support Systems (DSS) or Executive Information Systems (EIS), for example, are extremely unlikely to be effective without the right kind of basic operational information systems or databases in place. Also, an organisation that tries to overcome the large backlog and heavy maintenance load of its IS/IT is unlikely to be able to develop substantial strategic information systems, without developing its staff skills and planning approaches. This means that the organisation needs to be at adequate level of readiness in regard to the IS/IT components and environment for the development, implementation, and operation of IS/IT to be successful. The structure that need to be adopted in the model needs to represent those components and organisational environment elements formed in maturity-like levels.

The model should be able to depict the organisational situations (both the existing/current situation and the needed/expected situation for IS to succeed) in terms of the four previously stated issues: IT (Systems), People (Staff, Skill, Head of IS/IT function), Process (General Practices), and Environment (Planning and initiation, Management style/Leadership, Structure, and Culture). Such a model should incorporate maturity-levelling technique to measure the gap between the current situation and the needed situation prior to IS/IT project implementation in terms of those issues. The maturity levels should reflect those levelling techniques that have been used by many of the maturity models in the research field (CMM, Earl, 1989; Galliers & Sutherland, 1991). The model should be structured according to levels/stages of maturity that are represented in terms of each of the four domains: IT, people, processes, and environment. This should apply for both the current/existing organisational status and the status needed by the predefined IT/IS project to be successful. By presenting the current existing and the needed organisational status in terms of the structure of the model, the readiness gap could be identified, and the route of progress on the maturity steps becomes visible.

Progress can be accomplished only when organisations move through the levels in sequential order (Galliers & Sutherland, 1991).

The model should not be sector-specific; rather it should be a general model that would apply to different sectors. Also, this model should be easy to use i.e. qualitative measures should be adopted as often as possible to ensure consistency and in-depth insight of the organisational situation.

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The model is to be a General Practitioner IS Consultant Tool (GPISCT) that points at the likely problem area(s) when an IS/IT project is decided upon for implementation. In many cases, the model would specifically and precisely point out the problem (as it would likely be the case when the position of the head of IT is not adequate) and suggest an improvement path. In other cases/instances, there would be a need for an industry-specific expert to examine the problem further and suggest industry-specific solutions as it would likely be the case in process-related problems (for example, in the way the speed of execution of a specific software function is measured). For the model to be useful, qualitative in-depth investigation of the organisation's situation is needed.

Since an information system and the environment it operates in spans the different work areas in the organisation, several element need to be chosen to cover these areas of concern. The components of the structure of the model need to be based on the IS/IT frameworks introduced in this study. Four of the components that were described in the Seven "Ss" used by McKinsey & Company (Pascale and Athos, 1981) which were also used in the Galliers & Sutherland (1991) model are suitable to be adopted in our model's structure. These components are: Structure, Systems, Staff, and Skill. Other structure components are also suitable to be adopted from the literature as being influential factors for IS/IT success. These are: culture, leadership style, and position of IS/IT head. These structure components are suitable to serve as attributes that represent the domains: IT, people, process, and environment. IS/IT project, in this study means the development, implementation, and operation of IS/IT in an organisation. If the project is confined to and isolated in a specific unit within an organisation, then the model is to be applied at that level.

Since the model is of the normative type that has a wide focus to provide a pragmatic diagnostic tool to serve as a GPISCT, several product and process normative models were selected and description of levels and components' descriptions were reviewed for extraction/adoption of useful elements for building the model. Table 5.1 lists those models that were referenced and used for element extraction/adoption, model structure, and guidelines of use. After elements had been formed/worded and positioned in the model attributes and levels, they were refined and the model was modified at different stages during the research. This modification process involved combining, deleting, rewording and/or changing levelling or attribute position of different elements. It is worth noting that when extracting/adopting elements from the descriptions in the process normative models, this extraction/adoption was made of the assumed product outputs the execution of the processes described in those models.

In the extraction process, the descriptions of components were chosen from the different normative models, categorised to be in their respective maturity levels. A wording, rewording and/or combining process was then applied to the large pool of elements to produce the levels of each of the attributes. The process of extraction described above was performed in the context of each level's requirements for IS/IT project success.

Referenced Model	Features Adopted
Capability Maturity Model (SW-CMM) (Paulk et al., 1993)	Maturity modelling and levelling, process elements; guidelines of progress
Capability Maturity Model (SE-CMM)	Process elements, 'Generic Practices' concept
• People-CMM • Personal Software Process (PSP) • Team Software Process (TSP)	Elements in People and Environment domains' attributes (Skill, Culture, Leadership, Staff); guidelines of progress
Trillium (Trillium, 1996)	Model structure, Guideline (90% fulfilment), idea of being able to join process elements from CMM and ISO 9000 standards in one model
Bootstrap (Kuvaja et al., 1994)	Process elements, Assessment method (multiple level assessment and overall average of level strength)
SPICE (Software Process Improvement and Capability dEtermination) (El Emam et al., 1998)	Process elements, concept of continuous verses level
Goal/Question/Metric (GQM) paradigm (Solingen & Berghout, 1999)	A goal-centred alternative structure to the wide-focused normative for generalisation
ISO 9000 series	Guidelines (relationship between ISO and CMM), elements of attributes (Process, culture, leadership)
• Nolan (1979) • Bhabuta (1988) • Earl (1989) • Hirschheim et al. (1988) • Galliers & Sutherland (1991)	Elements of attributes (Skill, Staff, Leadership, Head of IS/IT, Systems, Culture, Structure)
Weill & Broadbent (1999)	Elements of attributes (Systems, Staff, Skill)

Table 5.1 Models referenced for element extraction

This extraction process was performed in parallel with selection of a normative process model to be adopted as a guideline for model use such as how to assess the maturity level and how to progress from one stage to the other. This led mainly to adopt the People-CMM process levels to be used as a guideline for progress between levels in the People's and Culture attributes/sections of our model. For the rest of the sections/attributes, the description of the next stage was sufficient enough to guide progress.

5.5 Description of Model

The readiness of the organisation for an IS/IT project can be depicted by the use of a model that explains particular requirements in terms of four domains embracing eight attributes: IT (systems), people (staff, skill, head of IS/IT function), process (practices), and environment (management style/leadership involvement, structure, and culture) (Figure 5.6). The environment attributes could be classified also as being of the people issues as culture and management style/leadership involvement, or closely tied to its systems as in case of structure. Each of the attributes is described on six levels/stages where each represents a maturity level describing the organisational situation in terms of the particular attribute (Figure 5.7).

The following section describes the domains (IT, people, process, and environment) in detail using the description of the attributes associated with each of them as they might occur in each of the six maturity levels. Each of the elements describing an attribute comprises an aspect of how the status of that particular attribute should be at different organisational IS/IT maturity levels. The levels described by the model do not intend to make a judgmental statement of the status of the organisational maturity. Some of the descriptions of the attributes of the early levels might be understood to have a negative notion. This should not be the case. The model is merely trying to describe, depending on accumulated experiences and previous research models introduced in the literature which are reviewed in earlier chapters, describe the status of organisations' IS/IT maturity at each of those levels.

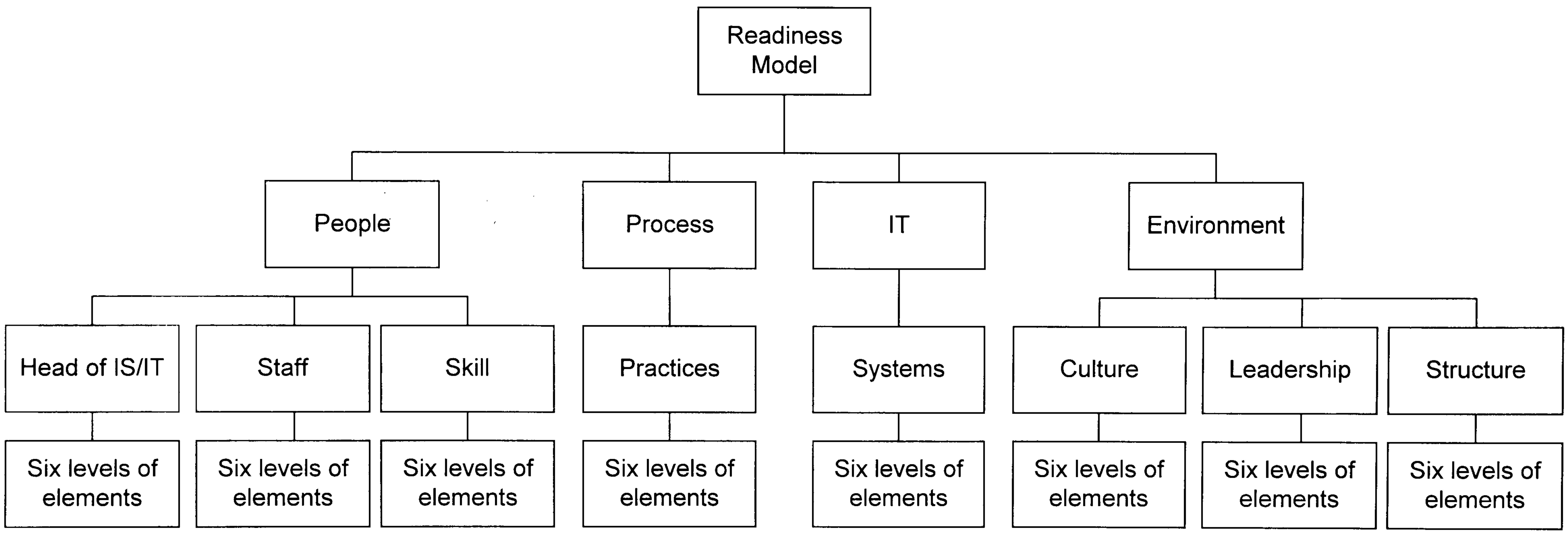

Figure 5.6: Structure of readiness model

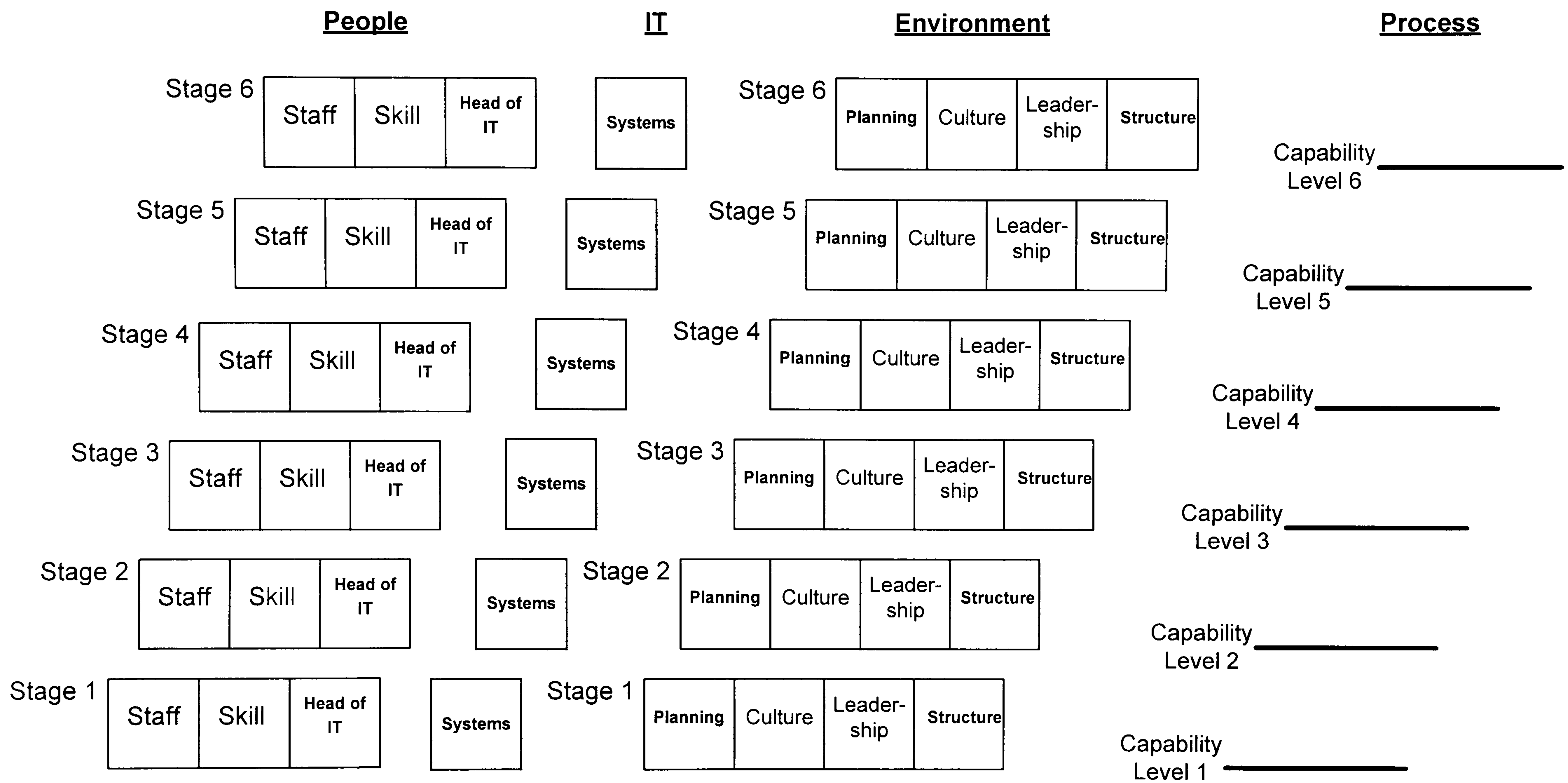

Figure 5.7: Model of Readiness

How attributes in the model could be interpreted is illustrated by the following example regarding Level 1 of the Systems attribute within the IT domain:
IS/IT systems that are developed/purchased at this maturity level tend to be small and mainly off-the-shelf financial packages, where the decisions regarding acquiring them tend to be of ad hoc nature. Those systems also tend to be independent of each others (stand-alone) and built/purchased in isolation from other IS/IT located in the organisation or even in the same group. The decisions regarding those systems are made at low levels in the organisation, mainly at the group level, and according to what group management see as the group's needs. Those needs and how to fulfil them are mainly decided upon in the light of what management see other people have and do externally.

The model is a General Practitioner IS Consultant Tool (GPISCT) that is used to assess the current organisational situation in terms of the model's characteristics descriptions introduced by the elements on the levels of the attributes. The model user would study the organisational situation in terms of each attribute i.e. Staff, Skill etc. and match this situation with the overall description of corresponding attribute on the model. If the organisational situation corresponds with the overall description of two levels in almost equal manner, then both levels could be said to match the organisational situation for that particular attribute. It is important to consider that the methods used in studying the organisational situation are mainly qualitative methods (interviews, observation, document review etc.) that allow for the accommodation of different organisational situations and environments. Such methods would be the most suitable to be used with a general wide-scope model as the readiness model.

The model should be used in specifying the levels of maturity of the different attributes mandated by the pre-selected IS. Those levels are considered to be the needed/target levels for the organisation to achieve in order to implement a successful IS which should lead to a successful IS/IT project. The difference between the current organisational situation and the needed/target in terms of all the domains' attributes constitutes the readiness gap (Figure 5.8)

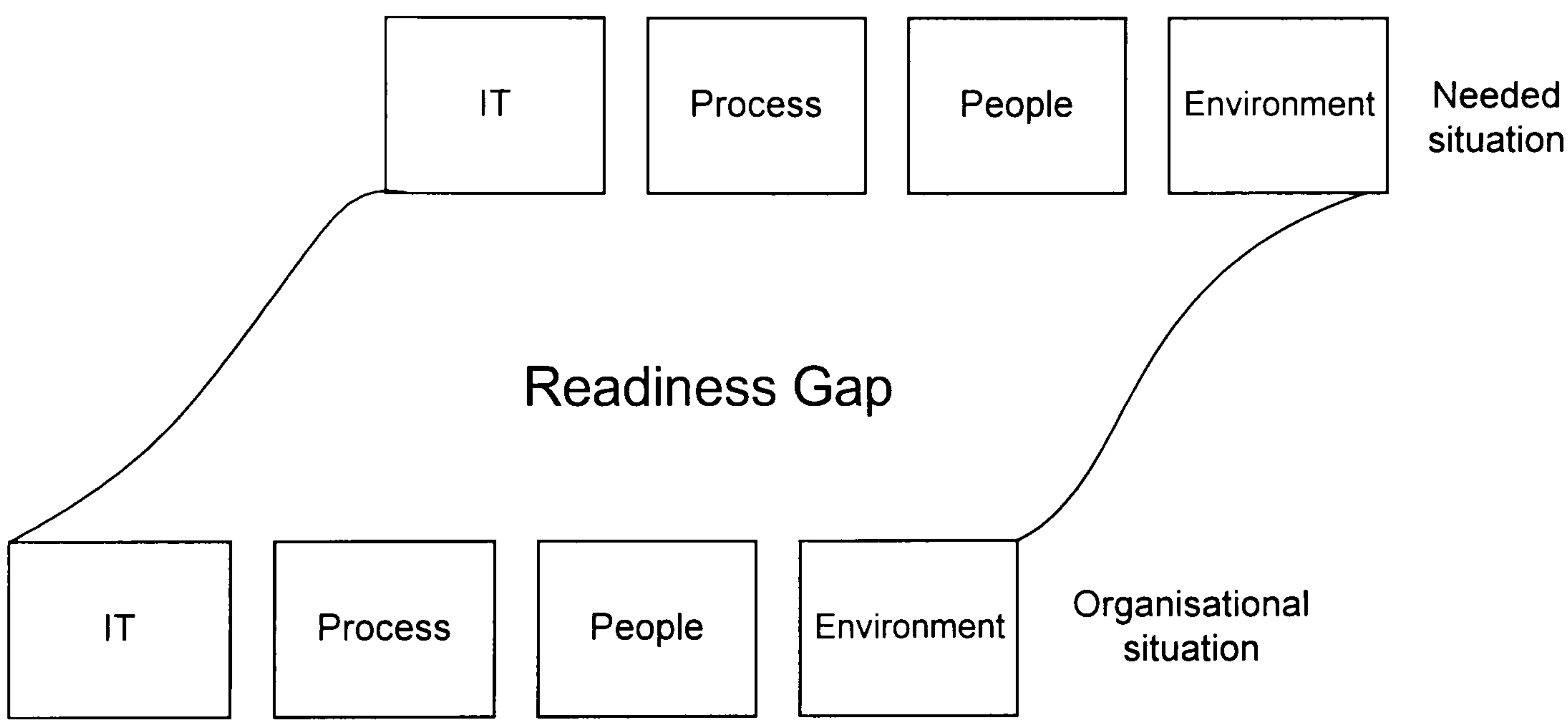

Figure 5.8 Readiness gap

The model is presented in the following sections:

First: Information Technology (IT)

IT (Systems)

Systems

Level 1

- Almost all existing systems are small packages for financial operations
- Ad hoc IS/IT development where each unit invests independently from the rest of the organisation and the approval process of IS/IT project differ between units
- Information systems are independent and unconnected organisation-wide or even within the same group, which makes IS/IT portfolios of each group differ from the rest of the organisation
- IS/IT development, maintenance, implementation and training are made at the group level, where groups manage their own IS/IT resources according to each group's needs in isolation of the rest from the organisation

Level 2

- An increase in the number of IS/IT application systems is being developed or purchased but concentration is still on operational systems in the financial area while a small number of other core business-oriented systems are being developed.
- Many of the IS/IT application systems still overlap in purpose, function and data stored in the organisation, where only some hardware, system software, and possibly a network are shared between groups

- Large maintenance load is being placed on IS/IT function because of the ad hoc nature of most systems
- All data are stored in units' systems, except data needed for organisational reporting are transferred to central systems

Level 3

- In-house IS/IT applications covering most major operation areas with office automation exists but in an isolated stand-alone manner
- Technical infrastructure consists of unconnected systems where no shared applications exist
- Systems have been implemented in most operational areas in the organisation where the use of IS/IT services varies among the business units
- Some IS/IT application systems have still been put together by users, and old user-developed systems are being used in uncontrolled, uncoordinated manner even though new systems are centrally developed, installed, and operated by IS/IT function

Level 4

- All needed operational IS/IT is mostly in place and some DSS start to appear
- Office automation is integrated and unified/standardised organisation-wide
- Existence of an organisation-wide network, where all groups are connected and the central IS/IT function provides communication services for all groups in the organisation
- Central coordination in the use of IS/IT throughout the organisation, where an effort is made by groups' IS/IT functions to follow standards set centrally

- The organisation-wide network is starting to being utilised to connect users to whatever shared applications and information systems that are needed
- Extensive use of standard e-mail messages throughout the organisation, and there is evidence of dependence on the organisation-wide network to conduct formal communication

Level 5

- Strategic IS/IT applications are developed with external-oriented data along with DSS and EIS. These are built over and based on the existing operational systems completed in the last stage
- New systems rely heavily on gathering and processing external in addition to internal data through the use of EDI systems with external entities such as customers, government and suppliers, which introduces problems of compatibility between external and internal data
- New systems intended to provide strategic advantages to the organisation or units, where IS/IT starts to be used to add value to organisational products and/or services
- Most new systems are decentralised, but with central coordination and control
- DSS and EIS systems are developed for the use of senior management

Level 6

- Inter-organisational systems with outside entities (government, suppliers, customers, etc.), with the use of Internet and e-commerce technology

- Existence of shared inter-organisational systems (with suppliers, customers, government, etc.) by using shared IS/IT infrastructure services such as Internet
- Intranet provision improves effectiveness
- No geographic constraints on the provision of information
- Existence of a diverse hardware architecture according to each unit's needs
- GSS and KMS systems are developed and successfully used

Second: People

Staff

Level 1

- No dedicated IS/IT staff or small number of low-level technicians and programmers
- No manager allocated responsibility for IS/IT
- External contractors may be used to develop/install systems as required
- Users' new recruits are not expected to have IS/IT-related skill

Level 2

- The small IS/IT staff consists, in addition to programmers and low level technicians, of system analysts where qualified individuals (mainly programmers and analysts) are selected, recruited, and transitioned into assignments
- DP manager who was recently appointed is responsible for IS/IT function

- IS/IT staff are now charged with the responsibility of adequately understanding the user requirements needed for systems' development
- New user recruits are expected to have basic IS/IT skill

Level 3

- Added to the programmers and analysts, dedicated IS/IT planners and database administrators are appointed
- Almost all needed technical specialist staff are in-house
- A technically-oriented IS/IT manager is appointed or DP manager might have a change in title
- IS/IT workforce are coordinated with current and future IS/IT needs at both the organisational and unit levels
- New user recruits are expected to have specific IS/IT-related skill

Level 4

- In addition to the programmers, systems analysts, and data base administrators, business analysts now exist to act as a liaison between their units and the IS/IT function
- High level manager for IS/IT services area is appointed, with middle management status
- Organisational staff (IS/IT and user) performance is quantified and measured against quantitative performance baselines

Level 5

- Core hybrid staff is sought, developed, and retained, while in some large organisations, some developed expertise is outsourced
- Combining the roles of IS/IT and business planners to plan the strategic IS/IT for individual groups and to the organisation as a whole, where the business/IS/IT planners have an experience from working in/with both users and the IS/IT function which makes them cross-disciplinary
- IS/IT manager has a senior management status
- The emergence of innovator workforce in the organisation

Level 6

- Core staff retained, widespread outsourcing of expertise in some large organisations
- Information staff shared between large allied companies
- Widespread user ownership
- IS/IT function head become a full member of the board of directors to play be an active part in setting strategic direction not only as an advisor, because strategic plans need to have the required IS/IT element 'cooked' in them from the beginning
- The existence of innovator workforce is widespread and rooted in the organisation

Skills

Level 1

- Users find it hard to acquire the skills to use the IS/IT that exist and skills are individually based and jealously guarded from others
- The emphasis is on technology rather than organisational or informational issues where there are limited technical skills in the organisation/unit
- IS/IT skills are specific to individual IS/IT applications
- Needed skills are of low level technical nature and there may exist limited advanced (programming or systems analysis) skills in the organisation
- There is almost no IS/IT training provided by the organisation

Level 2

- Users begin to have the needed training and skills to use the new IS/IT that being developed/purchased
- Still little in-house technical expertise in IS/IT development (methodology, structured techniques) and other important skills
- IS/IT staff acquire the skills needed to develop and maintain complete systems such as programming and analysis, in addition to being able to install off-the-shelf ready-made packages
- Limited project management skills
- IS/IT individuals have the skills required to perform their assignments and begin to have the relevant training and development opportunities
- Individuals in the organisational workforce have remuneration and benefits based on their contribution and value to the organisation

Level 3

- Considerable technical competence in the organisation because of the well-developed IS/IT related skills (programming, analysis, security, networking etc.)
- The organisational workforce are constantly enhancing their IS/IT capabilities to perform their assigned tasks and responsibilities
- DP/IS/IT manager and staff lack, but work on building, interpersonal skills
- Project management is realised to be needed in this stage, which results in well developed project management skills

Level 4

- Systems staff have business skills, because business knowledge and skills are required now of IS/IT staff besides technical capability to fit in more with the rest of the organisation; at the same time, users gain proper insight into IS/IT related issues
- IS/IT head and staff have good interpersonal skills
- All individuals are involved in capturing/documenting their knowledge and experience from performing IS/IT-related work to be used in enhancing their competency and performance
- Organisation's workforce have the ability to mentor, that is to use the IS/IT-related experience to provide personal support and guidance and to share professional and personal skills and experiences with less experienced staff, with the goal of development of these individuals. This guidance can involve developing knowledge, skills, and process abilities, improving performance, handling difficult situations, and making career decisions

Level 5

- Core technical skills are developed, and some expertise might be outsourced
- IS/business planners have the skill and experience to plan the strategic information systems for individual units and the organisation as a whole, where they gained this experience from working in/with both users and IS/IT function
- As the IS/IT function becomes an integral part of the organisation, hybrid skills are used wherever possible, and entrepreneurial skills start to be encouraged within the IS/IT and user workforce, while very knowledgeable users of IS/IT become quite normal, where they now contribute freely to the whole IS/IT operation without any sensitivity from IS/IT function personnel
- IS/IT head has senior executive skills
- Individuals and workgroups are continuously improving their IS/IT-related capability for performing their work processes

Level 6

- Head of IS/IT, also a member of the board of directors, has all the skills and knowledge necessary for both IS/IT and business roles
- Consensus management skills are widely evident
- Skills are shared between allied large organisations, where outsourcing of specialist skills is widespread
- IS/IT staff are keeping up with the strategic needs of the groups they work with

- Individuals and workgroups are optimising their IS/IT-related capability for performing their work processes

Head of IS/IT function

Level 1

- There is no individual responsible for systems

Level 2

- There is a DP manager under a financial control group

Level 3

- There is a new IS/IT manager appointed, or DP manager might have a change in title, who is viewed as a technocrat

Level 4

- There is an IS/IT manager who has middle manager status

Level 5

- There is an IS/IT manager who has senior manager status

Level 6

- There is an IS/IT manager who is on the Board of Directors

Third: Environment

Management style/Leadership involvement

Level 1

- Has little concern for the potential utility of IS/IT

Level 2

- Considers IS/IT to be the concern of technologists not management but supportive of IS/IT, where priority and thrust are to minimise the expense of IS/IT utilisation

Level 3

- Considers IS/IT to be one of the many ways to cut costs in the firm and the expenditure on IS/IT as a way of saving cost, where IS/IT is looked at as a utility that provides service at minimum cost

Level 4

- Considers IS/IT to be vital for smooth functioning of operations

Level 5

- Considers IS/IT as one of the vital parts of the competitive strategy, where a flexible IT infrastructure is perceived as an asset for competitive edge and is brought up in this way during project justification

Level 6

- Considers IS/IT as the single most critical factor for the organisation

Structure

Level 1

- There is no central IS/IT function or no formal IT/IS organisational structure because the organisation does not consider the actual benefit of use of IS/IT
- Responsibility for IS/IT is dispersed throughout the organisation
- Head of the organisation or site CEO is actively involved in IS/IT purchasing
- Independent business units with little synchronisation in regard to IS/IT

Level 2

- Separate DP/IS/IT function has recently been introduced where groups are encouraged to seek advice from this newly formed central IS/IT function
- There is a decentralised responsibility for IS/IT function, where groups have full freedom in managing their IS/IT with increased self-reliance regarding IS/IT matters which is apparent throughout the organisation

Level 3

- Official power is vested in the IS/IT function, where a new technical IS/IT manager is appointed or the DP manager might have a change in title to IS/IT manager which goes with a similar change in department name
- There are an organisation-wide IS/IT architecture policy and standards for telecommunications, preferred suppliers, e-mail, etc.

- Management of the IS/IT function is centralised
- IS/IT staff seek control of IS/IT matters

Level 4

- IS/IT function is well established and its mission is to exploit the IS/IT for business purpose and provide competitive IS/IT in a partnership environment with users
- Decentralised responsibility of IS/IT services with central standards and policy for coordination, implementation and utility
- Units' IS/IT function reports to units' business manager
- Significant degree of involvement of users in IS/IT-related decisions, where IS/IT investments are derived from users' stated needs

Level 5

- Federal decentralised management structure with flexibility to support IS/IT initiatives, where there exist a strategic coalition and partnership between IS/IT function and user groups in large organisations
- Decentralised IS/IT function units, with a central IS/IT function providing organisational wide communication system, major data processing, and large-scale hardware in large organisations
- In some organisations, the budget of central IS/IT function is paid for by business units for services rendered

Level 6

- Central co-ordination of the strategic coalition between IS/IT function and user groups
- Still, decentralised IS/IT function units with a central IS/IT function providing organisational wide communication system, major data processing, and large- scale hardware
- An overall integration of views regarding IS/IT in the organisation

Culture

IS/IT Function and Users Relationship (Culture)

Level 1

- The relationship between user and the technical staff that may exist in the organisation or contracted from outside is of support for the existing IS/IT products.
- There is no recognition in the organisation of the importance of working towards building a constructive relationship between IS/IT function and users or among staff members at the same group.

Level 2

- IS/IT function wants to satisfy user needs but there is no control of user IS/IT- related activities
- The organisation start to recognises the need for building the capabilities for implementing timely communication across the organisation and for the

workforce to acquire the skills for sharing information and coordinating their activities efficiently

Level 3

- IS/IT function seeks control over the activities of users concerning IS/IT matters, which is faced by implicit and explicit resistance
- There exists a flow of information within the organisation, where voices start to be raised for using this flow of information to incorporate the knowledge of individuals into decision-making processes, and to gain their support to establish work commitments on both IS/IT function and user sides

Level 4

- IS/IT function supports the activities of users
- There exists an emphasis on organisational integration between workgroups among which is the IS/IT function.
- Workgroups (IS/IT and users) have the responsibility and authority for determining how to conduct their business activities most effectively
- An improvement in the efficiency and quality of interdependent work, resulted from the integration of the capabilities and knowledge of different workgroups on both IS/IT function and user sides, and with each other

Level 5

- IS/IT function and users cooperate on equal bases as partners
- In addition to the existence of the characteristics stated in the second, third, and fourth points of level 4 above, there exists a continuous strive for integration of organisational workgroups

Level 6

- IS/IT function is a central resource which has mainly a coordinating role
- There exists a strive to optimise integration of organisational workgroups

Fourth: Process

Generic practices

Level 1

Ad hoc level

Level 2

GG 1 Achieve Specific Goals

GP 1.1 Identify Work Scope

GP 1.2 Perform Base Practices

Level 3

GG 2 Institutionalise Managed Process

GP 2.1 Establish an Organisational Policy

GP 2.2 Plan the Process

1. Obtain management sponsorship for performing the process.
2. Define and document the process description.
3. Define and document the plan for performing the process.
4. Review the plan with relevant stakeholders and get their agreement.
5. Revise the plan as necessary.

GP 2.3 Provide Resources

GP 2.4 Assign Responsibility

1. Assign overall responsibility and authority for performing the process.
2. Assign responsibility for performing the specific tasks of the process.
3. Confirm that the people assigned to the responsibilities and authorities understand and accept them.

GP 2.5 Train People

GP 2.6 Manage Configurations

GP 2.7 Identify and Involve Relevant Stakeholders

1. Identify stakeholders relevant to this process and decide what type of involvement should be practised.
2. Share these identifications with project planners or other planners as appropriate.
3. Get stakeholders involved as planned.

GP 2.8 Monitor and Control the Process

1. Measure actual performance against the plan.
2. Review accomplishments and results of the process against the plan.
3. Review activities, status, and results of the process with the immediate level of management responsible for the process and identify issues.
4. Identify and evaluate the effects of significant deviations from the plan.
5. Identify problems in the process and in the plan.
6. Take corrective action when requirements and objectives are not being satisfied. when issues are identified, or when progress differs significantly from the plan.
7. Track corrective action to closure.

GP 2.9 Objectively Evaluate Adherence

GP 2.10 Review Status with Higher-Level Management

Level 4

GG 3 Institutionalise Defined Process

GP 3.1 Establish a Defined Process

1. Select the standard process that best fits the specific instances from the organisation's set of standard processes.
2. Establish the defined process by tailoring the selected standard processes and other process assets according to the organisation's tailoring guidelines.
3. Ensure that the organisation's process objectives are appropriately addressed in the defined process.
4. Document the defined process and the records of the tailoring.
5. Revise the description of the defined process as necessary.

GP 3.2 Collect Improvement Information

1. Store process and product measures in the organisational measurement repository.
2. Submit documentation for inclusion in the organisational library of process-related assets.
3. Document lessons learned from the process for inclusion in the organisational library of process-related assets.
4. Propose improvements to the organisation's process assets.

Level 5

GG 4 Institutionalise Quantitatively Managed Process

GP 4.1 Establish Quality Objectives

1. Obtain quantitative objectives for the project's defined process or, if they are not available, from other sources.
2. Allocate the quantitative objectives to the process.

GP 4.2 Stabilize Subprocess Performance

1. Statistically manage the performance of one or more subprocesses that are critical contributors to the overall performance of the process.
2. Estimate the ability of the process to achieve its established quantitative objectives considering the performance of the statistically-managed subprocesses.
3. Incorporate selected process performance measurements into the organisation's process performance baselines.

Level 6

GG 5 Institutionalise an Optimising Process

GP 5.1 Ensure Continuous Process Improvement

1. Establish and maintain quantitative process improvement objectives that support the organisation's business objectives.
2. Identify process improvements that would result in measurable improvements to process performance.
3. Define strategies and manage deployment of selected process improvements based on the quantified expected benefits, the estimated costs and impacts, and the measured change to process performance.

GP 5.2 Correct Common Cause of Problems

5.6 Modifications Cycles of Model

Having produced a tentative model, it was then applied to four organisations, where amendments were made. The approach was to interview IS/IT projects' leaders and concerned staff within the organisations studied. The interviews focused on the experiences of each organisation in planning, development, implementation and operation of IS/IT within the context of specific IS/IT project. Three of the IS/IT projects were studied in historical perspective, while one was a longitudinal study. As a result of the interviews, the tentative model was continually refined and each organisation eventually assessed in the context of the revised model. As a result of this assessment, along with the assessment of the requirements needed by the project to succeed in terms of the model structure, conclusions were drawn to specify the organisational Readiness Gap and what steps each organisation might take in terms of the attributes of each domain's (IT, People, Process, and Environment) in order to reach the readiness likelihood success status of the IS/IT project. The model went through further refinement after all of the case studies were completed. Examples of model modifications are presented at the conclusion of each case study introduced in the next chapter.

5.7 Summary

The chapter started by setting the ground for the introduction of the new evaluation framework and the readiness model. It summarised the shortcomings in the present IS/IT evaluation approaches and the way communication theory has been adopted into IS/IT research field. The chapter then introduced a new framework of IS/IT that overcomes the shortcomings in the understanding of IS/IT projects which is presented in terms of a new theoretical adoption. This new adoption is based on both the Shannon & Weaver (1949) theory of communication and Schramm's (1954, 1971) modification of it. This framework would enhance the understanding of IS/IT success measurement and be a base for future research in this area. In addition, this chapter introduced an approach for measuring organisational readiness for successful implementation of a predetermined information system. This approach, it, is hoped, will increase the likelihood of the success of IS/IT at the business level, and give organisations the ability to measure the readiness gap and predict the level of success of an IS/IT project. The approach should also provide management with effective guidance that contributes to meeting their business objectives and achieving their Critical Success Factors (CSFs).

Chapter 6: Case Studies

6.1 Introduction

Use of case studies in this research aims to test and validate the model produced in the previous chapter in as close to a 'real life' situation as possible. While the elements and issues addressed by the model are 'logical' and supported by the literature, it was important to experience the actual implementation of the model in a real organisational setting as much as possible. In addition, to solicit the opinions of the people involved with IS/IT projects in organisations regarding the usefulness and practicality of the model in these real situations.

In this research, organisations selected as case studies were based in the Middle East. The organisations are such that they were characterised under different issues, sizes, sectors, and status of IS/IT project. They fall under private and government sectors. Those organisations are from oil, banking, service, and retail industries. They are also characterised as large and medium size. In addition, the organisations acquired different IT infrastructures. The status of their IS/IT projects was different, as initially described by the organisations as being: successful, semi-successful, failure, or under development. Some of those projects were bespoke, while others had customised third party packages where the organisation had contracted with external vendors. From the latter category, projects were sourced differently. Some organisations had their own people working on the project development alongside the external vendor, while in one case the external vendors had the full responsibility for the project development.

Background and History
Sequence of Events of Project
Analysis and Discussion
Attribute Analysis and discussion (eight attributes)
a) General comments
b) Status prior to project
c) Status at end of project
d) Target status
Summary and Conclusion

Table 6.1: Structure of Case Study

This chapter presents four case studies that were conducted in four different organisations: a governmental public service institution (ServIns), a major Middle Eastern oil company (Oilco), A joint public-private owned bank (Bank), and an electronics and electrical products' vendor (Eleco).

The cases will be presented in almost an identical structure. Table 6.1 outlines the skeleton structure of each case. A background and history of the organisation and the IS/IT project is presented first, followed by the sequence of events concerning the project. The study will then present the status of each attribute of the four domains, as presented in the readiness/GP model. These are People (Staff, Skill, Head of IS/IT function), Environment (Leadership, Culture, Structure), IT (Systems), and Process (Practices). For each of the attributes, the case starts with general comments explaining the related features of the attribute in the organisation. This is followed by the status of the attribute prior to the initiation of the project, followed by the status of the attribute at the completion of the project then the target status as seen by the researcher (i.e. the needed status). The case will end by presenting concluding remarks concerning the case study.

The chapter ends by presenting a summary of the cases and general concluding remarks. It is worthwile to state that when using the model in the case studies, more than one level might seem to apply, but what should be selected is the one that applies the most. In the case that two of the models apply fully or partially but almost equally, then both levels are chosen.

6.2 ServInst Case Study

6.2.1 Background and History

The ServInst is a public-sector institution which provide services and receives public and government money which it invest. It is subjected to the supervision of the Minister of Finance who chairs its Board of Directors which also consists of a representative from each of the following:

- Ministry of Social Affairs and Labour
- Ministry of Defence
- Civil Servant Commission
- Ministry of Interior
- The Chamber of Commerce and Industry
- The Trade Union Federation
- Three expert members.

The assets owned and managed by the organisation equal to about US $10 billion and ServInst yearly revenue equals about US $ one billion.

The organisational structure of the Institution consists of five main sectors (Figure 6.1):

1. General Administration Sector
2. Servwork Sector
3. Automation Sector
4. Investment Sector
5. Public Service Sector

The organisation was among the first in the country to be computerized and the first to depend heavily on IS/IT in conducting its work processes. This was a strategic decision made by the founding chairman in 1979. Not long after the formation of the organisation, the old/current system was built in the early 1980s by an international software development vendor which trained the newly hired staff who had no previous computer skills or knowledge. The training was system-specific that enabled the staff to take-over the day-to-day operation and maintenance of the system. The system was mainframe-based using COBOL and VSAM and sequential file types for batch processing. Around the mid-1980s a large 'stand alone' personnel information system was developed, based on an inverted-relational database management system, to accommodate about 800 employees. The users of all the organisational information systems are about 90% of the organisation's staff (more than 700 employees). In the mid-1980's there was a complete change of the top management, where a different team replaced the founding chairman and his team. This new team remains in charge of the organisation until the current time.

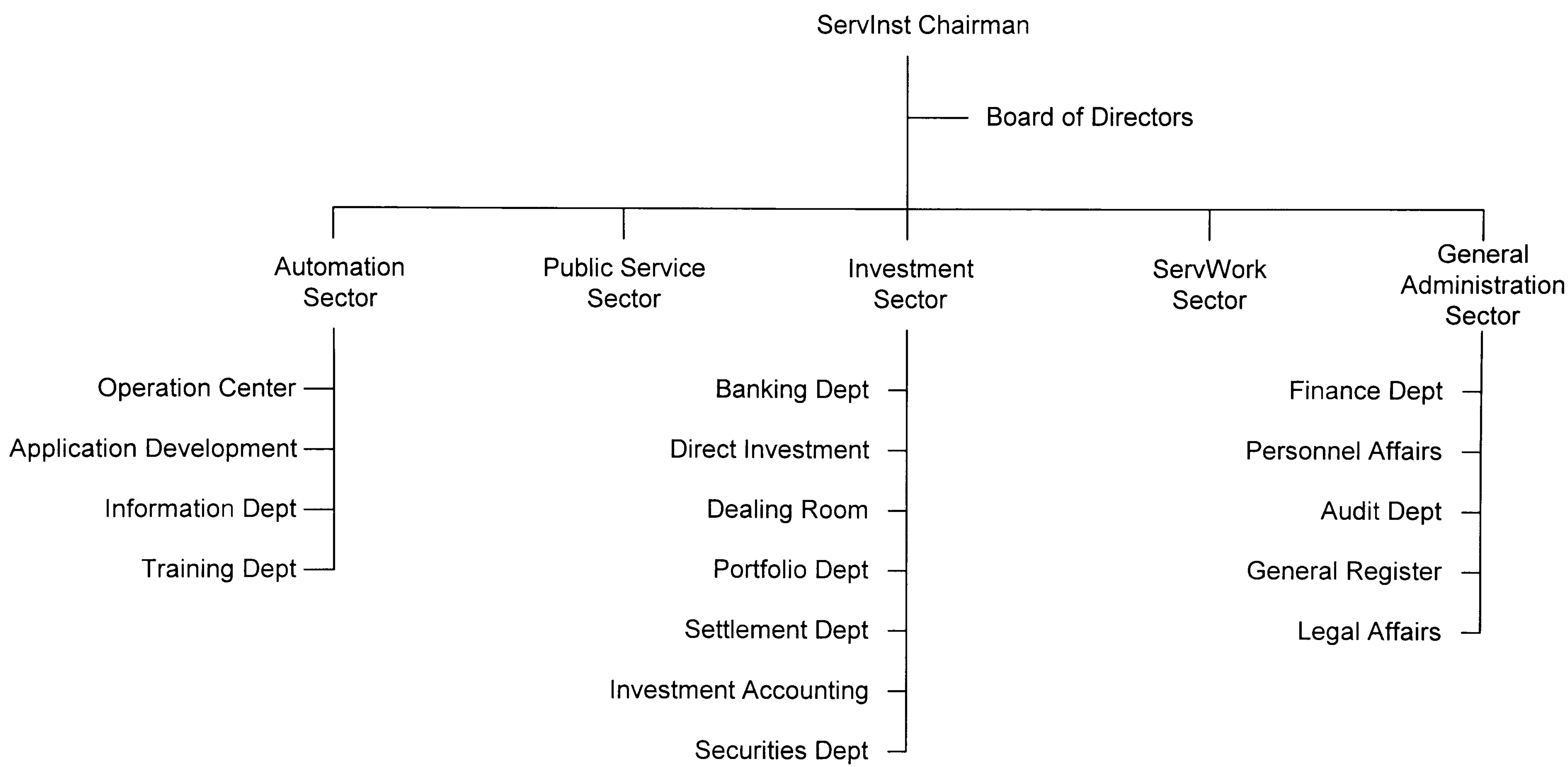

Figure 6.1: ServInst Organisational Chart

6.2.2 Sequence of events

- In 1992, the organisation planned to open a branch to provide services to the public in another location in the country and relocate the training department and image file-storage on remote sites. At that time, the organisation was facing the problem that the computer master-file had reached the maximum record size allowed by IBM-VSAM type file which the organisation uses. This is a limitation of such a file type that could be expanded to a maximum limit. If this limit is reached then the solution is to go for a database environment. For those reasons the top management decided to conduct a total re-systemization of the mainly batch COBOL-based systems' environment to a relational database-based system environment and to a new network that can support the proposed branch and new remote sites. The re-systemisation decision was made because top management had been informed by external sources that many local organisations have converted to database environment and they were successful.
- The objectives of the project were to install a new network that could support the branching plan and the remote sites. Also, to conduct a total re-systemization of all the organisational systems to convert from a batch-COBOL-VSAM-based environment into a relational database management systems (R-DBMS)-based environment using a fourth generation language as a host language for coding the application programs. This re-systemization was to include the independent 'stand-alone' personnel system which is based on an inverted R-DBMS package that uses a query language for data query and manipulation.

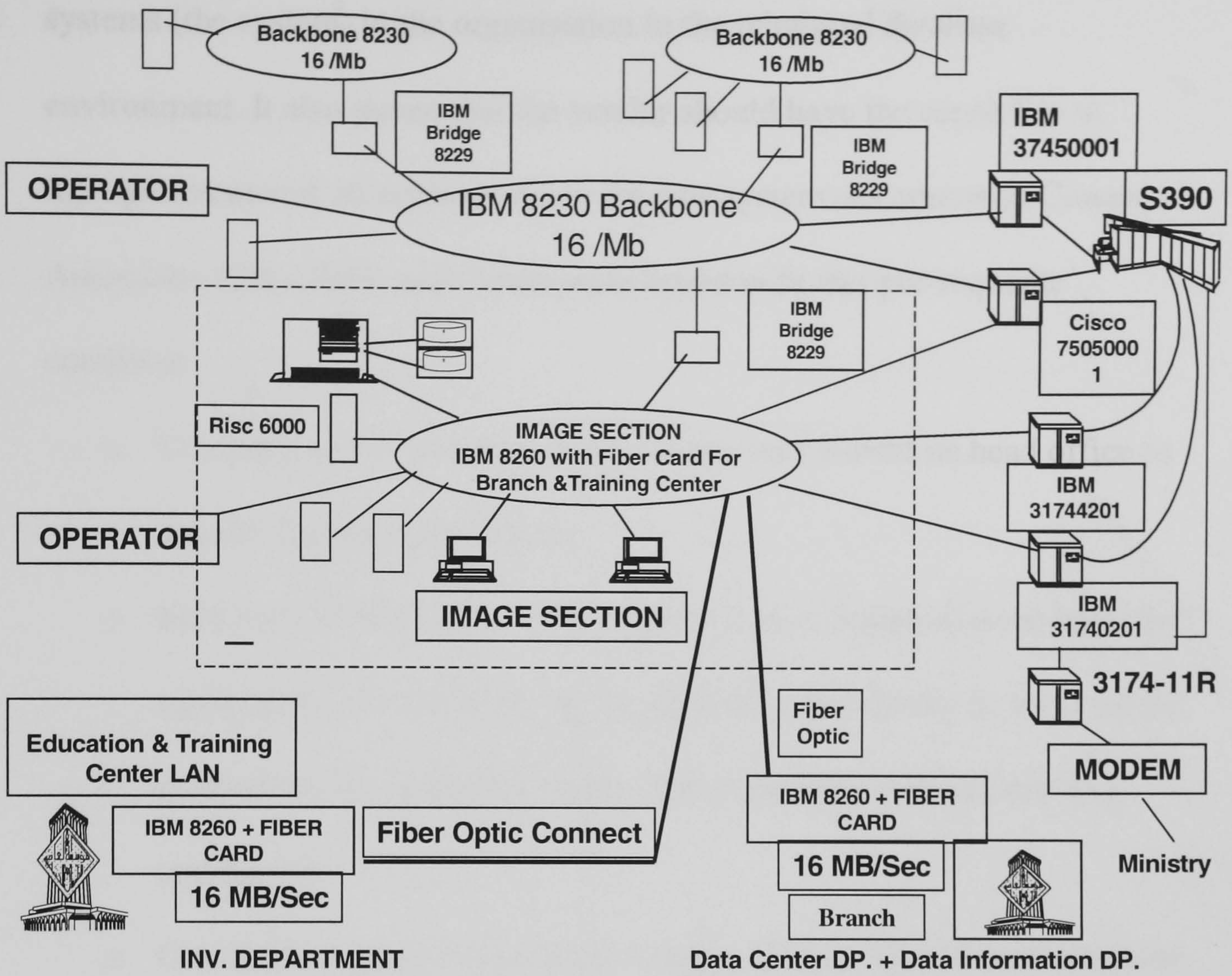

Figure 6.2: ServInst New System Network Design

- The project would involve converting all the application programs that make up the organisational systems.
- A steering committee was formed of the Chairman's Deputy, IT/IS Unit Head, Head of Systems Department, and Head of Operations Department. Later, when a vendor was chosen and the project started, the vendor's team head joined the committee.
- On the request of top management, the IS/IT unit (Automation Sector) decided to do a feasibility study where they examined the products of three international vendors. They limited themselves to those vendors that could provide the organisation with a 'total solution', which meant changing all

systems (the system) in the organisation to the relational database environment. It also meant that the vendor should have the capability to reprogram/convert all applications to the new system environment. Computer Associates (CA), IBM, and Oracle were found to fit this pre-requisite condition.

  - CA had a small operation in the country and moved its head office to another country in the region.
  - IBM had the R-DBMS "DB2", but their local branch did not have the capabilities for converting the applications. In order to do so, it would subcontract the project to many other companies and act only as a coordinator.
  - Oracle had a small office in the country, while it had its regional head office in another regional country.

- Other conditions were produced by the IS/IT unit team, that was conducting the feasibility study regarding the project, to be the bases for vendor selection:
  - The DBMS product had to be a full relational DBMS
  - The development needed to include utilisation of CASE tool for ease of design
  - The DBMS had to support the use of credible fourth generation language and not only the query language.
  - Training had to be part of the whole development contract that allows for technology and experience transfer from the vendor to the organisation.

- In 1993, after the feasibility study was concluded, the organisation formed a team consisting of the IS/IT unit manager and a full-time consultant that was hired to serve in this team. The team was formed for the following reasons:
    - To produce a general system's specification based on the 'total solution' idea and a report for proposal (RFP). This needed to be done while having in mind the at-most utilisation of the existing organisational IT infrastructure, especially the hardware.
    - To recommend a vendor to conduct the detailed requirement specifications which was termed 'strategic study'.
    - To oversee the detailed requirement specifications of the 'strategic study'
    - To recommend a vendor out of the three specified by the feasibility study to develop and implement the system
    - To form the team which represent the organisation side in the project development team
- After several meetings with the vendor's representatives, the initial recommendation of the team was made in favoure of Oracle. This decision was based on:
    - CA was much more expensive than the other two vendors. It also had no support office in the country, and its product was an 'inverted-relational' not 'full-relational' DBMS.
    - IBM was expensive, and it would subcontract the project to many vendors which could cause problems in development, coordination and support. Also, its CASE tools were largely customized to support the methodology used by only one of the subcontracting vendors.

    - Oracle had the most reasonable price, and its product had started to gain good reputation worldwide. Also, the company was planning to establish an office in the country that could provide after-installation support.

- The final selection decision needed to be made after conducting the 'strategic study' to ensure that the vendor had the capability to deliver the specified systems.The team had requested Oracle to conduct the 'strategic study'. This was an independent study from the project contract for the 'total solution'. Oracle was chosen because its price to conduct this study was half the price of the lowest bid made by the other companies. Also, the initial study favoured Oracle; if this study was to be made by Oracle, and it was the most likely to be chosen, then some of the output of the study (data entity relational diagram) could be directly incorporated in the CASE tool method which would save the organisation time and money, which they would have incurred had they chosen any of the other vendors. In fact, an informal decision was made to use Oracle, but for formality reasons, which include government regulations, this process had to be followed.
- The 'strategic study' was conducted by four Oracle employees and spanned over four months.
- The study included interviews with all users' representatives, especially the managers and key persons. Questionnaires were also used in addition to reviewing the existing documents.
- This study's outcome was to provide the organisation with such information as:
    - The resources required for the project: staff, time, hardware, etc..

  - Document/define all work processes; such documentation/definitions did not exist.
  - Determine the interaction between different systems.
  - Information regarding data-files' condition, formats, storage media types, size, backups, etc..
  - Find opportunities to improve on processes and structure.
  - Match the project's requirements to the capabilities of potential products and vendors.
  - A data entity relation diagram
- At the end of the study, the organisation officially announced Oracle to provide the R-DBMS and develop the applications needed in SQL fourth generation language and signed the contract which was to take two years to implement fully the 'total solution'.
- The vendor provided the organisation with the team members' names and résumés and these people were interviewed and approved. Approval of vendor staff by the organisation was not stated as a term in the contract, but was agreed upon by the two parties verbally.
- The two project teams from both the vendor and the organisation worked together in a partnership to provide the joint project team but each had their own leader. The IS/IT manager led the team from the organisation side.
- Because the requirements were defined in the 'strategic study', the joint project team started the work on the design of the system.
- For the first six months, activities went according to plan. After that and while still in the design phase, the vendor started to change its team members, reallocating the experienced ones to other projects abroad and replacing them

with members with less or little experience. The reallocation and replacement of the vendor staff continued throughout the project life.

- On the organisation side things did not look much better, and departments, both IS/IT and users, demanded that the key staff assigned to the project in the early stages return to their original posts. They claimed that the day-to-day work was negatively affected by their full-time assignment to the project. Top management caved in, and most of these who left the team were replaced with junior, less experienced members.
- In spite of the low level of experience and skill of those junior staff, no training was provided and they were left to learn the basic skills on the job.
- As the project progressed and the new system output started to appear, user resentment and criticism started to grow. No effort was made by the project team to clear possible misunderstandings or increase awareness regarding the project's aims, objectives and implications.
- As the project progressed in time, top management support became less. This had its negative effect on the needed approval for changes and modifications in system design, organisational structure, and work processes that would come up during the development phase. User rejections and reservations gradually gained top management sympathy and support.
- By the end of the project duration, users rejected a large number of the systems' functionalities on the ground that they did not fulfil the needs for conducting the work tasks of the organisation.
- Both sides, the vendor and the organisation, agreed on an extension of the contract with amended penalty terms put by the organisation. This was followed by a second extension with no acceptable results.

- Four years from the time it started, and at a cost of between US $ 7 to 10 million, the project was declared a failure and the matter is now in the hands of the courts.
- One decade has passed from the time the first study for a new system was conducted, the organisation still has its 20 year-old system. At the time of preperation of this thesis, criticism of inefficiency of the organisation and waste of money is a hot subject in the country's national media and parliament.

6.2.3 Analysis and Discussion

The following sections address each attribute of the four domains of the readiness/GP model within the context of ServInst.

6.2.3.1 People

1) Staff

People		
Staff	Skill	Head of IS/IT

•

a) General comments

- After withdrawal of the experienced staff, the vendor provided inexperienced staff to the project.

- There were not enough qualified staff in the organisation who could handle both the on-going daily organisational work and the re-systemization project. Both of those tasks needed total commitment.
- The organisation decided to remove its key people from the project team and return them to their original groups to do their daily tasks, while assigning staff with little or no experience to the project.
- The junior staff assigned to the project team had no training prior to, or during the project
- Because of the complexity of the project and the need for a holistic view of the integrations between the many different sub-systems, training the inexperienced staff assigned to the project was highly unattainable. This is because the current systems were not sufficiently documented, and this makes the knowledge and the know-how reside only in heads of key-people. This is complicated by the nature of the culture that exists in the organisation being an individual un-cooperative culture. Staff try to keep their knowledge and experience to themselves for different reasons including job security. Key people consider keeping the knowledge to themselves would make them indispensable and increase their value to the organisation.
- Two years from the time the project started, the project leader on the vendor side was changed and the new one had a different approach to the project development; he attempted to change the new system design.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 3. This is because the organisation had programmers, analysts, and database administrator for the personnel system, and almost all needed technical staff. Also, the IS/IT staff are coordinated with current and future IS/IT needs at both the organisational and unit levels and new user recruits are expected to have specific IS/IT-related skill. Additionally, the technically-oriented IS/IT manager still has a middle management title. The description of this level in the readiness model is as follows:

- Added to the programmers and analysts, dedicated IS/IT planners and database administrators are appointed
- Almost all needed technical specialist staff are in-house
- A technically-oriented IS/IT manager is appointed or DP manager might have a change in title
- IS/IT workforce are coordinated with current and future IS/IT needs at both the organisational and unit levels
- New user recruits are expected to have specific IS/IT-related skill

c) Status at termination of project

The status of the staff at the termination of the project deteriorated to mostly agree with the general descriptions of some of level 1 and level 2 characteristics. This is because project team members have changed from both the organisation and vendor sides to have less experienced mostly junior staff. This had an impact on the overall staff status. Level 1 and 2 descriptions are as follows:

Level 1

- No dedicated IS/IT staff or small number of low-level technicians and programmers
- No manager allocated responsibility for IS/IT
- External contractors may be used to develop/install systems as required
- Users' new recruits are not expected to have IS/IT-related skill

Level 2

- The small IS/IT staff consists, in addition to programmers and low level technicians, of system analysts where qualified individuals (mainly programmers and analysts) are selected, recruited, and transitioned into assignments
- DP manager who was recently appointed is responsible for IS/IT function
- IS/IT staff are now charged with the responsibility of adequately understanding the user requirements needed for systems' development
- New user recruits are expected to have basic IS/IT skill

d) Target status

The proposed target situation needs to agree with the general description of level 5 because the system spans all organisational functions which needs an IS/IT head that has at least the power of user managers. Also, an organisation that depends to a great extent on IS/IT and has been in such a situation for 20 years needs to have a strategic vision of IS/IT and staff who can plan accordingly. This also requires staff on both the user and IS/IT sides who would understand each other's work to be able to have integration of groups and systems. The organisation need to have a core hybrid staff to be developed and retained, and to combine the roles of IS/IT and business planners to plan the strategic IS/IT for individual groups and to the organisation as a whole, where the business/IS/IT planners acquire experience from working in/with both users and the IS/IT unit which makes them cross-disciplinary. The organisation also needs to restore to the IS/IT manager the senior management status he had a decade ago. The description of level 5 is as follows:

- o Core hybrid staff is sought, developed, and retained, while in some large organisations, some developed expertise is outsourced
- o Combining the roles of IS/IT and business planners to plan the strategic IS/IT for individual groups and to the organisation as a whole, where the business/IS/IT planners have an experience from working in/with both users and the IS/IT unit which makes them cross-disciplinary
- o IS/IT manager has a senior management status
- o The emergence of innovator workforce in the organisation

The result of Staff analysis is as follows:

People Staff				
Status	Prior to	At termination	Target	Gap
Maturity level	3	1-2	5	3,4,5

2) Skill

People		
Staff	Skill	Head of IS/IT

a) General comments

- The contract signed with Oracle included up to US $ 70,000 worth of training (courses/programmes).
- The contract also included technology/experience transfer by having organisational staff work alongside the vendor's.
- The plan was that, as the project progressed through the development life cycle phases, the proportion of organisation staff would increase while the vendor's staff decreased (vendor's/organisation: 80%-20% in phase I, 60%-40% in phase II, 40%-60% in phase III, 20%-80% phase IV). This would reach the situation where each of the vendor's staff members would work with and train four of the organisation's staff.
- The project leader on the organisation side noted that he did not have the needed skills for such a major project. He did not receive proper training, and had no previous experience.
- The organisation assigned inexperienced staff to the project, while the project needed the best skill and experience. This was true with both the IS/IT unit and user groups.
- The vendor's experienced staff were withdrawn after six months. Many of the vendor's new staff who came into the project had little experience.

- In many instances, especially in the advanced stages of the project, the organisation's staff were more experienced than the vendor's staff who were suppose to train them. On a few occasions, the organisation requested the removal of some of the vendor's staff because it thought they were incompetent.
- Skills of the organisation's IS/IT staff on the project team were mainly of COBOL programming with limited systems analysis. Very limited numbers had the skills to use the inverted relational DBMS and its query language.
- Training was largely not available for the inexperienced staff who worked on the project. The organisation, at some time during the project, provided the staff with video-based lectures to be viewed in the employees' own time. This did not result in considerable success.
- The vendor did not suggest any training or pre-project skill requirements for the project team members on the organisation side before the start of the project.

b) Status prior to project

The status mostly agreed with the general description of level 2 because users in the organisation had the needed training and skills to use the IS/IT. The technical expertise was limited in scope where IS/IT project development was mainly done to accommodate new changes in governmental laws and regulations that reflect into the way ServInst conducts its work. This made project management skills limited to such small projects, but required the organisation to provide IS/IT staff who had the relevant training and development opportunities needed to perform such assignments. Since the IS/IT job market has a high turnover, the organisation felt obliged to provide its IS/IT staff with remuneration and benefits based on their contribution and value to the organisation in order to retain them.

The description of this level (level 2)in the readiness model is as follows:

- Users begin to have the needed training and skills to use the new IS/IT that being developed/purchased
- Still little in-house technical expertise in IS/IT development (methodology, structured techniques) and other important skills
- IS/IT staff acquire the skills needed to develop and maintain complete systems such as programming and analysis, in addition to being able to install off-the-shelf ready-made packages
- Limited project management skills
- IS/IT individuals have the skills required to perform their assignments and begin to have the relevant training and development opportunities
- Individuals in the organisational workforce have remuneration and benefits based on their contribution and value to the organisation

c) Status at termination of project

The status of the skill deteriorated at the project termination to mostly agree with the general descriptions of some of level 1. Project team members have changed from both the organisation and vendor sides to have less experienced mostly junior staff. Level 1 description is as follows:

- Users find it hard to acquire the skills to use the IS/IT that exist and skills are individually based and jealously guarded from others
- The emphasis is on technology rather than organisational or informational issues where there are limited technical skills in the organisation/unit
- IS/IT skills are specific to individual IS/IT applications

- Needed skills are of low level technical nature and there may exist limited advanced (programming or systems analysis) skills in the organisation
- There is almost no IS/IT training provided by the organisation

d) Target status

The proposed target situation needs to comply with at least with the general description of level 4, in addition to the strategic planning capabilities and senior management skills in level 5. This is because the system spans all organisational functions, which needs an IS/IT head who has the senior management skills. Also, an organisation that depends to a great extent on IS/IT needs to have a strategic view of IS/IT, and a staff that can plan accordingly. This also requires good communication skills to enable the integration of the different organisational groups. The descriptions of levels 4 and 5 are as follows:

Level 4

- Systems staff have business skills, because business knowledge and skills are required now of IS/IT staff besides technical capability to fit in more with the rest of the organisation; at the same time, users gain proper insight into IS/IT related issues
- IS/IT head and staff have good interpersonal skills
- All individuals are involved in capturing/documenting their knowledge and experience from performing IS/IT-related work to be used in enhancing their competency and performance
- Organisation's workforce have the ability to mentor, that is to use the IS/IT- related experience to provide personal support and guidance and to share professional and personal skills and experiences with less

experienced staff, with the goal of development of these individuals. This guidance can involve developing knowledge, skills, and process abilities, improving performance, handling difficult situations, and making career decisions

Level 5

- Core technical skills are developed, and some expertise might be outsourced
- IS/business planners have the skill and experience to plan the strategic information systems for individual units and the organisation as a whole, where they gained this experience from working in/with both users and IS/IT function
- As the IS/IT function becomes an integral part of the organisation, hybrid skills are used wherever possible, and entrepreneurial skills start to be encouraged within the IS/IT and user workforce, while very knowledgeable users of IS/IT become quite normal, where they now contribute freely to the whole IS/IT operation without any sensitivity from IS/IT function personnel
- IS/IT head has senior executive skills
- Individuals and workgroups are continuously improving their IS/IT-related capability for performing their work processes

The result of Skill analysis is as follows:

People Skill				
Status	Prior to	At termination	Target	Gap
Maturity level	2	1	4-5	2,3,4,5

3) Head of IS/IT

People		
Skill	Staff	Head of IS/IT

a) General comments

- IS/IT unit head and the project leader had a middle management status.
- The head of the project did not have enough authority to implement changes and modifications needed mainly in the organisational structure and processes.

b) Status prior to project

- At the beginning of the project, the situation mostly agreed with the general description of level 4, where the IS/IT manager has middle manager status. The description of this level in the readiness model is as follows:
    - o There is an IS/IT manager who has middle manager status

c) Status at termination of project

- The situation of the head of IS/IT at the termination of the project remained the same as it was at the beginning, at level 4.

d) Target status

- The proposed target situation needs to agree with the general description of level 5, so that the IS/IT head acquires the power needed to manage and enforce policies of IS/IT that spans organisation-wide. Also, to be able to participate in strategic decisions. The description of level 5 is as follows:

- There is an IS/IT manager who has senior manager status

The result of Head of IS/IT analysis is as follows:

People Head of IS/IT				
Status	Prior to	At termination	Target	Gap
Maturity level	4	4	5	5

6.2.3.2 Environment

1) Leadership

Environment		
Leadership	Culture	Structure

a) General comments

- The leadership support to the project was strong in the beginning, but as the time went on, the support became weaker.
- The prolonging of the project affected top management support negatively.
- Top management attitude towards IS/IT fluctuated according to the external and internal pressures. For example, if the media focus on a certain aspect of IS/IT in the organisation that aspect receives priority over others. Also, internally-spread rumours could affect the amount of support given to a certain IS/IT aspect or in general.
- Top management gave priority to the daily operation of the organisation over the project.
- Top management relied on acquiring their IS/IT related knowledge from external sources and largely on what other organisations were doing.
- Even though the organisation was heavily dependent on IS/IT in its day-to-day operation, top management considered IS/IT as a tool necessary for smooth functioning, while the heavy dependency on IS/IT should have called for viewing IS/IT with strategic consideration and its flexibility as an asset.

- At the time when no system output had yet been produced, top management support was high. As the system development progressed, users started to view the output, and top management started to receive many complaints and rumours which caused the support and enthusiasm to lessen.
- The incentive approach in the organisation is individually-based not team-based, which did not support knowledge sharing and cooperation.

b) Status prior to the project

- At the beginning of the project, the status mostly agreed with the general description of levels 2 and 3 because the attitude of the top management fluctuated according to the external and internal pressures. It is important to note that the cost issue was of little importance for top management in the organisation because it was a governmental institute that had at hand a large amount of income from government and other institutions and a large amount of return on its large investments. Level 3 leadership in a government-run organisation would consider IS/IT mainly as a utility to provide services. The descriptions of these two levels in the readiness model are as follows:

Level 2

- o Considers IS/IT to be the concern of technologists not management but supportive of IS/IT, where priority and thrust are to minimise the expense of IS/IT utilisation

Level 3

- o Considers IS/IT to be one of the many ways to cut costs in the firm and the expenditure on IS/IT as a way of saving cost, where IS/IT is looked at as a utility that provides service at minimum cost

c) Status at termination of project

The status of the leadership at the termination of the project agreed mainly with level 2 description. Top management lost enthusiasm and left the project team with little support.

d) Target status

The proposed target situation agrees at most with the general description of level 5's strategic view of IS/IT, because the organisation is an important national service provider that depends almost entirely on IS/IT in running its work processes. In the case of lack of success of the organisational IS/IT, a national problem might occur. As this thesis is being written, such a problem is formulating and complaints regarding the inefficiency of the organisation's management are widespread in the media and in the parliament. The description of leadership's level 5 is as follows:

- Considers IS/IT as one of the vital parts of the competitive strategy, where a flexible IT infrastructure is perceived as an asset for competitive edge and is brought up in this way during project justification.

The result of Leadership analysis is as follows:

Environment Leadership				
Status	Prior to	At termination	Target	Gap
Maturity level	2-3	2	5	3,4,5

2) Culture

Environment		
Leadership	Culture	Structure

a) General comments

- There was a lack of positive relationships between different groups/ departments in the organisation.
- Different managers were suspicious of the project by thinking it was a plan being executed to deprive them of their powers in favour of others. This caused them to resent the project and not to cooperate with the project team.
- Key staff considered keeping knowledge and experience to themselves as a job security tool, they were not forthcoming in cooperating with the project team.
- The lack of decisive leadership by top management allowed the conflicts between different entities in the organisation to go in an increasing mode until the end of the project. Also, security and confidentiality issues were obstacles in taking the incremental approach in building the systems, which was preferred by the vendor. The project team were prevented from incremental changes. Top management did not want them to 'touch' the investment working sub-system when the team saw fit, even though it was covered by the contract to convert it to the database environment.
- There was a lack of strong support from the top management for necessary changes in the processes and structure.

- The vendor did not suggest any changes in the culture, and in fact, the issue of culture was never mentioned.
- Groups/departments lacked a cooperative work environment. Despite the fact that work processes cut through departments' boundaries, there was no cooperation between them. Also, within each group, the individualistic attitude kept people from sharing knowledge.
- Some of the key users felt threatened by the new system because it would automate some of their tasks that they believed would give them advantage if they remained un-computerised. An example of this is a key employee who memorized all of the organisation's account numbers to be filled in forms. He resisted the automation of the process.
- The project team did not make an effort to relieve the tension in the relationship that occurred in the organisation because of the introduction of the project.
- The project team, at some point in the project, adopted the user-centric approach in testing the system's functions. The key users at that time became a burden on the project by being negative and demanding all the time.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 1 because the relationship between users and the technical staff was one of support and maintenance for the existing IS/IT, where there was no recognition in the organisation of the importance of working towards building a constructive relationship between IS/IT unit and users or among staff members. The description of level 1 in the readiness model is as follows:

- The relationship between users and the technical staff that may exist in the organisation or contracted from outside is of support for the existing IS/IT products.
- There is no recognition in the organisation of the importance of working towards building a constructive relationship between IS/IT function and users or among staff members at the same group.

c) Status at termination of project

The status of the culture at the termination of the project remained the same as it was at the beginning on level 1.

d) Target status

The proposed target situation should at least agree with the general description of level 4 and preferably level 5, because the system is a highly integrated system that cuts through unit and group boundaries. In such an environment, the relationships between all organisational workforce need to be those of integration and cooperation. The organisation needs the IS/IT unit to support the activities of users, and both cooperate on equal bases as partners. There also needs to exist an emphasis on organisational integration between different workgroup capabilities and knowledge on both IS/IT unit and user sides, Those workgroups (IS/IT and users) need to have the responsibility and authority for determining how to conduct their business activities most effectively. The descriptions of these two culture levels, 4 and 5 in the readiness model, are as follows:

Level 4

- IS/IT function supports the activities of users

- There exists an emphasis on organisational integration between workgroups among which is the IS/IT function.
- Workgroups (IS/IT and users) have the responsibility and authority for determining how to conduct their business activities most effectively
- An improvement in the efficiency and quality of interdependent work, resulted from the integration of the capabilities and knowledge of different workgroups on both IS/IT function and user sides, and with each other

Level 5

- IS/IT function and users cooperate on equal bases as partners
- In addition to the existence of the characteristics stated in the second, third, and fourth points of level 4 above, there exists a continuous strive for integration of organisational workgroups

The result of Culture analysis is as follows:

Environment Culture				
Status	Prior to	At termination	Target	Gap
Maturity level	1	1	4-5	2,3,4,5

3) Structure

Environment		
Leadership	Culture	Structure

a) General comments

- Even though the IS/IT unit in the organisational chart has a senior status through the 'technical office' of the 'Automation Sector', the new top management, unlike the previous one, left the position empty for over a decade.
- The head of the IS/IT unit is the same as the project leader, who has a middle management position.
- Even though structure changes were obviously needed as implied by the IS/IT unit head, the vendor did not suggest any changes in the 'strategic study'.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 3, because the IS/IT unit technically-oriented manager has a middle management authority and status, where management of the IS/IT unit is centralised and seeks control of IS/IT matters in the organisation. Also, there are no organisational IS/IT architecture policy and standards; rather, there are accepted lists for choices of preferred suppliers of IS/IT products. The description of this level in the model is as follows:

- o Official power is vested in the IS/IT function, where a new technical IS/IT manager is appointed or the DP manager might have a change in title to IS/IT manager which goes with a similar change in department name

- There are an organisation-wide IS/IT architecture policy and standards for telecommunications, preferred suppliers, e-mail, etc..
- Management of the IS/IT function is centralised
- IS/IT staff seek control of IS/IT matters

c) Status at termination of the project

The status of the structure at the termination of the project remained the same as it was at the beginning, at level 3.

d) Target status

The proposed target situation needed to agree with the general description of level 4 as for the need to have architecture policy and standards for coordination, implementation and utility of IS/IT, but also to emphasise (as in level 5) that the IS/IT unit and project team need to have senior authority to execute their mission to implement a strategic coalition and partnership with user groups based on a strategic view of IS/IT. The descriptions of levels 4 and 5 are as follows:

Level 4

- IS/IT function is well established and its mission is to exploit the IS/IT for business purpose and provide competitive IS/IT in a partnership environment with users
- Decentralised responsibility of IS/IT services with central standards and policy for coordination, implementation and utility
- Units' IS/IT function reports to units' business manager
- Significant degree of involvement of users in IS/IT-related decisions, where IS/IT investments are derived from users' stated needs

Level 5

- o Federal decentralised management structure with flexibility to support IS/IT initiatives, where there exist a strategic coalition and partnership between IS/IT function and user groups in large organisations
- o Decentralised IS/IT function units, with a central IS/IT function providing organisation-wide communication system, major data processing, and large-scale hardware in large organisations
- o In some organisations, the budget of the central IS/IT function is paid for by business units for services rendered

The result of Structure analysis is as follows:

Environment Structure				
Status	Prior to	At termination	Target	Gap
Maturity level	3	3	4-5	4,5

6.2.3.3 IT

Systems

IT
Systems

a) General comments

- There were problems with the format of the data-files in the organisation. The size of the master file record size reached the maximum that is allowed by VSAM file format.
- The data that were coming from external governmental entities were written in a non-compatible format that required special, time-consuming, conversions. Also, these governmental data were not reliable, with bad data both in context and in content that required editing procedures both computerised and by people.
- The new system design was not successful in resolving the ownership of the data within the organisation.
- The vendor treated the project as if it was building a new system in an organisation that had no prior systems. The new design changed all the interfaces and environment that the user was used to, which caused resentment of the user.
- After two years in the project, the vendor changed the system design, which caused unease for project members on the organisation side.

b) Status prior to project

- At the beginning of the project, the status mostly agreed with the general description of level 4 but in an unfulfilled way. This was because all needed operational IS/IT was mostly in place but did not fully serve the organisational needs, and office automation existed, but in an isolated not standardised manner. Also, there existed an organisation-wide network, where all groups were connected and the central IS/IT unit provided communication services for all groups, but it did not accommodate the planned expansion and did not support e-mail. The description of level 4 in the readiness model is as follows:
    - All needed operational IS/IT is mostly in place and some DSS start to appear
    - Office automation is integrated and unified/standardised organisation-wide
    - Existence of an organisation-wide network, where all groups are connected and the central IS/IT function provides communication services for all groups in the organisation
    - Central coordination in the use of IS/IT throughout the organisation, where an effort is made by groups' IS/IT functions to follow standards set centrally
    - The organisation-wide network is starting to being utilised to connect users to whatever shared applications and information systems that are needed
    - Extensive use of standard e-mail messages throughout the organisation, and there is evidence of dependence on the organisation-wide network to conduct formal communication

c) Status at termination of the project

The status of the systems at the termination of the project remained the same as it was at the beginning at weak level 4.

d) Target status

The proposed target situation needs to still agree with the general description of level 4 but with a new network infrastructure that utilises e-mail and connects to the Internet to facilitate better service for the external customers.

The result of Systems analysis is as follows:

IT Systems				
Status	Prior to	At termination	Target	Gap
Maturity level	4	4	4	Improvements

6.2.3.4 Process

Practices

Process

Practices

a) General comments

- Processes were not defined and documented prior to the project.
- No process change was suggested by the vendor
- No process change were allowed by top management and users when the need was recognised by the project team later in the project.
- Because of the inability to reengineer processes, 'corner-cutting' and 'go around' techniques were used, such as allowing two units to access, modify, and delete the same data. This caused problems and conflicts for project team with users and among user groups.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 2-GG 1. The description of this level in the readiness model is as follows:

GG 1 Achieve Specific Goals

- GP 1.1 Identify Work Scope
- GP 1.2 Perform Base Practices

c) Status at termination of project

The status of the process at the termination of the project improved to include some of the generic practices of level GG 2. Those additional practices were the result of the 'strategic study' conducted after the start of the projectand are designated GP 2.1, GP 2.2, and GP 2.7. The level description is as follows:

GG 2 Institutionalise Managed Process

- GP 2.1 Establish an Organisational Policy
- GP 2.2 Plan the Process
    1. Obtain management sponsorship for performing the process.
    2. Define and document the process description.
    3. Define and document the plan for performing the process.
    4. Review the plan with relevant stakeholders and get their agreement.
    5. Revise the plan as necessary.
- GP 2.3 Provide Resources
- GP 2.4 Assign Responsibility
    1. Assign overall responsibility and authority for performing the process.
    2. Assign responsibility for performing the specific tasks of the process.
    3. Confirm that the people assigned to the responsibilities and authorities understand and accept them.
- GP 2.5 Train People
- GP 2.6 Manage Configurations
- GP 2.7 Identify and Involve Relevant Stakeholders

1. Identify stakeholders relevant to this process and decide what type of involvement should be practised.
2. Share these identifications with project planners or other planners as appropriate.
3. Get stakeholders involved as planned.

- GP 2.8 Monitor and Control the Process
  1. Measure actual performance against the plan.
  2. Review accomplishments and results of the process against the plan.
  3. Review activities, status, and results of the process with the immediate level of management responsible for the process and identify issues.
  4. Identify and evaluate the effects of significant deviations from the plan.
  5. Identify problems in the process and in the plan.
  6. Take corrective action when requirements and objectives are not being satisfied, when issues are identified, or when progress differs significantly from the plan.
  7. Track corrective action to closure.
- GP 2.9 Objectively Evaluate Adherence
- GP 2.10 Review Status with Higher-Level Management

d) Target status

According to the project manager, the proposed target situation needs to agree with the general description of level 4-GG 3.The description of level 4-GG 3 is as follows:

GG 3 Institutionalise Defined Process

- GP 3.1 Establish a Defined Process
  1. Select the standard process that best fits the specific instances from the organisation's set of standard processes.
  2. Establish the defined process by tailoring the selected standard processes and other process assets according to the organisation's tailoring guidelines.
  3. Ensure that the organisation's process objectives are appropriately addressed in the defined process.
  4. Document the defined process and the records of the tailoring.
  5. Revise the description of the defined process as necessary.

- GP 3.2 Collect Improvement Information
  1. Store process and product measures in the organisational measurement repository.
  2. Submit documentation for inclusion in the organisational library of process-related assets.
  3. Document lessons learned from the process for inclusion in the organisational library of process-related assets.
  4. Propose improvements to the organisation`s process assets.

The result of Process Practices analysis is as follows:

Process Practices				
Status	Prior to	At termination	Target	Gap
Maturity level	2-GG 1	3-GG 2	4-GG 3	3-GG 2

6.2.4 Summary and findings

- Vendor used the project to train own new inexperienced staff.
- Organisations need to have in the contract the qualifications of the vendor's staff and require prior approval for any change or new recruitment. This is because the vendor's staff had high turnover. Experienced staff agreed upon by the organisation were assigned to the project for a short time, only at the beginning of the project. Many of the vendor's new staff who came into the project had little experience, where many of those said on occasions that they were "filling time between the jobs" until they found a better job in their own countries.
- It is important to recognise when measuring the organisational readiness to focus on the staff in the organisation that will be available for the project. There might be a competent staff in the organisation but who will not be available. It might be, as in this case, only the inexperienced staff that are available.
- The vendor asked for a key person of each of the users' functions to participate in the system testing to approve the new systems' functions. This made the approval to be subject to this one person's prejudices and reservations. It could have been different if the approval was through a team representing each user's function.
- Lack of positive relationships between different groups in the organisation caused resistance to needed change in structure and processes.

- Because key staff considered keeping knowledge and experience to themselves as a job security tool, they were not forthcoming in cooperating with the project team. This was complicated by the almost complete absence of systems' documentation, and the little documentation that existed was obsolete or not comprehensive.
- The individualistic culture almost entirely prohibited the existence of in-house training programmes for new and junior staff by senior and key staff. Those programmes that were rarely conducted were largely ineffective because they lacked the practical know-how knowledge and documentation.
- The lack of decisive leadership by top management allowed the conflicts between different entities in the organisation to go on in an increasing mode until the end of the project, which had a negative effect on the project success.
- The lack of strong support from the top management prevented the project team from implementing necessary changes in the processes and structure.
- The project team did not make an effort to relieve the tension in the relationship that occurred with users that was caused by the introduction of the project. They should have introduced a user awareness programme that would explain the benefit of the project and work towards eliminating unfounded suspicions.
- Level 3 Leadership does not fully apply in government institutions such as ServInst. Such a government-run organisation would consider IS/IT mainly as a utility to provide services. This does not call for a modification to the model but to caution when using the model for government organisations.
- The project leader thinks that the vendor's main concern at that time was to win the contract, so the vendor stayed away from highly sensitive areas such as culture, processes and structure that might cause it to lose the bid.

- Because top management caved in under the pressure of both IS/IT unit and user groups, the project team was not allowed to modify the organisational structure when it was obviously needed to solve some of the design problems that appeared later in the project.
- The new system design was not successful in resolving the ownership of the data within the organisation. This was an issue that caused user resistance to the project.
- The vendor treated the project as if it was building a new system in an organisation that had no prior systems. The new design changed all the interfaces and environment that the user was used to. This caused resentment of the user. The new design was understood to imply to the users to forget their experience and knowledge that they had built over many years. This knowledge and experience is considered by many key users as giving them their value in the organisation. It was perceived by many users that they would start a fresh if this system was to be implemented. This problem is even more dramatic than it sounds because most of the people and especially the key staff on both IT/IS and users sides, knew of IT/IS only through the current old system, and at this organisation only. They had not been subjected to IS/IT in any other context. Almost all of them had no IS/IT course work during their schooling years. Almost all of them come from non-technical educational disciplines and backgrounds. They were subjected to IS/IT and trained only in this organisation and on this system. Most IS/IT personnel do not even own computers at home. Working with IS/IT for many years at one of the pioneering organisations in introducing IS/IT in the country became a personal prestige that produces a social status in addition of being a skill and a career, especially for those in the IS/IT

unit who carry the "Systems Engineer" title. To think that the new system would deprive them of all of the status they gained and return them to square one by becoming trainees instead of the experts was a cause of strong resentment by almost all the key organisational staff.

- The 'strategic study' did not address the real problems with the system. For example, the user managers had to answer a questionnaire with a multiple choice answer regarding enhancing the performance indicators of the work task. Many of the performance indicators were not applicable to the actual situation. Those indicators were important for the vendor's own experience in other countries' environment where the questionnaire was originated, such as saving time and money, customer satisfaction, etc.. Those were the not the actual indicators for the user manager.
- The withdrawal of the vendors' experienced staff who were agreed upon had negatively affected the organisation's trust in the vendor. The organisation did not have this issue in the contract and took the vendor's initial agreement as being enough of an assurance. Also, the organisation understood that the vendor would do its best for the project to succeed because it would give the vendor a good reputation in the local market.

Project Manager comments regarding the readiness/GP model

> " I am surprised that many of the problems that we fall into have been detected by the model, had we had such a tool the project outcome could've been much different"

6.3 Oilco Case Study

6.3.1 Background and History

In 1934, Oilco was established by two major international oil companies in a partnership with the country's government. The company was initially involved in exploration of oil and gas, on-shore and off-shore. In 1938, oil was found in commercial quantities, and in June 1946, the first crude shipment left this country, where oil exports started to be and remain its chief source of income. In 1975, the government took over 100% of Oilco. In February 1979, Oilco inaugurated its first commercial gas project. In late 1990, and because of an international political conflict, about 80% of the Company's installations and infrastructure, including its IS/IT, were destroyed. The company was able to rehabilitate and repair much of the oil installations and the company's infrastructure around the middle of 1991. Out of the ambitious plan set out by the company for rehabilitation operations, the IS/IT project, which is the subject of this case study, has come about.

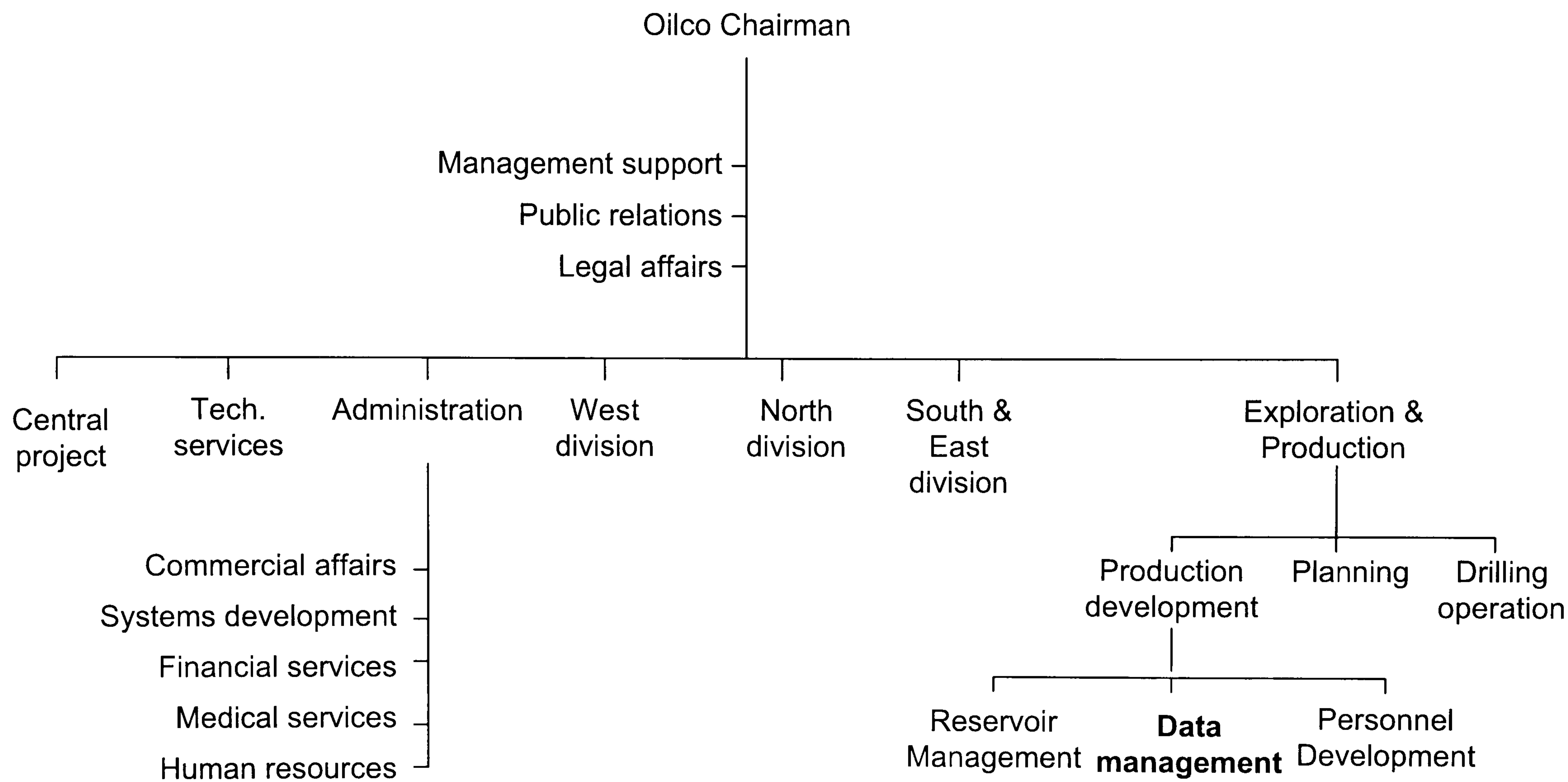

Figure 6.3: Oilco Organisational Chart

6.3.2 Sequence of Events of Project

- In 1992, as part of the rebuilding activities of the destroyed infrastructure, an international oil consultant rated the state of Oilco's data as 2/10 of how it should be. The chairman and his deputy EMD (Executive Managing Director) expressed the need for a project that would resolve this serious problem.
- Later in 1992, various feasibility studies for a data management project were solicited from different international vendors. Those studies were conducted to produce proposals for tender by mid-1993.
- In 1994, and as part of the rebuilding activities, an organisation-wide communication network of a general-purpose nature was implemented and in 1996, Oracle was chosen to be the 'backbone' relational DBMS for Oilco applications.
- In 1996, Oilco's central IS/IT migrated from the different IS/IT platforms that existed to a unified Unix network platform.
- In June 1996, an Exploration & Production Data Management (E&P-DM) steering committee was set up to oversee E&P Data Management project implementation.
- In the early days of the E&P-DM steering committee life, it was decided but was not announced officially because of political reasons, to go with GeoQuest Finder database package for the Oilco Data Management system. This was done after reading the different vendors' proposals that were made in 1992/1993, but mainly because the members knew that GeoQuest Finder (Table 6.2) was used at other regional oil companies in other countries in the region.

What is Finder?

1. As an integrated data management system, Finder supports on-line storage of company's information, such as well headers, seismic navigation and production data. Data are stored in a unique, industry-standard data model, which is based on the Oracle relational database management system.
2. Managers, geoscientists and engineers can access Finder as the main source for verified and approved data, which can be viewed, selected and retrieved for data analysis and interpretation. Final results of an interpretation can be saved in Finder's master database for long-term storage.

3. Finder integrated data management system environment consists of:

- Finder - master on-line integrated database system which is integrated with database manipulation software tools:

    - Enterprise - Finder Enterprise represents the concept of 'one-stop-shopping' for all types of company's E&P data that might be stored in different databases. It is the central component in Finder integrated data management system and is the core tool that Finder uses to manipulate data. With Enterprise the company can register all its databases, whether they are in-house developed or commercial third-party, into an integrated federation of databases. Enterprise maintains and synchronizes indexes of all information in the company's registered databases or applications.
    - AssetDB - physical data asset archival application. It organises and catalogues physical assets, such as core samples, well reports, seismic sections and logs on paper or film, financial documents, and maps. AssetDB offers fast search capabilities and complete on-line ordering procedures for selected assets. Electronic documents of any origin and type, including scanned images and files created by word processors, can be organised and maintained by this tool.
    - GeoWeb – a platform-independent, web-enabled data browsing application. It allows users to view, search and retrieve E&P data stored in Enterprise-connected databases over Internet or intranet networks, according to company business rules and security procedures. It allows access to company data worldwide.
    - LogDB - log archival and management application.
    - SeisDB - seismic trace archival and management application software. By archiving the original log and seismic data using this and LogDB applications, the company can protect its E&P data, which is a valuable asset for oil companies. These tools allow a large number (hundreds of thousands) of original data tapes to be placed on any high-density media, allowing this original data to always be available to the users on-line. These two tools should reduce the cost of maintaining log and seismic tape archives, which is a problem that the oil sector in general suffers from.
    - SmartMap - a map viewing application to visualise, browse, query and analyse all E&P mapping data.

Table 6.2: What is Finder?

- GeoQuest was then asked to conduct a new feasibility study for the project, which was completed in December 1996.
- Because of the long administrative routines, due mainly to complicated governmental regulations, Finder system was finally chosen in 1998 to be used for the implementation of the company's E&P Integrated Data Management System, and a contract was signed with Schlumberger GeoQuest.
- The Integrated E&P Data Management Project began in mid-1998, as an alliance project between Schlumberger GeoQuest and an Oilco project development team under a financial group that was moved later to be under Exploration & Development Group.

Project objectives

- The main objective of the Integrated Exploration & Production (E&P) Data Management Project was to migrate multi-disciplinary E&P data related to production, reservoir, geologic, geophysical, petroleum, drilling and surface facilities from several legacy systems, hard copies and/ tapes to a modern, secure and robust integrated database system using a commercial package named Finder. Easy data access to the integrated E&P database was expected to greatly enhance staff productivity. An internal company study had shown that the company's geoscientists spend about 35% their time on data search (hardcopy, diskettes, Excel sheets, Access sheets, legacy applications), reformating and re-organising. This project was to cover the data for four predetermined geographical oil-producing areas in the country: North, West, East and South; and to make the data accessible to Oilco's geoscientists, petroleum engineers, technical supervisors and their associated managers.

Other objectives

- Wider accessibility to Finder via an Internet browser interface tool (GeoWeb) that allows the data built by Finder to be accessible by management through World Wide Web (WWW). This was to provide Management with a simpler approach for data access, extraction and report generation.
- Linkage of selective production application with Finder.
- Establishing links from production operations to Finder.
- Integration of Finder with Electronic Document Management System (EDMS)
- Enabling the implementation of Data Management (DM) projects for other groups in the company.
- Finder is aimed at 500 users on an organisation-wide network. Affected divisions/units are spread over four oil production geographical areas and comprise twelve divisions/units:
    - DM : Data Management
    - DO : Drilling Operation
    - EXP: Exploration
    - FDD: Field Development (3 divisions in North, South, and West geographical areas)
    - PO: Production Operation (4 divisions in North, South, East and West geographical areas)
    - GO: Gas Operation
    - RM: Reservoir Management

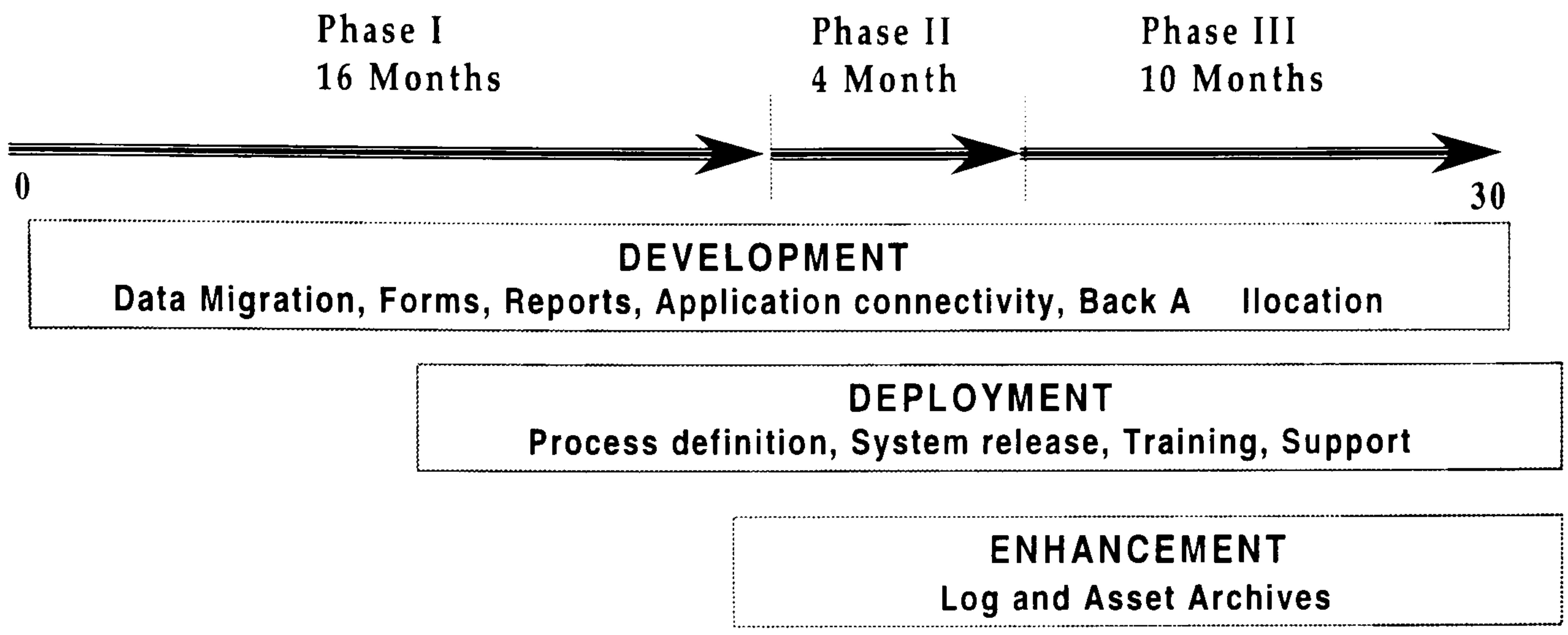

Figure 6.4: Oilco Project Phases

- Implementation of the project was in three phases over 30 months, (Figure 6.4).
- Joint Oilco/GeoQuest alliance team was to implement phase I (seven stages) of the project with GeoQuest executing Phase I for North area and to carry out training, Oilco staff to conduct almost the same steps in Phase II for West area, and Phase III for South & East areas, where the vendor would have an advisory role during Phases II and III (Table 6.3).
- The project started in June 1998, where GeoQuest role was:
    - o Initiation and project environment set-up which included project management and control procedure, setting of project plan, index and list of the digital data to be loaded, conducting a detailed user requirement, and setting procedures for data acquisition.
    - o Loading of historical data for North area such as seismic related data, production related data, reservoir data etc.
    - o Setting a convention mechanism for transferring data to other Oilco application programs.
    - o Loading of the new data that is generated during Phase I for North area.
    - o Replacement of Production Accounting Extension system (an old statistical system for production data).

- o Training of Oilco project team where Oilco team role was to work closely with GeoQuest team and learn from them.

Phase I (Development)

Aim and Objectives of Phase I of project

- Migrate multi-disciplinary E&P data related to production, reservoir, geologic, geophysical, petroleum, drilling, and surface facilities from several legacy systems, hard copies, and tapes to Finder for the North area.
- Make Finder accessible to Oilco geoscientists, petroleum engineers, technical supervisors and their associated managers.
- Load seismic and reservoir data for North area.
- Receive services from GeoQest to train Oilco staff to conduct Phases II & III of data classification and entry for West and South areas.

Deliverables

- Migrate production data from legacy databases of North area
- Generation of Oil Ministry Monthly Production Reports.
- E&P applications connectivity to Finder & links with other Oilco systems.

Phase II (Deployment)

Aim and Objectives of Phase II of project

Deploy the DM system to end-users by:

- Installing adequate user-oriented hardware and software and network for Finder to go live.
- Identifying and changing business and dataflow processes for capturing, validating and storing all pertinent E&P data.
- Providing tailored Finder users with a training programme based on users' needs and disciplines.
- Supporting the system with a skilled DM team to operate maintain, and manage the 'live' Finder system.
- Providing DM Coordinators to be allocated within user groups on user sites.
- Conducting awareness programmes to overcome users' sceptical and reserved attitude towards the system.

Deliverables

- Effective data workflow and service lines
- Validation and management of data.
- Generation of daily task data and reports.
- Web-enabled data query and access.
- Export/import of data to/from E&P applications.
- System and database backups to be run daily, weekly and monthly, with backup tapes are kept off-site to provide data security and to ensure disaster recovery capability.

Table 6.3: Project phases aims and deliverables

Difficulties faced in Development

- Data preparation took longer than expected because the old data were spread around the company's installations in different forms with no unified filing system, and sometimes, no filing system at all.
- Administration-related difficulties like visas for staff and high turnover of GeoQuest people, where some of the more qualified people were transferred to other projects in other countries and new less experienced or inexperienced staff were brought in.
- In the development phase, some of the user requirements were not clear regarding, for example, forms and reports. Also, development was based on existing business and dataflow processes.
- User feedback was low due, in the major part, to the unenthusiastic user attitude towards the project.
- Many of the Oilco team had to be trained with the basic skills related to the IS/IT project during the project's development. They were expected to have such skills as those of Unix and Oracle.
- Also, many of the team members did not have full-time commitment to the project in the initial stages because they were staffers in other teams in the company and were assigned only part-time to the project.

Difficulties encountered in Deployment

- In planning, the deployment team faced difficulties with users' acceptance of change in their work process.
- The team also faced uncertainty on the time and resources required for the completion of its task.
- With the structure, the project span was multi departmental and because of the lack of flexibility, the structure remained as it was even when change was needed.
- Obtaining support of a Top Management directive to go forward. The team also had difficulties with regard to users' co-operation throughout the deployment activities.
- Also, the lack of experience among most of the team members caused difficulties and delays in performing tasks.
- As the case was with the development team, many of the deployment team had to be trained during the project with the basic skills related to the project such as Unix and Oracle skills. Team members needed those skills to be useful in the project.
- Also, many of the team members did not have full-time commitment to the project because they were assigned to other tasks in their original groups in the company. Most of the team members were assigned to the team on a part-time basis until advanced stages in the project, when top management assigned them fully to the project.

Table 6.4: Difficulties faced in project

- After six months on the project a number of problems surfaced. Examples of those shortfalls are that the contract did not state what would happen after the data were entered into the database; how the users were going to be connected to the system and whose responsibility it would be to train them. It did not even specify whose responsibility it was to install the needed hardware for the users to be connected to the system. Also, it did not state whose responsibility it was to collect, gather, and fetch, the old data from different sites in the company and clean and convert them to a readable format for data entry in the new system. Such problems caused delays and budget overruns that almost caused the termination of the project (Table 6.4). Because of these difficulties a system implementation team was formed entirely from Oilco staff to overcome these problems.
- Even though it was not planned for, but for the purpose of overcoming some of the problems stated above, a deployment phase in the project was started six months after the beginning of the main Data Management project and in parallel with the development phase.
- The deployment team was formed in an ad hoc fashion, bringing people from different areas in the company who, in most cases, had no previous knowledge and experience related to the project.
- The company went into top management change at about mid-life of the project.
- At the end of project, the project team started an awareness programme targeted at users, and focused at user managers to promote the use of the system.
- In 1998, the project started with only 13 licences for Finder use by the DM team members, and the hardware was a small server of little capability.

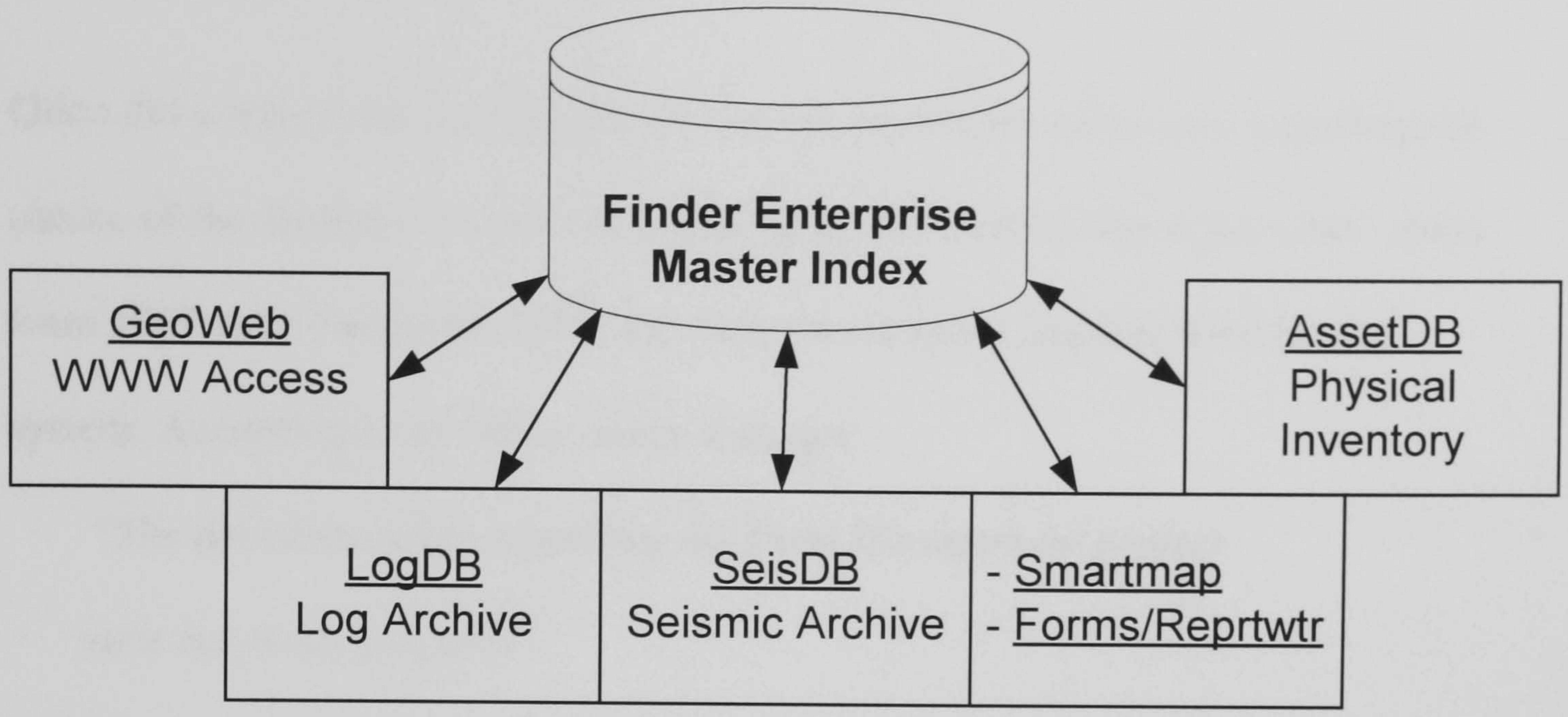

Figure 6.5: Finder integrated data management system environment

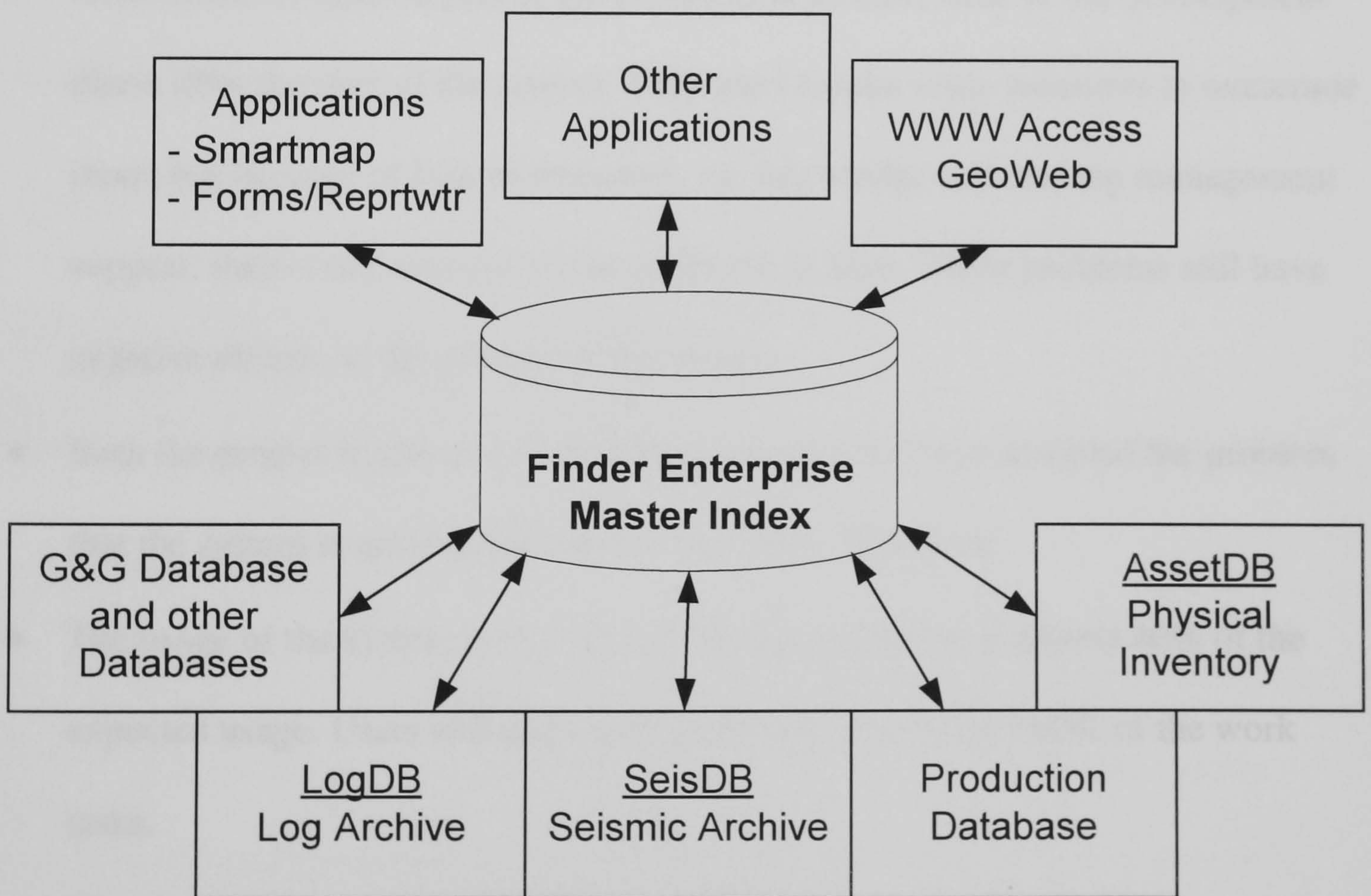

Figure 6.6: Oilco E&P Data Management Project

General Remarks

- Oilco did not have the knowledge and expertise to make a decision regarding the choice of the database system needed, which contributed to the eight years' delay form 1992 until December 2000, the time the company implemented Finder system. According to an Oilco senior manager,

  "The decisions taken regarding the Data Management project were not made properly".

- The project was not developed as the consultant proposed in the feasibility study. No consideration was given to the preparation steps in the actual contract with vendor. In the initial study in 1996, the vendor recommended some pre-steps and Oilco's old top management did not approve them because of financial issues.
- Oilco team recognised part of the problems at an early time in the development phase after the start of the project. They tried to take some measures to overcome them, but because of lack of resources, i.e. knowledge and real top management support, they could not resolve the problems in time. Those problems still have negative effects on the success of the project.
- Both the project leader and the implementation team head admitted the problem that the system is not used by users in the way it should be.
- The usage of the system at the time of writing this thesis is around 40% of the expected usage. Users still rely on their old ways to conduct 60% of the work tasks.
- The problem caused by Oilco old top management's decision not to approve the recommended pre-steps produced by the consultant was compounded by

GeoQuest's acceptance to submit a different proposal from the initial one, for building a system in a way that could be easily foreseen to end with failure.

- The final proposal by the vendor did not address what to do next after loading the historical data. It did not address the needed hardware and software licences, training, processes, organisational structure, skills, user and management issues, etc.. The proposal even missed addressing some issues prior to loading the historical data, such as fetching, collecting, gathering and cleaning the old data.
- New top management became interested in having this project succeed and they gave it considerable support.

6.3.3 Analysis and Discussion

The following sections address each attribute of the four domains of the readiness/GP model within the context of Oilco.

6.3.3.1 People

1) Staff

People		
Staff	Skill	Head of IS/IT

a) General comments

- The project leader came to the project only a month prior to the official start date set by the contract, when he was allocated a team of thirteen partly dedicated personnel. Almost all, including the project leader, had no prior experience in IS/IT-related projects and did not know what was the nature of the project.

- During the project, major changes in the staff status occurred and the team ended with twenty-five personnel, mostly different from those who were appointed at the start of the project due to the newly hired staff and the support given by the new top management to bring in more qualified personnel from other areas in the company.
- The Oilco project team were not fully dedicated to the project at its initial stages. This was true for both the development and deployment teams. This problem was mostly resolved towards the end of the project.
- The project suffered from lack of adequate human resources, in terms of quantity and quality, until the late stages of the project life.
- The vendor/consultant staff went through changes throughout the project life.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 2, because the available IS/IT staff for the project consisted, in addition to a few programmers and low level technicians, of a few system analysts, and the recently appointed group head/manager. The small IS/IT staff consisted, in addition to programmers and low level technicians, of system analysts where qualified individuals (mainly programmers and analysts) were selected, recruited, and transitioned into assignments:

- o DP manager who was recently appointed is responsible for IS/IT function
- o IS/IT staff are now charged with the responsibility of adequately understanding the user requirements needed for systems' development
- o New user recruits are expected to have basic IS/IT skill

c) Status at end of project

The status of the staff at the end of the project mostly agrees with the general description of some level 3 characteristics, because in addition to the programmers and analysts, there exist dedicated database administrators who were appointed during the project. Also, almost all needed technical specialist staff are now in the team and the team head was promoted to manager status. The IS/IT staff are coordinated with current and future IS/IT needs at both the organisational and unit levels in regard to Finder, and users are expected to have specific IS/IT-related skills to use Finder. Level 3 description is as follows:

- Added to the programmers and analysts, dedicated IS/IT planners and database administrators are appointed
- Almost all needed technical specialist staff are in-house
- A technically-oriented IS/IT manager is appointed or DP manager might have a change in title
- IS/IT workforce are coordinated with current and future IS/IT needs at both the organisational and unit levels
- New user recruits are expected to have specific IS/IT-related skill

d) Target status

The current situation (level 3) seems to fulfil the proposed target situation concerning the staff attribute. The group seems to have enough personnel for maintaining and updating the system. The corrective steps taken by top management, and the project and deployment team leaders were fruitful in providing both development and implementation teams with the needed staff who fit level 3 description. Providing the budget for hiring the needed staff, allowing qualified staff to join the team from other groups in the company, and promoting the team head to a middle management status, all contributed to the achievement of the target staff level.

The result of Staff analysis is as follows:

People Staff				
Status	Prior to	At end	Target	Gap
Maturity level	2	3	3	-

2) Skill

People		
Staff	Skill	Head of IS/IT

a) General comments

- The project started with a level of skill lower than it actually required to be successful. The project team, in general, did not have even the minimum needed skill and received no relevant training prior to the start of the project.
- The consultant's 1996 study recommended that prior to the project, the project team should acquire at least some skill in dealing with UNIX and Oracle related issues. This recommendation was not applied.
- Training of the project development and deployment teams was conducted during the project.
- There was a lack of adequate skill on the vendor/consultant side. About 50% of those on the vendor/consultant side were inexperienced.

b) Status prior to project

At the beginning of the project, the status of skill of both the users and IS/IT people involved in the project mostly agreed with the general description of level 1 because staff did not have the required skills or the knowledge of the organisational needs behind the project. These staff were allocated to the project from different parts of the organisation with no specific related skills. The description of this level in the readiness model is as follows:

- Users find it hard to acquire the skills to use the few IS/IT that exist and skills are individually based and jealously guarded from others

- The emphasis is on technology rather than organisational or informational issues where there are very limited technical skills in the organisation/unit as a whole
- IS/IT skills are specific to individual IS/IT applications
- Needed skills are of low level technical nature and there may exist very limited advanced (programming or systems analysis) skills in the organisation
- There is almost no IS/IT training provided by the organisation

c) Status at end of project

At the end of the project, there was a difference between the skill of the IS/IT staff and users. This occurred because of the support the IS/IT people received from top management, while users still suffered from the resentment for the project which hindered their participation in the training programmes and gaining experience from using the system. The situation of the users' skill improved on that before the project, but not as much as needed. The skill situation of the user staff mostly agrees with some of the general descriptions of level 2 as follows:

- Users begin to have the needed training and skills to use the new IS/IT that being developed/purchased
- Still little in-house technical expertise in IS/IT development (methodology, structured techniques) and other important skills.
- IS/IT staff acquire the skills needed to develop and maintain complete systems such as programming and analysis, in addition to being able to install off-the-shelf ready-made packages
- Limited project management skills

- IS/IT individuals have the skills required to perform their assignments and begin to have the relevant training and development opportunities
- Individuals in the organisational workforce have remuneration and benefits based on their contribution and value to the organisation

The level of skill of the IS/IT staff at the end of the project mostly agrees with some of the general descriptions of the level 3 characteristics because considerable technical competence existed among IS/IT staff after being trained and acquiring experience from working in the project. Those skills, which included programming, analysis, security, networking, etc., are being enhanced by the experience and internal half/one day seminars held within the group. Because of being faced by resentment from users, the project group recognised the need to acquire interpersonal skills and develop their project management skills which are the subject of some of the short seminars held within the group. Level 3 description is as follows:

- Considerable technical competence in the organisation because of the well developed IS/IT related skills (programming, analysis, security, networking etc.)
- The organisational workforce are constantly enhancing their IS/IT capabilities to perform their assigned tasks and responsibilities
- DP/IS/IT manager and staff lack, but work on building, interpersonal skills
- Project management is realised to be needed in this stage, which results in well developed project management skills

d) Target status

- The current situation (level 3) seems to fulfil the needed target situation concerning skill of IS/IT staff. They seem to have needed skill for operating, maintaining and updating the system. The corrective steps taken by project leader and deployment team head by providing training to the teams' staff while in the project, and the support received from new top management which allowed providing both development and deployment team with the needed skill either by new staff recruitments or training the existing ones.
- The user skills need to be improved to reach level 3 which seems to be the adequate level for such a system that requires the skills for using it, and users need to work constantly on enhancing their IS/IT capabilities to perform their assigned tasks and responsibilities.

The result of Skill analysis is as follows:

People Skill				
Status	Prior to	At end	Target	Gap
Maturity level	1	2(user), 3(IS/IT)	3	Level 3 (user)

3) Head of IS/IT

People		
Skill	Staff	Head of IS/IT

a) General comments

- At the beginning of the project, the head of the project was considered to be the team head inside a division that was supplying administration services.
- The new top management thought that this project was of a technical nature not administrative, so the team was moved and upgraded to become a group and the project head became the Data Management group manager in a technical-oriented division (Exploration and Development).

b) Status prior to project

At the beginning of the project, the situation mostly agreed with the general description of level 2. The description of this level in the readiness model is as follows:

- o There is a DP manager under a financial control group

c) Status at end of project

Currently, at the end of the project, the Head of the Data Management became a manager with technical nature job, which agrees with the description in level 3, which is as follows:

- o There is a new IS/IT manager appointed, or DP manager might have a change in title, who is viewed as a technocrat

d) Target status

The proposed target situation for the Data Management head is to be of middle manager status, but not viewed as a technocrat, to be able to participate in the business-related decisions where s/he can bring into them the technological perspective. It seems that top management views and attitudes are moving in this direction. This needed situation should mostly agree with the description of the level 4 characteristics. The description of level 4 is as follows:

- There is an IS/IT manager who has middle manager status.

The result of Head of IS/IT analysis is as follows:

People Head of IS/IT				
Status	Prior to	At end	Target	Gap
Maturity level	2	3	4	Level 4

6.3.3.2 Environment

1) Leadership

Environment		
Leadership	Culture	Structure

a) General comments

- Top management did not want to pay for the full solution/project in the beginning and told the project team that they could ask for more at the time the money was needed, even though it is known that the budget-approvl process in the company takes more than a year.
- Top management view of IS/IT and the project changed by the change of top management persons that occurred about half way into the project life and the situation improved to become as described by the project leader

  "It became so that whenever we raised a budget they approved it without constraints."
- Top management were kept informed regarding the project status by a monthly news letter along with monthly, quarterly, and annual progress reports, and by regular feedback by the project team manager during senior management meetings.
- Leadership assessment before the project of the old top management fitted the criteria of stage one.

b) Status prior to project

At the beginning of the project the status mostly agreed with the general description of level 1. The description of level 1 in the readiness model is as follows:

- Has little concern for the potential utility of IS/IT

c) Status at termination of project

The status of the leadership at the end of the project was improved dramatically by the change of top management to agree mainly with level 4 characteristics, because of new management that considers IS/IT to be vital for smooth functioning of operations. The description of level 4 for leadership in the readiness model is as follows:

- Considers IS/IT to be vital for smooth functioning of operations

d) Target status

For a system so vital to a company in the oil sector, where oil is the main economic source of income to the country at large, the integrity and ease of accessibility to data of such importance requires a management that, at least, considers IS/IT crucial for the company's operations, which requires providing the needed budget and support to an IS/IT project as important as the E&P Data Management/Finder project. The current leadership level is adequate as a target level.

The result of Leadership analysis is as follows:

Environment Leadership				
Status	Prior to	At end	Target	Gap
Maturity level	1	4	4	-

2) Culture

Environment		
Leadership	Culture	Structure

a) General comments

- Users were not involved from the beginning in the project. They were not involved in requirement specifications and process change decisions.
- The organisation suffered from lack of trust and communication between IS/IT and user groups. This was manifested in the users' spreading of what IS/IT people felt as "false rumours" regarding the capabilities of the Finder system to top management.
- The project team did not consider the culture issue until it was obvious that it was an obstacle to the success of the project and, even then, they did not know how to deal with it until the project was almost finished.
- At the end of project, the project team started an awareness programme targeted at users, and focused at user managers to promote the use of Finder system which was mostly ignored.
- The team also allocated support personnel at user sites and had a help desk along with Internet project page for fault reports and inquiries.
- After the execution of the above steps, the use of the system went from 10% to 40% in three months.

b) Status prior to the project

The cultural situation from the beginning of the project until just before the end was mostly in agreement with the general description of level 1. This situation was one of lack of cooperation between the development team and users. The description of this level 1 in the readiness model is as follows:

- The relationship between user and the limited low-level technicians that may exist in the organisation or contracted from outside is of support for the existing IS/IT products that are mainly off-the-shelf ready-made packages.
- There is no recognition in the organisation of the importance of working towards building a constructive relationship between IS/IT function and users.

c) Status at end of project

The status of the culture at the end has improved after the introduction of the user awareness programme and allocating the support personnel on-site with the users. The current situation agrees with the general theme of level 2 cultural characteristics in the readiness model. The description of level 2 is as follows:

- IS/IT function wants to satisfy user needs but there is no control of user IS/IT- related activities
- The organisation start to recognises the need for building the capabilities for implementing timely communication across the organisation and for the workforce to acquire the skills for sharing information and coordinating their activities efficiently

d) Target status

Still, the organisation needs to improve communication and implement a program that takes it to meet the criteria in level 4 for the system to be fully successful. The system spans many groups in a complementary workflow fashion. There is a need to have integration between workgroups, among which is the IS/IT unit, for the system to be fully successful and improve the efficiency and quality of interdependent work. This proposed target situation mostly agrees with level 4 characteristics of culture in the readiness model. Before the groups reach this level, IS/IT needs to have control on activities regarding the workflow concerning the system. Without such control and making them aware of the benefits, users will continue ignoring the system and keep doing work according to their old ways. This intermediary level mostly adheres with the general description of level 3 characteristics. The following are the descriptions of levels 4 and 3:

Level 4

- IS/IT function supports the activities of users.
- There exists an emphasis on organisational integration between workgroups among which is the IS/IT function.
- Workgroups (IS/IT and users) have the responsibility and authority for determining how to conduct their business activities most effectively.
- An improvement in the efficiency and quality of interdependent work, resulted from the integration of the capabilities and knowledge of different workgroups on both IS/IT function and user sides, and with each other.

Level 3

- IS/IT function seeks control over the activities of users concerning IS/IT matters, which is faced by implicit and explicit resistance.
- There exists a flow of information within the organisation, where voices start to be raised for using this flow of information to incorporate the

knowledge of individuals into decision-making processes, and to gain their support to establish work commitments on both IS/IT function and user sides.

The result of Culture analysis is as follows:

Environment Culture				
Status	Prior to	At end	Target	Gap
Maturity level	1	2	4	3,4

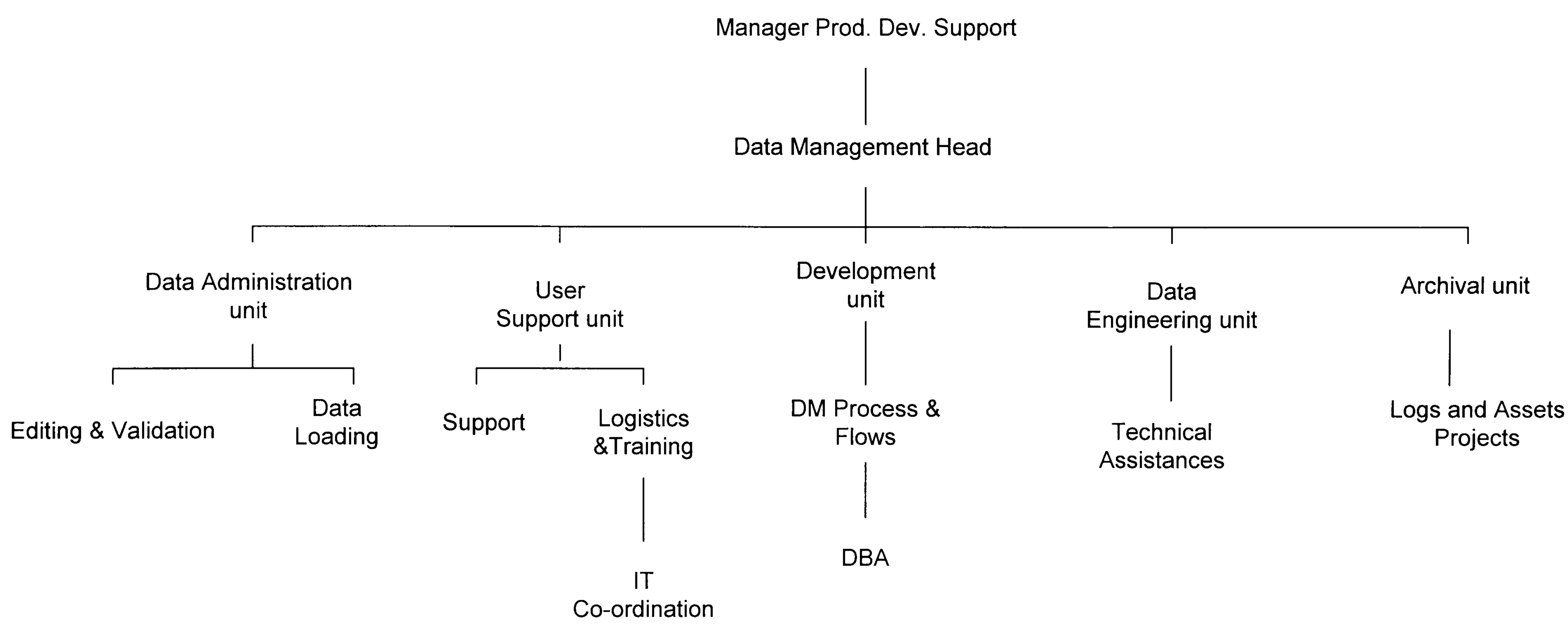

Figure 6.7: Oilco Structure of Data Management

3) Structure

Environment		
Leadership	Culture	Structure

a) General comments

- Data Management was a team inside a division that was supplying administration services. New top management thought that this project was of a technical nature, not administrative.
- The organisational position of the Data Management unit (Figure 6.7) was not taken into consideration from the beginning, and it was a source of some problem during the project when the team was under an administrative-oriented division that did not fully understand the team's needs. Also, the hierarchal position of the team and its head did not provide enough power to be taken seriously enough when interacting with user groups and management.
- The internal structure in the Data Management team/group was formed at the beginning of the project according to the vendor's recommendation, and it went through until the start of deployment where the structure changed at Data Management unit. This was done because the needs at the deployment phase changed.
- Structure at Oilco is rigid. It is very difficult to do any kind of restructuring; there is no flexibility.
- No restructuring was performed on the user side because of the inflexibility in Oilco structure, even when it was seen to be needed.

- Close to the end of the development phase, new management were convinced that the project team should be a group by itself. Data Management team was given more weight, where the project leader was promoted and the project team became a function under a technical division (Exploration & Development). This gave the team more power and started to demand more co-operation from user groups.

b) Status prior to project

At the beginning of the project the status mostly agreed with the general description of level 2, because the group/team had recently been introduced where they were assigned the responsibility for developing the system. Also, responsibility for IS/IT is decentralised among groups, where groups have full freedom in managing their IS/IT with increased self-reliance regarding IS/IT matters, which is apparent throughout the organisation. The description of this level in the readiness model is as follows:

- Separate DP/IS/IT function has recently been introduced where groups are encouraged to seek advice from this newly formed central IS/IT function.
- There is a decentralised responsibility for IS/IT function, where groups have full freedom in managing their IS/IT with increased self-reliance regarding IS/IT matters which is apparent throughout the organisation.

c) Status at end of project

The current structure situation is the same one that was formed towards the end of the project when the project team's position was elevated. At the time, the structure situation started to agree with the general theme of level 3 characteristics, which are described in the readiness model as follows:

- Official power is vested in the IS/IT function, where a new technical IS/IT manager is appointed or the DP manager might have a change in title to IS/IT manager which goes with a similar change in department name.
- There are an organisation-wide IS/IT architecture policy and standards for telecommunications, preferred suppliers, e-mail, etc.
- Management of the IS/IT function is centralised.
- IS/IT staff seek control of IS/IT matters.

d) Target status

The current structure situation would be enough to achieve most of the project's aims. For the system to be fully successful by serving as a base for other Data Management systems organisation-wide, the structure situation needs to have the position of IS/IT unit on a higher level to be able to coordinate this bigger task. The proposed target situation needs to mostly agree with the level 4 characteristics described in the readiness/GP model is as follows:

- IS/IT function is well established and its mission is to exploit the IS/IT for business purpose and provide competitive IS/IT in a partnership environment with users.
- Decentralised responsibility of IS/IT services with central standards and policy for coordination, implementation and utility.
- Units' IS/IT function reports to units' business manager.
- Significant degree of involvement of users in IS/IT-related decisions, where IS/IT investments are derived from users' stated needs.

The result of Structure analysis is as follows:

Environment Structure				
Status	Prior to	At end	Target	Gap
Maturity level	2	3	4	4

6.3.3.3 IT

Systems

IT

Systems

a) General comments

- The company had an organisation-wide communication network based on Unix network platform.
- E-mail and Internet are used extensively within the company as part of day-to-day job tools.
- A relational DBMS is the basis for Oilco's application software.
- Finder database package uses RDBMS environment in implementing Oilco's Data Management system, where Finder is based on relational database rules using Oracle (Version 7.3.4) as its main driver for all of its on-line transactions.
- The DM team members started the project with one small server and little capability hardware.
- At deployment, the team recognised that more licences and a bigger server with bigger storage and power were needed.
- The deployment team had to struggle with the shortage of hardware which caused some delays until extra budget was approved, because old top management did not approve enough budget at the beginning. This was changed later with the new top management.

- The project database hardware is configured around two Sun E3000 dual 250MHz CPU servers with 1Gb of RAM each. One server is used for the live deployed system and the other for development, maintenance, and backup purposes. There is a total of about 260Gb of disk space attached to the two servers. System and database backups are being run daily, weekly and monthly, and the backed-up tapes are kept off-site to provide data security and to ensure disaster recovery capability.
- All of the current users can connect to the servers from their PCs and access Finder database system from within the normal Windows desktop using the company's network.
- The graphical interface of Finder enables users to easily store, display and retrieve selected data. Finder also supports various data formats and classes.
- Currently, the system offers users the following utilities in an on-line environment:
    - Shorter cycle of dataflow
    - On-line accessibility with improved data quality
    - Automated report generation
    - Monthly production reports for Ministry of Oil
    - Data Management System loaded with all the historical and up-to-date production data
    - Connectivity with E&P applications and other corporate databases
    - Management can browse Finder's database via the Internet using GeoWeb program

- Top management started to ask about the capabilities of developing a decision support system.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 3 because IS/IT applications covering most major operation areas with office automation existed but in an isolated stand-alone manner. In different parts of the organisation, technical infrastructure consisted of unconnected systems, but systems had been implemented in most operational areas in the organisation where the use of IS/IT services varies among the business units. Also, some IS/IT application systems had been put together by users, and old user-developed systems were being used in an uncontrolled, uncoordinated manner. The description of this level in the readiness model is as follows:

- In-house IS/IT applications covering most major operation areas with office automation exists but in an isolated stand-alone manner
- Technical infrastructure consists of unconnected systems where no shared applications exist
- Systems have been implemented in most operational areas in the organisation where the use of IS/IT services varies among the business units
- Some IS/IT application systems have still been put together by users, and old user-developed systems are being used in uncontrolled, uncoordinated manner even though new systems are centrally developed, installed, and operated by IS/IT function

c) Status at end of project

The status of the systems at the end of the project mostly agree with the general description of level 4 in the readiness model. Some characteristics in this level have not yet appeared, but there has been talk about implementing them. Those are the use of DSS and the central standardisation of packages and office automation tools. There has been noticeable progress on the standardisation issue, but it has still not been applied organisation-wide. The characteristics of level 4 are described below:

- All needed operational IS/IT is mostly in place and some DSS might start to appear
- Office automation is integrated and unified/standardised organisation-wide
- Existence of an organisation-wide network, where all groups are connected and the central IS/IT function provides communication services for all groups in the organisation
- Central coordination in the use of IS/IT throughout the organisation, where an effort is made by groups' IS/IT functions to follow standards set centrally
- The organisation-wide network is starting to being utilised to connect users to whatever shared applications and information systems that are needed
- Extensive use of standard e-mail messages throughout the organisation, and there is evidence of dependence on the organisation-wide network to conduct formal communication

d) Target status

The proposed target situation still need to mostly agree with the general description of level 4 that seems to meet the needed situation for Finder to function properly.

The result of Systems analysis is as follows:

IT Systems				
Status	Prior to	At end	Target	Gap
Maturity level	3	4	4	-

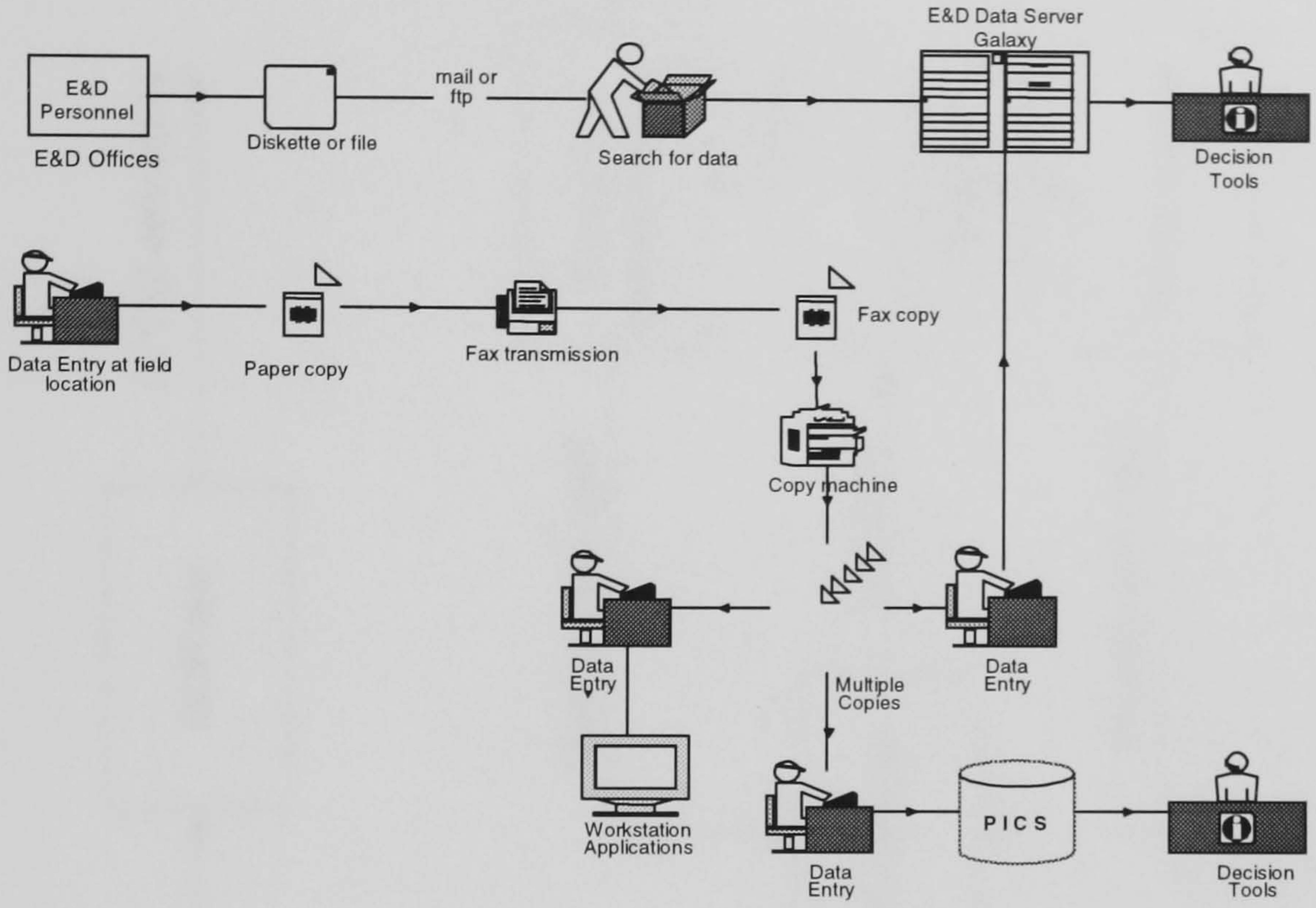

Figure 6.8: Data Workflows – Before improvement

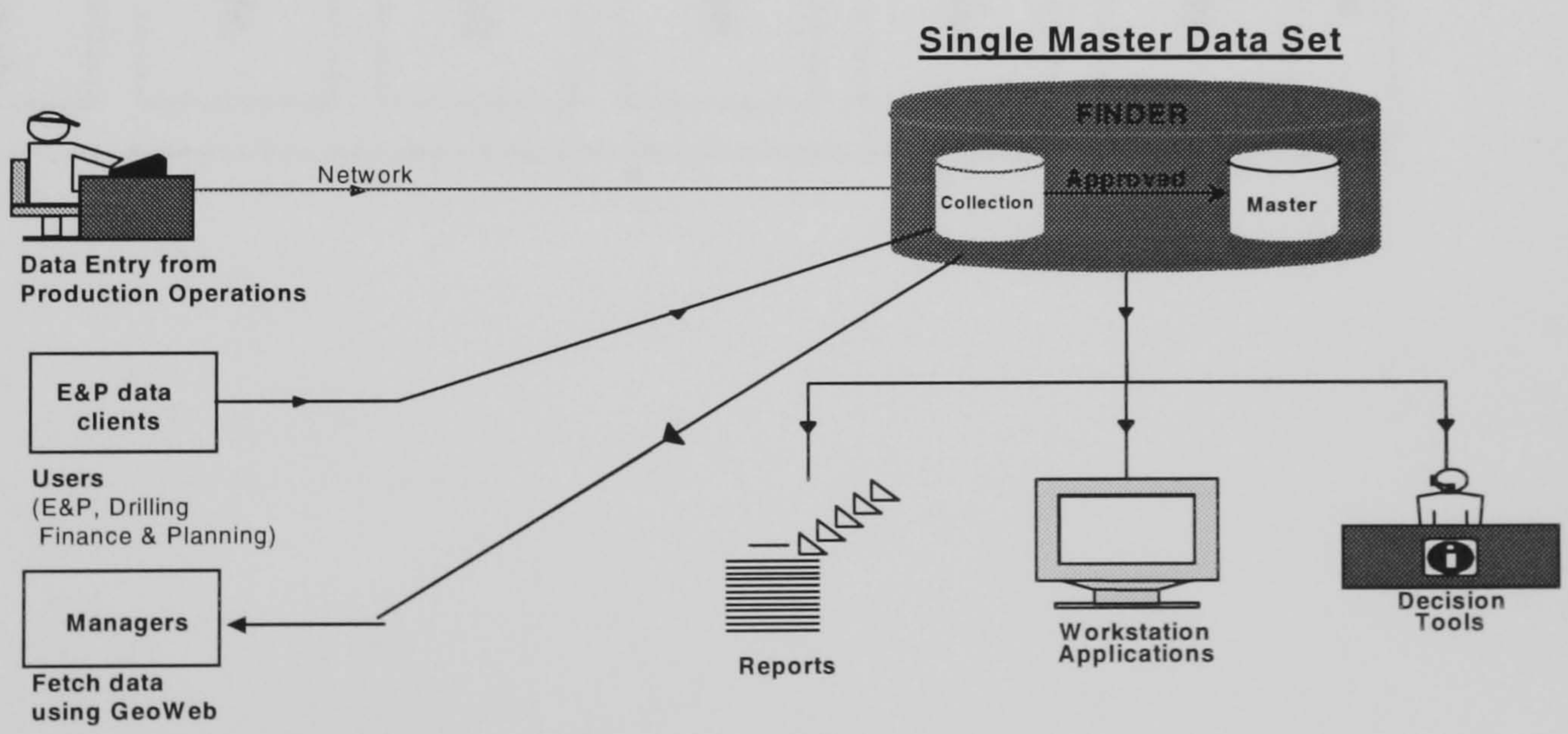

Figure 6.9: Data Workflows – Improved

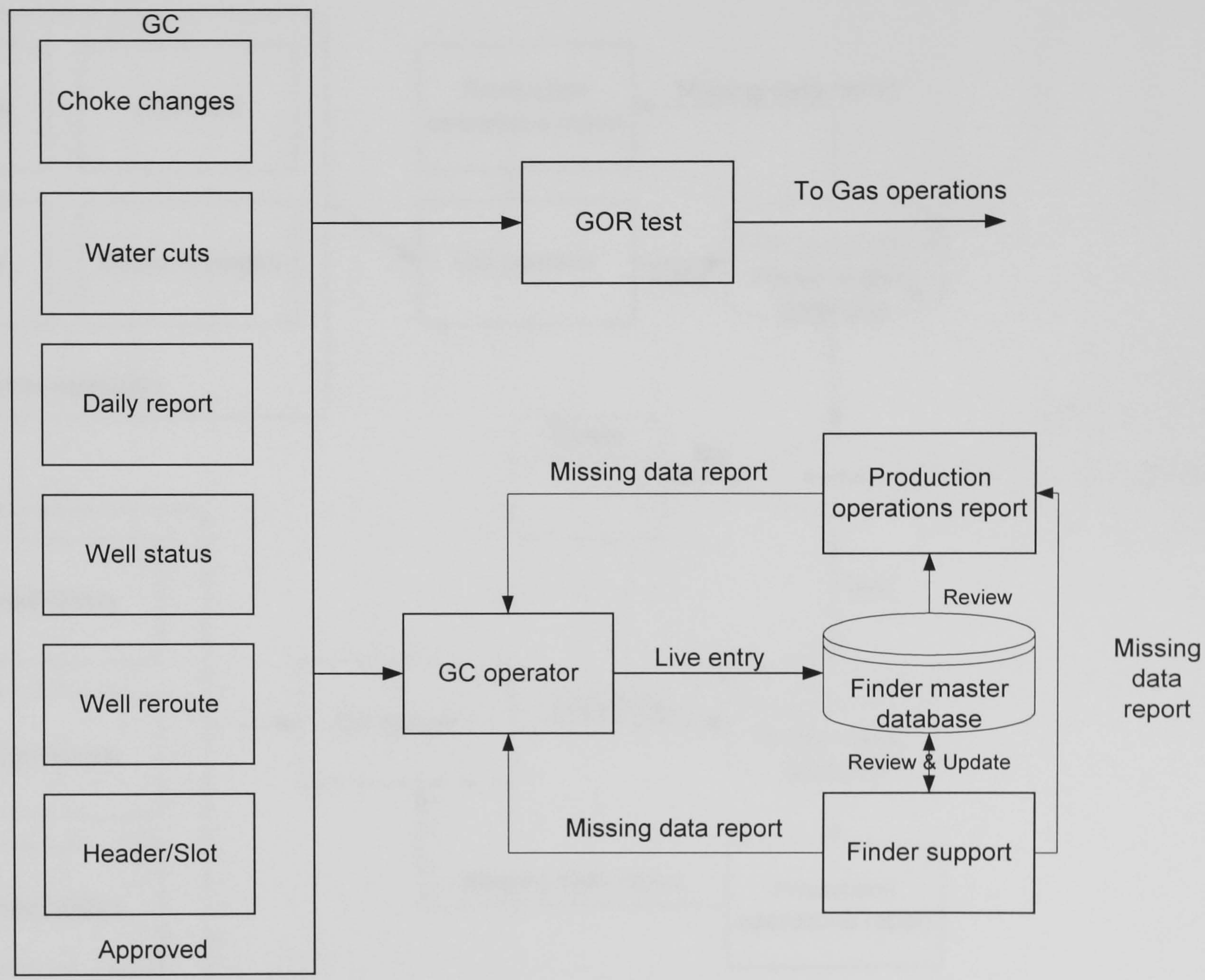

Figure 6-10: Old GC Daily transaction data flow

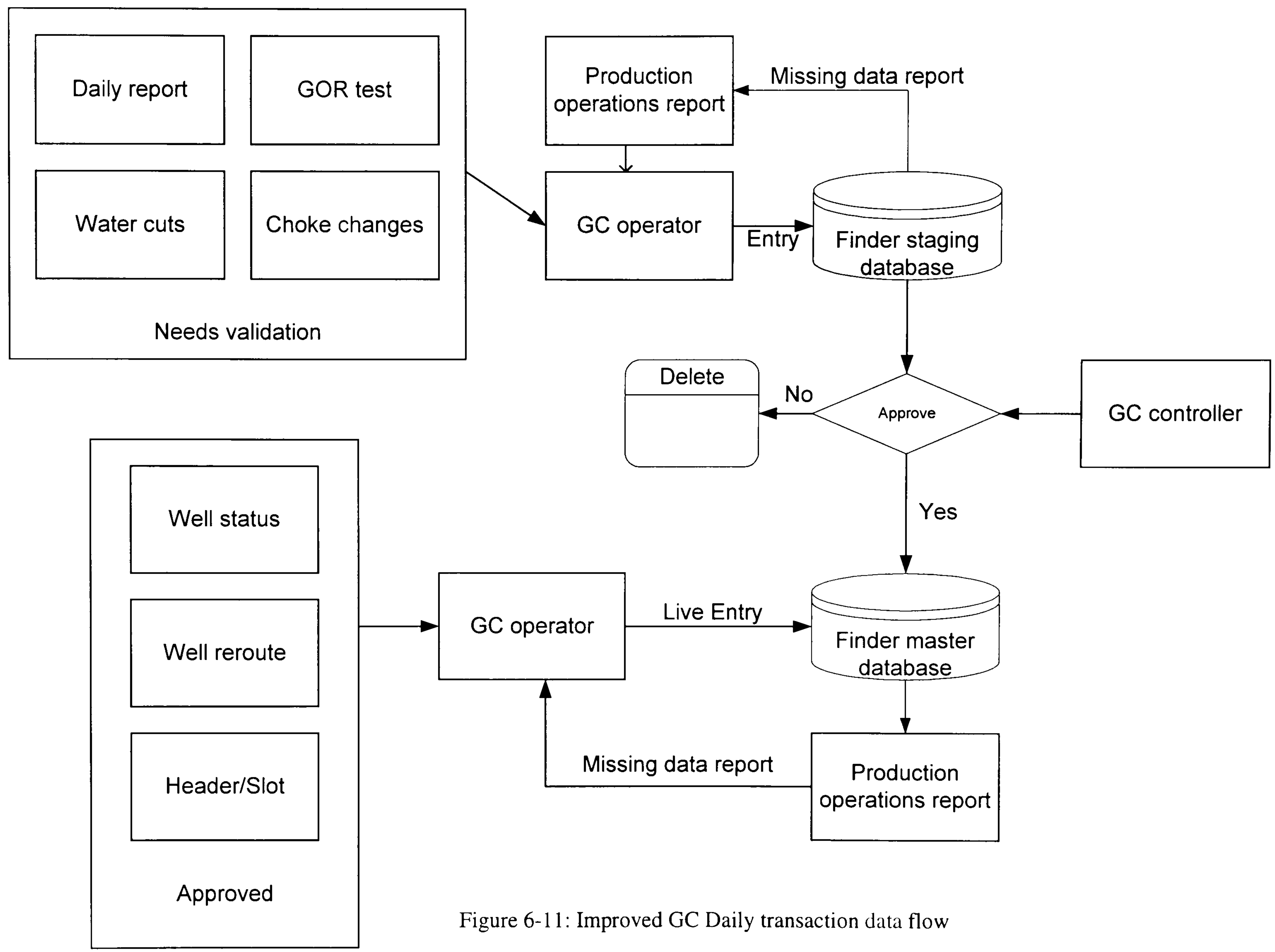

Figure 6-11: Improved GC Daily transaction data flow

6.3.3.4 Process

Practices

Process

Practices

a) General comments

- The contractor/consultant recommended conducting BPR in 1996, and Oilco's old top management did not implement it.
- BPR was not conducted in the beginning because there were no budget allocated by the old top management to do BPR, even though the vendor's feasibility study included BPR as a recommendation.
- BPR was done later during the project. The project team had to change the processes in the way of capturing the data and retrieving /disseminating them (Figures 6.8, 6.9). They had to do BPR or process changes and even after the project officially ended, they still see the need to change, some processes. Now, the policy is whoever captures/generates the data is the one who should enter them in the system (example GOR). The more understanding of the processes the team acquire, the more they see the need to modify/change the processes.
- The consultant wanted/tried to contract to do BPR/Process Changes but Oilco team did it themselves, where they admit that they "struggled a lot in doing it", but they claim they "did it successfully and gained experience by this". They also think they are capable of conducting BPR better than a consultant

because they “understand the culture and political issues in the organisation better than the consultant”, which they believe would affect the success of BPR.

- BPR or process changes were conducted to fit Finder system.
- Those changes took place after the system development phase and into deployment.
- The changes that were done to the processes targeted the way data are captured and distributed. There were changes done that targeted some organisational entities in changing the responsibility for producing, entering, or manipulating some data to other organisational entities. This was done to fulfil the new needs. This affected all classes of data and whoever was responsible for them.
- The changes in the processes affected both the main/generic processes and the smaller specific sub-processes. An example of changes to main processes is the Well Completion process which was previously managed by the Field Development department/unit, and was shifted to the Drilling Operation department/unit. Also an example of the changes to the small/specific processes is the change to the generation of Well Perforation and Drilling Depth processes’ reports and entries, both of which are now performed by different entities.
- Another example on BPR or process change is shown in the “Data Flow: GC Daily Transactions: Current – Staging Database” and “Data Flow: GC Daily Transactions : Previous Practice” (Figure 6.10 and Figure 6.11). The FINDER Staging Database in the new process was implemented so that the data entry could be validated by a higher level quality control personnel.

After the data is entered into the FINDER Staging Database they are validated, and when approved, are then sent to FINDER Master Database. Also, there was a separation of Well Status, Well Reroute, and Header/Slot documents from the validation process because it was decided that entry of such data by the GC (Gathering Centre) is always correct.

b) Status prior to project

From the interviews with the Oilco project leader and head of implementation team, it was decided that the level of the processes at the beginning of the project was Weak level 3-GG2, where level 3-GG2 practices were fulfilled in a weak manner. Level 3-GG2 description is as follows:

GG 2 Institutionalise Managed Process

- GP 2.1 Establish an Organisational Policy
- GP 2.2 Plan the Process
    1. Obtain management sponsorship for performing the process.
    2. Define and document the process description.
    3. Define and document the plan for performing the process.
    4. Review the plan with relevant stakeholders and get their agreement.
    5. Revise the plan as necessary.
- GP 2.3 Provide Resources
- GP 2.4 Assign Responsibility
    1. Assign overall responsibility and authority for performing the process.

2. Assign responsibility for performing the specific tasks of the process.
3. Confirm that the people assigned to the responsibilities and authorities understand and accept them.

- GP 2.5 Train People
- GP 2.6 Manage Configurations
- GP 2.7 Identify and Involve Relevant Stakeholders
  1. Identify stakeholders relevant to this process and decide what type of involvement should be practised.
  2. Share these identifications with project planners or other planners as appropriate.
  3. Get stakeholders involved as planned.

- GP 2.8 Monitor and Control the Process
  1. Measure actual performance against the plan.
  2. Review accomplishments and results of the process against the plan.
  3. Review activities, status, and results of the process with the immediate level of management responsible for the process and identify issues.
  4. Identify and evaluate the effects of significant deviations from the plan.
  5. Identify problems in the process and in the plan.

6. Take corrective action when requirements and objectives are not being satisfied, when issues are identified, or when progress differs significantly from the plan.
7. Track corrective action to closure.

- GP 2.9 Objectively Evaluate Adherence
- GP 2.10 Review Status with Higher-Level Management

c) Status at end of project

Also, as understood from the interviews, the level for processes at the end of the project is level 3-GG2, where level 3-GG2 practices were fulfilled most of the time.

d) Target status

Since the development and deployment teams were not experienced in conducting process improvement or BPR, the progress of the process domain was slow. It might be that the teams were improving the processes by ‘trial and error”. According to the project leader and deployment team head, level 4-GG3 would be enough to be the target process level. Even though it would be better to have even more mature processes, it is unrealistic at this time to expect more than this level from the organisation because of negative cultural attitudes towards change. Collecting improvement information in level 4-GG3 would be important for improving the business processes for a sector that needs to be able to meet the projected increasing demand for oil production. The description of level 4-GG 3 is as follows:

GG 3 Institutionalise Defined Process

- GP 3.1 Establish a Defined Process
    1. Select the standard process that best fits the specific instances from the organisation's set of standard processes.
    2. Establish the defined process by tailoring the selected standard processes and other process assets according to the organisation's tailoring guidelines.
    3. Ensure that the organisation's process objectives are appropriately addressed in the defined process.
    4. Document the defined process and the records of the tailoring.
    5. Revise the description of the defined process as necessary.

- GP 3.2 Collect Improvement Information
    1. Store process and product measures in the organisational measurement repository.
    2. Submit documentation for inclusion in the organisational library of process-related assets.
    3. Document lessons learned from the process for inclusion in the organisational library of process-related assets.
    4. Propose improvements to the organisation's process assets.

The result of Process analysis is as follows:

Process Practices				
Status	Prior to	At end	Target	Gap
Maturity level	Weak 3-GG2	3-GG2	4-GG3	4-GG3

6.3.4 Summary and findings

- The project did not address the preparation of any of the attributes before the project began. Skill, Culture, Leadership, Staff, Structure, Systems, and Head of IS/IT were not prepared for the project, nor the need for BPR or process changes.
- Oilco team attempted during the project to fill the gaps and fulfil what should have been performed as pre-steps before the start of the project. Those attempts continued even after the project ended. The team achieved some, but still not enough progress to make the project a success. The project for Oilco team turned out to be more like a rescue mission where they were, and still are, trying to implement some of what should have been implemented before the beginning of development of the system, such as improving relationship with users.
- IS/IT awareness maturity of the old top management of Oilco was low. It seemed that the success of the project for the old top management was not as important as the prestige of having "GoQuest Finder" at Oilco. This system was already being used by the major oil companies in the regional countries. The reason for making such a clearly problematic decision became obvious when the researcher noticed that the decision was made at difficult political times for the old Oilco top management. At those times, Oilco's management were under heavy criticism where their integrity and competence in managing the oil company were questioned. This criticism eventually led to sacking them. Announcing in the media about computerising the company's operations and implementing a well reputed software system (Finder) would have relieved some of the criticism. Making such announcement does not require having a full, lengthy and complete project. On the contrary, the shorter the time the project finishes in, the sooner

the announcement could be made. The way the project was approved would have served this purpose.

- The final proposal by the vendor did not address what to do next after loading the historical data. It did not address the needed hardware and software licences, training, processes, organisational structure, skills, user and management issues, etc.. The proposal even missed addressing some issues prior to loading the historical data such as fetching, collecting, gathering and cleaning the old data.
- The new top management became interested in having this project succeed and they gave it considerable support.
- The evaluation tables show that Culture, Skills, Structure and Process remain problem areas. It is worth noticing that attributes with score difference of one level between the needed level and the initial level weremostly reached by the rescue measures taken by Oilco's project team. On the other hand, those attributes where the difference was two and more, except the Leadership attribute, remain a problem area which the team are working on resolving. The leadership issue was resolved by the change of top management, a point that is supported by the literature (Galeirs & Southerland, 1991). Also, the awareness programme targeted towards top management helped in this regard. The case shows that the timely change of top management contributed to the survival of the project. Had the attitude of the old top management remained as it was at the beginning of the project, the project could have been terminated.
- The improvement on Culture has an effect on the usage of the system. The execution of the awareness and support programme improved communication between project team on one side and users and management on the other, which made usage of the system increase from 10% to 40% in three months.

- The Skill of the IS/IT people is on a satisfactory level. The project does not suffer from any shortage of technical skill. As to users' skill needed, still some training and support is required, even though improvement is apparent from the initial stage.
- The Structure seems to be tied with the Culture. Decentralisation of control would not resolve the problems regarding the system use, especially when there still exist communication problems between IS/IT and user groups.
- Since the team is not experienced in process improvement or BPR, the improvement on Process domain is slow. It seems that the team is improving the Process by 'trial and error' method.

Project Manager comments regarding the readiness/GP model

> " The model highlights important issues that need to be considered before starting the project. The initial project proposal contained some simillar issues but were not as comprehensive, and the company should've implemented them."

6.4 Bank Case

6.4.1 Background and History

The Bank was established in late 1973 by an initiative from the government, as a joint venture between the Ministry of Finance, the Central Bank, all commercial banks registered in the country, insurance companies, and some large industrial investment firms. The Bank was established with a share capital of US $35 million, which was subsequently increased to US $70 million. The government share is 53%. The government has also provided the Bank with a long-term loan of US $700 million, with a grace period of five years and a 2.7% annual rate of interest. In December 2000, the parliament passed a new law allowing the government to provide the Bank with a loan facility up to U.S. $700 million in the form of a revolving facility.

The primary goal of the Bank is to promote industrial development in the country by pursuing the following objectives:

- To participate in developing a long-term strategy for industrial growth and identifying those sectors and activities which would best suit local conditions and constraints.
- To initiate industrial projects and investments in promising sectors.
- To provide financing, whether in the form of equity, or medium or long-term credits for new projects, as well as the expansion of existing ones.
- To finance projects outside the country, with an emphasis on the nearby region, especially where country interests are involved.

- To bring new technologies to the country and identify foreign partners with the necessary expertise.
- To support the development of domestic money and capital markets in co-operation with other major financial institutions.

The penetration of IS/IT into the Bank is low. Out of 250 staff, only 70 are registered users of the mainframe core system. The concentration has been on processing the basic business transactions, through a system which was inaugurated in 1981. As a consequence, the design used and the user interface is not effective in delivering high quality services to the users.

6.4.2 Sequence of Events

- In the second half of 1999, the Bank's top management (Bank's chairman) pushed for "an idea to provide advanced services" to Bank's customers, because of passing comments made by some members of the Bank's board (Figure 6.12), many of whom are representatives of IT-intensive private sector organisations. Those 'advanced services' refer to:
    - Internet banking
    - Telephone banking
    - Branching (there is only the main headquarters currently)
- When this idea came up, top management established a committee of IS/IT unit's staff to do a study to determines whether it is possible to improve the current IS/IT to meet those new needs or whether a new system should be implemented.

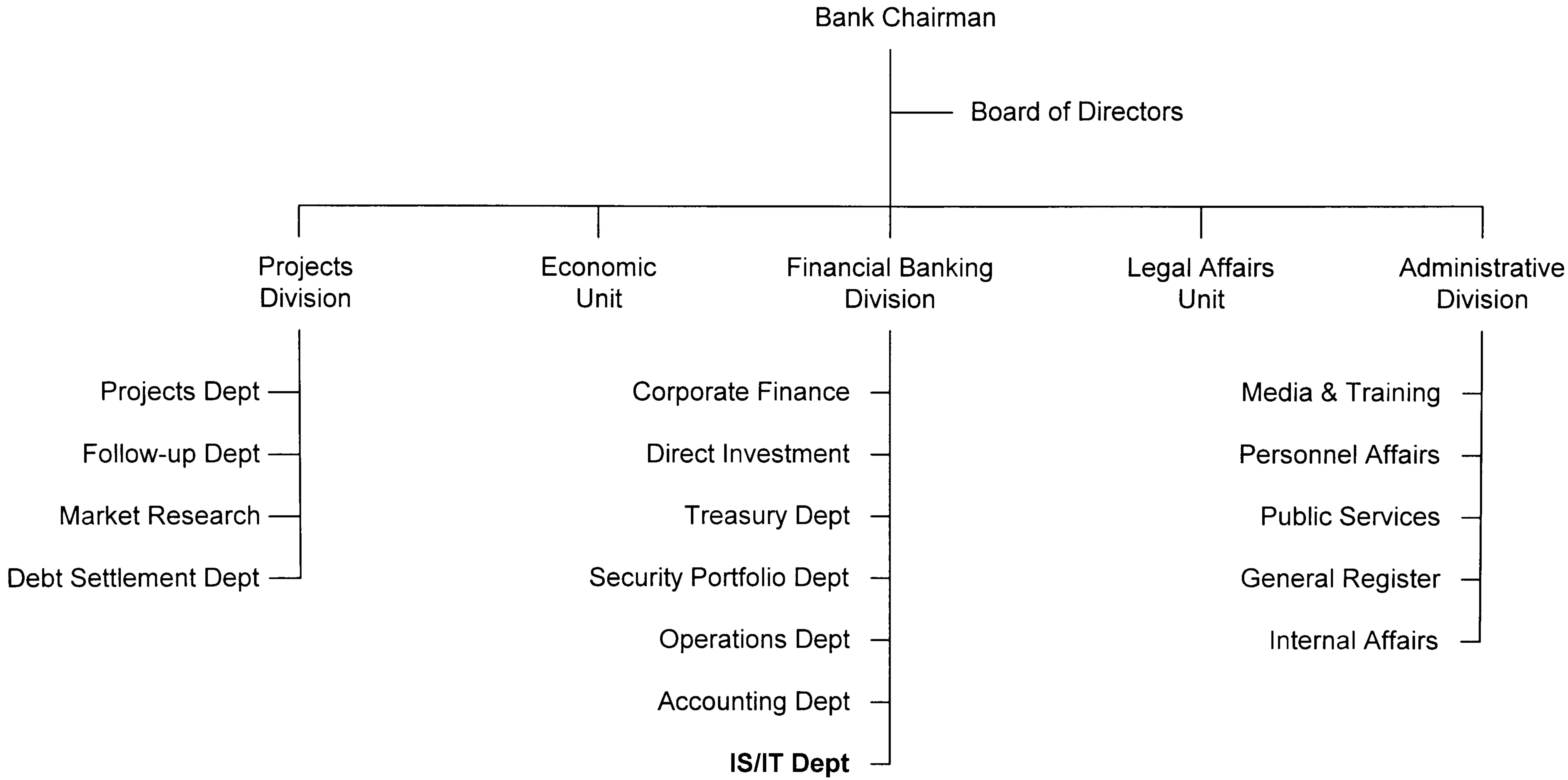

Figure 6.12: Bank Organisational Chart

- The vendor of the current system was approached for possible improvement of the current system to meet the new needs. The vendor provided a hardware solution only.
- This study gave both users and IS/IT people the opportunity to voice their dissatisfaction with the 17 year old system.
- The Bank's study committee was faced with two options, either to change the hardware only and mainly meet the chairman's ideas, or change the whole system and meet everybody's needs i.e. chairman, IS/IT unit, and users. The study recommended the latter option.
- "To have an objective outside opinion, the Bank hired a consultant firm to conduct a study", which gave recommendations regarding "the best way to tackle the solution."
- The consultant's study suggested changing the current system with a new one. It suggested doing that in steps until the Bank reached the needed state in meeting the new requirements. The steps were as follows:
    1. First, to install a bank-wide network and implement some office automation software based on this network. This software should include financial software and internal e-mail.
    2. To train users to use those tools and to share files and printers.
    3. The Bank then should install a new and total core banking system.
    4. After completing the previous steps, the Bank can install on top of the new infrastructure whatever tools the Bank needs to support Bank's needs i.e. Internet banking, telephone banking, etc..

- The consultant has also recommended that the Bank should hire a consultant company to study the requirements and produce a Report For Proposal (RFP) for the core system. This consultant should help in the selection process of vendors and systems.
- The Bank started to implement the consultant's recommendations by performing the following steps:
  - In December 1999 the Bank signed a contract installing a new network. On April 2000 it was ready to be used with office automation and e-mail software. Even though the new core system(s) had not yet been decided upon, the choice of the network configuration was made. The project leader explained that he implemented a flexible and almost standard configuration that would support whatever candidate core system the Bank might implement later. This would include Client/server, TCP/IP and Ethernet, Relational DBMS etc.
  - Users were trained in using the network features of file and printer sharing, office automation software, e-mail, and Internet browsers. They started to use the new tools and centralised backups were periodically taken by IS/IT unit.
  - Efforts to discourage users from using the old unconnected small PC-based systems that they built and kept over the years were not successful in most cases.
  - IS/IT personnel were also trained in using the functions needed for operating the tools that they newly acquired, such as security and software monitoring.

- The old system was still running separately from the new network and tools, where some users had two terminals on their desks.
- In May 2000, the Bank chose an international consulting firm to be the consultant which should implement step 3 of the recommendations made by the first consultant's study. This new consultant firm would also help in the selection process of vendors and systems.
- Besides chosen this consulting firm, five other well known international consulting firms proposed for this contract. Among the criteria that the Bank had for choosing the consultant was the degree of experience and qualifications of the people the firm was going to assign to the project. Résumés were supplied by two of those firms, while others refused.
- It was specified in the contract that it was forbidden for the consultant firm or any of its subsidiaries to enter in any bid for the system(s) under study.

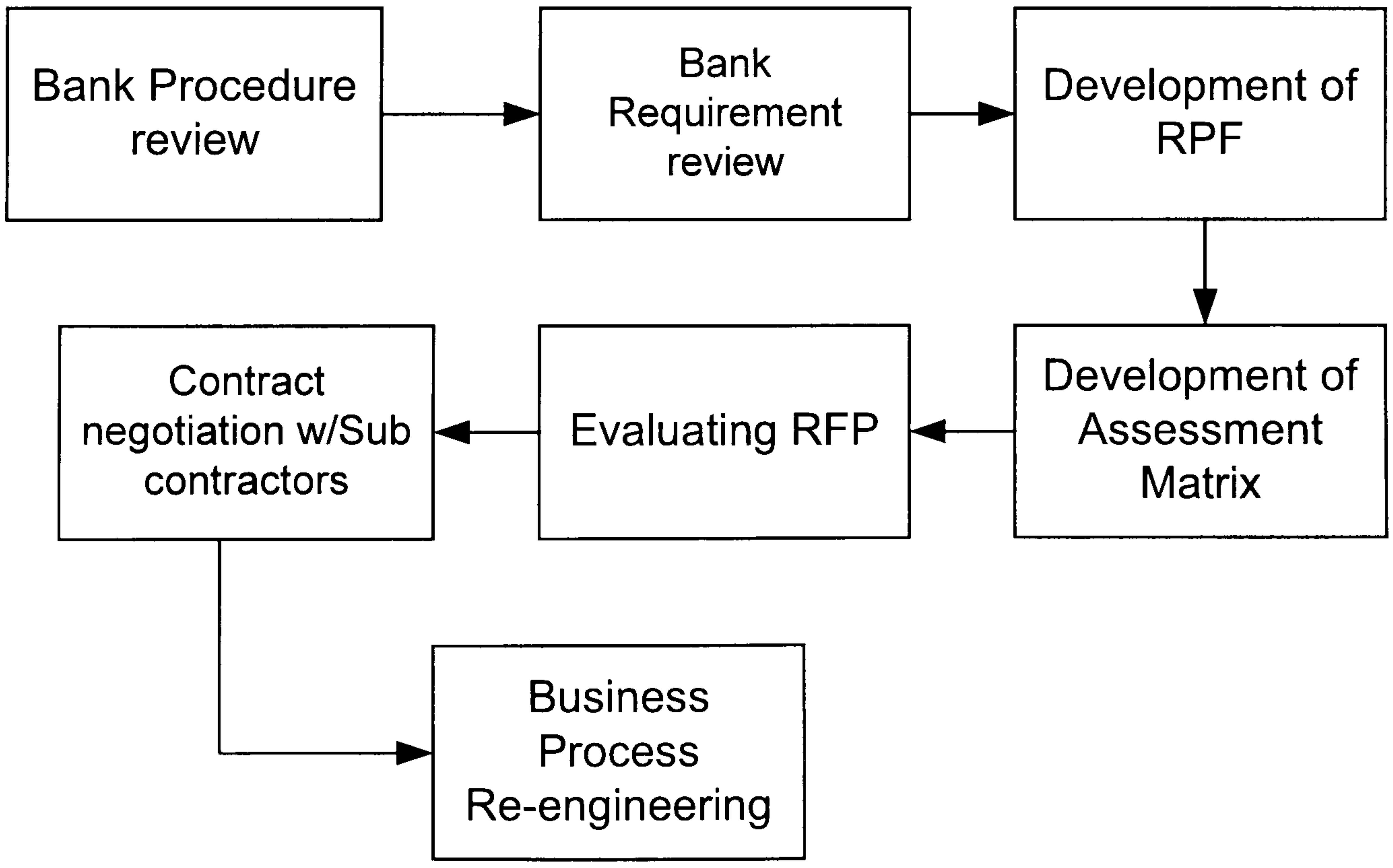

Figure 6.13 Consultancy project description

- Contract signing with consultant firm: In May-2000, a contract was signed with the consultant firm to start the consultancy services.
- Requirement gathering and assessments: In June 2000, the consultant started the requirement gathering from the Bank's departments then produced an RFP which specified all the department requirements for a new system. Each department reviewed and signed the document produced by the consultant. This activity took about two months.
- IT steering committee meeting approved the proposed RFP. This committee consisted from the deputy bank chairman, head of the legal affairs unit, and the project leader from the Bank side.
- In late August 2000 five international vendors were invited to tender. The consultant then evaluated vendors' responses to the RFP by a scoring system. One of the vendors did not put a bid because it did not think its system could meet the Bank's requirements. Another vendor scored very low. The following is the summary of the overall scoring:

Vendor A (V-A)	Vendor B (V-B)	Vendor C (V-C)	Vendor E (V-C)
84.13%	94.48%	84.02%	69.89%

- After along selection process which is explained in detail in Appendix-F, where all studies and evaluations favoured either V-B's proposal or the combination of V-C with V-F proposals, but the steering committee selected V-A (V-F did not enter the bid, since it was for a total solution banking system and V-F had a financial system only).

- After it was selected, V-A conducted "Gap Analysis" which it took approximately 4 weeks. In the Gap Analysis, both the Bank and V-A identified all the gaps between how the Bank did business and how the software did business, and if there were differences, how they could be resolved.
- After the Gap Analysis, V-A produced the final cost for all the customisation agreed upon. Furthermore, the final solution cost was reached, and changes were clearly labelled to be: implementation tasks, system customisation, Bank policy and procedure change, or any work-around changes to be done to meet the Bank's requirements.
- V-A started the customisation of its proposed Core Banking System according to the agreement with the Bank. During this process, there were some amendments and changes which arose for different reasons. New government regulations needed to be implemented in the system; also, as the users started to be subjected to the environment of development, they started to have new ideas and requirements. Most of them were minor, but some had a major impact on the customisation. This was a cause of some friction both internally between the IS/IT unit and users, and externally between the Bank and V-A.
- As the customisation process was going on, the Bank implemented a training programme for both users and IS/IT staff.
- Until the time this research ended, the implementation of the core banking system had not yet been completed.

6.4.3 Analysis and Discussion

The following sections address each attribute of the four domains of the readiness/GP model within the context of the Bank.

6.4.3.1 People

1) Staff

People		
Staff	Skill	Head of IS/IT

•

a) General comments

Many of the staff in the IS/IT unit have not been able to maintain skills consistent with today's needs. Many key skills are missing and technical skills, such as programming and systems analysis skills, are stuck in the past, which makes the underlying assumed skills of the job titles these staff hold differ from the skills they actually have.

- For many past years in the old system life, the IS/IT staff lacked business skills to assist the users to define their needs and to develop new features in the system.
- In agreement with the new organisational chart (see Figure 6.15) a Database Administrator (DBA) was hired. The DBA's task will be the administration of the proposed relational DBMS.

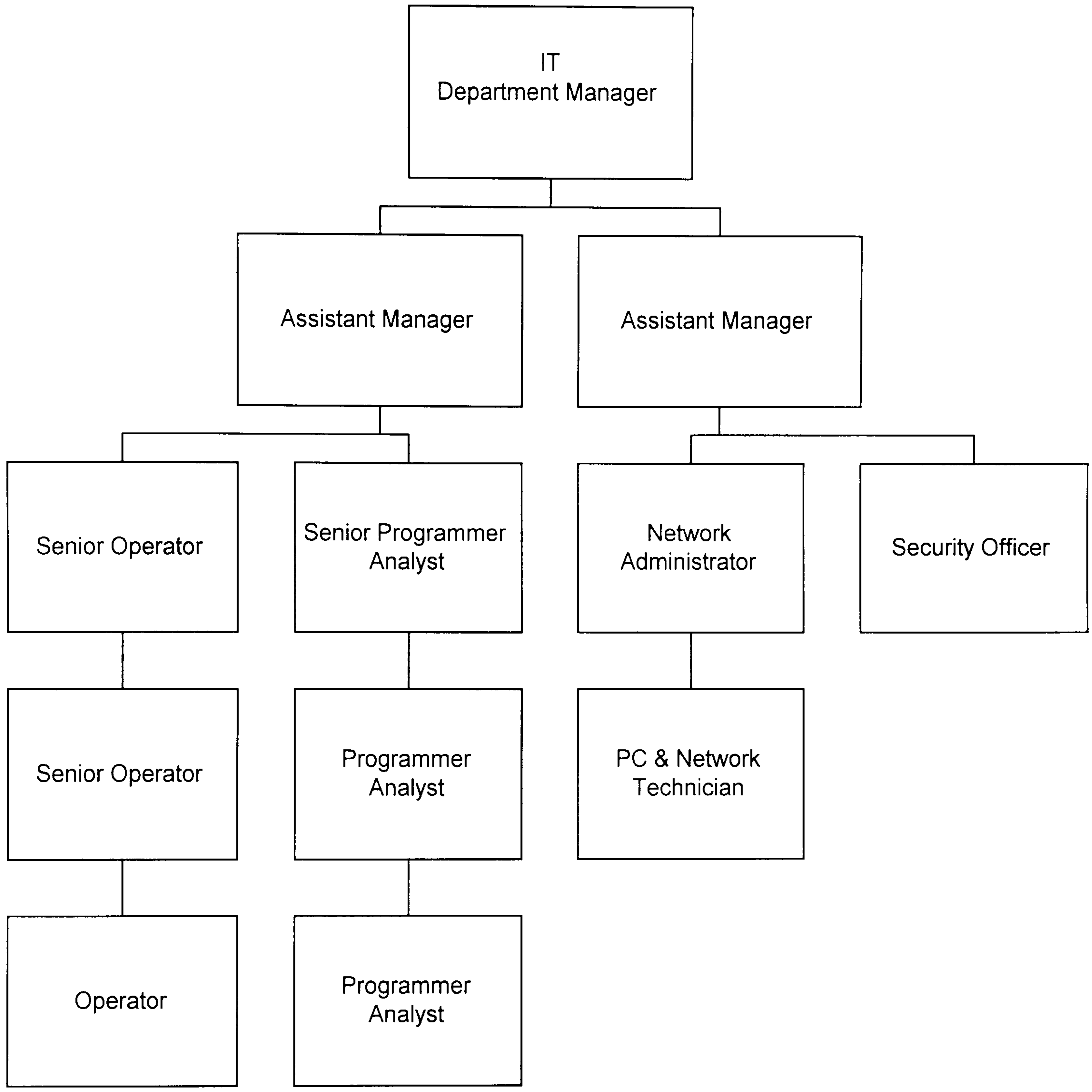

Figure 6.14: Current IS/IT function chart

- Following the implementation of the new system, the maintenance operations will be outsourced to the vendors of the new hardware, systems' software, and core banking system. This is reflected in the new organisational chart of the IS/IT unit (Compare Figures 6.14 and 6.15). The new organisation does not contain any programmer, and system or business analyst positions.

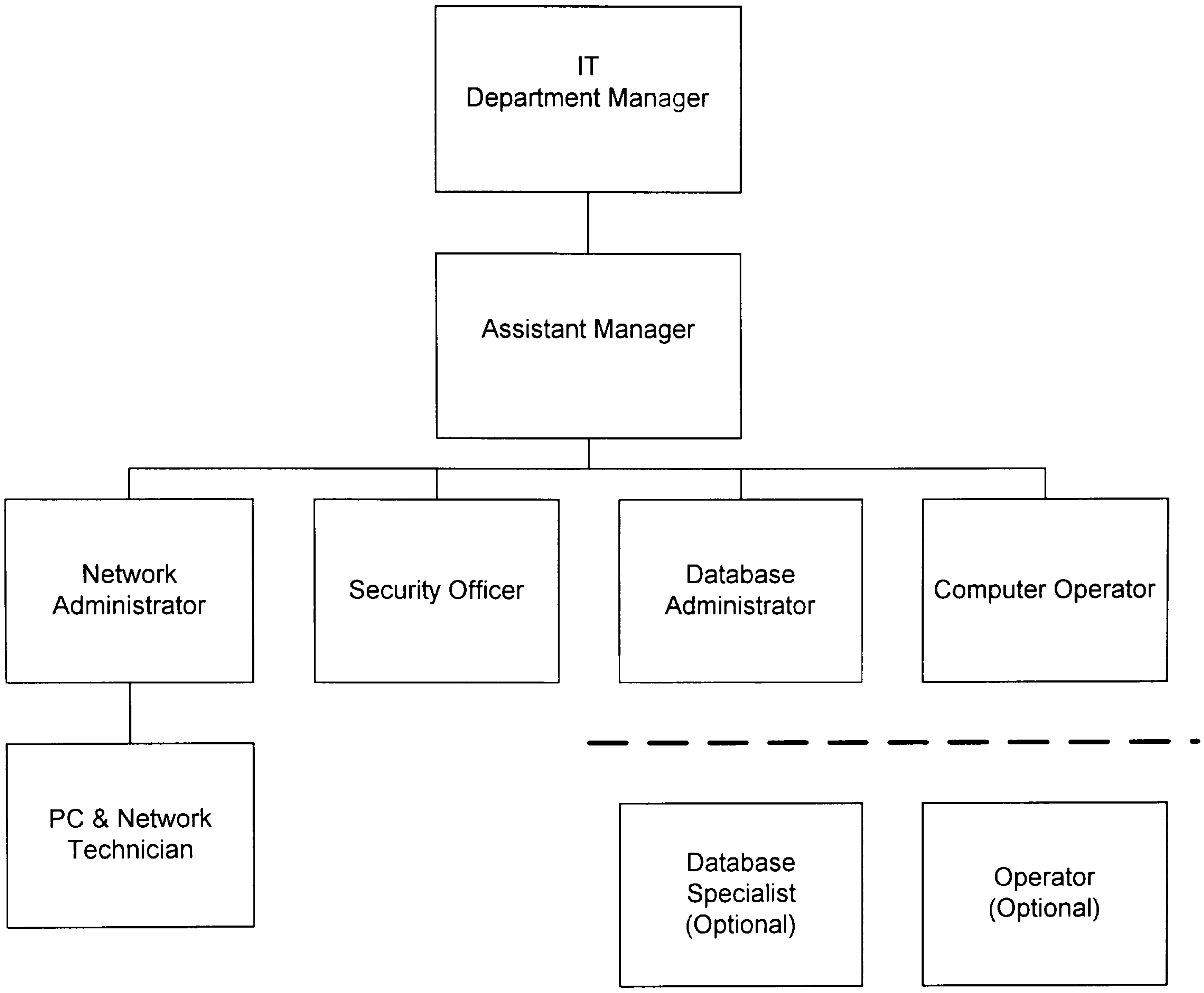

Figure 6.15: Proposed IS/IT function chart

- There is a need for V-A to appoint a credible business analyst(s) to work as a liaison between users and the IS/IT unit for implementing changes and new requirements in the system. This might be a potential problem area if the vendor does not provide adequate expertise and resources, a problem which is common in the county's IS/IT market.
- For the Bank to restructure almost totally the IS/IT unit relying almost entirely on the vendor's support, is like wandering into a minefield, especially in a market place that is known for having weak after-sales support, and even more so with a vendor which has no prior experience such as V-A.

IT Management	3
Business Analysts/Developers	3
Network Support and Security	3
Computer Operations	3
Secretarial Work	1
	13

Table 6.5: Old/current numbers and description of IS/IT staff

b) Status prior to the project

Even though staff show some of the level 2 staff characteristics in the readiness/GP model, in reality the underlying skill and experience assumptions of the job titles the staff hold do not reflect the actual staff situation. This is because of the obsoleteness of the skills of those staff. In addition, only one staff member (IS/IT head) has the know-how. Instead of assuming the managerial role, he was working as programmer, technician, and analyst where he left the IS/IT department and the system in a backward condition. Although the situation might be seen as level 2, but in reality level 2 staff criteria do not apply to the Bank situation at the beginning of the project. The staff situation agrees with the general description of the staff characteristics of level 1 in the readiness model. The description of this level in the readiness model is as follows:

- No dedicated IS/IT staff or small number of low-level technicians and programmers
- No manager allocated responsibility for IS/IT
- External contractors may be used to develop/install systems as required
- Users' new recruits are not expected to have IS/IT-related skill

c) Current status

Because of the new organisational structure of the IS/IT unit has been implemented and many of the needed staff for the new system have been recruited, the current/proposed staff situation agrees with the general description of the staff characteristics of level 3 in the readiness model providing the vendor will supply the technical staff and expertise necessary for the smooth operation of the system. This level's description is as follows:

- Added to the programmers and analysts, dedicated IS/IT planners and database administrators are appointed
- Almost all needed technical specialist staff are in-house
- A technically-oriented IS/IT manager is appointed or DP manager might have a change in title
- IS/IT workforce are coordinated with current and future IS/IT needs at both the organisational and unit levels
- New user recruits are expected to have specific IS/IT-related skill

IT Management	2
Database Administration	1
Network Support and Security	3
Computer Operation	1
Secretarial Work	1
	8

Table 6.6: Consultant's proposed IS/IT staff numbers and description

d) Target status

Because the new system will span all organisational functions, the Bank needs to have a dedicated liaison body of staff with adequate understanding of both the different business functions and the functional capability of the Bank's IS/IT. Also, because of this wide span of the system, the managerial position of the IS/IT unit heads need to be of senior calibre in order to have the needed power and respect within the organisation. The target level of Staff should agree with the general description of level 4 staff characteristics in the readiness model. Level 4 description is as follows:

- In addition to the programmers, systems analysts, and data base administrators, business analysts now exist to act as a liaison between their units and the IS/IT unit
- High level manager for IS/IT services area is appointed, with middle management status
- Organisational staff (IS/IT and user) performance is quantified and measured against quantitative performance baselines

The result of Staff analysis is as follows:

People Staff				
Status	Prior to	Current/proposed	Target	Gap
Maturity level	1	1	3	3

2) Skill

People		
Staff	Skill	Head of IS/IT

a) General comments

- The IS/IT unit have out-dated skills and it would require significant training effort to bring them up to date. Many needed skills have become obsolete such as programming and analysis. The pace of change in the IS/IT has been dramatic over the last 17 years, since the time the old system was inaugurated, and the Bank has not kept up.
- Users complained of the lack of banking business knowledge among the IS/IT staff.
- Users lack any kind of IS/IT skills that are of value compared with the current technological situation in the outside world.
- The training programme introduced after the installation of the network and office automation software seems to enhance the IS/IT-related skills of users.
- The training programme has enhanced the skills of mainly the technicians among the IS/IT staff.
- Those IS/IT staff who were chosen to participate in the training programmes were assigned operational responsibilities in running the new network and software. This was coupled with promises of new organisation in the IS/It department, change of titles, and promotions, once the new system's implementation is completed.

- The new project did not contribute in any serious way to the skill of the majority of IS/IT unit people because most of the studies and development/customisation were performed by the external consultant staff. This made many of them feel insecure and prepared to leave the Bank.

b) Status prior to project

Even though skill shows some of the level 2 characteristics in the readiness/GP model, this does not in reality reflect the underlying assumptions of the job titles staff hold because of the obsolete old skills. Also, because the system's know-how is limited to one person in the IS/IT unit, level 2 criteria do not apply to the situation prior to the project. So, at the beginning of the project, the status mostly agreed with the general description of level 1. The description of this level in the readiness/GP model is as follows:

- Users find it hard to acquire the skills to use the few IS/IT that exist and skills are individually based and jealously guarded from others
- The emphasis is on technology rather than organisational or informational issues, where there are very limited technical skills in the organisation/unit as a whole
- IS/IT skills are specific to individual IS/IT applications
- Needed skills are of low level technical nature and there may exist very limited advanced (programming or systems analysis) skills in the organisation
- There is almost no IS/IT training provided by the organisation

c) Current status

Because of the training programmes introduced to both user and some IT/IS staff, the skill situation has currently shown some improvement from the beginning of the project. It now mostly agrees with the general description of level 2 characteristics. Level 2 description is as follows:

- Users begin to have the needed training and skills to use the new IS/IT that being developed/purchased
- Still little in-house technical expertise in IS/IT development (methodology, structured techniques) and other important skills
- IS/IT staff acquire the skills needed to develop and maintain complete systems such as programming and analysis, in addition to being able to install off-the-shelf ready-made packages
- Limited project management skills
- IS/IT individuals have the skills required to perform their assignments and begin to have the relevant training and development opportunities
- Individuals in the organisational workforce have remuneration and benefits based on their contribution and value to the organisation

d) Target status

Because the system spans all functions and aspects of the Bank's operations, communication skills are needed for all workgroups, including IS/IT, to be able to complement and actually integrate their work, making the best of the integrated work environment that is facilitated by the new system. Also, new technology introduced in the Bank requires a high level of knowledge and competence to operate and maintain it. Even though the Bank has not decided yet if it will maintain the software itself or outsource this side of the IS/IT unit, the operation of the network, hardware and system software will remain an in-house function, mainly for security reasons. These requirements call for the target level of skill to agree with the general description of level 3 characteristics in the readiness model, which are as follows:

- Considerable technical competence in the organisation because of the well developed IS/IT related skills (programming, analysis, security, networking etc.)
- The organisational workforce are constantly enhancing their IS/IT capabilities to perform their assigned tasks and responsibilities
- DP/IS/IT manager and staff lack, but work on building, interpersonal skills
- Project management is realised to be needed in this stage, which results in well developed project management skills

The result of Skill analysis is as follows:

People Skill				
Status	Prior to	Current	Target	Gap
Maturity level	1	2	3	3

3) Head of IS/IT

People		
Skill	Staff	Head of IS/IT

a) General comments

Authority and control of the development and daily activities are concentrated in one key individual (Head of IS/IT). This has negative implications where the security of the Bank is largely vested in that one individual. He appears to be the only person who thoroughly understands the old systems. Also Quality Assurance of IS/IT unit output is carried out by this head of IS/IT unit. There is no review body to monitor the quality of the deliverables. The IS/IT unit head did not provide advice to help top management to understand what strategic business opportunities will arise in the future from new technologies.

Table 6.7 shows the new Specification for IS/IT unit head as stated in the new IS/IT unit structure document.

Proposed responsibilities of IS/IT Head
• Report to the General Manager of the Bank. • Manage and lead the IT staff • Attend the different Committees to contribute in the decision making process of the Bank and define the role of IT in implementing the strategies and resolutions. • Prepare the Department strategy in tandem with the overall plans and directives of the Bank.

Table 6.7: Proposed responsibilities of IS/IT Head

b) Status prior to the project

The head of IS/IT did not assuming the managerial role, he was performing the operational tasks. Even though his official situation agrees with level 2 in the readiness/GP model, in practice the head of IS/IT criteria for the Bank situation at beginning of the project agree mostly with the general description of the characteristics of level 1 in the readiness level. Level 1 description is as follows:

- There is no individual responsible for systems

c) Proposed status

The situation that is proposed by the consultant in the project plan (Table 6.7) for the IS/IT head is to agree mostly with the description of level 4 in the readiness model. Level 4 description is as follows:

- There is an IS/IT manager who has middle manager status

d) Target status

- Because the new project is considered to be a total solution that spans all aspects of the Bank operations, the head of IS/IT need to have a senior position. It is not practical , because of the low level IS/IT awareness of top management, to ask for this person to be on the Bank's board which would serve the Bank better by having an input in the Bank's strategic decisions. The needed target and the possibly attainable level of IS/IT head of the Bank is level 5 of the readiness model. Level 5 description is as follows:
  - There is an IS/IT manager who has senior manager status

The result of Head of IS/IT analysis is as follows:

People Head of IS/IT				
Status	Prior to	Proposed	Target	Gap
Maturity level	1	4	5	2-5

6.4.3.2 Environment

1) Leadership

Environment		
Leadership	Culture	Structure

a) General comments

- The Bank Chairman was the one who asked to modify the system as he recognised the 'state of play' at other organisations. This came about after the Bank started to have the idea of expanding.
- Up to this point, top management had no concern regarding the importance of IS/IT, as it is clear from their declining to invest in IS/IT for 17 years.
- In an interview with a newly appointed senior manager, he described some of the business objectives for the Bank that is operating in what he understands as a changing world. He sees that the Bank needs flexibility to move in any direction that it may wish. For example, retail banking, branches, insurance, remote banking or ATMs.
- Mixed signals come from top management regarding the way they consider IS/IT. On occasions, they spoke of "computers" being the speciality of the "computer department" and if it had any suggestions they would be welling to look into it.
- Some suggestions went to top management from junior staff over the past few years, but they were not taken up because "it cost too much and we don't need it that much".

- There was pressure from some board members to modernise the Bank.

b) Status prior to the project

The level of leadership maturity of the top management before the development of the system and at the beginning of the project fluctuates between the general description of level 1 and level 2 characteristics in the readiness model. The situation mostly agreed with the following general description of leadership:

Level 1

- Has little concern for the potential utility of IS/IT

Level 2

- Considers IS/IT to be the concern of technologists not management but supportive of IS/IT, where priority and thrust are to minimise the expense of IS/IT utilisation

c) Current/ proposed status

No evidence yet of that the current level of leadership maturity regarding IS/IT has improved. The change in attitude could be attributed to the pressure from the board of directors. The current situation of leadership IS/IT maturity remains at levels 1 and 2 as described in the readiness model.

-

d) Target status

The Bank management needs to recognise that technology is changing too fast for the non-specialist to keep up. It is therefore an essential part of a truly professional relationship between a business and its IS/IT staff that they help management to understand that business opportunities would arise from IS/IT utilisation in new areas such as electronic commerce. This vision does not exist in the Bank, at least not in those professionals whose position would give them the necessary influence. This means that the Bank's top management need to consider IS/IT as a strategic tool to achieve a competitive edge in pursuing the Bank's goals. It also needs to view the flexibility of strategic IS as an asset for the Bank. This means that the needed target level of maturity of the Bank's leadership regarding IS/IT is to agree with the general description of level 5 in the readiness model. The description of this level is as follows:

- Considers IS/IT as one of the vital parts of the competitive strategy, where a flexible IT infrastructure is perceived as an asset for competitive edge and is brought up in this way during project justification.

The result of Leadership analysis is as follows:

Environment Leadership				
Status	Prior to	Current	Target	Gap
Maturity level	1-2	1-2	5	3,4,5

2) Culture

Environment		
Leadership	Culture	Structure

a) General comments

- The users were complaining of a great many day-to-day problems and frustrations with the systems. In at least one instance, when this was brought to the attention of IS/IT unit staff by an outsider, it was immediately identified as a bug and remedial action was set in motion. This points to a lack of communication between IS/IT unit and users.
- There are no facilities for users to report problems and have them formally recorded. Consequently, there is no concerted plan for remedial action and user frustration builds up, and the trust between user and the IS/IT unit declines.
- There was no communications infrastructure for the sharing of information. Users did not have the ability to access information and share it with colleagues and customers. It also severely limited the IS/IT unit's options when considering new systems development.
- Lack of unified understanding of the business nature of the Bank. The IS/IT unit believes that the Bank is different from any other Bank and has a unique set of processing requirements. The users however thought that the Bank was not unique and followed normal banking practices, albeit without some of the activities that other Banks perform.

- Power concentrated in few individuals. Knowledge of the old mainframe system and the whole of the control of the development and day-to-day IS/IT activities held by a small number of individuals (often only one).
- The security of the Bank is largely vested in the one individual who appears to be the only person who thoroughly understands the systems

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 1. The description of this level in the readiness/GP model is as follows:

- o The relationship between user and the limited low-level technicians that may exist in the organisation or contracted from outside is of support for the existing IS/IT products that are mainly off-the-shelf ready-made packages.
- o There is no recognition in the organisation of the importance of working towards building a constructive relationship between the IS/IT function and users.

c) Current status

The current situation of the culture within the Bank is still the same, no effort was made to change it. It still agrees with level 1

d) Target status

Because the new system spans all of the Bank's operations and functions, complementary work is expected between different groups, including IS/IT. For integration to happen, people need to communicate and cooperate. The needed target situation should agree with the general description of level 4 characteristics in the readiness model:

- IS/IT function supports the activities of users.
- There exists an emphasis on organisational integration between workgroups among which is the IS/IT function.
- Workgroups (IS/IT and users) have the responsibility and authority for determining how to conduct their business activities most effectively.
- An improvement in the efficiency and quality of interdependent work, resulted from the integration of the capabilities and knowledge of different workgroups on both IS/IT function and user sides, and with each other.

The result of Culture analysis is as follows:

Environment Culture				
Status	Prior to	Current	Target	Gap
Maturity level	1	1	4	2,3,4

3) Structure

Environment		
Leadership	Culture	Structure

a) General comments

- Power is concentrated in a few individuals within the IS with a centralisation approach where even the most trivial change to a user report must go through a lengthy and time-consuming process.
- Top management expressed the need for the new system to be flexible to support whatever future business direction the Bank chooses. This requires a flexible structure that combines between centralisation and decentralisation in forming coalitions between the IS/IT unit and users.

b) Status prior to the project

The IS/IT unit situation did not change over the past 17 years since the introduction of computers into the Bank. Even though the IS/IT unit is not new it still had the same role from the time it was formed. In addition, users had lost trust in the old system, so they relied on their own separate PC-based systems for many of their needs. This made the level of structure at the beginning of the project agree with the general description of level 2 characteristics in the readiness model. The description of this level in the readiness model is as follows:

- Separate DP/IS/IT function has recently been introduced where groups are encouraged to seek advice from this newly formed central IS/IT function.
- There is a decentralised responsibility for IS/IT function, where groups have full freedom in managing their IS/IT with increased self-reliance regarding IS/IT matters which is apparent throughout the organisation.

c) Current/ proposed status

The proposed structure after the implementation of the new system will keep the IS/IT unit in its organisational position. If this happened, then at best, the level of structure would agree with the general description of level 3 in the readiness model. The description of this level in the readiness model is as follows:

- Official power is vested in the IS/IT function, where a new technical IS/IT manager is appointed or the DP manager might have a change in title to IS/IT manager which goes with a similar change in department name.
- There are an organisation-wide IS/IT architecture policy and standards for telecommunications, preferred suppliers, e-mail, etc.
- Management of the IS/IT function is centralised.
- IS/IT staff seek control of IS/IT matters.

d) Target status

Because the new system spans all Bank's functions and departments, the new system target needs the structure to generally agree with level 4 description in the readiness model. The description of this level in the readiness model is as follows:

- IS/IT function is well established and its mission is to exploit the IS/IT for business purpose and provide competitive IS/IT in a partnership environment with users.
- Decentralised responsibility of IS/IT services with central standards and policy for coordination, implementation and utility.
- Units' IS/IT function reports to units' business manager.
- Significant degree of involvement of users in IS/IT-related decisions, where IS/IT investments are derived from users' stated needs.

The result of Structure analysis is as follows:

Environment Structure				
Status	Prior to	Proposed	Target	Gap
Maturity level	2	3	4	4

6.4.3.3 IT

Systems

IT

Systems

a) General comments

- Investment in IS/IT has been static over a number of years. This has led to a systems portfolio which is severely out of date.
- The IS/IT unit 1999 report of work shows that almost all system changes were for report modifications. This has followed a year in which no application development was done "due to the Y2K".
- The limitations of the mainframe system have led to several departments re-entering information from printouts and other sources into (stand-alone) PC-based worksheets so that they can analyse the information. This is an extremely time-consuming and error-prone task.
- Where PCs are in use, there is no means to ensure that compatibility is maintained by using the latest version of the software across all users.
- There are a high number of special report requests and report changes by the users which contribute to the IS/IT unit performance problem.
- The Bank's operational processes are riddled with apparent reconciliation errors that arise because the data flows between systems are poorly designed as in loans, LC (Letter of Credit), LG (Letter of Guarantee), and closure-of-facility.

- There is no clear distinction between operational systems and informational systems. This leads to performance problems as update transactions fight for database resources with complex queries. Given the number of reports requested by the users this issue may contribute to the performance problems.
- The Bank installed a network to be used with office automation and e-mail software. The network configuration is a flexible and almost standard configuration that would support the core system the Bank is implementing. This would include Client/server, TCP/IP and Ethernet, Relational DBMS etc..
- The network enables users to share files and printers. It also provide them with office automation software, e-mail, and Internet browsers. Users started to use the new tools and centralised backups were periodically taken by the central IS/IT unit.
- There is a serious efforts towards convincing users to discard their old, small, PC-based, unconnected, almost individually-based systems. These efforts have not proven fruitful in most cases.
- On the IS/IT technical side, new features were provided with the network, such as security, automatic periodical backup, and software monitoring.
- The old system is still running separately from the new application tools that are running on the communication network, where some users have two terminals on their desks.

b) Status prior to the project

Formally, the Bank shows some of level 3 system characteristics for the situation prior to the project, but because the system became technologically obsolete at the beginning of the project, it actually agrees with the general description of mostly level 1 and partly level 2. Even though the Bank had had a centralised system for many years, management allowed the users to build uncontrolled unconnected small systems in an ad hoc fashion, where all are in the financial area. Also, because of the many errors in the old systems, the IS/IT unit was overloaded with requests for fixes. The situation proves that the Bank situation went backward in the maturity progress. The following is the description of level 1 and 2 in the readiness/GP model.

Level 1

- Almost all existing systems are small packages for financial operations
- Ad hoc IS/IT development where each unit invests independently from the rest of the organisation and the approval process of IS/IT project differ between units
- Information systems are independent and unconnected organisation-wide or even within the same group, which makes IS/IT portfolios of each group differ from the rest of the organisation
- IS/IT development, maintenance, implementation and training are made at the group level, where groups manage their own IS/IT resources according to each group's needs in isolation from the rest of the organisation

Level 2

- An increase in the number of IS/IT application systems is being developed or purchased, but concentration is still on operational systems in the financial area, while a small number of other core business-oriented systems are being developed.
- Many of the IS/IT application systems still overlap in purpose, function and data stored in the organisation, where only some hardware, system software, and possibly a network are shared between groups

- o Large maintenance load is being placed on the IS/IT function because of the ad hoc nature of most systems
- o All data are stored in units' systems, except data needed for organisational reporting are transferred to central systems

c) Current and target status

The current situation shows many of the characteristics of the target systems level. The existence of an organisation-wide network and shared integrated office automation applications where security, backups, and software monitoring are done centrally, are all characteristics of systems' level 4. The new system as proposed by the consultant agrees with the general description of level 4 (from the interview with the project manager). The description of this level is as follows:

- o All needed operational IS/IT is mostly in place and some DSS might start to appear
- o Office automation is integrated and unified/standardised organisation-wide
- o Existence of an organisation-wide network, where all groups are connected and the central IS/IT function provides communication services for all groups in the organisation
- o Central coordination in the use of IS/IT throughout the organisation, where an effort is made by groups' IS/IT functions to follow standards set centrally
- o The organisation-wide network is starting to being utilised to connect users to whatever shared applications and information systems that are needed

- o Extensive use of standard e-mail messages throughout the organisation, and there is evidence of dependence on the organisation-wide network to conduct formal communication

The result of Systems analysis is as follows:

IT Systems				
Status	Prior to	Current	Target	Gap
Maturity level	1-2	4	4	-

6.4.3.4 Process

Practices

Process

Practices

a) General comments

- Quality Assurance of IS/IT unit's services, as an example of process situation, is carried out by the head of the function. There is no independent review body to monitor the quality of the deliverables. There is no Quality Manual that defines not only the process to be followed but also the measures that can be used to judge how successful and effective the process is. The Bank therefore does not have a true picture of the cost of the IS/IT process versus the benefits that its systems deliver.
- There is no clear distinction between operational systems and informational systems. This leads to performance problems as update transactions fight for database resources with complex queries. Given the number of reports requested by the users this issue may contribute to the performance problems.

b) Status prior to the project

The status of the processes fits level 3-GG2, but in a weak way which is almost level 2-GG1.

c) Current/ proposed status

No process change has yet been made, but there are suggestions for customisations of process to match the software. The consultant firm's suggestion on what it terms "BPR" is stated in its Consultancy Proposal to the Bank under the heading "Business Process Re-engineering (BPR)":

"Once a vendor has been selected and a contract negotiated and signed, the team comprised of (consultant firm name), the selected vendor and the Bank will conduct a study to examine what are the recommended changes to the way the Bank does business. The reason for this exercise to be conducted at this stage is to ensure that all changes made are in line with the way the selected software supports the business. The aim is to get the Bank to follow the software and not the other way around. This should minimize the customisation cost."

d) Target status

The new process level, as the project leader thinks, needs to be in level 4-GG3 (which really needs an expert in Banking processes to predict this needed level).

The result of Process analysis is as follows:

Process Practices				
Respondent:	Prior to	Current	Target	Gap
Stage	Weak 3-GG2	Weak 3-GG2	4-GG3	3-GG2, 4-GG3

6.4.4 Conclusion

- The use of IS/IT in the Bank is well behind that normally expected from a Bank which is set up to promote the industrial sector of a major finance centre.

- The Bank management needs to recognise that technology is changing too fast for the non-specialist to keep up. It is therefore an essential part of a truly professional relationship between a business and its IS/IT staff that they help management to understand that business opportunities which would arise from IS/IT utilisation in new areas such as electronic commerce. This vision does not exist in the Bank, at least not in those professionals whose position would give them the necessary influence.
- This means that the Bank's top management need to consider IS/IT as a strategic tool to achieve a competitive edge in pursuing the Bank's goals. It also needs to view the flexibility of strategic IS as an asset for the Bank.
- There is no independent review body to monitor the quality of the deliverables. There is no quality manual that defines not only the process to be followed but also the measures that can be used to judge how successful and effective the process is. The Bank therefore does not have a true picture of the cost of the IS/IT process versus the benefits that its systems deliver.
- The capabilities of the old/current core system applications do limit the operational capability of the Bank. However, there is a much more serious problem to be addressed. The current IS/IT very poorly serves the Bank's decision makers, at all levels. The existence of large amounts of data on hardcopy listings is a major inefficiency. Users cannot directly extract the information they need the system; rather, they have used different versions from different PC-based tools to develop many spreadsheets etc.. This is an error-prone and time-consuming task that could be eliminated. They should be concentrating on their core competence as a Lending Officer or Credit Assessor. etc., not on developing complex computer literacy skills. If two

users take the same data and process them to draw out comparable information, they will often disagree on the results, leading to time-wasting discussion and investigations. There are two reasons for this: first, transcription errors, and second, differences in the analysis they are applying.

- There is no clear distinction between operational systems and information systems. This leads to performance problems as update transactions fight for database resources with complex queries. Given the number of reports requested by the users, this issue may contribute to the performance problems.
- However, there is a more serious problem. The Bank's operational processes are riddled with apparent reconciliation errors that arise because the data flows between systems are poorly designed. Those scenarios applies equally to loans, Letters of Credit (LC) and Letters of Guaranttee (LG). The closure of a facility has similar problems.
- There is no communications infrastructure for the sharing of information. This is probably the most serious consequence of the Bank's failure to invest in modern technology. Without the ability to access information and share it with colleagues and others (within and outside the Bank), such as customers the users cannot do their job effectively. It also severely limits the IS/IT unit's options when considering new systems development options.
- Power is concentrated in a few individuals. Knowledge of the old mainframe system and the whole of the control of the development and day-to-day IS/IT activities is held by a small number of individuals (often only one). This has many implications, one of which is that the security of the Bank is largely

vested in that one individual and he appears to be the only person who thoroughly understands the systems.

- There is a danger that the vendor does not fulfil its responsibility of providing the needed expertise and other resources for the operation. If this happens, the Bank's staff will be in level 1 instead of being in level 3 as planned by the Bank.
- Even if the Bank succeeds in achieving level 3, it is not enough. There needs to be a dedicated and competent liaison body between users and the IS/IT unit.
- Since the new project is considered to be a total solution which spans all aspects of the Bank operations, the head of IS/IT should have a senior managerial position. It is not practical, because of the current mentality of top management, to ask for this person to be on the Bank board, which would serve the Bank better. Also, no person in the Bank that has the skill and knowledge to take on such a senior position and responsibility. The current project leader was a young junior staff member in the IS/IT department who had no prior experience until he was given the role of leadership of the project on the Bank side. If he is to be the IS/IT head after the implementation of the project, this attribute (Head of IS/IT) might become a potential problem area.
- It is essential that the IS/IT unit help top management to understand what business opportunities for strategic advantage will arise in the future from new technologies. This does not currently exist in the Bank.
- In general, the Bank shows the criteria of a certain level, but because of the bad management it also shows criteria of a lower level, i.e., point 3 in Stage

3. Even though the Bank had a centralised system from 17 years ago, the old management made the user build uncontrolled unconnected, small systems. It was a step backward in the maturity progress.

- It could be that the easiest progress could be made on the systems attribute. To achieve such progress, the organisations needs only to buy the IS/IT and networks.
- The Bank seems that have taken some correct pre-steps, especially in the IT Infrastructure factor. Currently, at the start of the implementation of the new systems, the Bank already shows that the IT Infrastructure attributes have already reached the Needed level.
- The People attributes, and especially Culture, could present trouble areas. Culture has not been addressed at all in any pre-steps actions. Skills, and especially user skill, could be a reason for delay in the success of the project, since the gap between the 'Before' and the 'Needed' represents two levels which require lengthy and concentrated training. Also, time is needed for users to gain experience with the new system, which training does not provide. Some level 3 criteria are linked to culture issues especially communication skills, and since Culture has not been addressed then this might remain a deficiency.
- The process remains an unclear area for prediction. Even though the Bank addressed BPR, it seems that the process changes is connected more to the software packages capabilities, features and requirements than to business needs. Also, it still remains unclear how the user will react to those process changes, especially since they were mainly been suggested by the technical people on the Bank, consultant, and V-A sides. The user was only consulted

and was not a participant in or an originator of the changes in processes. Also, those changes suggested by the user concentrated on changes in the software not the process, which could indicate that the user would like to keep processes the way they are. In addition, process changes came late in the project, after the system has been already decided upon, and as part of customisation. This indicates that those changes are more linked to the software capabilities than to business needs.

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Project Manager comments regarding the readiness/GP model

" Many of the aspects in the model are obvious, others are not, but all need to be brought to attention. The model does this in a nice way."

6.5 Eleco Case Study

6.5.1 Background and History

The Eleco company was established in 1955 as a private enterprise which has grown to become one of the largest private companies and the largest retailer of electrical and electronics products in the country, with a market share of more than 50% of the total electrical and electronics products' market capacity. The company has over 2000 employees and more than 24 showrooms. It consists of four main units: Central Air-Conditioning Products Sales, Electrical and Electronics Products Sales, Computers and Computer-Related Products Sales, and Spare Parts and Workshop (Figure 6.16).

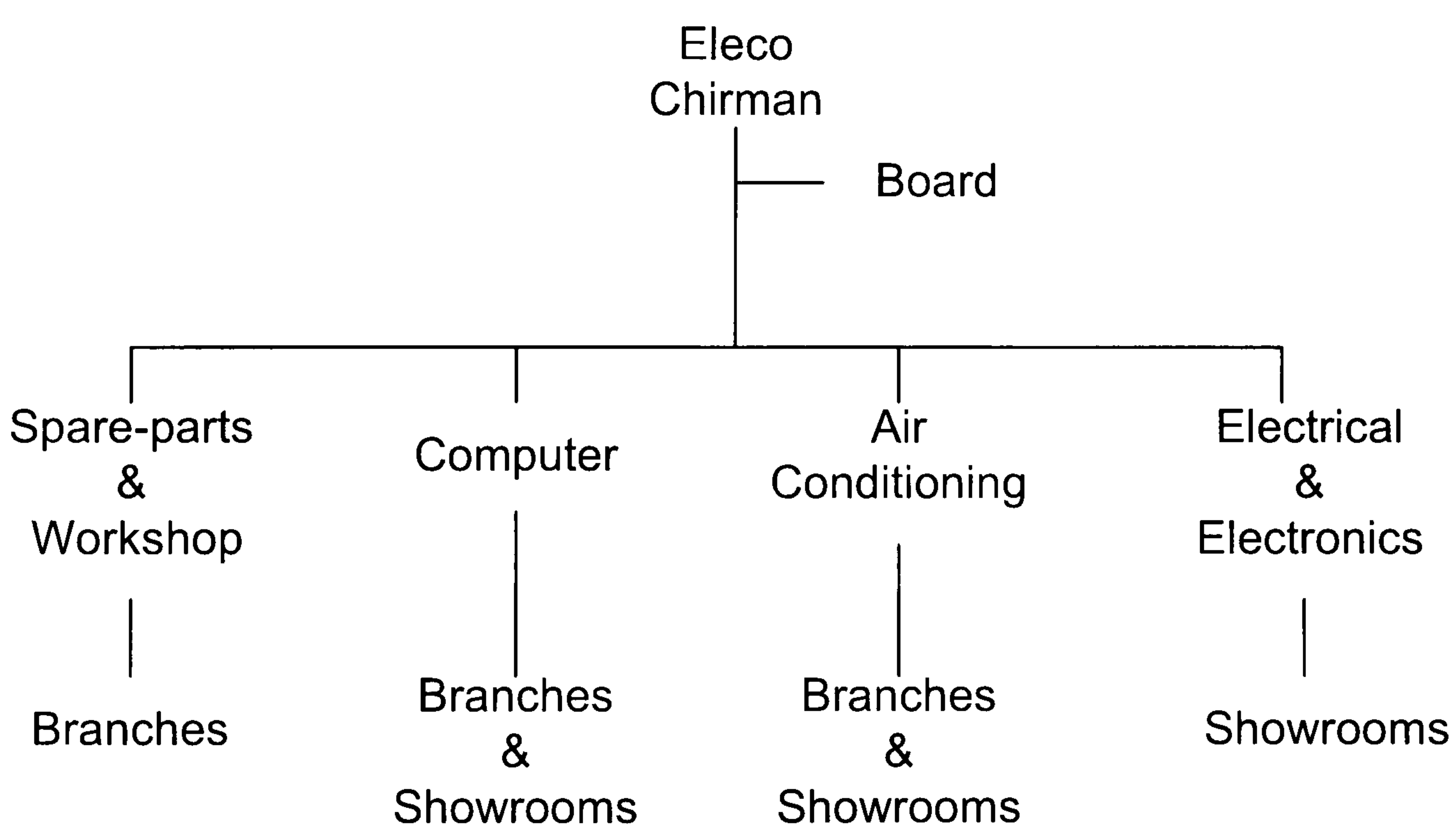

Figure 6.16: Eleco organisation chart

The company has four separate not integrated computer systems (Figure 6.17). Both the Computer unit and the Electrical and Electronics unit share a purchasing and sales system. The Central Air-Conditioning unit and the Spare Parts and Workshop unit each has its own dedicated system. The company also has a central accounting department that uses a central accounting system that processes data from all units in the company. The company acquired the ISO9002 certification in the year 2000.

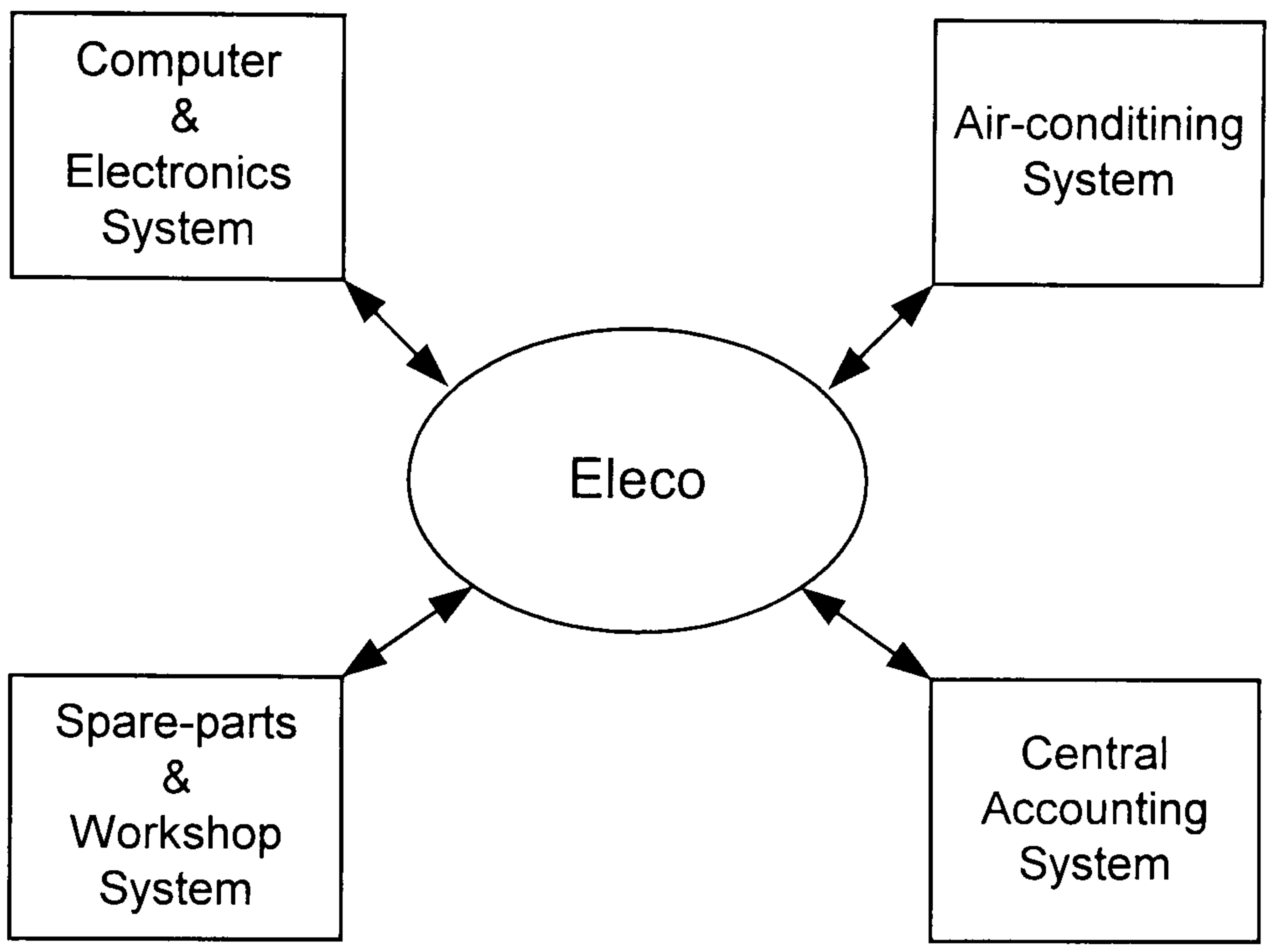

Figure 6.17: Eleco IS/IT systems

This case study is concerned with the spare parts system in the Spare Parts and Workshop unit (SP&W). SP&W (Figure 6.18) consists of one Data Processing (DP) department and two subunits: the spare parts sales subunit and the workshop subunit. SP&W has three branches. Each branch has spare parts and runs a workshop. All products sold by the company, except computers and central air-conditioning products, are serviced in the branches' workshops.

The SP&W had no formal documentation regarding any formal planning regarding their IS/IT projects. Also, no other formal documentation, except the programming code, is present regarding the system under study.

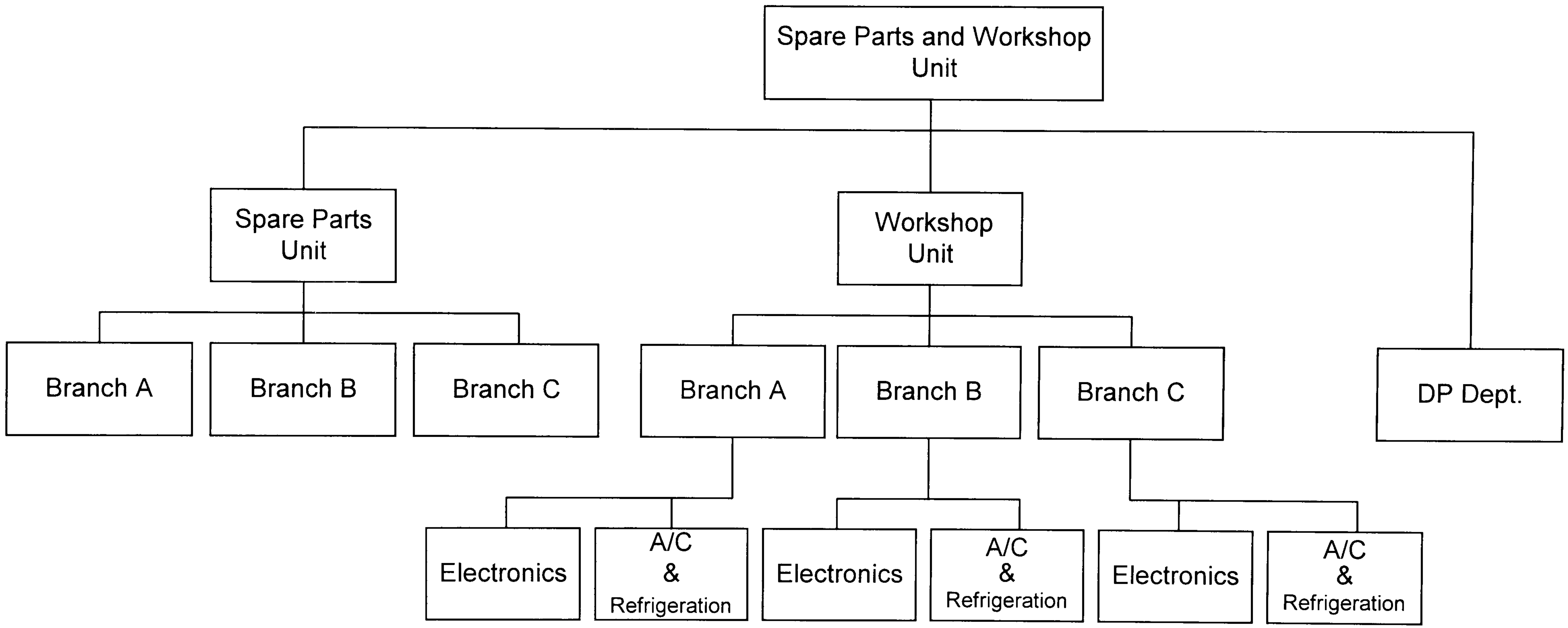

Figure 6.18: Organisational chart of spare parts and workshop unit

6.5.2 Sequence of Events

- In the mid-1980s the Eleco had purchased a computerised inventory system for spare parts which was custom-made for a major automobile spare part dealer in the country. Eleco continued to use the system until 1994. This system had only supported the inventory function of the spare parts subunit. The purchasing and sales functions were performed manually. The system fulfilled about 70% of the spare parts subunit's inventory operational needs.
- Because of the shortcomings in the inventory system and to computerise the purchasing and sales functions of the unit's operations Eleco hired a consultant in 1989/1990 to conduct a study for developing an information system to serve both the spare parts and workshop subunits. Because of national political events that took place in the country, the consultant's study was terminated and discarded.
- In 1994, the company purchased J.D. Edward package to replace the inventory system in the spare parts subunit. The package was implemented then, and remained in operation until 1998. In order for the company to implement the package, it had to change and tailor many of the unit's work processes to match the package design. The user was not comfortable with this action and resisted it all along.
- The decision to purchase the J.D. Edward package was made by Eleco's top management without consulting the subunit's management and users.
- In spite of the unforeseen need for process change and unexpected high costs of customising some of the package's functions, the package still

fulfilled only about 75% of the subunit's needs and more high costs for continuous customisation and maintenance were charged by the package vendor for the package to remain usable and keep up with new changes and demands in the work processes. This made Eleco's top management feel that they were overcharged and having this package was a bad decision.

- In addition, management and user were complaining that the vendor did not have a local branch, but a regional one in another country. This made the vendor's response to problems and requests for support take a long time, and caused complications due to the lack of face-to-face communications between the vendor's support staff and Eleco's management and users.
- The workshop subunit functions were performed manually until 1995. Because of the experience with J D Edwards package, Eleco's management decided in early 1995 to develop an in-house Service Management System which was implemented in 1996. This is mainly an operational-based system for record keeping and inquiry, which also prints invoices and basic reports for the workshop operations. The system was developed by the small Data Processing (DP) department in SP&W. The system currently fulfils 90% of the workshop subunit's operational needs.
- In early1998, the company's top management decided that keeping the J D Edward's package implemented in the spare parts section, was very costly. They were persuaded by the newly promoted DP department head in SP&W, who still carried a programmer title at the time, to go for an in-house developed replacement. The DP head was the programmer that developed the workshop's system. His main persuasion theme focused on the low cost and high rate of success of the workshop's system. Also, top

management thought that this would be a feasible option since costly modifications are needed in order for J D Edward's package to accommodate for the Y2K problem. It also was seen as a feasible option, because it would allow for the linkage between the existing in-house developed workshop Service Management System and the spare parts system to be developed. So, top management gave permission to start the development of an in-house system to replace J D Edward's package.

- The hardware used in the unit is a mini computer (IBM AS-400). This model of computers with the operating system are sold and maintained in the country by the newly acquired Eleco computer subunit.
- The system software consisted of OS-400 operating system and DB2 Relational Database Management System (RDBMS), and there exists a unit-wide communications network.
- Both spare parts and workshop unit's systems were developed in-house using RPG programming language that came with the hardware and operating system with no extra cost.
- The company did not need to hire any extra personnel for system development. The programming was mainly done by the DP head and, to a limited extent, by his assistant.
- The system was completed and implemented for operation in February 1999.
- The unit is planning to connect all branches to both systems. Currently, the branches communicate with unit's headquarter by fax, telephone, and internal post, using hard-copy forms.

- In general the users were satisfied with the new spare parts system that has a very primitive, monochrome green-over-black interface and MS-DOS like environment, with no utilisation of the new interface technologies, but the users seemed unaware of the present advances in the capabilities and developments in information technology, especially those related to computer software.
- SP&W also maintains a PC-based spreadsheet system for its personnel management, where it produces personnel reports and sends hardcopies to the company's central accounting department.
- Internal email is available for management but seldom used, especially for official matters. Also, no WWW access or e-business system in existence is in the unit.
- The company started to feel the need to link all units so they formed an internal committee to study this matter.
- After this system has been implemented, SP&W started a project that is ongoing to link the spare parts system with the workshop system to allow for information sharing in such functions as service cost calculation and invoice production.

6.5.3 Analysis and Discussion

The following sections address each attribute of the four domains of the readiness/GP model within the context of Eleco.

6.5.3.1 People

1) Staff

People		
Staff	Skill	Head of IS/IT

a) General comments

- The DP manager is the only person who thoroughly understands the unit's two systems, and he was the one who developed them. So, the entire control of the development and maintenance is focused in one person.
- The unit's DP department has a small IS/IT staff consisting of five employees in total. The head of the department is of supervisory position, which is below middle management status, and the rest are low-level technician staff.
- There is a programmer/analyst who is also the DP manager.

b) Status prior to project

At the beginning of the project, the status mostly agreed with some characteristics of both of level 1 and level 2, because there was a small number of IS/IT staff of low-level technicians and a programmer, and users' new recruits were not expected to have IS/IT-related skill. Also, there existed a DP manager who was recently appointed as responsible for the IS/IT unit. The description of this levels 1 and 2 in the readiness model is as follows:

Level 1

- o No dedicated IS/IT staff or small number of low-level technicians and programmers (there is a small number of staff who are mainly technicians)
- o External contractors maybe used to develop/install systems as required

- Users' new recruits are not expected to have IS/IT related skill

Level 2

- DP manager who was recently appointed is responsible for IS/IT function
- IS/IT staff are now charged with the responsibility of adequately understanding the user requirements needed for systems' development

c) Status at end of project

No recognisable change had occurred to the staff status at the end of the project.

d) Target status

The main progress that was needed and achieved is the formalisation of the DP department where a DP head was appointed to accommodate for the new responsibilities incurred as a result of in-house system development and maintenance and the unit need to recruit additional staff at least for backup purposes, and to bring in more technical knowledge than currently exists, in anticipation for future requirements. The remainder of level 2 characteristics need to be fulfilled. The small IS/IT staff should consist, in addition to a programmer and low level technicians, of at least one more systems analyst. Also, new user recruits should be expected to have basic IS/IT skills needed for the use of the system, and this includes the language of the system's interface.

The result of Staff analysis is as follows:

People Staff				
Status	Prior to	At end	Target	Gap
Maturity level	1-2	1-2	2	Part of level 2

2) Skill

People		
Staff	Skill	Head of IS/IT

a) General comments

- Skill of IS/IT personnel is limited to operating the hardware and software for day-to-day activities.
- After Eleco acquired the computer unit, IS/IT staff started to have more technical training, but still a low level type.
- Only the IS/IT head and his assistant, to a limited degree, have the programming skills, and no evidence was seen that they are keeping up with advances in information technology, even though the IS/IT head was usually called upon by management for advice on IS/IT-related issues.
- Users' skills are of the data entry kind. Some of them have problems in typing and understanding the language of the system.

b) Status prior to project

The skill status from before the project, as the above comments show, mostly agreed with the general description of level 1, because of very limited technical skills in the unit, where IS/IT skills are specific and of low level technical nature, and only one or two individuals have the more advanced skills. Also, IS/IT training is very limited and low level. The description of this level in the readiness model is as follows:

- The emphasis is on technology rather than organisational or informational issues where very limited technical skills in the organisation/unit as a whole
- IS/IT skills are specific to individual IS/IT applications
- Needed skills are of low level technical nature and there may exist very limited advanced (programming or systems analysis) skills in the organisation
- There is almost no IS/IT training provided by the organisation

c) Status at end of the project

At the end of the project, the skill status in the unit mostly agreed with the general description of level 2. Because of the experience in developing the two systems in-house, IS/IT staff acquired limited project management skills. And because they are now responsible for maintaining the in-house developed system, IS/IT staff acquire the skills needed to develop and maintain complete systems, such as programming and analysis, and perform their assignments and begin to have better quality training. The description of this level in the readiness model is as follows:

- Users begin to have the needed training and skills to use the new IS/IT that being developed/purchased
- Still few in-house technical expertise in IS/IT development (methodology, structured techniques) and other important skills
- IS/IT staff acquire the skills needed to develop and maintain complete systems such as programming and analysis, in addition to being able to install off-the-shelf ready-made packages
- Limited project management skills

- IS/IT individuals have the skills required to perform their assignments and begin to have the relevant training and development opportunities

d) Target status

Because of the operational nature of the system, the level of skill in the unit seems to be adequate for the day-to-day operations. The target situation should be level 2, but users need to have more training, and new user recruits need to have the needed skills to operate the system, among which being able to read and type in the language of the system's interface.

The result of Skill analysis is as follows:

People Skill				
Status	Prior to	At end	Target	Gap
Maturity level	1	2	2	-

3) Head of IS/IT

People		
Skill	Staff	Head of IS/IT

a) General comments

- Before the development of the workshop system, no formal DP head position existed. Following the deployment of that system and the beginning of development of the spare parts system, the programmer who developed the workshop system was promoted to become the new DP department head with a supervisory position. He was first appointed to work as a technician, since he had technician level credentials. During his work at the unit, he learned programming in his own time.
- The DP head still carries the same title and position under the unit's management.

b) Status prior to project

At the beginning of the project the situation mostly agreed with the general description of level 2. The description of this level in the readiness model is as follows:

- o There is a DP manager under a financial control group.

c) Status at the end of the project

At the end of the project the status of DP manager did not change, it remained at level 2.

d) Target status

Since the DP manager is called upon to give advice on IS/IT issues, the head of IS/IT unit should have a higher position than the supervisory status that he now holds. If this happens, then a more qualified person could be recruited and would contribute more in terms of advancing the utilisation of IS/IT in the unit. The target status for head of IS/IT unit should be level 3. This is reflected in the following description

- There is a new IS/IT manager appointed or DP manager might have a change in title who is viewed as a technocrat

The result of Head of IS/IT analysis is as follows:

People Head of IS/IT				
Status	Prior to	At end	Target	Gap
Maturity level	2	2	3	3

6.5.3.2 Environment

1) Leadership

Environment		
Leadership	Culture	Structure

a) General comments

- Cost issues dominated decisions which top management have made regarding the systems.
- Decisions regarding IS/IT are made at top management level, driven by what they see other companies in the country's retail sector are using, but with some consultation with IS/IT staff.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 3, because top management recognises the value of IS/IT as a way to cut costs, and cost issues dominated IS/IT decisions. The description of level 3 in the readiness model is as follows:

- o Considers IS/IT to be one of the many ways to cut costs in the firm and the expenditure on IS/IT as a way of saving cost, where IS/IT is looked at as a utility that provide service at minimum cost.

c) Status at termination of project

The status of the leadership at the end of the project remained the same as it was before the project.

d) Target status

The target status for leadership is a need to mostly agree with level 4 because top management who actually makes the decisions regarding IS/IT matters need to recognise the value of the system more than its being a cost-base. The cost-base view had affected at least the quality of system interface. The description of level 4 for leadership in the readiness model is as follows:

- Consider IS/IT to be vital for smooth functioning of operations

- The result of Leadership analysis is as follows:

Environment Leadership				
Status	Prior to	At end	Target	Gap
Maturity level	2	3	4	4

2) Culture

Environment		
Leadership	Culture	Structure

a) General comments

- Only one person, who is the DP manager, holds knowledge of the system. He was the one who developed the unit's two systems. Even though hard copies of the programs' source code have been filed, there is no standardized documentation process in place. The entire control of the development and day-to-day running is invested in one key individual.
- Adding to the previous point, the DP manager does not speak the native language. Even though it was apparent that at least some of the users have problems with understanding and typing in English, and the hardware and software support the native language, the system's interface language is English.
- The users do not have much say in IS/IT-related maters. Those are dictated by top management after taking the advice of the IS/IT unit. IS/IT personnel, having little job security and being aware of management attitude towards IS/IT as a cost-based element, the advice given to top management would bring those issues into consideration. For example, the choice to develop an in-house system using programming in a third generation programming language that only the DP manager knows and who produces no documentation for others to understand, would strengthen his position in the

company. This advice was given to top management, even though there might exist better alternatives that cost more.

- In spite of the existence of a network communications infrastructure within the unit, it is only available for management by whom it is seldom used. Since management style in the company is of a centralised nature, this reflects the lack of vision on the part of top management regarding the value of IS/IT.
- The last point is also reflected in the lack of investment in communication infrastructure between different units and systems in the company.

b) Status prior to project

The cultural situation from the beginning of the project mostly agrees with the general description of level 1. This situation was one of lack of constructive relationship between IS/IT unit and users. The description of level 1 in the readiness model is as follows:

- o The relationship between user and the limited low-level technicians that may exist in the organisation or contracted from outside is of support for the existing IS/IT products that are mainly off-the-shelf ready-made packages.
- o There is no recognition in the organisation of the importance of working towards building a constructive relationship between IS/IT function and users.

c) Status at end of project

The status of the culture at the end has not improved, it remained at level 1.

d) Target status

The organisation started to recognise the need for building the capabilities for implementing timely communication across the organisation, and for the workforce to acquire the skills for sharing information and coordinating their activities efficiently. This was one of the factors that persuaded management to choose an in-house developed system, so the two systems could be linked and share information. For an operational type system, level 2 seems to fulfil the target status concerning culture. The main progress that is needed is for the IS/IT unit to recognise the importance of satisfying user needs. This should come with the new responsibilities incurred as a result of in-house system development and maintenance, but the obstacle is the heavy handed, centralised type management, where decisions regarding IS/IT are made by top management, and users have little to say in them.

The result of Culture analysis is as follows:

Environment Culture				
Status	Prior to	At end	Target	Gap
Maturity level	1	1	2	2

3) Structure

Environment		
Leadership	Culture	Structure

a) General comments

- The situation in the company at large is that different units have different, not integrated, IS/IT agendas.
- Top management is actively involved, even more the IS/IT people, in making IS/IT decisions.
- There exists a DP department in the spare parts and workshop unit.

b) Status prior to project

At the beginning of the project, the status mostly agreed with the general description of level 1 and some of level 2, because responsibility for IS/IT is dispersed throughout the organisation, where top management is actively involved in IT/IS purchasing and in independent business units with little synchronisation with regard to IS/IT. Also, a separate DP department has recently been introduced. The description of levels 1 and 2 in the readiness model is as follows:

Level 1

- o Responsibility for IS/IT is dispersed throughout the organisation
- o Head of the organisation or site CEO is actively involved in IT/IS purchasing
- o Independent business units with little synchronisation in regard of IS/IT

Level 2

- Separate DP/IS/IT function has recently been introduced where groups are encouraged to seek advice from this newly formed central IS/IT function.
- There is a decentralised responsibility for IS/IT function, where groups have full freedom in managing their IS/IT with increased self-reliance regarding IS/IT matters which is apparent throughout the organisation.

c) Status at end of project

The status of structure did not change at the end of the project.

d) Target status

Because the management style in the company is centralisation, the view of IS/IT being a cost-base issue affected the quality of the system. The company need is to be in level 2 where it should have decentralisation of responsibility for IS/IT matters. This situation should implement the remainder of level 2 characteristics which are reflected in the following point in level 2 in the model:

- There is a decentralised responsibility for IS/IT function where groups have full freedom in managing there IS/IT with increased self-reliance regarding IS/IT matters is apparent throughout the organisation.

The result of Structure analysis is as follows:

Environment Structure				
Status	Prior to	At end	Target	Gap
Maturity level	1/2	1/2	2	2

6.5.3.3 IT

Systems

IT
Systems

a) General comments

- The systems in the unit are not connected as at the time of the study.
- The hardware, systems software, and network are shared among users and systems.
- Systems are still developed with no formal planning.
- The readiness model for systems in particular is tailored more towards the whole organisation than individual units within it.

b) Status prior to the project

At the beginning of the project, the status mostly agreed with the general description of level 1. The description of this level in the readiness model is as follows:

- o An increase in the number of IS/IT application systems is being developed or purchased but concentration is still on operational systems in the financial area while a small number of other core business-oriented systems are being developed.

- Many of the IS/IT application systems still overlap in purpose, function and data stored in the organisation, where only some hardware, system software, and possibly a network are shared between groups
- Large maintenance load is being placed on IS/IT function because of the ad hoc nature of most systems
- All data are stored in units' systems, except data needed for organisational reporting are transferred to central systems

c) Status at end of project

The status of systems at the end of the project is still mostly agrees with level 3 and moving towards enabling both system to connect but they are still unconnected. The automation of the previously manual workshop system makes information systems cover almost all operations in SP&W. The description of level 3 is as follows:

- In-house IS/IT applications covering most major operation areas with office automation exists but in an isolated stand-alone manner
- Technical infrastructure consists of unconnected systems where no shared applications exist
- Systems have been implemented in most operational areas in the organisation where the use of IS/IT services varies among the business units
- Some IS/IT application systems have still been put together by users, and old user-developed systems are being used in uncontrolled, uncoordinated manner even though new systems are centrally developed, installed, and operated by IS/IT function

d) Target status

The target status for this operational system needs to take into consideration that in order to meets its operational objectives, level 3 is adequate. But to make the environment a base for higher level systems such as DSS, it needs to be connected to, at least, the other system in the unit. Also, in order to provide better customer service, it will be necessary to change and enhance the system's user interface from layout and language aspects. The use of colours, windows, and the native language are achievable using the currently available hardware and software in the organisation. The connectivity issue calls for the systems status to mostly agree with the description of level 4. This description is as follows:

- All needed operational IS/IT is mostly in place and some DSS start to appear
- Office automation is integrated and unified/standardised organisation-wide
- Existence of an organisation-wide network, where all groups are connected and the central IS/IT function provides communication services for all groups in the organisation
- Central coordination in the use of IS/IT throughout the organisation, where an effort is made by groups' IS/IT functions to follow standards set centrally
- The organisation-wide network is starting to being utilised to connect users to whatever shared applications and information systems that are needed

- Extensive use of standard e-mail messages throughout the organisation, and there is evidence of dependence on the organisation-wide network to conduct formal communication

The result of Systems analysis is as follows:

IT Systems				
Status	Prior to	At end	Target	Gap
Maturity level	2	3	4	4

6.5.3.4 Process

Practices

Process

Practices

a) General comments

- It is important to note that evaluation of the process maturity in the unit was performed entirely on the respondents' perceptions and/or accounts. Because of accessibility, resources, and time limitations it was beyond the researcher ability to conduct this evaluation by studying the processes directly. When it is possible, the actual maturity status should be directly studied by the evaluator.
- The company has just passed ISO9002. The unit manager interviewed headed the ISO team in the company. In such cases, software organisations' maturity varies between levels 1 to 3 of CMM (Paulk, 1995).

b) Status prior to and at end of project

According to the account of the unit manager who was the head of the ISO certification committee at the organisation, the process level from before the development of the system and currently agrees with level 3-GG 2 strongly but is close to being half-way in 3-GG 3.

d) Target status

Because the system is an operational system that does not require any group information sharing or any sharing-based culture, the current level fulfils the needed status for the system to meet its objectives.

The result of Process analysis is as follows:

Process Practices				
Status	Prior to	At end	Target	Gap
Maturity level	GG2	GG2	GG2	-

6.5.4 Conclusion

- The DP manager is the only person who thoroughly understands the unit's two systems, and he was the one who developed them. So, the entire control of the development and maintenance is focused in one person. This has implications for security and the mere existence of the system, especially since there is no documentation other than the programming list of code.
- The style of management in the company is centralised, where most IS/IT-related decisions are made at top management level, with little consultation with the user group. This, with the feeling of job insecurity of the mostly foreign staff, seems to positively affect the expectation from the information system. The staff seem willing to work in whatever situation is available. Having IS/IT seems a positive contribution to the work environment, which

would also provide them with 'computer skills' that would increase their value in the work market, both locally and in their original countries.

- Even though it could be used for unit level measurement, the systems part of the model in particular is mainly targeted towards the whole organisation.
- It is important to note that evaluation of the process maturity in the unit was performed entirely on the respondents' perceptions and/or accounts. Because of accessibility, resources, and time limitations, it was beyond the researcher's ability to conduct this evaluation by studying the processes directly. When it is possible, the actual maturity status should be directly studied by the evaluator.
- The users do not have much say in IS/IT-related maters. Those are dictated by top management after taking the advice of the IS/IT unit. IS/IT personnel having little job security and being aware of management attitude towards IS/IT as a cost-based element, the advice given to top management would bring those issues into consideration. For example, the choice to develop an in-house system using programming in a third generation programming language that only the DP manager knows, and who produces no documentations for others to understand, would strengthen his position in the company. This advice was given to top management, even though there might exist better alternatives that cost more.
- In spite of the existence of a network communications infrastructure within the unit, it is only available for management who seldom use it. Since management style in the company is of a centralised nature, this reflects how top management value IS/IT.

- Top management who actually make the decisions regarding IS/IT matters need to recognise the value of the system as being more than a cost-base. The cost-base view had affected at least the quality of system interface. This could be the case when centralised management style is in effect. In might be that in organisations where IS/IT decisions are made mainly by IS/IT people, a lesser level of leadership maturity might be adequate, since IS/IT people can justify the adequate minimum systems requirements to be of high level, which would cost more even if management looked at IS/IT as a cost-base. This means that when leadership is centralised, we need a higher level of leadership maturity is needed to recognise the value of spending more on IS/IT, while with non-centralised leadership we can achieve the same result with less mature leadership, because IS/IT people would have more say in the IS/IT decisions, where they can justify more spending.
- It is important to recognise that the target situation of the systems in the individual units cannot be totally separated from that in the organisation at large, even though the systems part of the readiness model is mainly targeted at the whole organisation. Since the company has unconnected systems between units (hardware, software, and networks), top management started to recognise the need to connect all of the units and systems together. Because the company has recently acquired a computer sales company/unit, this had brought some IS/IT expertise into Eleco. This expertise is giving top management some useful advice in regard of IS/IT issues which has been manifested lately in the formation of a committee within the organisation to study the issue of connectivity and integration of all Eleco's units. To reach this situation of connecting all organisational systems, at least level 4 should

be attained where the company should have an organisation-wide network that provides communication between different units, and eliminates redundancies in systems and resources. The company at large now shows characteristics of level 1.

- The company's units now have different systems but with many similar functions, like purchasing, store/inventory, and sales. The Air-conditioning unit and Computer unit also have workshop and spare parts systems.
- Building a company-wide network is important for information and systems' sharing. Also, managing the network will require additional and maybe totally different skills, and modifications to the company structures. This should be accompanied by enabling organisation-wide e-mail and maybe office automation tools.

Spare-parts Unit Manager comments regarding the readiness/GP model

> "The issues introduced by the model are very important and
> need to be taken seriously when planning an IT project."

6.6 Summary and Conclusion

The findings and impacts of cases on the model are shown in Table 6.8.

Table 6.8: Main Findings and Model Alterations

Case Title	Main Findings	Impact and Alteration to Model
ServInst case	• Vendor used the project to train own new inexperienced staff. • Organisations need to have in the contract the qualifications of the vendor's staff and require prior approval for any change or new recruitment. • When measuring the organisational readiness to focus on the staff in the organisation that will be available for the project not in the organisation in-large. • Lack of positive relationships between different groups in the organisation caused resistance to needed change in structure and processes. • Key staff considered keeping knowledge to themselves as a job security tool, and they were not forthcoming in cooperating with the project team. • The individualistic culture almost entirely prohibited the existence of in-house training programmes for new and junior staff by senior and key staff. • The lack of decisive leadership by top management allowed the conflicts between different entities in the organisation to go on in an increasing mode. • The lack of strong support from the top management prevented the project team from implementing necessary changes in the processes and structure.	• Rewording of most model items • Merging of items in most levels and attributes • Deletion of some items that found to be unclear or unnecessary • Adding explanation sheets for Process assessment • Recognising that government and private sectors differ in high maturity levels regarding their external competitive views

	• The project team did not make an effort to relieve the tension in the relationship that occurred with users that was caused by the introduction of the project. • Level 3 Leadership does not fully apply in government institutions such as ServInst. Such a government-run organisation would consider IS/IT mainly as a utility to provide services. • Because top management caved in under the pressure of both IS/IT unit and user groups, the project team was not allowed to modify the organisational structure. • The new system design was not successful in resolving the ownership of the data within the organisation which caused user resistance to the project. • The vendor treated the project as if it was building a new system in an organisation that had no prior systems. • The 'strategic study' did not address the real problems with the system. • The withdrawal of the vendors' experienced staff who were agreed upon had negatively affected the organisation's trust in the vendor.	

Continue Table 6.8

Continue Table 6.8

Oilco case	• The project did not address the preparation of any of the attributes before the project began. • Oilco team attempted during the project to fill the gaps and fulfil what should have been performed as pre-steps before the start of the project. • IS/IT awareness maturity of the old top management of Oilco was low. • The final proposal by the vendor did not address what to do next after loading the historical data. • The new top management became interested in having this project succeed and they gave it considerable support. • After the end of the project, the Culture, Skills, Structure and Process remain problem areas. • The improvement on Culture has a positive effect on the usage of the system. • The Skill of the IS/IT people is on a satisfactory level. The project does not suffer from any shortage of technical skill. • The Structure seems to be tied with the Culture. Decentralisation of control would not resolve the problems regarding the system use.	Rewording and changes of: • Levels 1,2, 3, in Skill • Levels 1, 2, 3 in Staff • Levels 1, 2, 3, 4 in Culture • Levels 1, 2, 4 in Head of IS/IT • Levels 2, 3, 4 in Structure • Levels 1, 2, 3, 4 in Systems • Expanding the Process explanation assessment sheets

	• Since the team is not experienced in process improvement or BPR, the improvement on Process domain is slow. It seems that the team is improving the Process by 'trial and error' method.	
Bank case	• The use of IS/IT in the Bank is well behind that normally expected from a Bank which is set up to promote the industrial sector of a major finance centre. • The Bank management needs to recognise that technology is changing too fast for the non-specialist to keep up. This means that the Bank's top management need to consider IS/IT as a strategic tool to achieve a competitive edge. • There is no independent review to monitor the quality of the IS/IT deliverables. • The capabilities of the old/current core system applications do limit the operational capability of the Bank and very poorly serves the Bank. • There is no clear distinction between operational systems and information systems. • The Bank's operational processes are riddled with apparent reconciliation errors that arise because the data flows between systems are poorly designed. • There is no internal communications infrastructure for the sharing of information in the Bank. • Power is concentrated in a few individuals who controlled the knowledge and day-to-	Rewording and changes of: • Levels 1,2, 3, 4, 5 in Leadership • Levels 2, 3 in Culture • Levels 1, 2, 4 in Head of IS/IT • Levels 1, 2 in Systems

	day IS/IT activities of the old mainframe system. • There is a danger that the vendor does not fulfil its responsibility of providing the needed expertise and other resources for the operation. • Since the new project is considered to be a total solution which spans all aspects of the Bank operations, the head of IS/IT should have a senior managerial position. • It is essential that the IS/IT unit help top management to understand what business opportunities for strategic advantage could arise from implementing new IS/IT. • It could be that the easiest progress could be made on the systems attribute when the organisations buy the IS/IT and networks. • The Bank seems that have taken some correct pre-steps, especially regarding the IT domain. Currently, at the start of the implementation of the new systems, the Bank already shows that the IT attribute have already reached the Needed level. • The People attributes, and especially Culture, could present trouble areas. Culture has not been addressed at all in any pre-steps actions. • The process remains an unclear area for prediction. Even though the Bank addressed BPR, it seems that the process changes made are insufficient.	

Continue Table 6.8

Continue Table 6.8

Eleco case	• The DP manager is the only person who thoroughly understands the unit's two systems. • The style of management in the company is centralised. The staff seem willing to work in whatever situation is available. • Even though it could be used for unit level measurement, the systems part of the model in particular is mainly targeted towards the whole organisation. • Evaluation of the process maturity in the unit was performed entirely on the respondents' perceptions and/or accounts. • The users do not have much say in IS/IT-related maters. Those are dictated by top management after taking the advice of the IS/IT unit. • In spite of the existence of a network communications infrastructure within the unit, it is only available for management who seldom use it. • Top management who actually make the decisions regarding IS/IT matters need to recognise the value of the system as being more than a cost-base. • The target situation of the systems in the individual units cannot be totally separated from that in the organisation at large. Top management started to recognise the need	Rewording and changes of: • Levels 2 in Staff • Levels 3 in Systems

	to connect all of the units and systems together. • The company's units now have different systems but with many similar functions, like purchasing, store/inventory, and sales. • Building a company-wide network is important for information and systems' sharing. Also, managing the network will require additional and maybe totally different skills, and modifications to the company structures.	

Continue Table 6.8

The case of the ServInst demonstrated an IS/IT project failure. The organisation contracted with an external vendor to develop a "full solution" systems based on the relational data base management system developed and marketed by the international company. Two and a half years after the start of the project, and spending millions of U.S. dollars, the project was terminated and considered by both parties (the organisation and vendor) to be failure.

The case of the oil company Oilco is a failed IS/IT project that the organisation is trying to rescue. The project was supposed to be developed by an international company through the customisation of their own developed package and building a database for the entire oil operation's data. The project failed in delivering the required outcome and the oil company was stuck with an unfinished technical system that even when finished is unusable and unacceptable by the target users. The oil company went to great effort to resolve the problems and shortcomings but with limited success.

The case of the electronics retail company Eleco demonstrates a bespoke IS/IT project with limited success. The largest electronics retailer in the country had two previous third-party packages for its spare parts and workshop unit, which is considered by Management to be the most money-generating unit. The company had purchased the first package from a local automobile dealership company. After two years of operating and constantly trying to customise the package in-house, the company recognised that the package did not serve its needs. Another package was then purchased from an international company based in another country in the region. The vendors customisation of the package was acceptable in the initial implementation stage, but as the company's experience with the use of the IS/IT grew and new needs emerged, the vendor was not able to fulfil the timely needs and requests, and the company started to recognise that the package was in its way of loosing its cost-effectiveness. A decision then was made to abandon the use of the package and build an in-house IS. It took the company close to a year to build the bespoke IS utilising a very small DP department with three staff members, one of them was a programmer with previous experience. Even though Management consider the system to be 70% successul, user reservations and observed difficulty in using the system indicate differently. Expansion of the new system is planed so that it could be deployed at the three remote branches of the spare parts and workshop unit using a Wide Area Network (WAN).

The case of the semi-government bank demonstrates an on-going project that this research followed considerable stages of its development cycle. The researcher interviewed Bank's Management at post planning stage when performing the exploratory work and after requirement specification and at an advanced stage of vendors' customisation of third-party packages purchased by the Bank from international vendor.

The project was meant to be "a total solution" for the Bank's operations. The Bank's Management tried to compensate from the internal lack of skill and knowledge by seeking professional advice from external consultants at different stages of the project. So far the project is proceeding according to plan, but the model forecasted that some problems would occur if appropriate and corrective steps are not taken, such as extensive training and recruiting/exchanging of IS/IT unit and user staff in addition to culture reforming programme.

When applying the readiness/GP model to the four case studies, it was apparent that some of what used to be considered characteristics of higher maturity in some of the reviewed maturity models are not valid any more. Such characteristics became normal occurrences at lower maturity levels; for example, the existence of networks, servers, email, databases and Internet utilisation as well as the skills that are related to them. While this was the case with mainly IT related characteristics where they tend to slip down the ladder of maturity overtime, People's and Environmental issues tend to stay constant. As to the Process issue, it seemed that there exist a relationship between IT and Process, which is supported by the need for revision of processes when introducing a new technology. Those revisions had most of the times led to business process reengineering or modification. Even though this did not seem to affect our general purpose process instrument, it would affect the industry-specific investigation and solutions. The previous points illustrate the need for such normative models to be revised and updated periodically and continuously.

Also, there were differences between the government and private sectors. The developed readiness/GP model (and other maturity models as well) suggests that at the higher levels of maturity, an external interest starts to formulate. This would be true of the private sector but not the government sector that, in most cases, has no external competition.

For specific attributes of the readiness/GP model that were expected to be closely related, this was found to be notso in some cases. So for Skill and Staff, while a staff title (System analyst, for example) should imply certain skills, this was found not to be the case. This could be noticed only in an in-depth qualitative investigation. This is true with regard to problems related to hiring consultants in developing countries.

Even though the consultant might be considered to have adequate skill and experience in similar condition in other countries that they worked in, those skills, due to cultural issues, were either not adequate enough or misplaced in the developing country. This was found to be a source of repeated complains in the cases studied and interviews conducted.

It was also noticed that the organisation that has ISO 9002 certification had conformed to level 3 of the process part of the model, a result supported by the literature (Paulk, 1995).

Regarding the components of the model, it was noticed that it is not necessary for all four domains in the structure of the readiness/GP model to be on the same maturity level for an IS to be successful. Different systems might need different maturity levels. In addition, more than one level might seem to apply, but what should be selected is the one that applies the most.

Chapter 7: Summary and Conclusions

7.1 Introduction

This chapter presents an overall summary of this study along with the major findings. The contribution and limitations of the research are also presented. The chapter also provides guidelines for the use of the readiness/GP model. Finally, the chapter outlines future research directions, which have emerged from this study.

7.2 Summary

The main goal for IS/IT projects is the successful timely delivery which meets the planned performance and objectives. However, IS/IT projects frequently fail. It has been reported that, on average, IS systems are delivered a year behind schedule, only 1% of projects finish on time and to budget and in the United States alone, 31.1% of projects are cancelled before they finish, 52.7% of projects are completed but with 189% of their original estimated cost. Out of those, only 42% of the originally-proposed features and functions are fulfilled.

The lack of success of new information systems (IS) by failing to meet the objectives expected to be achieved continues to be a major concern for organisations (McDermott, 1987). These projects are either abandoned, significantly redirected, or even worse, they were 'kept alive' in spite of their failure, where the cost of having funded them and the missed opportunities of not benefiting from their intended capabilities can represent a tremendous loss for an organisation. The situation is made even worse by the lack of credible measurements of success for those completed systems. When classifying types of measures, four general measurement approaches could be identified: Goal-centred, Normative, Comparative, and Improvement.

Goal-centred measurement approach is also called ‘measurement against purpose’, normative measurement approach is also called ‘conformance measurement’, comparative measurement approach: is also called ‘benchmarking’, and improvement measurement approach is concerned with assessing to what degree the current product/system or process was adapted to the changes in requirements and environment in the workplace and organisation. In practice, the improvement approach is not performed separately but combined with any of the other measurement approaches mainly with the normative approach which is often represented in maturity based models.

Many IS/IT projects that fail are blamed mainly on poor project management practices, but it is necessary to look beyond those traditional explanations as the main cause and to consider possible organisational factors that may promote IT/IS project failure. The process of planning, designing, developing and implementing of IS/IT has changed over the past decade towards ready-made packages.

In an attempt to improve the likelihood of IS/IT project success, it is essential to understand the quality of IS components and the environment it operates in, hence a number of measures of IS/IT success and IS/IT investment evaluation were developed within the IS/IT research field.

In early studies within the IS/IT research field, ‘IS/IT success’ is determined by its achievement of the IS/IT objectives, where measurement of success was performed on the technical level using technical attributes that focus on performance characteristics such as resource utilisation, hardware utilisation efficiency, reliability, response time, ease of terminal use, etc. (DeLone & McLean, 1992; Hamilton and Chervany, 1981). Other studies used different measures such as the extent to which the information system is used by management (Cerullo, 1980; Ginzberg, 1981; Zmud, 1979), or the impact of an IS on individual or organisational performance (Hamilton and Chervany, 1981; Kriebel, 1979; Lucas, 1975). In later studies, IS/IT success is described as the desired state of an information system mainly on the usage level using factors such as use and user satisfaction (Gatian, 1994; Seddon, 1997). In some instances, the term 'IS/IT success' is used to mean the desired state of the IS/IT function, rather than the information systems, in an organisation (Hamilton & Chervany, 1981; Myers et al., 1998). In a different approach, some studies applied all-purpose hard financial measures in evaluating the value of IS/IT. They used such measures as return on investment (ROI) and cost-benefit analysis (CBA) (Brynjolfsson & Hitt 1995,1996,1998; Dewan & Min 1997; Farbey et al.1994, 1995; Moony et al., 1996; Strassmann 1997).

Evaluation measures have been criticised especially in measuring the success of IS/IT projects at the business level (DeLone & McLean, 1992; Ishman, 1996). They were also criticised for not being able to provide value to the organisation. In fact, many researchers advocate that a major problem with IS/IT investments is the way in which they are evaluated (Farbey et al. 1994; Strassman, 1997; Willcocks, 1996). This criticism has been sounded regarding both the hard financial-based measures and the soft non-financial measures.

DeLone and McLean (1992) introduced an IS/IT measurement model that combines both 'soft' and 'hard' measurements. This study became the basis for a large amount of subsequent IS/IT success measurement research (Ballantine et al., 1996; Seddon, 1997; Garrity & Sanders, 1998). DeLone & McLean (1992) study. This study, and in spite of its promising approach in resolving the IS/IT measurement problem, had generated a considerable amount of debate and criticism in the IS/IT literature. In order to try to find out the reasons behind this criticism by back-tracing the theoretical path the study was built upon, namely Shannon & Weaver (1949) communication theory and its adoption into the IS/IT field by Mason (1978) which are the parent studies of DeLone & McLean (1992), it was found out that there exist shortcomings in the adoption of those studies and solutions were needed. The shortcomings in Shannon & Weaver (1949) were reflected in the theory's adoption into the IS/IT field. In addition, the shortcomings of the way the theory was adopted into the IS/IT research field by Mason (1978) has also contributed to the problem. All of those shortcomings in the communication theory itself and its adoption contributed to the problems in IS/IT success measurements.

Other measures have been developed with the aim of improving organisational processes which have been generally recognised as a main factor contributing to the success of IS/IT. Examples of these are Capability Maturity Model (CMM), Trillium, Bootstrap (Kuvaja et al., 1994), Software Process Improvement and Capability dEtermination (SPICE) (El Emam et al., 1998), IT Infrastructure Library (ITIL) (Central Computer and Telecommunications Agency, 1992), Goal/Question/Metric (GQM) paradigm (Solingen & Berghout, 1999), etc. In addition, IS/IT literature discusses other measures that assess organisational maturity in terms of IS/IT planning (Bhabuta, 1988; Earl, 1986, 1988, 1989), IT infrastructure (Weill & Broadbent, 1999), IS/IT utilisation (Nolan, 1979), and management of IS function (Hirschheim et al., 1988; Galliers & Sutherland, 1991).

To contribute to the resolution of the shortcomings in the theoretical adoption of the communication theory in the IS/IT field, this study introduced a novel IS/IT evaluation framework which provides a holistic view of IS/IT evaluation on the business level based on a new theoretical adoption. This new adoption is based on both the Shannon & Weaver (1949) theory of communication and Schramm's (1954, 1971) modification of it. Introducing this evaluation framework presented the opportunity to recognise that IS/IT measures which exist and are used in the IS/IT field are post-project/post-implementation measures that do not contribute considerably to the success of the following projects. The researcher then introduced an alternative pre-project/pre-implementation measurement approach/model that would measure organisational readiness for successful implementation of a predetermined information system. This approach is hoped to increase the likelihood of the success of IS/IT at the business level, and give organisations the ability to measure the readiness gap and predict the level of success of an IS/IT project. This approach is meant to also provide management with effective guidance that contributes to meeting their business objectives and achieving their Critical Success Factors. The approach is based on the readiness/GP model that consists of four interacting domains that contain eight attributes: IT (systems), people (staff, skill, head of IS/IT function), process (generic practices), and environment (management style/leadership involvement, structure, and culture). Each of the attributes is described by characteristics explaining a maturity status where the maturity is described on six levels.

After the introduction of the novel evaluation framework and the readiness/GP model, four case studies were conducted. The use of case studies in this research aims to test and validate the readiness/GP model in as close to a ‘real life’ situation as possible. While the elements and issues addressed by the model are 'logical' and supported by the literature, it was important to experience the actual implementation of the model in a real organisational setting as far as possible. In addition, to solicit the opinions of the people involved with IS/IT projects in organisations regarding the usefulness and practicality of the model in real situations. Organisations selected as case studies were based in the Middle East. They were characterised under different issues, sizes, sectors, and status of IS/IT project. They fall under private and government sectors. They are from oil, banking, service, and retail industries and are also characterised as large and medium size. In addition, the organisations acquired different IT infrastructures. The status of their IS/IT projects were different as initially described by the organisations as being: successful, semi-successful, failure, or under development. Some of those projects were bespoke, while others had customised third party packages. Some organisations had their own people working on the project development alongside the external vendor, while in one case the external vendors had the full responsibility for the project development.

The case of the service organisation demonstrated an IS/IT project failure. The organisation contracted with an external vendor to develop a “full solution” system based on the relational data base management system developed and marketed by the international company. Two and a half years after the start of the project, and spending of millions of U.S. dollars, the project was terminated and considered by both parties (the organisation and vendor) to be failure.

The case of the oil company is a failed IS/IT project that the organisation is trying to rescue. The project was supposed to be developed by the branch of an international company to customise their own developed package and build a database of the entire oil operation data of the company that was accumulated for many years from manual and PC based systems. The project failed in delivering the required outcome and the oil company was stuck with an unfinished technical system that even when finished is unusable and unacceptable by the target user. The oil company went into great effort to resolve the problems and shortcomings, but with limited success.

The case of the electronics retail company demonstrates a bespoke IS/IT project with limited success. The largest electronics retailer in the country had two previous third party packages for its spare parts and workshop unit, which is considered by Management to be the most money-generating unit. The company had purchased the first package from a local automobile dealership company with its source-code. After two years of operating and constantly trying to customise the package in-house, the company recognised that the package did not serve its needs. A third-party package was then purchased from a regional branch of an international company based in another country in the Middle East region. The vendor's customisation of the package was acceptable in the initial implementation stage, but as the company's experience with the use of the IS/IT grew and new needs emerged, the vendor was not able to fulfil the timely needs and requests, and the company started to recognise that the package was on its way to losing its cost-effectiveness. A decision then was made to abandon the use of the package and build an in-house IS. It took the company close to a year to build the bespoke IS utilising a very small DP department with three staff members, one of whom was a programmer with previous experience. Even though Management considered the system to be 70% success, user reservations and observed difficulty in using the system indicate differently. Expansion of the new system is planned so that it could be deployed at the three remote branches of the spare parts and workshop unit using a Wide Area Network (WAN).

The case of the semi-government bank demonstrates an on-going project of which the research followed considerable stages of its development cycle. The researcher interviewed bank's Management at the post planning stage when performing the exploratory work and after requirement specification and at an advanced stage of vendors' customisation of third-party packages purchased by the bank from international vendor.

The project was meant to be "a total solution" for the bank's operations. The bank's Management tried to compensate of the internal lack of skill and knowledge by seeking professional advice from external consultants at different stages of the project. So far the project is proceeding according to plan, but the model forecasted the that some problems would occur if appropriate and corrective steps are not taken, such as extensive training and recruiting/exchanging of IS/IT unit and user staff in addition to a culture reforming programme.

7.3 Main Conclusions and Findings

- The research field of IS/IT evaluation is still inconclusive, especially in measuring the success of IS/IT projects on the business level. Many of the evaluation measures have been criticised in the literature for suffering serious shortcomings. In fact, many researchers advocate that a major problem with IS/IT investments is the way in which they are evaluated.

- Investments in IS/IT in recent years became more linked to the achievements of the organisations' business objectives, while IS/IT success was previously measured at either user or technical levels or in hard financial terms. 'IS/IT success' was determined by its achievement of the IS/IT objectives, where measurement of success was performed on the technical level using technical attributes that focus on performance characteristics such as resource utilisation, hardware utilisation efficiency, reliability, response time, and ease of terminal use.

Due to the wide range of measurement approaches, it was found that holistic classification is needed. Therefore, the research produced a novel classification as such:

- 'Hard' financial measurements such as return on investment (ROI) and cost-benefit analysis (CBA).
- 'Soft' non-financial measurements such as the technical quality of IS/IT, usage measurements such as use and user satisfaction.
- Processes-oriented measurements such as Capability Maturity Model (CMM), Trillium, Structured Process Improvement for Construction Enterprises, Bootstrap, and Software Process Improvement and Capability dEtermination (SPICE)
- Product-oriented measurements such as IT Infrastructure Library (ITIL), Goal/Question/Metric (GQM)
- Other measures that assess organisational maturity in terms of IS/IT planning such as Bhabuta and Earl models, IT infrastructure such as Weill & Broadbent model, IS/IT utilisation such as Nolan model, and management of IS function such as Hirschheim et al. model and Galliers model.

- From the initial study, the research found the following factors and attributes to affect the success of IS/IT in organisations:
    - Quality and portfolio of information technology (hardware, software, networks) in the organisation,
    - Organisational structure and the IS/IT positioning in the organisational structure,
    - Management style and support of IS/IT operations,
    - IS/IT planning and top management scanning of the environment,
    - Authority of IS/IT function head,
    - Vendor support of organisational IS/IT,
    - IS/IT staff skills and expertise,
    - User technical knowledge and skills,
    - Organisational culture and relationships between IS/IT function and users,
    - Quality of work processes.
    - Critical success factors (CSFs) could be used as the success measures of IS/IT on different levels of the organisation including the business level.
    - Success of IS/IT could be measured at different levels; technical, usage, and influence.

- It was found that many IS/IT projects that fail are blamed mainly on poor project management practices. It was necessary to look beyond traditional explanations of poor project management as the main cause and to consider possible organisational factors that may promote IT/IS project failure. Because the process of planning, designing, developing and implementing of IS/IT has changed over the past decade, and there is a trend towards planning and implementation of third party products instead of bespoke products, the problems resulting from this change introduce different challenges which organisations have to face. These were found to be mainly related to organisational factors such as people, processes, IT components and environment.

- Organisations needed to be able to predict more accurately the level of success of IS/IT projects in order to lessen the risk of a failure of those projects. The earlier this prediction could be achieved, the more likely it was that changes needed to facilitate a successful system could be made. It is therefore important to identify the 'readiness gap' in the organisation for a particular IS/IT project. This gap is the difference between the current organisational situation in terms of IT, people, process and environment, and the situation needed to successfully develop, implement, operate and maintain the intended IS/IT.

- It became apparent that there was a need for a tool that can assist management in predicting the success of IS/IT projects before launching them. However, the IS/IT research field was still lacking a credible measurement tool that could be used to determine the organisational state of readiness within which successful implementation of IS/IT projects could be achieved. Such a tool would also assist the organisation in building an improvement plan to bring it into the required readiness status in terms of having the adequate capabilities and environment for planning, development, operation and maintenance of information systems that would increase the likelihood of IS/IT project success. This has illuminated the need for the establishment of a measurement approach to increase the likelihood of successful implementation of IS/IT projects in meeting their intended objectives.

- This research has produced a novel evaluation framework of IS/IT measurement which brings together the various levels of an IS/IT system with an overlapping measurement approach. The evaluation framework presents CSFs to be used in the measurement of success of the IS/IT on the level of intended effect/objective. If the objective is on a certain level i.e. operational, managerial, strategic, etc., and the CSFs on that level are fulfilled, then the information system has accomplished its objectives and would contribute to the business objectives by contributing to the higher levels of objectives than its deployment's (Figure 5.2 and Figure 5.4). This should show in those higher levels through emergence properties. CSFs could be used as a measurement of IS/IT success because it could measure attainment of objectives at different levels of deployment i.e. project, group, unit, or organisation, and it could also be of different types 'hard' financial or 'soft' non-financial measures.

- From the evaluation framework, this research has highlighted two feedback loops that affect an IS/IT project. The first is the one that is generated by the users to help in the refinement of the IS/IT requirements' specification. The second is a result of the project outcome that enables organisational learning in terms of IS/IT projects.

- This research produced the needed readiness/General Practice model which introduced a balanced approach between the main factors affecting IS/IT success. The readiness of the organisation for an IS/IT project can be depicted by the use of a model that explains particular requirements in terms of four domains containing eight attributes: IT (systems), people (staff, skill, head of IS/IT function), process (practices), and environment (management style/leadership involvement, structure, and culture) (Figure 5.6). The environment attributes could be classified also as being those of the people issues as culture and management style/leadership involvement, or closely tide to its systems as in the case of structure. Each of the attributes is described on six levels/stages where each represents a maturity level describing the organisational situation in terms of the particular attribute (Figure 5.7). This approach is hoped to increase the likelihood of the success of IS/IT at the business level, and will give organisations the ability to measure the readiness gap and predict the level of success of an IS/IT project. It aims at determining the current/existing organisational status and the needed status for the successful implementation of a predefined IS/IT project. This alternative approach provides management with effective guidance that contributes to meeting the business objectives by achieving the CSFs of the IS/IT project they intend to launch. After the model was developed, it was tested and modified through the use of case studies.

- When applying the model in the case studies, it was apparent that some of what used to be considered characteristics of higher maturity in some of the maturity models reviewed are not anymore valid. Those became normal occurrences at lower maturity levels; for example, the existence of networks, servers, email, databases and Internet utilisation; also the skills that are related to them. While this was the case with mainly IT related characteristics where they tend to slip down the ladder of maturity overtime, People's and

Environmental issues tend to stay constant. As to the Process issue, it seemed that there exist a relationship between IT and Process, which is supported by the need for revision of processes when introducing a new technology. Those revisions had most of the times led to business process reengineering or modification. Even though this did not seem to affect our general purpose process instrument, it would affect the industry-specific investigation and solutions. The previous points illustrate the need for such normative models to be revised and updated periodically and continuously.

- There was a difference between the government and private sectors. The model (and other maturity models as well) suggests that at the higher levels of maturity, an external interest start to formulate. This would be true of the private sector but not the government sector that, most of the time, has no external competition of value.

Cases-related findings:

- Specific attributes of the domains of the readiness/GP model that were expected to be closely related were found not to be in some cases. For Skill and Staff, while a staff title (System analyst, for example) should imply certain skills, it was found that this was not the case. This could be noticed only in an in-depth qualitative investigation. This was true in regard to the problem of foreign, and especially Western, consultants in developing countries. Even though the consultant might be considered to have adequate skill for the job to be rendered in his/her original country, those skills, due to cultural issues, were either not adequate enough or misplaced in respect of their job in the developing country. This was found to be a source of repeated complaints in the cases studied and interviews conducted.

- It was also noticed that the organisation that has ISO 9002 certification had conformed to level 3 of the process part of the model, a result supported by the literature.

- Furthermore, it was noticed that it is not necessary for all four domains in the structure of the readiness/GP model to be on the same level for IS to be successful. It could be that the needed situation is different for the success of different types of information systems. This means that it might be that different types of information systems require different sets of combinations in different industries/sectors.

- It was also apparent that the level of skill of the external consultant's staff would tend to fluctuate during the project and to be lower at the end, which was a cause of problems. This was because vendors used to replace their initially assigned experienced staff with less experienced to mainly ones train them on the projects.

- It was also apparent that culture had a negative effect in most cases. The uncooperative culture was a cause of problems that contributed to the failure of one project and hampered the full success of another.

- The case studies also showed that a top management Maturity level lower than the status required by the project was a cause of problem. In one case, the project started to move in a positive direction only when top management change had happened and the new management expressed adequate support for the project.

- In general, the cases show that acquiring the needed IT components (hardware, system software, and networks) was not a problem in all the projects studied. This could be because all the organisations under-study enjoyed a good monetary situation.

- Despite the acknowledgement of the importance of process change and/or reengineering by IS/IT managers interviewed in the exploratory work, the cases did not show any serious attempt to change processes for work improvement. Some process change was attempted to make it agree with the ready-made software packages purchased.

7.4 Meeting research objectives

Achievement of research objectives is listed as follows:

- To enhance and build theory by reviewing a large body of literature, and by integrating diverse research fields into a holistic and integrated perspective (Achieved in Chapters 2 and 4).
- To evaluate and classify the different approaches to IS/IT success measurement and to identify the effectiveness of the different models of IS/IT measurement as stated in the literature (Achieved in Chapters 2 and 4).
- To propose a new way of adoption of communication theory into the IS/IT field that resolves some of the shortcomings in previous attempts (Achieved in Chapter 5).

- To propose a new framework of IS/IT measurement that overcomes some of the shortcomings that exist in the research field (Achieved in Chapter 5).
- To identify the requirements for a balanced approach which integrates the main factors of IS/IT success (IT, People, Process, and Environment) (Achieved in Chapters 2 and 5).
- To assess the currently defined IS/IT success levels and to establish an alternative approach to measuring success at business level (Achieved in Chapter 5).
- To validate and adapt the model through detailed case studies (Achieved in Chapter 6).
- To produce implementation guidelines that assist consultants and management in identifying the organisational readiness gap before the initiation of a new IS/IT project (Achieved in Chapters 6 and 7).
- To produce recommendations for future work (Achieved in Chapter 7).

It can therefore be claimed with confidence that all of the research objectives have been achieved.

7.5 Guidelines for readiness/GP model implementation

The readiness/GP model has proved useful not only in clarifying the level of organisational maturity, but also in providing an insight into aspects of IS/IT implementation, operation, use, and management which need particular attention. The following recommendations are offered as guidelines for implementation of the model:

- The readiness/GP model should be used when an IS/IT project has been embarked on, and before the tender is assigned to an internal or external developer. This is because only when the target IS is specified, would it be possible to determine the target organisational status needed for the successful implementation of the project. Also, embarking on a specific development requires prior knowledge of the project requirements that is determined in part by the needed steps to be implemented for the organisation to reach the ready status.
- Prior to conducting the readiness study, the area/unit/department/group that is concerned with the project needs to be identified. This is important for the identification of the scope of the project, and resources and environment available. This is all important because it might be the case that not all organisational resources (i.e. IT, skill, staff, etc.) are available to the project. The readiness study should be limited, as possible, to those resources.
- As is the case with evolutionary maturity models, progress on the model's levels should be in sequential order. Skipping could be achieved regarding the first level, and only when an experienced management are in charge who were previously subjected to similar situations and understand the benefits/advantages of following the 'correct' path to readiness
- When problem areas are detected by the model and a specific industry/sector solution is needed, an industry/sector-specific specialist should be consulted. This is because of the generality of the model where industry specific problems are not addressed. This generality feature allows the model to be used in different sectors/industries. The model is used as 'first and quick' diagnostic tool towered identifying the 'current' and 'target/needed' maturity

levels. If a clear gap is distinguished then the organisation is advised to carry detailed study of the problem area using industry specific expertise.

- The model is more valuable to the organisation when an IS/IT function/unit/department is present or feasible to exist. In small organisations where this is not the case, the model would be of limited use, if any.
- When using the model, more than one level might seem to apply, but what should be selected is the one that applies the most. In the case that two of the models apply fully or partially but almost equally, then both levels should be chosen.

7.6 Limitation of the study

This study, as is usually the case with other research, has some limitations. These limitations are mainly related to generalisability, and time, accessibility and resources constraints.

The four case studies did not cover all levels of maturity of all the attributes in the readiness/GP model, This is because it was not possible to determine the level of maturity of the organisation prior to conducting the case study to make it one of the sample selection criteria.

Also, it is important to note that evaluation of the process level of maturity in the organisation under study was performed entirely on the respondents' perceptions and/or accounts. Because of accessibility, resources, and time limitations it was beyond the researcher's ability to conduct this evaluation by studying the processes directly. When it is possible, the actual maturity status should be directly studied by the evaluator.

7.7 Future research

The following is an outline of possible directions of future research which have emerged from this study:

- The model may be further enhanced by the development of an organisational-specific set of instruments or tables within organisations. Those instruments could specify the organisational situation in terms of the different attributes. Such specification could address the existing systems by names and types, specify the staff titles and ranks, specify names of departments, etc..
- Since it was found that it is not necessary that all four domains in the structure of the readiness/GP model be on the same level for IS to be successful, this means that it might be that different types of information systems require different sets of combinations in different industries/sectors. This opens up the opportunity for further research, and highlights the importance of a thorough investigation of the implementation of the model.
- Further research could address national environmental issues affecting the success of IS/IT projects in an explicit way. Such issues include national economic situation, legal situation, and national IT infrastructure such as electricity and communication networks, and national culture factors.
- Further research could also be conducted to provide more detailed description of the different levels of each attribute. Also, continuous research to update the model' characteristics in order to keep up with the changes in the technology and its implications on other attributes such as systems, skill and staff.

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Appendix-A: Comparison of Staged-View and Continuous-View Architectures

This section shows that the staged- and continuous-view architectures are implemented differently, but there are similarities in the concepts behind the levels.

a. Staged-view Architecture

SW-CMM (Paulk et al., 1993) looks at the organisation's maturity in a single collective view, shown in Figure 4.11. Compliance with a KPA in a staged-view model is binary (the organisation's processes comply or they do not). The organisation increases its maturity by complying with additional KPAs. The order of complying with KPAs is fixed by the model. The initial level in the staged-view model is Level 1, which indicates that the organisation does not fully comply with the Level 2 KPAs.

At the lowest maturity level of the model, an organisation is in the Initial phase. It develops software, but development is done in an ad-hoc manner where a different approach is used for different software products. In many cases, budget and time estimates are not met. The quality of the products is unpredictable as it is based on individuals' effort, knowledge and experience.

The organisation has to introduce basic management activities to rise to the second level of SW-CMM, the Repeatable stage. At this stage, more uniformity is brought into the software development process in such a way that the organisation is capable of producing products in similar ways with similar quality. Quality assurance and configuration management are important for the transition from stage 1 to stage 2 in SW-CMM.

As the organisation rises to the third level, the Defined, it should become capable of describing and managing its software development processes according to standards. As the organisation becomes familiar with the main parts of its standardized development processes, it then can control them.
In order for the organisation to achieve the Managed level, it needs to quantify data regarding the software development processes. This data should be analysed and used in establishing estimates for planning and changes.

The highest maturity level of SW-CMM is the Optimising level. At this level, the organisation continuously improve its processes. This includes seeking and eliminating root causes of product and process defects, as well as incorporating new technology as appropriate. The organisation should be capable of adopting its development processes according to the needs dictated by the characteristics of the product to be developed.

b. Continuous-view Architecture

In the SE-CMM, a continuous model, an organisation first achieves Level 1 in a process area (see Table AA.1) by performing all of the process area's base practices in any manner. Not performing the base practices will earn the organisation a Level 0, the initial level in continuous-view models, in that process area. To improve the capability of a process area beyond Level 1, an organisation complies with additional generic practices (see Table (AA.2)) in the way it performs the base practices.

For each level of the SE-CMM, these generic practices are based on the same principles as the corresponding level in the SW-CMM. SE-CMM Level 2 generic practices, for example, address project management discipline, as applied to a process area. This means that an organisation can achieve Level 2 in "Verify and Validate System", for example, if its projects perform all the process area's base practices and allocate adequate resources to perform the validation and verification activities. The organisation needs also to perform all of Level 2 generic practices such as assigning responsibilities for preparing for and performing the necessary tests and analyses, and documenting the project's test and other verification processes etc..

If these project processes are tailored from an organisational standard set of test processes, using organisationally approved tailoring guidelines, and if the organisation uses well-defined data and performs appropriate reviews including peer reviews where needed according to Level 3 generic practices, then the organisation achieves Level 3 in "Verify and Validate System", and so on for the rest of the levels regarding all of the 18 process areas. In this manner, the organisation earns a level between 0 and 5 in each of 18 process areas.

No.	Process Area
01	Analyse Candidate Solutions
02	Derive and Allocate Requirements
03	Evolve System Architecture
04	Integrate Disciplines
05	Integrate System
06	Understand Customer Needs and Expectations
07	Verify and Validate System
08	Ensure Quality
09	Manage Configurations
10	Manage Risk
11	Monitor and Control Technical Effort
12	Plan Technical Effort
13	Define Organisation's SE Process
14	Improve Organisation's SE Process
15	Manage Product Line Evolution
16	Manage SE Support Environment

17	Provide Ongoing Skills and Knowledge
18	Coordinate With Suppliers

Table AA.1: Process Areas of the SE-CMM, Version 1.1

Level 1	Perform the Process
Level 2	Allocate Resources
	Assign Responsibilities
	Document the Process
	Provide Tools
	Ensure Training
	Plan the Process
	Use Plans, Standards, and Procedures
	Do Configuration Management
	Verify Process Compliance
	Audit Work Products
	Track With Measurement
	Take Corrective Action
Level 3	Standardize the Process
	Tailor the Standard Process
	Use a Well-Defined Process
	Perform Defect Reviews
	Use Well-Defined Data
Level 4	Establish Quality Goals
	Determine Process Capability
	Use Process Capability
Level 5	Establish Process Effectiveness
	Continuously Improve the Standard Process
	Perform Causal Analysis
	Eliminate Defect Causes
	Continuously Improve the Defined Process

Table AA.2: Generic Practices of the SE-CMM

C. Staging and Equivalent Staging for Continuous-view Models

"Staging" is a concept by which a continuous-view model can be made to behave like a staged-view model (Bate, 1995; SEI, 1999). A capability level profile is a list of process areas and their corresponding capability levels. The profile may be an achievement profile when it represents the organisation's progress for each process area while climbing up the capability levels. Or, the profile may be a target profile when it represents an objective of process improvement. A target staging concept defines an order in which process areas of a continuous model are to be addressed and associated requirements (generic practices) on capability levels to be achieved. Achieving those capability level ratings in that subset of process areas and associated generic practices earns the organisation an overall Maturity Level rating. Equivalent staging is a target staging that is defined so that the results of the target staging can be equivalent to the maturity levels of the staged representation. Such staging permits benchmarking of progress between organisations, enterprises, and projects, regardless of the CMM representation view used (SEI, 1999).

Table (AA.3) shows the target profiles that must be achieved when using the continuous representation in order to be equivalent to a maturity level when using a staged representation.

The columns of the figure are: Process Area, the category (CAT) to which the process area is assigned, the maturity level (Mat- Lev) assignment of the process area in the staged-view representation, the capability levels (Cap- Lev1, Cap- Lev 2, Cap- Lev 3, Cap- Lev 4, Cap- Lev 5) in the continuous-view representation.

Process Area	CAT	Mat-Lev	Cap-Lev 1	Cap-Lev 2	Cap-Lev 3	Cap-Lev 4	Cap-Lev 5
Requirements Management	REQM	2	TP2	TP2	TP3		
Measurement and Analysis	MA	2	TP2	TP2	TP3		
Project Monitoring and Control	PMC	2	TP2	TP2	TP3		
Project Planning	PP	2	TP2	TP2	TP3		
Process and Product Quality	PPQA	2	TP2	TP2	TP3		
Assurance							
Supplier Agreement	SAM	2	TP2	TP2	TP3		
Management							
Configuration Management	CM	2	TP2	TP2	TP3		
Decision Analysis and	DAR	3	TP3	TP3	TP3		
Resolution							
Product Integration	PI	3	TP3	TP3	TP3		
Requirements Development	RD	3	TP3	TP3	TP3		
Technical Solution	TS	3	TP3	TP3	TP3		
Validation	VAL	3	TP3	TP3	TP3		
Verification	VER	3	TP3	TP3	TP3		
Organisational Process	OPD	3	TP3	TP3	TP3		
Definition							
Organisational Process Focus	OPF	3	TP3	TP3	TP3		
Integrated Project	IPM	3	TP3	TP3	TP3		
Management							
Risk Management	RSKM	3	TP3	TP3	TP3		
Organisational Training	OT	3	TP3	TP3	TP3		
Organisational Process	OPP	4	TP4	TP4	TP4		
Performance							
Quantitative Project	QPM	4	TP4	TP4	TP4		
Management							
Organisational Innovation and	OID	5	TP5	TP5	TP5		
Deployment							
Causal Analysis and	CAR	5	TP5	TP5	TP5		
Resolution							

Table AA.3: Target Profiles and Equivalent Staging,
SEI (1999)

The Target Profiles (TP1, TP2, TP3, TP4, TP5) are indicated in the capability levels' columns according to their equivalent maturity level in the staged-view representation. When using the table, the following points need to be considered:

- To achieve Target Profile 2 (TP2), the first 7 process areas (Requirements Management to Configuration Management) must have satisfied Capability levels 1 and 2.
- To achieve Target Profile 3 (TP3), the first 18 process areas (Requirements Management to Organisational Training) must have satisfied capability levels 1, 2, and 3.
- To achieve Target Profile 4 (TP4), the first 20 process areas (Requirements Management to Quantitative Project Management) must have satisfied Capability Levels 1, 2, and 3.
- To achieve Target Profile 5 (TP5), all of the process areas must have satisfied Capability Levels 1, 2, and 3.
- To reach Maturity Levels 4 and 5, specific process areas are required to attain Capability Levels 4 and 5. The Maturity Level 4 process areas operate on the selection of the organisation's sub-processes to be stabilized and quantitatively understood, based on the business objectives of the organisation.

Continuous-view representation may be extended to cover the capability level target profiles for individual process areas that are above Capability Level 3 by mapping of sub-processes to process areas in a way that a process area has been placed under quantitative management.

Appendix-B: PSP Architecture

1. PSP Principles

While PSP is still new, it has been derived from proven principles in other fields. The basic principles of PSP are as follows:

- Software professionals will better understand what they do if they define, measure and track their work.
- Software professionals will then have a defined process structure and measurable criteria for evaluating and learning from their own and others' experience.
- With the knowledge and experience, software professionals can select those methods and practices that best suit their particular tasks and abilities.
- By using a customised set of orderly high-quality personal practices that are consistently applied, software professionals will be more effective members of their development team and projects.

2. PSP framework

PSP has a maturity framework much like that of the CMM, as shown in Figure AB.1, which illustrates the PSP framework. Each process improvement phase is briefly described and the description concentrates on the design, code and test phase; however, these phases are only examples. PSP applies not only to those but also to almost any other aspect of the software process, including requirements specification, product maintenance, test planning, and documentation development.

a. PSP0: Baseline process

The first step in the PSP is to establish a baseline that includes some basic measurements and a reporting format. This baseline provides a consistent basis for measuring progress and a defined foundation on which to improve. PSP0 should be the process currently used to develop software, but enhanced to provide measurement. The PSP0 is enhanced to PSP0.1 by adding a coding standard, size measurement and the process improvement proposal (PIP). The PIP is a form that provides a structured way to record process problems, experiences and improvement suggestions.

b. PSP1: Personal planning process

Using the data from the previous step, PSP1 adds planning to PSP0. The initial increment adds a test report and size and resource estimation. In PSP1.1, task and schedule planning are introduced. Once an individual's performance rate is known, s/he can plan the work more accurately, make commitments more realistic, and meet those commitments more consistently.

c. PSP2: Personal quality management

One PSP goal is to enable early learning of how to deal realistically and objectively with the software defects that result from the errors and mistakes made. To manage the defects, one must know how many there were. PSP2 adds review techniques to PSP1 to find defects earlier when they are least expensive to fix. This is done by gathering and analysing the defects found during compiling and testing from earlier software programs. With this data, it is possible to establish review checklists and make individual process quality assessments. PSP2.1 addresses the design process.

The PSP does not prescribe how to design but rather how to complete a design. That is, when the design is finished what should be the output? PSP2.1 establishes design completeness criteria and examines various design verification and consistency techniques.

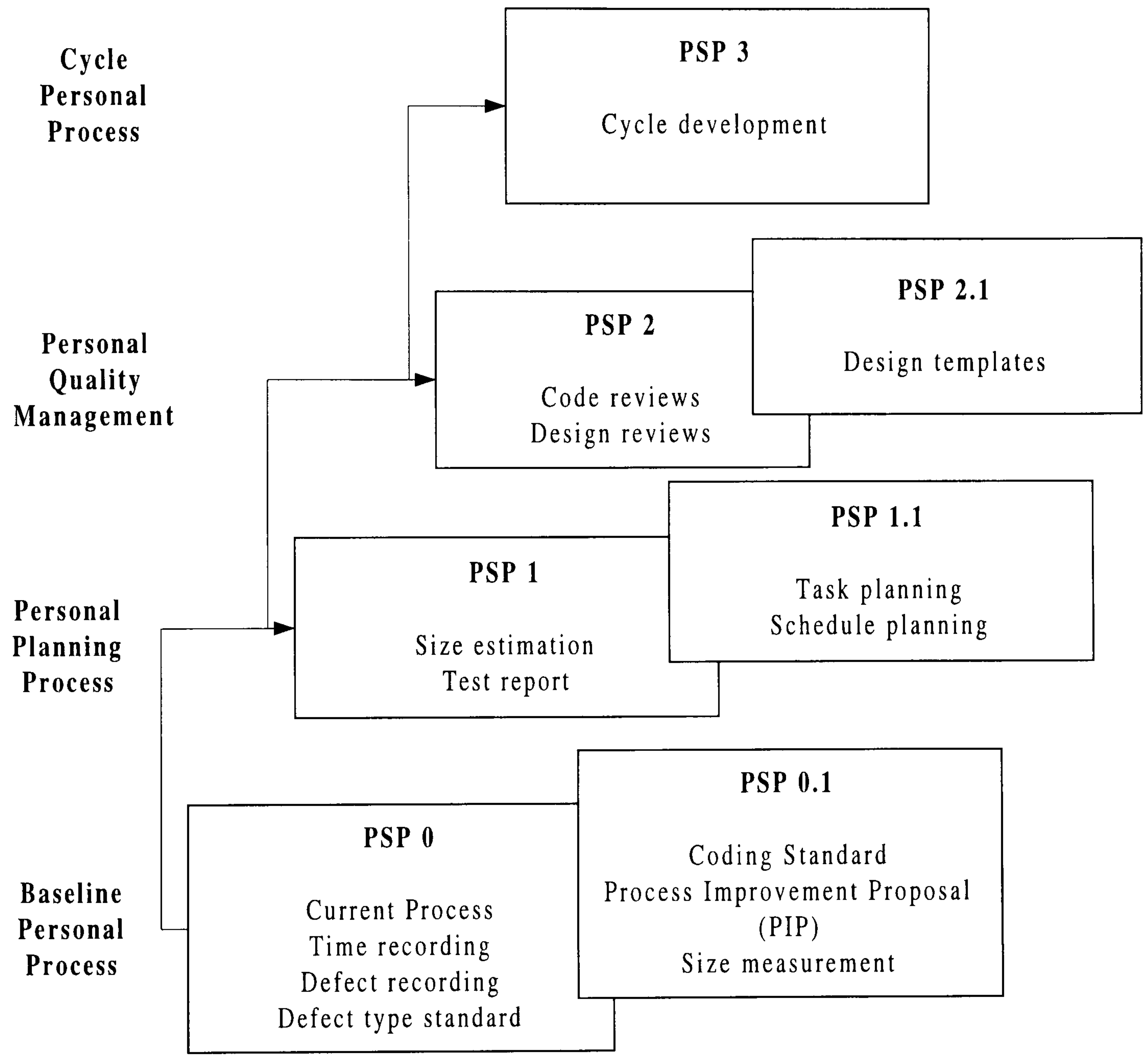

Figure AB.1: PSP Framework,
Humphrey (1995)

d. PSP3: Cycle personal process

Until PSP3, the PSP concentrates on a simple linear process for building small programs. In PSP3, an iterative approach is introduced for developing larger programs. In each iteration, a complete PSP2 process is carried out, including design, code, compile and test. Each enhancement builds on the previously completed increments, so the PSP3 is suitable for large programs. The cyclic PSP3 process effectively scales up to larger programs only as long as each successive increment is of high quality. A very important part is the performance of regression testing, re-running earlier tests to verify that the new increment did not cause problems with previously working functions.

Appendix-C: ISO 9000 Standards

The 1994 version of ISO 9001, 9002 and 9003 standards have been used extensively as the basis for independent (third party) quality system certification. This has resulted in the certification of around 400,000 organisations worldwide, with many more in the process of setting up and implementing quality management systems.

The ISO protocol requires that all standards be reviewed at least every five years to determine whether they should be confirmed, revised or withdrawn. The 1994 versions of the ISO 9000 family were revised by ISO to lately introduce the ISO 9000:2000 family.

The ISO 9000:2000 family includes standards to be used to establish a management system that provides confidence in the conformance of a product to established or specified requirements. The standard recognises that the word 'product' applies to services, processed material, hardware and software intended for, or required by an external customer.

There are five sections in the standard that specify activities that need to be considered when implementing the ISO system. Those sections require the listing of activities used by the organisation to supply its products. The five sections are: Product Realization, Quality Management System, Management Responsibility, Resource Management and Measurement, Analysis and Improvement. Those apply to all types of organisations. Together, the five sections define what should the organisation should do consistently to provide product that meets customer needs and applicable regulatory requirements. In addition, these sections aid in enhancing customer satisfaction by improving the organisational quality management system. The Quality Management System introduced by ISO 9000 standards is based on eight quality management principles:

1. Customer focus: Organisations depend on their customers and therefore should understand current and future customer needs, should meet customer requirements, and strive to exceed customer expectations.
2. Leadership: Leaders establish unity of purpose and direction of the organisation. They should create and maintain the internal environment in which people can become fully involved in achieving the organisation's objectives.
3. Involvement of people: People at all levels are the essence of an organisation and their full involvement enables their abilities to be used for the organisation's benefit.
4. Process approach: A desired result is achieved more efficiently when activities and related resources are managed as a process.
5. System approach to management: Identifying, understanding and managing interrelated processes as a system contributes to the organisation's effectiveness and efficiency in achieving its objectives.
6. Continual improvement: Continual improvement of the organisation's overall performance should be a permanent objective of the organisation.
7. Factual approach to decision making: Effective decisions are based on the analysis of data and information.
8. Mutually beneficial supplier relationships: An organisation and its suppliers are interdependent and a mutually beneficial relationship enhances the ability of both to create value.

ISO New Features

The ISO 9000 family change to the new standard, denoted ISO 9000:2000 (ISO 9000:2000), introduced the following key changes compared to the previous ISO 9000:1994 standard:

- It is process-based and concentrates heavily on control of processes. This is a general tendency in management, and is expected to be more effective and efficient than the traditional focus on functions of the company.
- Customers are in-focus and the standard has an outside orientation. This will remedy what seems to be a major problem with the previous ISO 9000 standard being inside-oriented.
- The ISO 9002 and 9003 standards are being cancelled which will, in practice, increase the requirements for a number of organisations if they choose to remain ISO-certified.
- The new standard is less oriented towards production and more towards service industries.

Appendix-D: Paulk (1995) Review

Paulk (1995) notices that there is a strong correlation between ISO 9001 and the CMM, although some issues in ISO 9001 are not covered in the CMM, and vice versa. He notices also that the level of detail differs significantly. For example, Section 4 in ISO 9001 is about five pages long; Sections 5, 6, and 7 in ISO 9000-3 comprise about 11 pages; and the CMM is more than 500 pages. To make a judgment, he argues, requires determining the exact correspondence, given the different levels of abstraction.

Table AD.1: Target Profiles and Equivalent Staging Summary Mapping between ISO 9001 and CMM,
adapted from Table.1 in Paulk (1995)

ISO 9001 Clause	Strong Relationship	Judgmental Relationship
4.1: Management responsibility	Commitment to perform	Ability to perform
	Software project planning Software project tracking and oversight Software quality assurance	Verifying implementation Software quality management
4.2: Quality system	Verifying implementation Software project planning Software quality assurance Software product engineering	Organisation process definition
4.3: Contract review	Requirements management Software project planning	Software subcontract management
4.4: Design control	Software project planning Software project tracking and oversight Software configuration management Software product engineering	Software quality management
4.5: Document and data control	Software configuration management Software product engineering	
4.6: Purchasing	Software subcontract management	
4.7: Control of customer-supplied product		Software subcontract management
4.8: Product identification and tractability	Software configuration management Software product engineering	
4.9: Process control	Software project planning Software quality assurance	Quantitative process management Technology change management

	Software product engineering	
4.10: Inspection and testing	Peer reviews Software product engineering	
4.11: Control of inspection, measuring, and test equipment	Software product engineering	
4.12: Inspection and test status	Software configuration management Software product engineering	
4.13: Control of nonconforming product	Software configuration management Software product engineering	
4.14: Corrective and preventive action	Software quality assurance Software configuration management	Defect prevention
4.15: Handling, storage, packaging, preservation, and delivery		Software configuration management Software product engineering
4.16: Control of quality records	Software configuration management Software product engineering Peer reviews	
4.17: Internal quality audits	Verifying implementation Software quality assurance	
4.18: Training	Ability to perform Training programme	
4.19: Servicing		
4.20: Statistical techniques	Measurement and analysis	Organisation process definition Quantitative process management Software quality management

Continue Table AD.1

Paulk claims that the biggest difference between the two measurement approaches is the explicit emphasis of the CMM on continuous process improvement. ISO 9001 addresses only the minimum criteria for an acceptable quality system. Another difference is that the CMM focuses strictly on software, while ISO 9001 has a much broader scope that encompasses hardware, software, processed materials, and services. Paulk also claims that the biggest similarity between the two documents is their bottom line: "Say what you do; do what you say." The fundamental premise of ISO 9001 is that organisations should document every important process and check the quality of every deliverable through a quality-control activity. ISO 9001 requires documentation that contains instructions or guidance on what should be done or how it should be done. The CMM shares this emphasis on processes that are documented and practised as documented. Phrases such as conducted "according to a documented procedure" and following "a written organisational policy" characterize the key process areas in the CMM. Paulk notices that on a more detailed level, some clauses in ISO 9001 are easily mapped to their equivalent CMM practices. Other relationships map in a many-to-many fashion, since the two documents are structured differently. For example, the training clause in ISO 9001 maps to both the Training Programme key process area and the training and orientation practices in all the key process areas.

b. Compliance Issues between ISO 9000 and CMM

Paulk notices that at first glance, an organisation with an ISO 9001 certificate would have to be at level 3 or 4 in the CMM. In reality, some level 1 organisations have been certified. One reason for this discrepancy is ISO 9001's high level of abstraction, which causes auditors to interpret it in different ways. If the auditor certifying the organisation has had TickIT training, for example, the design reviews in ISO 9001 will correspond directly to the CMM's peer reviews, which are at level 3. But Paulk notices that not all auditors are well-versed in software development. He thinks that the virtue of a model like TickIT is that it produces auditors who understand how to apply ISO 9001 to software. Another reason for the discrepancy, seen by Paulk, is that an auditor may not require mastery to satisfy the corresponding ISO 9001 clause.

Paulk also claims that an organisation assessed at level 1 of CMM could be certified as compliant with ISO 9001. That organisation would, however, have to have significant process strengths at level 2 and noticeable strengths at level 3. He also claims that private discussions indicate that many level 1 organisations have received ISO 9001 certificates. If an organisation is following the spirit of ISO 9001, it is likely to be near or above level 2. However, organisations have identified significant problems during a CMM-based assessment that had not surfaced during a previous ISO 9001 audit. This seems to Paulk as being related to the greater depth of a CMM-based investigation.

Paulk argues that although the CMM does not adequately address some specific issues, in general it encompasses the concerns of ISO 9001. He thinks that the converse is less true. ISO 9001 describes only the minimum criteria for an adequate quality-management system, rather than addressing the entire continuum of process improvement. He predicted that future revisions of ISO 9001 may address this concern. The differences, according to Paulk, are sufficient to make a rigid mapping impractical, but the similarities provide a high degree of overlap.

Paulk, at the beginning of the study, presented the three important questions that he attempted to answer at the end of the study. Those questions are:

1. At what level in the CMM would an ISO 9001-compliant organisation be?
2. Can a level 2 (or 3) organisation be considered compliant with ISO 9001?
3. Should my software-quality management and process-improvement efforts be based on ISO 9001 or on the CMM?

Paulk answers were as follows:

An ISO 9001-compliant organisation would not necessarily satisfy all the key process areas in level 2 of the CMM, but it would satisfy most of the level 2 and many of the level 3 goals. Further, because ISO 9001 does not address all the CMM practices, a level 1 organisation could receive ISO 9001 registration.

A level 2 (or 3) organisation would probably be considered compliant with ISO 9001, but even a level 3 organisation would need to ensure that it adequately addressed the delivery and installation process described in clause 4.15 of ISO 9001, and it should consider the use of included software products, as described in clause 6.8 of ISO 9000-3. With this caveat, obtaining certification should be relatively straightforward for a level 2 or higher organisation.

As to whether software process improvement should be based on the CMM or ISO 9001, the short answer is that an organisation may want to consider both, given the significant degree of overlap. A market may require ISO 9001 certification; addressing the concerns of the CMM would help organisations prepare for an ISO 9001 audit. Conversely, level 1 organisations would certainly profit from addressing the concerns of ISO 9001. Although either document can be used alone to structure a process-improvement programme, the more detailed guidance and software specificity provided by the CMM suggests that it is the better choice, although admittedly this answer may be biased.

Paulk concludes the study by advocating that

> "Organisations should focus on improvement to build a competitive advantage, not on achieving a score whether that is a maturity level or a certificate. The SEI advocates addressing continuous process improvement as encompassed by the CMM, but even then there is a need to address the larger business context in the spirit of Total Quality Management."

Appendix F: Detailed Description of Vendor Selection

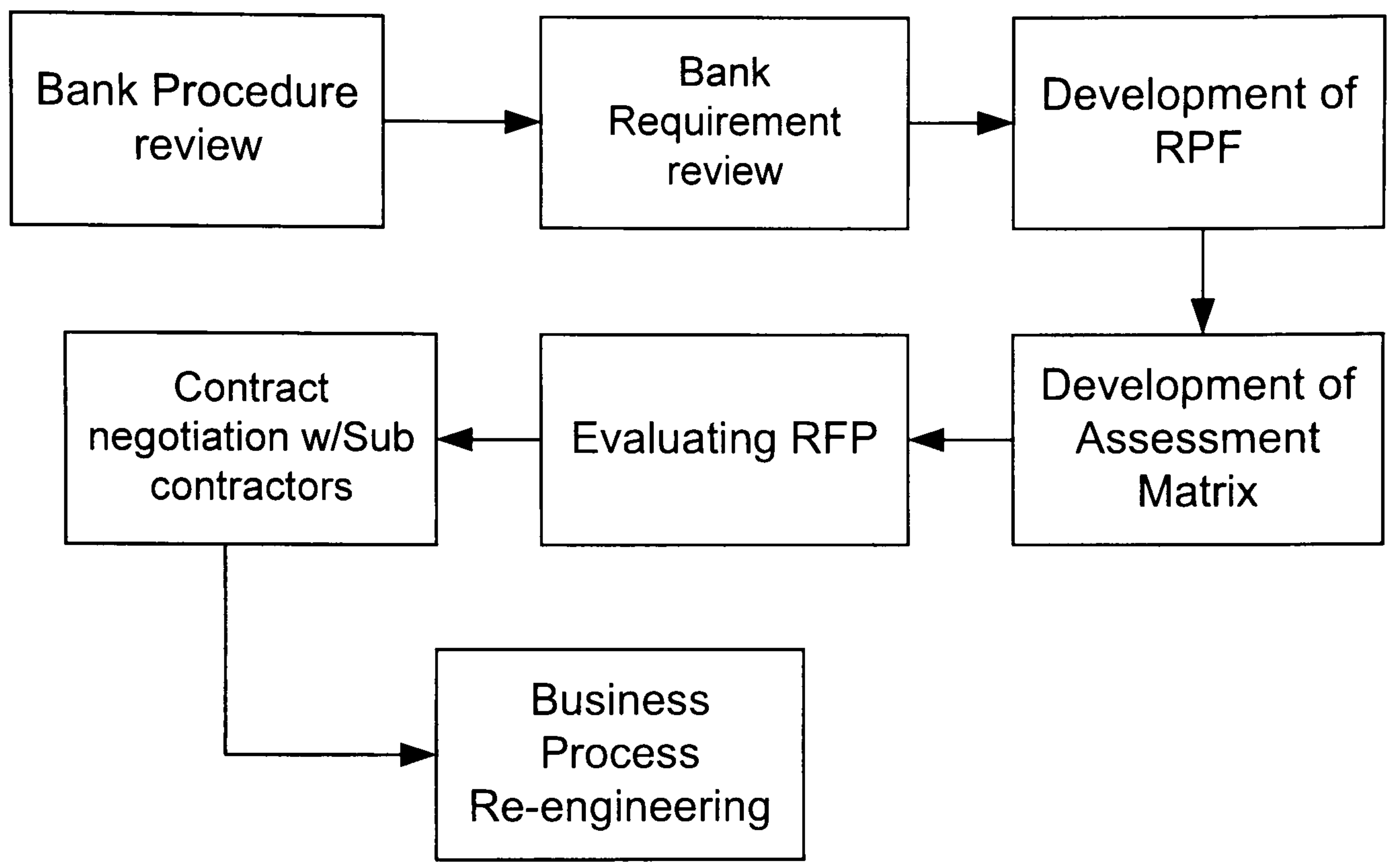

Figure AF.1: Consultancy Project Description

- Contract signing with consultant firm: In May-2000, a contract was signed by the chairman and managing director with the consultant firm to start the consultancy services.
- Requirement gathering and assessments: In June 2000, the consultant started the requirement gathering and assessment process by visiting every department of the bank to specify the departments directly involved in the new Core Banking System and to produce the actual RFP. The RFP specified all the department requirements for a new system. Each department reviewed and signed the document produced by the consultant. This activity took about two months.

- Demonstration of system development stages: after finishing the previous two steps, a demonstration of all the different stages of the project and the new system implementation was held in the bank in the presence of the chairman, managing director, and all the department managers in the bank.
- IT Committee meeting to approve RFP: The IT steering committee then met to review the RFP document presented by the consultant and it was approved to be released to elicit bids from core banking system vendors. The steering committee was formed by the deputy bank chairman, head of the legal affairs unit, and the project leader from the bank side.
- RFP released to five vendors by consultant: In late August 2000 the consultant firm released RFP to five international vendors.
- Consultant's evaluation of vendor proposal: The consultant then evaluated vendor responses to the RFP by a scoring system. One of the vendors did not put a bid because it did not think its system could meet the bank's requirements. Another vendor scored very low. The following is the summary of the overall scoring:

Vendor A (V-A)	Vendor B (V-B)	Vendor C (V-C)	Vendor E (V-C)
84.13%	94.48%	84.02%	69.89%

- It was clearly obvious that vendor B was the best vendor of the four, and the bank had to invite vendors to perform a demonstration to confirm the functionality of their prospective systems, and to be evaluated on yet another scoring system.
- Vendor demonstrations held in the bank: Each of the vendors spent two consecutive days to demonstrate its product for the following departments:

Accounting, Treasury, Financial Controller, Internal Audit, Corporate Finance, Direct Investment, Risk Management, Projects, Follow-Up. and Operations, including all different sections. After all the vendor demonstrations, all the departments were asked to evaluate each vendor and the final result were as follow:

V-A	V-B	V-C
68.29%	87.36%	83.03%

- Again, V-B appeared to be the vendor preferred by users by a small margin over V-C. The major weakness of V-C was the simplicity of the Accounting and Financial Control System. Although it included most of the functionality that the Accounting Department requires, the V-B system was far superior to V-C in that area.
- Final recommendation letter from consultant: In late November 2000, as part of its consultancy service, the consultancy firm submitted a final recommendation to the bank on its preferred vendor, which was V-C.
- IT Committee meeting to discuss recommendation: After reviewing the recommendation document submitted by the consultant, the committee felt that it was necessary to conduct a sight visit to other banks in the country that had any of the three systems fully installed. Two banks were found to have two of the proposed systems. V-A's system was not implemented in any bank in the country.
- Sight visits to both banks: from the sight visit, it was clear that both banks had some reservations on both systems, especially the bank that had

implemented the V-B system. The bank had faced many difficulties in the functionality of the new system. Some of the users claimed that the system had difficulties with Arabic letters. Some of them have mentioned that the Central Bank reports were not produced properly. The Treasury Department mentioned that the system did not cover their requirements because it is not a treasury system. Finally, the bank had problems with V-B support, since V-B does not have any local agent in the country.

- Regarding the other bank, they mentioned that the V-C system had some problems at the beginning, and lots of customisation or system changes had to be performed in order to meet their requirements. The bank had also complained about the local support which V-C currently has through two local companies.
- The committee then felt that it was necessary to meet with a representative from each of V-B and V-C to clarify some of these issues.
- IT Committee meetings with Vendors: After the meetings with both vendors, the committee decided to invite V-F to demonstrate its financial system. V-F did not enter the bid, since it was for a total solution banking system and V-F had a financial system only. The reason behind reviewing this system was because it was brought to the committee's attention, by word-of-moth, that the V-F financial system interfaces and works well with the V-C system; furthermore, they heard that it is very powerful in the financial area, which might cover all the requirements of both the Accounting Department and the Financial Controller.
- Demonstrations of V-F financial system: After attending the demonstration of V-F'S financial system, the committee felt that the combination of V-F's

Financial system and V-C's Systems presented the strongest position to meet the bank's requirement, because the first had proven to be very strong in the financial area especially in accounting, and the second is strong in the banking area, especially in treasury and lending.

- IT Committee meeting to make final selection: After adjusting the over all score for V-C's system with the value of V-F's financial system, and including the latest prices for all three systems, the final comparison matrix that the committee discussed in its meeting is presented as Table AF.1. Even though all studies and evaluations preferred either V-B or V-C with V-F, the final selection was on V-A.
- Gap Analysis: V-A conducted the Gap Analysis which it took approximately 4 weeks. In the Gap Analysis, both the bank and V-A identified all the gaps between how the bank did business and how the software did business, and if there were differences, how they could be resolved. To start the Gap Analysis, the bank had issued a Letter of Intent to V-A. The letter of intent made the bank liable to pay a US $45,000 charge if the bank did not sign the contract with V-A after the Gap Analysis. At this stage, the bank's legal team, in coordination with the IT Steering Committee, had gathered all the specific details of clauses that the bank wished to include in the final contract for example local support terms.

Evaluation Criterion	Evaluation Wight %	Vendors		
		V-A	V-B	V-C & V-F
Perceived customisation	4%	2.5	3.5	2
System construction/ integration evaluation	4%	2	3	4
Vendor implementation experience	4%	0	4	2
Vendor support during and after implementation	9%	9	2	6
Potential to meet the likely future needs of the bank and the value for money factor	7%	4	6	5
User satisfaction as a result of demonstrations	14%	9.52	12.22	11.62
Original response to the RFP	34%	28.56	31.96	30.12
Overall software price implementation, training customisation, expenses	24%	17.7	15	18.52
Totals	100%	73.28	77.68	79.26

Table AF.1: Evaluation criteria and result

- Final pricing after Gap Analysis: After the Gap Analysis, V-A produced the final cost for all the customisation agreed upon. Furthermore, the final solution cost was reached, and changes were clearly labelled to be: implementation tasks, system customisation, bank policy and procedure change, or any work-around changes to be done to meet the bank's requirements.

- Contract Signing with V-A: The bank signed a contract with V-A for a full solution system to cover all aspect of the bank's activities. The project was to take 20 months.
- Customisation: V-A started the customisation of the Core Banking System according to their agreement with the bank. During this process, there were some amendments and changes which arose for different reasons. New government regulations needed to be implemented in the system; also, as the users started to be subjected to the environment of development, they started to have new ideas and requirements. Most of them were minor, but some had a major impact on the customisation. This was a cause of some friction both internally between the IS/IT unit and users, and externally between the bank and V-A.
- As the customisation process was going on, the bank implemented a training programme for both users and IS/IT people.
- Implementation: Until the time this research ended, the implementation of the core banking system had not yet been completed.