PB-ISAM: A PROCESS-BASED FRAMEWORK FOR INFORMATION SYSTEMS EFFECTIVENESS ASSESSMENT IN ORGANISATIONAL CONTEXTS

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Approval of the Graduate School of Informatics

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ABSTRACT

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INFORMATION SYSTEMS EFFECTIVENESS ASSESSMENT
IN ORGANISATIONAL CONTEXTS

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A number of approaches of assessment associated with IS effectiveness have been examined, fundamental guidelines for research in this area have been derived, and a novel model of IS effectiveness has been proposed. A process based assessment method (PB-ISAM) based on the proposed effectiveness model has been elaborated. The new model and the new assessment method have been evaluated via three case studies. Specific implications have been drawn concerning the relationships between processes and the information system assessed. The three case studies have provided insight into the IS effectiveness field and for future work.

Keywords: Information systems effectiveness, information systems evaluation, information systems success, information system process maturity.

ÖZ

PB-ISAM: ÖRGÜTSEL BAĞLAMLARDA BİLGİ SİSTEMLERİ ETKİLİLİĞİNİ ÖLÇMEK İÇİN SÜRECE DAYALI ÇERÇEVE

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Bilgi sistemleri etkililiği değerlendirilmesi ile ilgili yaklaşımlar incelenmiş, bu alandaki araştırma çalışmalarını yönlendirecek temel ilkeler belirlenmiş, ve yeni bir bilgi sistemleri etkililiği modeli önerilmiştir. Bu model ile ilişkilendirilmiş bir süreç temelli ölçüm yöntemi geliştirilmiştir. Bu yeni model ve yeni ölçüm yöntemi üç örnek olay üzerinde değerlendirilmiştir. Süreçler ile değerlendirilen bilgi sistemleri arasındaki ilişkiler konusunda özgül sonuçlara varılmıştır. Örnek olaylar, bilgi sistemleri etkililiği alanına ve bu alanda yapılacak çalışmalara katkıda bulunmuştur.

Anahtar kelimeler: Bilgi sistemleri etkiliği, bilgi sistemleri değerlendirilmesi, bilgi sistemleri başarısı, bilgi sistemi süreç olgunluğu.

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I would also like to thank my mother, my father and my sister, Seçil, for their emotional support and patience during these years.

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LIST OF ACRONYMS AND ABBREVIATIONS

ABET:	Accreditation Board for Engineering and Technology
ALN:	Asynchronous Learning Network
BNQP:	Baldrige National Quality Program
CCTA:	Central Computing and Telecommunications Agency
CMM:	Capability Maturity Model
CMMI:	Capability Maturity Model Integrated
CobiT:	Control Objectives for Information and Related Technology
COSO:	Committee of Sponsoring Organisations of the Treadway Commission
CSF:	Critical Success Factor
D&M:	DeLone and McLean
EFQM:	European Foundation for Quality Management
HTML:	HyperText Markup Language
IID:	Iterative and Incremental Development
IS:	Information Systems
ISACA:	Information Systems Audit and Control Association
ISO/IEC:	International Organisation for Standardisation/ International Electrotechnical Commission
IT:	Information Technology
ITGI:	Information Technology Governance Institute
ITIL:	Information Technology Infrastructure Library
ITSM:	Information Technology Service Management
KPI:	Key Performance Indicator
OGC:	Office of Government Communications

PB-ISAM: Process-based Information Systems Assessment Model

P-CMM: People-Capability Maturity Model

ROI: Return on Investment

SA-CMM: Software Acquisition Capability Maturity Model

SCRUM: An agile method for management of software development projects

SDD: Software Design Documentation

SEI: Software Engineering Institute

SERVQUAL: Service Quality

SPICE: Software Process Improvement and Capability dEtermination

SRS: Software Requirements Specification

SW-CMM: Software-Capability Maturity Model

CHAPTER 1

INTRODUCTION

1.1 Information systems effectiveness assessment

One of the top ten issues of information systems management is *measuring and improving IS effectiveness* (Earl, 1989; Chang and King, 2005; DeLone and McLean, 2003, 2004; Seddon, Staples, Patnayakuni, Bowtell, 1999). Furthermore, *measuring IS effectiveness* is consistently reported in the top 20 on the list of most important information systems issues by the members of the Society for Information Management (SIM), an organisation of information systems executives (Myers, 2003). In fact, information systems effectiveness has proven practically impossible to define and measure (Niederman, Brancheau, and Wetherbe, 1991). There are many possible explanations for this difficulty. Evaluation, by its nature, is a very subjective undertaking which cannot be separated from human intellect, history, culture and social organisation. The role of the information system in organisational performance can be subtle and difficult to differentiate from other factors (Nolan and McFarlan, 2005; Crowston and Treacy, 1986; Niederman et al., 1991). Evidence suggests that poor performance of the information system is a serious inhibitor to good organisational performance. In addition, empirical research has shown that high

information systems effectiveness is associated with high organisational performance (Carlson and McNurlin, 1992; Chang and King, 2005). In that, assessment is an essential requirement of a feedback loop for continuous improvement of the information system and such improvement relates directly to the overall performance of the organisation as measured by effectiveness. "Just as a human being needs a diversity of measures to assess his or her health and performance, an organisation needs a diversity of measures to assess its health and performance" (Drucker, 1989, p. 230). Systematic measurements are needed to guide action. "What gets measured gets attention" (Eccles, 1991, p. 131). In parallel, DeLone and McLean (2003, 2004) emphasize the need for a validated measuring instrument of information systems effectiveness, which could provide a standardized evaluation mechanism enabling comparisons across departments, systems, users, organisations. They additionally assert that, such a measurement will help to build cumulative research tradition which could clarify effectiveness measures. It is clear that information systems assessment is vital to the organisation. Furthermore, organisations need a comprehensive framework for assessment to aid them in developing an information systems evaluation approach.

1.2 Thesis objective

It is evident that IS assessment is not well established in the current literature, and the few recent studies show that more research is needed (Beise, 1989; Brynjolfsson and Hitt, 1998, 1994; Chong, 2001; Clark, 1992; DeLone and McLean, 1992, 2003; Dickson, Wells, and Wilkes, 1988; Gottschalk, 2001; Myers et al., 1997; Saunders and Jones, 1992). Many studies have been conducted attempting to identify factors that contribute to information systems effectiveness (DeLone and McLean, 1992, 2004; Seddon et al, 1999; Palvia, Perkins, and Zeltmann, 1992; Li, 1997; Cortada, 1995, 1998). However, the dependent variable in these studies, information systems effectiveness, has been an elusive one to define. Different researchers have addressed different aspects of success, making comparisons difficult and the prospect of building a cumulative tradition for IS research similarly elusive. Furthermore, since all three of (1) the organisational

needs, (2) organisational culture, as well as (3) the organisational history affect the structure of an information system in an organisation (Bilgen, 2003); the criteria and assessment methods for the evaluation of IS effectiveness are expected to be specific to and highly dependent on the organisational characteristics. Therefore, in practice, it becomes inevitable for an organisation to develop its own assessment methodology by means of aligning generally accepted methods with its characteristics that are relevant to that particular methodology (Jahnke, 2004).

To organize this diverse research, as well as to present a more integrated view of IS effectiveness; this study aims to form a basis for developing a model that is believed to portray the manner IS effectiveness is assessed. The extensive survey of the relevant literature point in the direction of an integrated approach to the assessment of IS effectiveness. In that regard, individual assessment frameworks considered (e.g. CMM, CobiT, ITIL) comply with the needs only partially. Therefore, although they yield convenient solutions in practice, they do not fulfill all of the necessities. The purpose of this research is to develop a comprehensive information systems assessment framework using existing information systems assessment theory as a base and incorporating theory from other disciplines. In conformance with the regard for the complementary nature of the fundamental frameworks in the literature, the study aims to propose an assessment model following the guidelines deduced from the literature collectively, with proper adaptations according to the needs and characteristics of the individual systems being assessed.

1.3 Thesis scope

It has been argued that information systems effectiveness evaluation is an important organisational process. However, it is difficult and faces a number of problems ranging from conceptual to operational issues. Therefore, research in the area is highly justifiable and desirable. This accounts for the wealth of the research studies, which are reviewed in Chapter 2. The literature study presented has revealed similarities and differences between the assessment methodologies.

Based on these, a number of principles for more appropriate assessment approaches are developed.

This study additionally argues that information systems effectiveness evaluation remains relatively poorly developed at the levels of theory, methodologies and practice. On the conceptual side, a better understanding of the subject of information systems evaluation is sought. Taking into account that information systems evaluation is an active and organisation-dependent undertaking, this thesis proposes a novel conceptual model of information systems effectiveness. In addition, this thesis challenges the available assessment approaches, and in order to evaluate the proposed conceptual model, an assessment framework has been developed. In order to carry out such research, an interpretive approach is taken. Empirical evidence is sought through case study research, and the proposed process based assessment method has been adopted to three case organisations. The assessment method has been explicitly elaborated and specific implications associated with the relationships between processes and the information systems assessed have been revealed.

Economic/financial evaluation of information systems is intentionally left out of the scope of this study. While metrics such as return on investment (ROI) may successfully be used as surrogates for IS effectiveness measurement in certain cases, it is widely known that non-functional benefits are sufficiently well recognised to justify this choice of scope for the current study.

In summary, the results of this research include a re-examination of the IS effectiveness assessment problem using methods of analyses contributed by (1) information systems, (2) software process development, and (3) information technology literature; yielding (a) a comprehensive, theoretically-derived, process based information systems assessment method, (b) a rich insight into the information systems effectiveness field, (c) the enhancement of information systems assessment theory by incorporating ideas from empirical research, and (d) guidelines for the information systems stakeholder (e.g. information systems

developer, user, or manager) on which information systems measures might best fit their organisation.

The fundamental contribution to the information systems body of knowledge is a comprehensive information systems effectiveness assessment method that can be further tested for usefulness and applicability. Future research is recommended to substantiate and improve on the findings of the current study.

1.4 Thesis outline

The remainder of the thesis is organised as follows. Chapter 2 presents a critical review of a number of approaches of evaluation related with information systems effectiveness. The chapter is subdivided into four sections: (1) effectiveness concerning information systems success and measurement issues, (2) effectiveness within the context of software process development, (3) effectiveness in regard to information technology assessment, and based on these, (4) discussion presenting a roadmap for information systems effectiveness evaluation are included. The chapter provides the background to the research by describing what has been done and document why this research is unique by showing the work that has not been covered by prior research.

Chapter 3 includes development of the conceptual model of information systems effectiveness, where model objectives, model relations and model components are explicitly elaborated. In addition, in this chapter, processes for the assessment of each of the three model components, which will be detailed in Chapter 4, are defined.

Chapter 4 describes the information systems effectiveness assessment framework. In this chapter, (1) maturity levels, (2) objectives, and (3) assessment metrics of each process are discussed.

Chapter 5 describes the case-study research conducted to validate and refine the IS effectiveness model and assessment framework proposed in this study. It includes a brief justification for the research approach and a detailed description of the research design. In this chapter, the proposed information systems effectiveness assessment framework is applied on three case studies. The maturity levels of every process of each of the three case organisations are presented. In the last part of this chapter, the findings of the three cases are discussed, where the experience and further understanding achieved by the empirical research are summarised and compared with the model and the guidelines proposed.

Chapter 6 outlines the contributions of the thesis in both academic and practical terms. It further discusses the suitability of the research design and the limitations of the research. Based on these, it addresses issues for the utilisation of the research contributions in terms of potential future research topics.

Finally, included in the appendices are the assessment templates used for each case study.

CHAPTER 2

LITERATURE REVIEW

This chapter provides a review of the pertinent literature and is divided into four sections. The first section is a literature review concerning information systems success and measurement issues. The second pertains to software process assessment with a concentration on the ISO/IEC 15504 and Software Engineering Institute's Software Capability Maturity Model. The third section investigates information technology quality assessment focusing on the two most comprehensive and common quality disciplines, CobiT and ITIL. It discusses how effective and efficient these two models are from an organisational perspective. The fourth section presents a critical discussion focusing on all three perspectives of effectiveness simultaneously with the aim of serving as a roadmap deduced from the literature.

2.1 Effectiveness within the context of Information Systems Evaluation

2.1.1 Information Systems Success

Many studies have been conducted attempting to identify factors that contribute to information systems effectiveness. However, the dependent variable in these

studies—IS success—has been an elusive one to define. Different researchers have addressed different aspects of success, making comparisons difficult and the prospect of building a cumulative tradition for IS research similarly elusive.

"IS Success" may be considered as an emerging concept of "IS Effectiveness" and "IS Quality" (Özkan and Bilgen, 2003). Information system success depends on numerous circumstances, rather than a black-and-white formula. These systems are open systems so they are affected by the environment, and influenced by the people who use them. However, these systems are also goal-driven, so we can measure IS success by focusing on whether the system contributes to the achievement of the goals of the organisation.

It therefore appears that neither a purely subjective paradigm nor a purely functional one is adequate for understanding the effectiveness of the deployment of an information system. There is a wide spectrum within which the concept of effectiveness may be interpreted and the dimensions in which such an interpretation may be placed. Definitional and measurement issues have retarded the orderly and scientific accumulation of knowledge in this field.

In fact, effectiveness of the IS function has proven practically impossible to define and measure. One important reason for this is that the role of the IS function in organisational performance, as well as effectiveness, can be subtle and difficult to differentiate from other factors. Some organisations define IS effectiveness in a way that the true value of it is hidden. Some depend on mostly qualitative rather than quantitative measures.

Within the organisational context, many studies suggest that the efficacy of IS deployment has a great value to the organisation. Evidence also suggests that high IS effectiveness is associated with high organisational performance, which yields a connection between assessment and productivity.

However on the "IS Quality" side, many studies show that both researchers' and practitioners' approach to information system quality is just like traditional

approaches to software quality. However, it is evident that software quality is only limited to the development of software system, while IS quality is seen in the organisational context, where the use of software is stressed (Özkan, 2003; Eriksson and Törn, 1991; Adalekun, 1991).

Information systems, by definition (DeLone and McLean, 1992) are integrated systems for providing information to support operations, processes, management analysis and decision-making functions within an organisation. Therefore IS quality shall comprise the requirements of the business organisation, the users, and the IT personnel.

Within the IS literature, there are five major models offered for assessing the information systems success. The DeLone and McLean (D&M) Information Systems Success Model is a framework and model for measuring the complex-independent variable in IS research. In their most recent paper (DeLone and McLean, 2003), DeLone and McLean state that many of the important IS success research contributions of the last decade focusing especially on research efforts that apply, validate, challenge, and propose enhancements to the original D&M Model presented in 1992.

Between 1992 and 2003, DeLone and McLean have also realized the impact of the Internet on IS success, and hence have added a new concept "measuring e-commerce system success" in this updated model (DeLone and McLean, 2004).

The Seddon Model (Seddon, Greaser, Willcocks, 2002), conceptually elaborates and clarifies the aspects of the D&M model, thereby effectively integrating core theoretical relationships espoused in the literature. Seddon's three construct categories are: system and information quality, general perceptual measures about net benefits about IS use, and IS behaviour.

Elements of DeLone and McLean's model have been tested many times by many researchers. Rai, Lang, and Welker (2002) have assessed the validity of IS Success Models in a quasi-voluntary IS use context. This is an empirical test done

on an information system in use, and the analysis was completely theoretical, the results supporting DeLone and McLean's focus on integrated IS success models and their observation that IS success models need to be carefully specified in a given context. Their conclusion supporting the selection of an evaluation framework for IS success specific to the *context* has additionally been supported by Nolan and McFarlan (2005) and Andresen (2001).

Seddon (1999) additionally identifies three distinct models intermingled in DeLone and McLean's model, each reflecting a different interpretation of IS Use. One is a process model of IS Success that depicts the sequence of events relating to an IS. A second embedded model is a representation of the behaviour that manifests as a result of IS Success. A third embedded model is a variance model of IS Success, which links System Quality and Information Quality with surrogate measures of the net benefits that accrue from IS use. Seddon's argument is that intermingling of the three models in one model of IS success creates confusion concerning the interpretation of the D&M. Hence to more clearly represent IS success, Seddon (1999) disentangles the process model from the variance model of IS success from a variance model of behaviours that occur as a result of IS success.

2.1.2 DeLone and McLean's IS Success Model

An important step in consolidating prior research was undertaken by DeLone and McLean (1992). They attempted to systematically combine individual measures from IS success categories to create a comprehensive measurement instrument. Their model rests on the foundation of the work of Shannon and Weaver (1949) and Mason (1978). Shannon and Weaver (1949) used accuracy and efficiency of the system producing the information as the definition of the technical level, the level of success in relating the intended meaning as the definition of the semantic level, and the effect of the information on the receiver as the definition of the effectiveness level. Mason (1978) extended the Shannon and Weaver (1949) model by renaming effectiveness as influence and presented this level as a series of events that take place at the receiving end of an information system. DeLone and McLean (1992) suggested that Mason's extension of communication theory to

IS measurement implies the need for separate success measures for each level of information (see Table 2.1).

Table 2.1 Comparison of three studies: Shannon & Weaver (1949), Mason (1978), and DeLone and McLean (1992)

Shannon& Weaver (1949)	Technical Level	Semantic Level	Effectiveness or Influence Level		
Mason (1978)	Production	Product	Receipt	Influence on Recipient	Influence on System
DeLone and McLean (1992)	System Quality	Information Quality	Use & User Satisfaction	Individual Impact	Organisational Impact

DeLone and McLean proposed that "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; and lastly, this IMPACT on individual performance should eventually have some ORGANISATIONAL IMPACT." (DeLone and McLean, 1992; capitalization of original authors.)

In their seminal paper, DeLone and McLean (1992) reviewed 180 papers containing empirical IS success measures that had been published in seven publications during the seven years 1981-1987. They classified a huge range of IS Success measures they found into six categories, and at the end of their paper they present their six categories of success measures in their model. As shown in Figure 2.1, DeLone and McLean's model depicts the relationships among the six IS success dimensions. This model is regarded as the most comprehensive IS assessment model within the body of IS research. DeLone and McLean argue that when measuring IS success, researchers should "systematically combine" measures from their six IS Success categories.

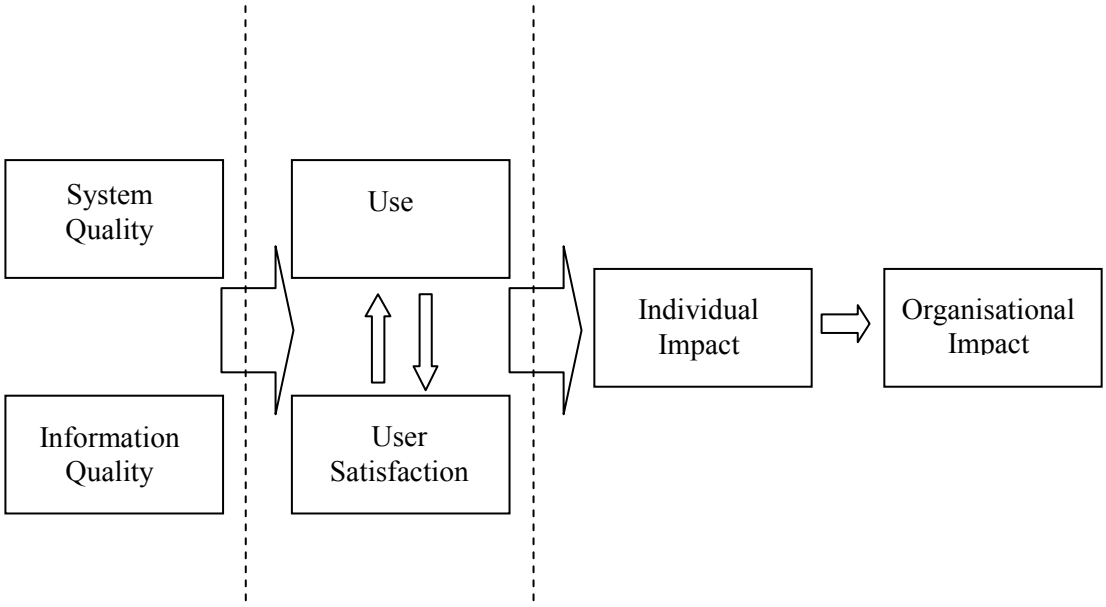


Figure 2.1 DeLone and McLean's IS Success Model (1992)

The definitions of the constructs of the IS Success Model based on the study of DeLone and McLean (1992) are described as follows:

1. System Quality: System quality refers to measures of the information processing system itself. System quality is the desired characteristics of the IS itself which are focused on by some IS researchers. These desired characteristics of the IS itself include convenience of access, flexibility of system, integration of systems, response time, realization of user expectations, reliability, ease of use, ease of learning, usefulness of IS, etc.

2. Information Quality: Information quality refers to measures of information and data for desired characteristics, such as accuracy, precision, currency, reliability, completeness, conciseness, relevance, understandability, meaningfulness, timeliness, comparability, and format.

3. Use: The use of IS refers to the consumption of the output by the recipient of an IS. The extent of the use of IS is one of the most frequently reported measures of the success of IS (Ein-Dor and Segev, 1978; Hamilton and Chervany, 1981). System use is chosen as the primary variable for the IS research framework due to

its mutual interdependency with other IS success dimensions (Ein-Dor and Segev, 1978).

4. User Satisfaction: User satisfaction refers to the recipient response to the use of the output of IS. When the use of IS is required, the preceding measures become less useful, and successful interaction with IS can be measured in terms of user satisfaction. Studies have found that user satisfaction is associated with attitudes toward computer systems so that user satisfaction measures may be biased by user computer attitudes (Lucas, 1978). Therefore, studies that include user satisfaction as a success measure should ideally also include measures of user attitudes so that the potentially biasing effects of those attitudes can be controlled in the analysis.

5. Individual Impact: Individual impact refers to the effect of information on the behavior of the recipient. Individual impact indicates that the IS environment has given the user a better understanding of the decision context, has improved the user's decisionmaking productivity, has produced a change in the user's activity, or has changed the decision maker's perception of the importance or usefulness of the IS environment. Emery (1971) states that information has no intrinsic value; any value comes only through the impact it may have on physical events. Such impact is typically exerted through human decision makers.

6. Organisational impact: Organisational impact refers to the effect of IS on organisational performance. More comprehensive studies of the effect of computers on an organisation include both revenue and cost issues within a cost and benefit analysis (Emery, 1971).

When looked into the model in more detail, System Quality and Information Quality are depicted as affecting both IS Use and User Satisfaction, which in turn are direct antecedents of Individual Impact. DeLone and McLean (1992, Figure 1, p. 62) conceptualize their model in terms of the ideas proffered by Shannon and Weaver (1949) and Mason (1978).

In terms of Shannon and Weaver's taxonomy, System Quality belongs to the technical level, and Information Quality belongs to the semantic level. IS Use, User Satisfaction, and Individual Impact belong to the effectiveness-influence level. The hierarchy of levels provide a basis for modeling System Quality and Information Quality as antecedents of IS Use, User Satisfaction, and Individual Impact.

DeLone and McLean (1992) applied Mason's arguments to model Use and User Satisfaction (response to use of IS output) as antecedents of Individual Impact (effect of information on behavior). A core aspect of the DeLone and McLean model is that Use is considered as an IS success variable, and consequently is included in their IS success model. They label IS Use as the consumption of IS output (1992), which they consider to be a precursor of Individual Impact. As per their model, IS Use is required to significantly impact realization of system benefits.

DeLone and McLean note the importance of specifying the dimensions of IS success and associated relationships carefully in a given context. In the context of Use for instance, User Satisfaction impacts IS Use, as a higher level of satisfaction builds greater user dependence on the system. The categories System Quality and Information Quality relate to *specific* qualities of the system or information generated by the system, and the categories User Satisfaction and IS Use are not defined in terms of a perception. While usefulness may be perceived, in part, from the effect that the IS has on the organisation and society, the measure relates specifically to users, and thus is more consistent with the Individual Impact category than either the Organisational Impact category or the Societal Impact category. As a result of this reasoning, Perceived Usefulness is positioned in the DeLone and McLean model as an Individual Impact.

2.1.3 The Updated D&M IS Success Model

Based on the research contributions to their original model (1992), and based on the changes in the role and management of information systems, DeLone and

McLean (2003) have updated their original success model with two new success dimensions added (Figure 2.2).

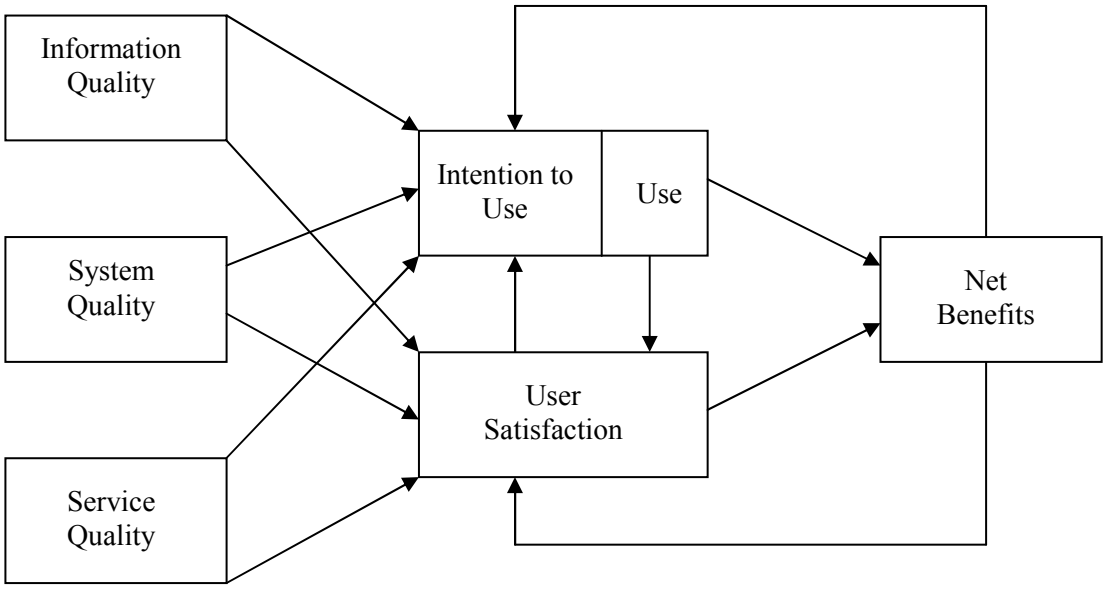


Figure 2.2 Updated DeLone and McLean's IS Success Model (2003)

Model extensions are "Service Quality", "Net Benefits" and the decomposition of the "Use":

7. Service Quality: The emergence of end user computing in the mid-1980s places IS organisations in the dual role of *information provider* (producing an information product) and *service provider* (providing support for end user developers) (DeLone and McLean, 2003). To measure the success of a single system, "information quality" or "system quality" may be the most important quality component. However, for measuring the overall success of the IS department, as opposed to individual systems, "service quality" may become the most important variable. The realisation of the absence and the importance of the "Service quality" dimension was initially asserted by various IS researchers (Pitt, Watson, and Kavan, 1995; Kappelman, Prybutok, and Van Dyke, 1997a; Kappelman, Prybutok, and Myers 1997b). They have proposed contingency models of IS success (e.g. SERVQUAL by Pitt et al, 1995; contingency theory of Kappelman et al, 1997b) updating the existing models of IS success to include the "service quality" dimension. DeLone and McLean have explicitly declare their

agreement with these and therefore extended their original model (1992) by adding the "service quality" as a separate dimension.

8. Intention to Use: Due to difficulties in interpreting the multidimensional aspects of "use", they have decomposed this dimension into "use" and "intention to use". These two are left in the same category because researchers may choose to stay with only "use". This is because "intention to use" is an attitude where "use" is a behavior and attitudes, and their links with behavior are difficult to measure. In the original model, Fig 2, "use" and "user satisfaction" are closely interrelated. With a *process* understanding, "use" must precede "user satisfaction"; and with a *causal* understanding positive experience with "use" will lead to greater "user satisfaction". Similarly, increased "user satisfaction" will lead to increased "intention to use" and thus "use" (DeLone and McLean, 2003).

9. Net Benefits: As the "impacts" of IS have evolved beyond the user, researchers have suggested additional IS impact measures: work group impacts, inter-organisational and industry impacts, consumer impacts, societal impacts. Rather than complicate the model with more success measures, DeLone and McLean grouped all the "impact" measures into a single impact or benefit category named as "net benefits".

DeLone and McLean define the process understanding of operational IS as:

> *an IS is first created, containing various features, which can be characterized as exhibiting various degrees of system and information quality. Next, users and managers experience these features by using the system or its information products. The use of the system and its information products then impacts or influences the user in the conduct of his work, and these individual impacts collectively result in organisational impacts.*

2.1.4 Seddon's IS Success Model

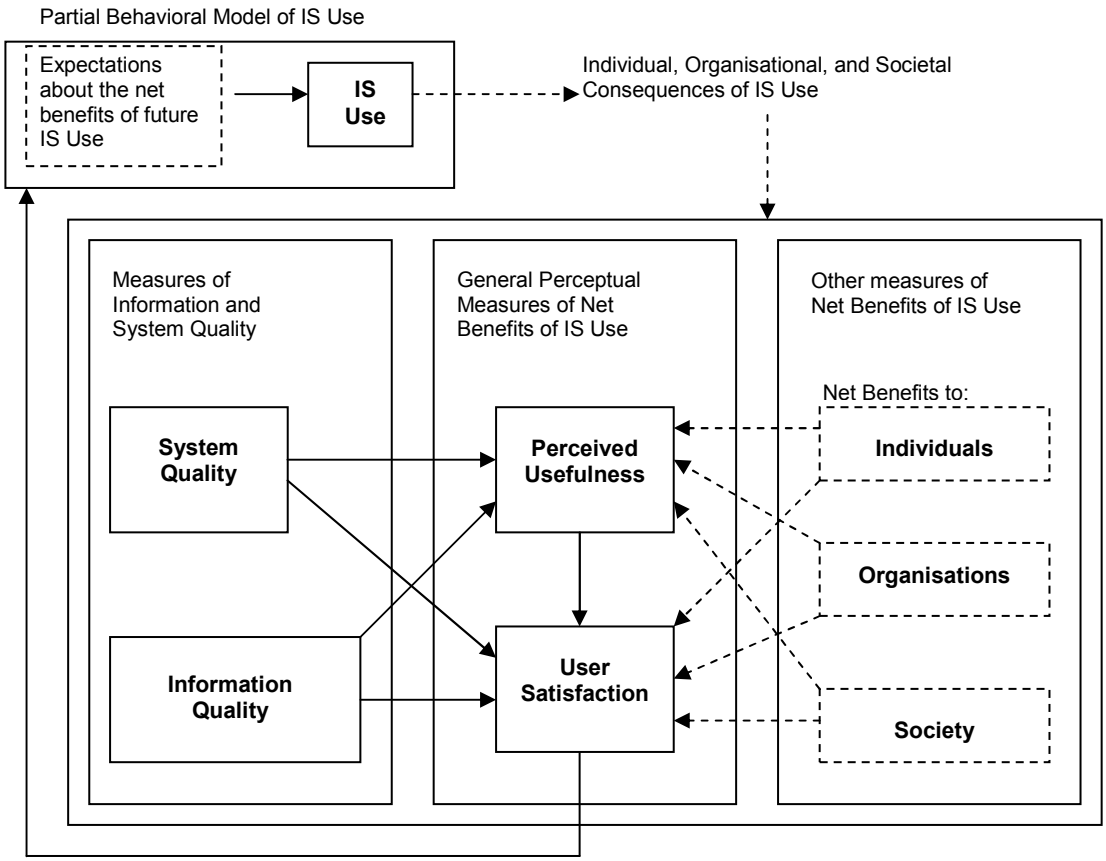


Figure 2.3 Seddon's Model of IS Success (1997)

The Seddon's IS success model is presented in Figure 2.3. A principal difference between Seddon's and DeLone and McLean's model is the definition and placement of IS Use. Seddon argues that use must precede impacts and benefits, but it does not cause them. Seddon (1999) considers IS Use to be a behavior that rejects an expectation of net benefits from using an information system anderefore models IS Use as a resulting behavior of IS success. This alternative definition of IS Use suggests that IS Use is a consequence of IS success, rather than being an inherent characteristic of IS success. Accordingly, IS Use as a behavior is separated from the IS Success Model, and IS related behavior is modeled as caused by IS success. This leads to three classes of interrelated variables. The first two classes of variables—information and system quality and perceptions of net benefits of IS Use—constitute the IS Success model, while a third class of variables focuses on IS Use as a behavior and constitutes the Partial Behavior Model of IS Use.

The model contains a direct path leading from System Quality and Information Quality to both Perceived Usefulness and User Satisfaction. Perceived Usefulness impacts User Satisfaction. The IS Success Model and the Partial Behavior Model of IS Use are linked by a path from User Satisfaction to Expectations of Net Benefits from Future IS Use, and this, consecutively, impacts IS Use.

DeLone and McLean's study is an important contribution to the literature on IS success assessment because it was the first that tried to impose some order on IS researchers' choices of success measures. However, although it distinguishes between individual impact and organisational impact, the 1992 model does not recognize explicitly that different stakeholders in an organisation may validly come to different conclusions about the success of the same information system. On the contrary, however, Seddon's (1997) re-specification of DeLone and McLean's model conceives that different individuals are likely to evaluate the consequences of information systems use in different ways: "IS Success is thus conceptualized as a value judgement made by an individual, from the point of some stakeholder" (Seddon, 1997).

The D&M IS success taxonomy and its six success categories are based on a process model of IS. In addition, DeLone and McLean argue that the six dimensions are interrelated, resulting in a success model that indicates that causality flows in the same direction as the information process. Seddon argues that "DeLone and McLean have attempted to combine both process and causal explanations of IS success in their model. After working with this model for some years, it has become apparent that the inclusion of both variance and process interpretations in their model leads to so many potentially confusing meanings" (Seddon, 1997, p.240). Hence, Seddon proposed a re-specified variance model of IS success. The combination of process and variance interpretations of IS success in one model (as in D&M model) is confusing. However, Seddon's recreation of the D&M model into two partial variance models (Seddon, 1997, p.245) makes the success model more complicated—this is not the intent of the original model.

The creation of the D&M IS success model was driven by a process understanding of IS and their impacts. This process model has just three components: the creation of a system, the use of the system, and the consequences of this system use. Each of these steps is a necessary, but not sufficient, condition for the resultant outcomes. Therefore, to understand fully the dimensions of IS success, a variance model is also needed. Thus, as Seddon states (1997), the application of the D&M model to empirical research requires a contextual variance specification of the model. For this, three components arise: production, use and net benefits. With Seddon, it is possible to combine these two necessary dimensions into one model (DeLone and McLean, 2003).

Seddon (1997) claims that *use* is a behavior, and is appropriate for a process model, and therefore "system use" as a success variable shall be removed from the causal success model. In that, he argues that *use* must precede impacts and benefits, but it does not cause them. However, system usage, in many cases is an appropriate measure of success as explained in more detail by DeLone and McLean (2003).

The D&M model appears to be just appropriate when adapting to the measurement for Internet/e-commerce success at the first glance. However there are difficulties. The difficulty of applying the D&M IS success model in order to define and operationalise IS success in specific research contexts has been overcome by Seddon's model (1999), by means of proposing a two-dimensional matrix for classifying IS effectiveness measures based on the type of system studied and on the stakeholder in whose interest the IS is being evaluated. In that Seddon et al.'s context matrix is a good reference for selection of success measures based on context for a research endeavour when selecting IS success dimensions and measures depending on the objectives and the context of the empirical investigation to be done.

2.1.5 Organisational Effectiveness in Information Systems

Organisational researchers have offered a variety of models for examining organisational performance, yet there is little consensus as to what constitutes a valid set of performance criteria (Cameron and Whetten, 1983; Lewin and Minton, 1986).

Thus, researchers have suggested that multiple models of organisational effectiveness are required as there is no universal theory of organisations. This is supported by three themes: (1) The use of effectiveness is diverse, (2) The criteria of effectiveness is expandable, (3) Disciplinary frameworks are diverse.

Several authors argue that there will always be a great variety and divergence in the meaning and use of *effectiveness* among researchers and practitioners. The usage has been so diverse, and the indicators are so various, that a single, clear definition is neither possible nor desirable (Goodman and Pennings, 1980; Pennings and Goodman, 1977).

Regarding the diversity of criteria, past literature suggests that studies of organisational performance should include multiple criteria (Cameron, 1986; Hitt and Brynjolfsson, 1996). Referring to the approach taken by the organisational psychologists Cameron and Whetton (1983), there are seven questions to answer when measuring organisational effectiveness. These seven guidelines are listed below:

> Guideline 1: *From whose perspective is effectiveness being judged?*
> It is important to make explicit who is defining and assessing effectiveness, since each constituency will use different criteria.
>
> Guideline 2: *On what domain of activity is the judgment focused?*
> The customer, process, and output/service define the domain being judged and it's important that this be explicitly stated, since many different domains exist in organisations and each one should be judged differently.

Guideline 3: *What level of analysis is being used?*
Effectiveness judgments can be made at many levels: individual, subunit, organisational, industry, societal. The appropriateness of the level depends on the constituency being used, the domain being focused on, the purpose of the evaluation, etc.

Guideline 4: *What is the purpose for judging effectiveness?*
The judgment almost always is affected by the purpose(s). Different data will be available, different sources will be appropriate, different amounts of cooperation or resistance will be encountered, different strategies will be necessary based on differences in purpose. The purposes also help determine appropriate constituencies, domains, levels of analysis, etc.

Guideline 5: *What time frame is being employed?*
Long-term effectiveness may be incompatible with short-term effectiveness, and sometimes effects and outcomes cannot be detected using the wrong time frame, since they may occur suddenly in the short term, or incrementally over the long term. The time frame should be made explicit.

Guideline 6: *What type of data are being used for judgments of effectiveness?*
Objective data or subjective, perceptual data? Objective data will tend to be more reliable, more easily quantifiable, and more representative of the 'official' position. These also limit the scope and usefulness of the data. Subjective data allows assessment of a broader set of criteria, but can be biased, and lack validity and reliability.

Guideline 7: *What is the referent against which effectiveness is judged?*
Comparing competitors, comparing to a standard, comparing to the organisational goals, comparing to past performance, or evaluating on the basis of characteristics the organisation possesses are all possible methods for comparison. Each one will yield different effectiveness judgments; therefore, the referent being used should be made clear.

Efficiency and effectiveness are performance domains that have been clearly distinguished. Efficiency refers to an input-output ratio or comparison, whereas effectiveness refers to an absolute level of either input acquisition or outcome attainment (Pennings and Goodman, 1977). McLean (1992) was first to call for a shift from a measurement focus on efficiency to effectiveness; in other words, doing the right thing rather than doing the thing right. Efficiency and effectiveness are different and require different measures: efficiency focuses on internal requirements, while effectiveness requires an external focus.

From the organisational view, the best performing organisations are both effective and efficient (Katz and Kahn, 1978), but there are trade-offs between the two (Mahoney, 1988). Progression along one dimension could entail regression along another (Kopelman, Brief and Guzzo, 1990). Hence, an organisation can be effective, efficient, both, or neither.

Organisational effectiveness may be defined as a hypothetical abstraction existing in people's minds giving meanings to ideas or interpretations about organisational effectiveness, but having no objective reality (Cameron and Whetton, 1983).

The history of organisational theory is commonly divided into several periods, whose names (e.g., human relations, open systems, resource dependence) identify the emergence of a new model highlighting organisational phenomena previously overlooked (Cameron and Whetton, 1983). As these models or organisations have been added to the existing conceptualizations over the years, a more composite understanding of organisations has resulted.

Consequently, major criteria of effectiveness change in predictable ways as organisations develop through their life cycles. Some shifts in state of development are resisted by the organisation much more than are others, and intervention into organisations may be needed to help make the transitions less painful and costly. Additionally, as new organisational forms (e.g. network type of organisations as a result of the Internet), are seen in many organisations, it is

inevitably becoming hard to identify the major criteria of effectiveness (additionally see section 2.4.1.13).

2.2 Effectiveness within the context of Software Development Process Evaluation

2.2.1 Software Process Quality and Information Systems Quality

Until recently, the practitioners and researchers in the general software domain have considered and focused primarily to the quality of the artifact being developed, on the software (Vidgen, Wood-Harper, and Wood, 1993; Eriksson et al, 1991; Adalekun, 1991; Garvin, 1987; Kallinikos, 2004; Dahlberg and Jarvinen, 1997; Özkan, 2003; Andersson and Von Hellens, 1997). This artifact, as a laboratory object, was analyzed and depicted usually away from its natural environment, the organisational context. Merging the organisational context with the artifact, we obtain information systems, which are multi-dimensional and entities with multiple perspectives (Özkan, 2004). Considering the quality of software, is definitely considering only the manufacturing process of that product, that is considering the operational level only, leaving out the context within which that product will operate. Of course the manufacturing quality of a product is important, but until recently, in the software area, all attention was focused only in this "manufacturing" process. This is understandable since software process quality models are originally intended for the assessment of the operational software processes and therefore, software process quality models are most beneficial at the operational level.

Although information systems quality cannot be separated from software process quality; they should be regarded as two different entities. It can be argued that information systems (IS) are the aim, whereas software serves for that aim, so that IS tend to be the organisational context where the developed software is used. IS therefore are built upon software, and the quality of software and software processes effect, if not determine the quality of the IS. The quality characteristics

of software differ from those of the IS of which it is part of. The quality of software focuses on the quality of the production of the object or artifact as widely used by many researchers, but the quality of IS focuses on the use of this object or artifact within the organisational environment. The borderline between a software and an IS may be clear if software is limited to programs, and IS is seen to be the organisational framework and context in which software is used. However, this definition may be considered to be to some extent insufficient, inadequate and poor for the discussion about software quality, as it obviously restricts the consideration to the technical characteristics of software and leaves out the usage of it, and the way users experience software, and influence their opinion about its related quality (Von Hellens, 1997).

Information systems are meaningful only when they are considered within a context, and the main distinction between a software system and an IS is that software is limited to the development process of a software system, while an IS is seen to be the organisational context in which software is used (Von Hellens, 1997). If we accept this difference and distinction, then we can argue that software quality means development process quality not considering the usage of that software, while IS quality will emphasize product quality assessed by the usage of software in an organisational background. Due to the multidisciplinary character of IS a discussion about the necessity of a societal viewpoint in these days of globalization of the software market, virtual global enterprises and cross-cultural teams follows with emphasis on software quality and process improvement (Siakas and Georgiadou, 1999).

The following sections present overviews of ISO/IEC 15504 and the Software Capability Maturity Model (SW-CMM) and Capability Maturity Model Integrated (CMMI) which provide frameworks for assessing and improving software processes of an organisation. Following these, an overview of another CMM, namely People Capability Maturity Model (P-CMM) is given.

2.2.2 ISO/IEC 15504

ISO (the International Organisation for Standardization) and IEC (the International Electrotechnical Commission) together form a system for worldwide standardization as a whole. In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC1. ISO/IEC TR 15504 provides a framework for the assessment of software processes. This framework can be used by organisations involved in planning, managing, monitoring, controlling and improving the acquisition, supply, development, operation, evolution and support of software.

Process assessment examines the processes used by an organisation to determine whether they are effective in achieving their goals. The assessment characterizes the current practice within an organisational unit in terms of the capability of the selected processes. The results may be used to drive process improvement activities or process capability determination by analyzing the results in the context of the organisation's business needs, identifying strengths, weaknesses and risks inherent in the processes.

ISO/IEC TR 15504 consists of the following parts, under the general title Information Technology – Software Process Assessment:
Part 1: Concepts and introductory guide (informative)
Part 2: A reference model for processes and process capability (normative)
Part 3: Performing an assessment (normative)
Part 4: Guide to performing assessments (informative)
Part 5: An assessment model and indicator guidance (informative)
Part 6: Guide to competency of assessors (informative)
Part 7: Guide for use in process improvement (informative)
Part 8: Guide for use in determining supplier process capability (informative)
Part 9: Vocabulary (normative)

The documents provide a structured approach to software process assessment for the following purposes:

- by or on behalf of an organisation with the objective of understanding the state of its own processes for process improvement;
- by or on behalf of an organisation with the objective of determining the suitability of its own processes for a particular requirement or class of requirements;
- by or on behalf of one organisation with the objective of determining the suitability of another organisation's processes for a particular contract or class of contracts.

The high level view of the relationships between process assessment, process improvement and process capability determination is shown in Figure 2.4, along with an indication of the places of the various components of ISO/IEC TR 15504 in the processes.

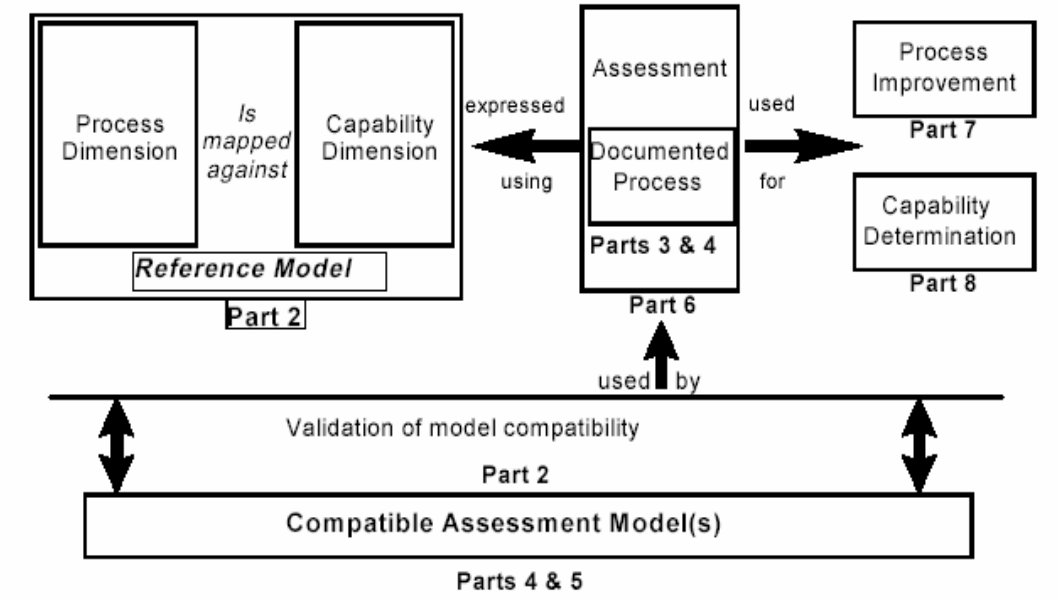


Figure 2.4 Overview of relationships of elements of ISO/IEC 15504 Standard

An assessment may be used for purposes of either Process Improvement or Capability Determination. Guidance on such usage is found in ISO/IEC TR 15504-7 and ISO/IEC TR 15504-8 respectively. Performance of an assessment requires a model (or models) compatible with the reference model in ISO/IEC TR 15504-2; an exemplar model is provided in ISO/IEC TR 15504-5. The assessment process must be documented and should be based upon a method in line with the

requirements defined in ISO/IEC TR 15504-3 and following the guidance provided in ISO/IEC TR 15504-4. A competent assessor is charged with ensuring that the assessment is conformant; guidance for the necessary skills and competencies are in ISO/IEC TR 15504-6.

ISO/IEC TR 15504 is designed to provide assessment results that are repeatable, objective, comparable within similar contexts, and able to be used for either process improvement or process capability determination.

The framework for the conduct of assessments is designed to support the achievement of dependable assessment results. The framework includes an architecture for rating processes and for presenting assessment ratings. The assessment framework also provides guidance on the conduct of the assessment.

ISO/IEC TR 15504 provides guidance in the contexts of both process improvement and process capability determination. It further provides a definition of the required skills and experience for assessors. The key determinant in the use of ISO/IEC TR 15504 is the purpose for which the assessment is being conducted. This may be:

- to promote an understanding of the software process;
- to support process improvement;
- to support process capability determination.

The approach to process assessment defined in ISO/IEC TR 15504 is designed to provide a basis for a common approach to describing the results of process assessment, allowing for some degree of comparison of assessments based upon different but compatible models and methods. The sophistication and complexity required of a process is dependent upon its context. For instance the planning required for a five person project team is much less than for a fifty person team. This context influences how a competent assessor judges a practice when assessing its adequacy and influences the degree of comparability between process profiles.

Field of application

Process assessment has two principal contexts for its use, as shown diagrammatically in Figure 2.5. Within a process improvement context, process assessment provides the means of characterizing the current practice within an organisational unit in terms of the capability of the selected processes. Analysis of the results in the light of the organisation's business needs identifies strengths, weaknesses and risks inherent in the processes. This, in turn, leads to the ability to determine whether the processes

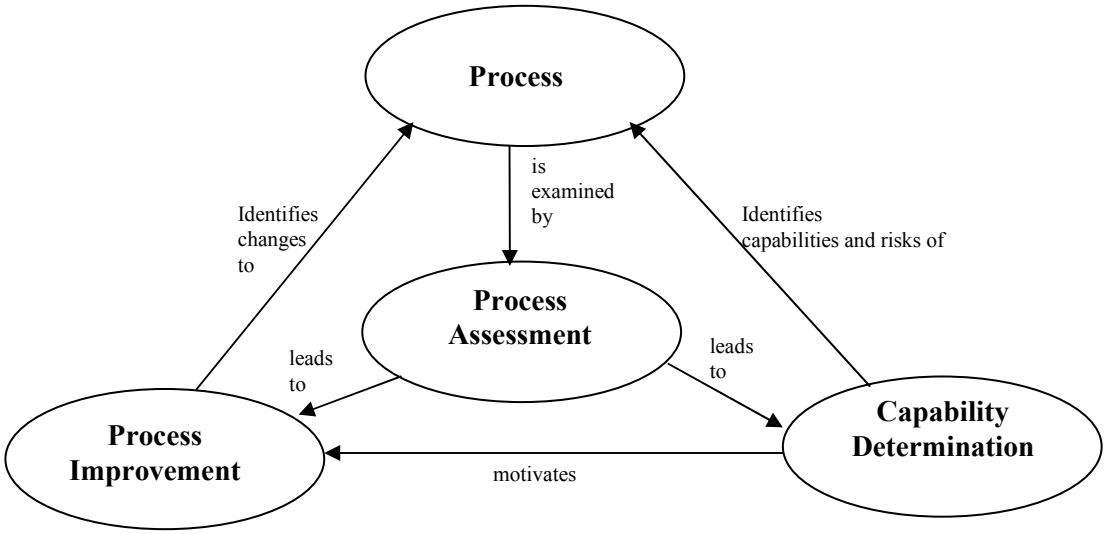


Figure 2.5 Software Process Assessment as defined in the ISO/IEC 15504 Standard

are effective in achieving their goals, and to identify significant causes of poor quality, or overruns in time or cost. These provide the drivers for prioritizing improvements to processes.

Process capability determination is concerned with analyzing the proposed capability of selected processes against a target process capability profile in order to identify the risks involved in undertaking a project using the selected processes. The proposed capability may be based on the results of relevant previous process assessments, or may be based on an assessment carried out for the purpose of establishing the proposed capability.

Two of the parts of ISO/IEC TR 15504 (parts 7 and 8) address the use of process assessment for process improvement and for process capability determination. Other parts of ISO/IEC TR 15504 address various issues relating to process assessment.

ISO/IEC TR 15504 has been designed to satisfy the needs of acquirers, suppliers and assessors, and their individual requirements from within a single source. The benefits arising from the use of this suite of documents include:

For **acquirers:**

- an ability to determine the current and potential capability of a supplier's software processes.

For **suppliers:**

- an ability to determine the current and potential capability of their own software processes;
- an ability to define areas and priorities for software process improvement;
- a framework that defines a road map for software process improvement.

For **assessors:**

- a framework for conducting assessments.

ISO/IEC TR 15504 is not intended to be used in any scheme for the certification / registration of the process capability of an organisation.

Relationship to other International Standards

ISO/IEC TR 15504 is complementary to several other International Standards and other models for evaluating the capability and effectiveness of organisations and processes. This section describes the relationship between ISO/IEC TR 15504 and the major related International Standards.

ISO/IEC TR 15504 incorporates the intent of the ISO 9000 series to provide confidence in a supplier's quality management whilst providing acquirers with a framework for assessing whether potential suppliers have the capability to meet their needs. Process assessment provides users with the ability to evaluate process capability on a continuous scale in a comparable and repeatable way, rather than

using the pass/fail characteristic of quality audits based on ISO 9001. In addition, the framework described in ISO/IEC TR 15504 provides the opportunity to adjust the scope of assessment to cover specific processes of interest, rather than all of the processes used by an organisational unit.

ISO/IEC TR 15504 is related in particular to the following components of the ISO 9000 series:

- ISO 9001 : 1994, Model for quality assurance in design, development, production, installation and servicing;
- ISO 9000-3 : 1997, Quality management and quality assurance standards - Part 3: Guidelines for the application of ISO 9001:1994 to the design, development, supply, installation and maintenance of computer software;
- ISO 9004-4 : 1993, Quality management and quality system elements - Part 4: Guidelines for quality improvement.

ISO/IEC TR 15504, and particularly part 2, is directly aligned to

- ISO/IEC12207 : 1995, Information technology - Software life cycle processes

This standard provides an overall contextual framework for software life cycle processes, and the process dimension of the reference model is closely mapped to this framework.

2.2.3 Software Capability Maturity Model (SW-CMM) and Capability Maturity Model Integrated (CMMI)

This section presents an overview of the Software Capability Maturity Model (SW-CMM) and Capability Maturity Model Integrated (CMMI) of which the Software Engineering Institute (SEI), Carnegie Mellon University. The Capability Maturity Model for Software (SW-CMM) is a reference model for appraising software process maturity and a normative model for helping software organisations progress along an evolutionary path from ad hoc, chaotic processes to mature, disciplined software processes.

CMMI is an upgrade of the SW-CMM with the following changes: (1) new process areas are added, (2) modern best practices are added, and (3) a generic goal (i.e. implementation goal) is added that applies to each process area. In

addition, a continuous representation is available as well as the staged representation of the SW-CMM.

Practices added in CMMI are improvements and enhancements to the SW-CMM. As indicated by SEI, many of the new practices in CMMI are already being implemented by organisations that have successfully implemented processes based on the improvement spirit of SW-CMM best practices.
Basically, CMM is a maturity growth model organized into five maturity levels. Each maturity level describes a stage in the maturity of a software organisation. The lowest level is level one, the initial level. Organisations at level one in SW SMM are characterized by working in an ad hoc manner and by unpredictable performance. Organisations at level two, the repeatable level, should deliver, and use software with a repeatable quality, in other words, they should repeat earlier successful performances in similar circumstances. For an organisation to be at level 2, it has to be at level 1 also. At the third level, the defined level, the aim should be the standardization of services. Organisations at level three should employ standard processes to select, develop, deliver and use software and should have implemented organisation-wide processes to train employees who use software and manage software related resources and problems. The fourth level, the managed level, should aim attaining quantitative control over the software processes. And finally at Level five, the optimizing level, continuous process improvement of use and delivery of software should be aimed.

In SW-CMM, each maturity level (except for level one) contains a number of key process areas. Except for Level 1, each maturity level is decomposed into several key process areas that indicate the areas an organisation should focus on to improve its software process. To reach a certain maturity level within the SW-CMM, each of the key process areas of that level and lower levels have to be implemented by the organisation whose software has been assessed. Moreover, for a key process area to be considered implemented each of the goals of the key process area should be reached. A key process area consists of goals and of activities, which are called key practices. An organisation that implements all activities from a certain key process area is expected to also reach the goals of that

key process area. This relationship between maturity levels, key process areas, common features and key practices is shown in Figure 2.6.

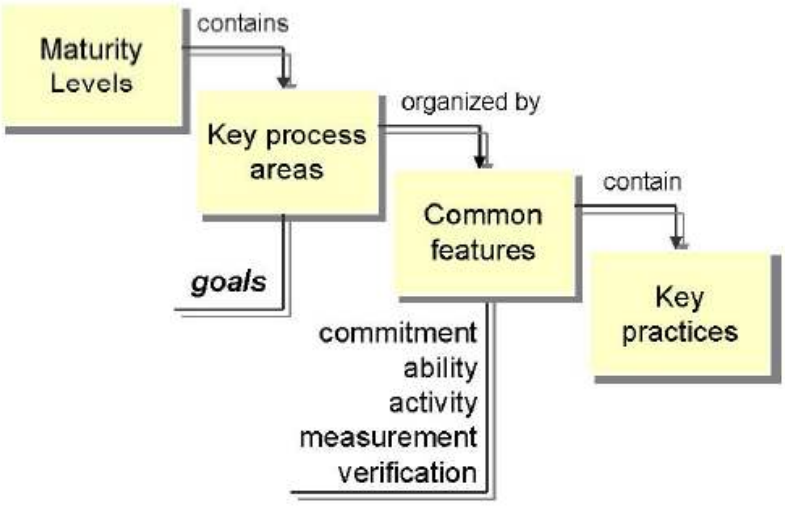


Figure 2.6 CMM Structure

The CMM model distinguishes between five kinds of practices, called common features, which together, these five common features ensure that the goals of the key process area are reached:

- Commitment to Perform: activities aimed at ensuring organisational and management commitment to the key process area activities.
- Ability to Perform: activities aimed at enabling the key process area.
- Activities Performed: the activities needed to get the job done.
- Measurement and Analysis: activities aimed at determining the status of the key process area.
- Verifying Implementation: activities aimed at verification of the implementation of the key process area.

The key practices describe the infrastructure and activities that contribute most to the effective implementation and institutionalization of the key process area. Table 2.2 shows characterizations of the five maturity levels highlighting the primary process changes made at each level (Paulk, Curtis, Chrissis, and Weber, 1993).

Table 2.2 The five maturity levels of SW-CMM

CMM level	Major Characteristics
1.Initial	The software process is characterized as ad hoc, and occasionally even chaotic. Few processes are defined, and success depends on individual effort.
2.Repeatable	Basic project management processes are established to track cost, schedule, and functionality. The necessary process discipline is in place to repeat earlier successes on projects with similar applications.
3. Defined	The software process for both management and engineering activities is documented, standardized, and integrated into a standard software process for the organisation. All projects use an approved, tailored version of the organisation's standard software process for developing and maintaining software.
4. Managed	Detailed measures of the software process and product quality are collected. Both the software process and products are quantitatively understood and controlled.
5. Optimizing	Continuous process improvement is enabled by quantitative feedback from the process and from piloting innovative ideas and technologies.

The staged structure of the CMM is based on principles of product quality that have existed for the last sixty years. In the 1930s, Walter Shewart, promulgated the principles of statistical quality control. His principles were further developed and successfully demonstrated in the work of W. Edwards Deming (Deming, 1994) and Joseph Juran (Juran, 1988, 1989). These principles have been adapted by the SEI into a maturity framework that establishes a project management and engineering foundation for quantitative control of the software process, which is the basis for continuous process improvement. The maturity framework into which these quality principles have been adapted was first inspired by Philip Crosby of in his book *Quality is Free* (Crosby, 1979). Crosby's quality management maturity grid describes five evolutionary stages in adopting quality practices. This maturity framework was adapted to the software process by Ron Radice and his colleagues, working under the direction of Watts Humphrey at

IBM (Paulk, et al., 1993). Humphrey brought this maturity framework to the Software Engineering Institute in 1986, added the concept of maturity levels, and developed the foundation for its current use throughout the software industry.

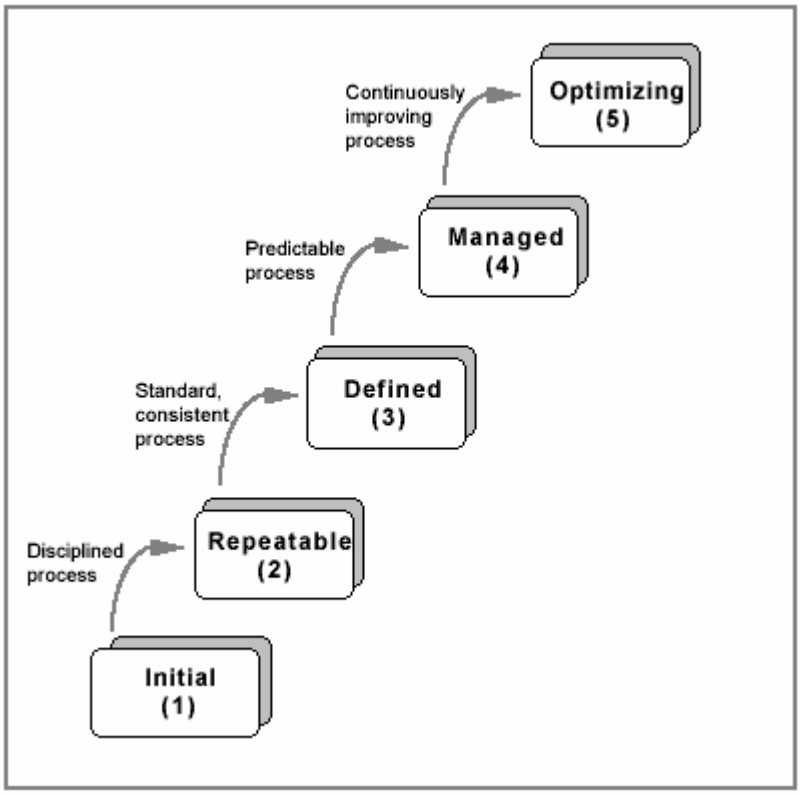


Figure 2.7 The Five Levels of Software Process Maturity

Early versions of Humphrey's maturity framework are described in SEI technical reports, papers, and in his book, *Managing the Software Process* (Humphrey, 1989). A preliminary maturity questionnaire was released in 1987 as a tool to provide organisations with a way to characterize the maturity of their software processes. Two methods, software process assessment and software capability evaluation, were developed to appraise software process maturity in 1987. Since 1990, the SEI, with the help of many people from government and industry, has further expanded and refined the model based on several years of experience in its application to software process improvement (Paulk, et al., 1993).

Although it is clear that the Process Maturity Levels used in Software Process Improvement Models (both in CMM and SPICE—ISO/IEC15504) originate from the five stages of Crosby's Maturity Grid (Paulk, et al, 1993), these process improvement models are adoptions of Total Quality Management concepts

pioneered by Deming, Juran, Crosby, and others to software development. This is not surprising because most of the quality approaches are based on organisational theory since realization of a need for quality initially appeared within the organisation ("Process" is a type of knowledge, and shall be improved by means of "process improvement" to enhance effectiveness. According to Crosby's "quality is free" paradigm, by improving the quality of the development process, the product quality is improved at the same time the cost is reduced and the development time is decreased) (Weinberg, 1992). Definitely, software process quality is an empty statement without some indication of its performance and applicability in the user environment. Therefore, the quality of software processes emphasize the quality of the production of the artifact called software in an organisational context. These are related closely and largely to the definition of quality, that quality is contingent and resides in the user's perception of the product (Siakas and Georgiadou, 1999). However, it is important for the IS developers to recognize that they are primarily engaged in a service-oriented business, rather than being in the business of producing high-quality software (i.e. the *product* versus the *service)* (Von Hellens, 1997; Humphrey, 1997; Laudon and Laudon, 2001). Based on this finding of Von Hellens, organisations using IS, should be aware that the artifacts that they are using are not only software but a service, and they should be treated as services.

Upgrading from SW-CMM to CMMI

As asserted by SEI **(**Shrum, 2004) hundreds of organisations are upgrading to the CMMI Product Suite worldwide, including those in North America, Europe, India, Australia, Asia Pacific, and the Far East. Compared to the early adoption of the SW-CMM, the adoption of CMMI has been more rapid by both industry and government. Many organisations are finding that upgrading from SW-CMM to CMMI-based process improvement is straightforward because implementing CMMI builds on their knowledge of the SW-CMM. Organisations can promptly move from a maturity level of the SW-CMM to the corresponding maturity level of CMMI. CMMI models are the most comprehensive process improvement models available for product and service development and maintenance, which

makes them world class (Shrum, 2004). They build on and extend the best practices of the SW-CMM and other process improvement models.

2.2.4 People Capability Maturity Model (P-CMM)

The People Capability Maturity Model (P-CMM) is a tool that helps organiztions successfully address the critical people issues. The P-CMM employs the process maturity framework of the Capability Maturity Model for Software (SW-CMM) as a foundation for a model of best practices for managing and developing an organisation's workforce. The SW-CMM has been used by software organisations around the world for guiding dramatic improvements in their ability to improve productivity and quality, reduce costs and time to market, and increase customer satisfaction. Based on the best current practices in fields such as human resources, knowledge management, and organisational development, the P-CMM guides organisations in improving their processes for managing and developing their workforce. The P-CMM helps organisations characterize the maturity of their workforce practices, establish a program of continuous workforce development, set priorities for improvement actions, integrate workforce development with process improvement, and establish a culture of excellence. Since its release in 1995, thousands of copies of the P-CMM have been distributed, and it is used world-wide by organisations, small and large, such as IBM, Boeing, BAESystems, Tata Consultancy Services, Ericsson, Lockheed Martin and QAI (India) Ltd (Curtis, Hefley, and Miller, 2001).

The People CMM is an organisational change model. It is designed on the premise that improved workforce practices will not survive unless an organisation’s behavior changes to support them. The People CMM provides a roadmap for transforming an organisation by steadily improving its workforce practices.

As claimed by the Software Engineering Institute (Curtis, et al., 2001), any Capability Maturity Model derived from Humphrey’s original maturity framework integrates principles from three domains: the targeted domain of processes, total quality management practices, and organisational change. First, the CMM was

designed to help an organisation adopt best practices in a targeted domain. The CMM for Software targeted software engineering processes, while the People CMM targets workforce management processes. Second, processes in the targeted domain are continuously improved to become more effective and predictable using Total Quality Management concepts pioneered by Deming, Juran, Crosby, and others. Third, the CMM constitutes a unique approach to organisational development that introduces these practices in stages (maturity levels) to create a succession of changes in the organisation's culture.

Changing an organisation's culture through staged improvements to its operating processes is a unique approach to organisational development. These cultural changes provide much of the CMM's power for implementing lasting improvements and distinguish it from other quality and process improvement standards. Curtis, et al, (2001) claim that although many process standards can transform an organisation's culture, few include a roadmap for implementation. Consequently, organisations often fail to implement the standard effectively because they attempt to implement too much too soon and do not lay the right initial foundation of practices.

2.2.5 SW-CMM and ISO/IEC 15504

Of all the CMMs, the SW-CMM is the one most closely associated with 15504, and the one for which the most content comparisons have been made, both internal and external to the SEI (Garcia, 1999). The evolution of a set of common CMM elements, both from a structural and content viewpoint, will also benefit CMM users engaged with 15504, since the 15504 practices can provide the software specific guidance related to common CMM elements that may not be currently expanded in staged CMMs. In that regard, since the communities evolving 15504 and CMMs are similar enough in character that where the goals of the two product types intersect, synergistic use can be expected.

15504 and the SEI's CMMs exhibit some different perspectives on process improvement in the software systems arena, as well as differences in levels of

abstraction. The levels of abstraction differences are due to the difference in purpose of the two products. 15504, as an international standard, is and must stay general enough in its normative components to encompass a number of process improvement approaches, including, but not limited to CMM-based improvement. SW-CMM, and other CMMs in general, are guidance and reference documents. Therefore they provide more informative material for users at a lower level of detail, attempting to provide a vision for what an improved organisation's practices would look like (Garcia, 1999).

2.2.6 Agile software process development methodologies

Agile development methodologies (e.g. Extreme Programming, Adaptive Software Development, SCRUM, etc.) promise higher customer satisfaction, lower defect rates, faster development times and a solution to rapidly changing requirements (Boehm and Turner, 2003; Highsmith, 2004).

DeMarco and Boehm (2002) defines agile as "investing heavily in individual skill building rather than organisational rule sets".

The principles and values of agile development are:

1. *Individuals and interactions over processes and tools:* Here the importance of working as a team is highlighted. Building the team is more important than building the environment.
2. *Working software over comprehensive documentation*: This is producing no document unless its need is immediate and significant.
3. *Customer collaboration over contract negotiation*: Co-located customer-developer interaction is observed. This is at a day-to-day level, in all development stages.
4. *Responding to change over following a plan:* It is the ability to respond to change that often determines the success or failure of a software project. This point is a result of test-based development where "design-implement-test" cycle is transformed into "design test-design software-implement-test".

Although agile development methodologies are becoming more and more popular, and the use of iterative and incremental development (IID) is encouraged (Larman and Basili, 2003; Paulk, 2001) both plan-driven and agile approaches have shortcomings. In that regard, Boehm and Turner (2003) suggest that in order to take advantages of their strengths and compensate for their weaknesses, these approaches should be balanced since they believe that future applications will need both agility and discipline. For example, rather than as observed in plan-driven methods where all-inclusive approaches are tailored down to fit a particular situation; building-up plan-driven emerging approaches is recommended. They also suggest that while balancing, the focus should be less on methods, but more on people, values and communications.

2.3 Effectiveness within the context of Information Technology Evaluation

2.3.1 Information Technology Governance and IT Quality

IT governance is defined as 'a structure of relationships and processes to direct and control the enterprise in order to achieve the goals of a business by adding value while balancing risk versus return over IT and its processes' (ISACA CobiT web site, 2004). Briefly, IT governance is the system by which IT within enterprises is directed and controlled. The IT governance structure specifies the distribution of rights and responsibilities among different participants, such as the board, business and IT managers, and spells out the rules and procedures for making decisions on IT. By doing this, it also provides the structure through which the IT objectives are set, and the means of attaining those objectives and monitoring performance.

Today, IT managers have a bewildering array of quality disciplines to choose from. On the one hand, CEOs tend to dictate quality models such as Six Sigma, EFQM, BNQP, ISO 9000 and the Malcolm Baldridge program. This is a tempting approach since quality theory originates from business process environments. On the other hand, IT auditors impose other IT-focused disciplines, such as Control

Objectives for Information and Related Technology (CobiT), CMM for software development and the Information Technology Infrastructure Library (ITIL) for IT operations and services (Anthes, 2004).

There is some overlap among these quality frameworks, and in most cases, they don't conflict. Indeed, most large companies use two or three of them. For example, IBM uses ISO 9000, CMM, ITIL, Six Sigma and several homegrown quality programs.

Meanwhile, other equally sophisticated companies don't use any of them, preferring to roll their own. For instance, MasterCard International Inc. has adapted parts of a number of programs to its own way of doing business. It underwent an external assessment for CMM and implemented some ideas from that, but it hasn't adopted the framework formally. Being a hybrid of quality programs, the program has reduced the development time for new software releases from 18 months to 12 as well as reducing the number of software defects.

Similarly, Hewlett-Packard (HP) has its own so called HP OpenView, where they map ITIL/ITSM to the CobiT and COSO frameworks. With a combination of industry control frameworks in both accounting and IT, HP recommends its own framework for companies to be in control of the IT services essential for business operations and reporting (HP ITSM and HP Openview documents, 2004).

Other companies, such as Nortel Networks Ltd. uses a telecommunications-oriented version of ISO 9000 because that's what its customers use. However it is important to note that, in the Nortel case, the choice of using a hybrid quality model is driven by the organisation’s customers and partners.

For some companies, an outside body's stamp of approval, such as an ISO 9000 or CMM certification, or the cachet that comes from a Baldridge award, may be an important factor. For example, a defense contractor may not be able to get work without a high CMM assessment, and an ISO 9000 badge may be a requirement for doing business, especially outside the U.S.

2.3.2 CobiT

Control Objectives for Information and related Technology (CobiT, in its 3rd edition since July 2000) is a set of documented best practices for IT governance that assists auditors, management and users to bridge the gaps among business risks, control needs and technical issues. Developed by the IT Governance Institute, a part of the Information Systems Audit and Control Association (ISACA), these guidelines have business orientation as the main theme. Thus, business process owners and managers, as well as auditors and users, can employ the guidelines successfully (ISACA CobiT web site, 2004; Brand and Boonen, 2004; Euclid, 2004; Lainhart, 2000).

The CobiT Framework provides Control Objectives, Management Guidelines, Framework and Audit Guidelines:

- ***Control Objectives:*** 34 high-level control objectives in 4 domains: one for each IT process across planning and organisation, acquisition and implementation, delivery and support and monitoring.
- ***Audit Guidelines:*** 318 detailed control objectives to provide management assurance and/or advice for improvement.
- ***Management Guidelines:*** generic and action oriented for the purpose of answering the following questions:
    - How far should we go, and is the cost justified for the benefit?
    - What are the indicators of good performance?
    - What are the critical success factors?
    - What are the risks of not achieving our objectives?
    - What do others do?
    - How do we measure and compare?
- The CobiT Framework includes:
    - ***Maturity Models*** - To map where the IT Organisation is today (on a Scale of 0 to 5) with regard to IT Processes compared to the best in the class in the Industry and International best practices.
    - ***Critical Success Factors (CSFs)*** - Management-oriented implementation guidelines to achieve control over and within IT processes.

- ***Key Goal Indicators (KGIs)*** - Performance of the IT process with respect to business requirements.
- ***Key Performance Indicators (KPIs)*** - Performance of the IT process with respect to process goals.

CobiT, apart from not being strong in security, as acknowledged by many practitioners, is “generic” (Jahnke, 2004). It is strong in IT controls and IT metrics, but it does not say how (i.e. lacking *process* understanding).

Since the documentation of the full CobiT standard is rather massive, the ISACA has realized the need for a more focused subset of the full standard. Hence, the ISACA is finalizing a special version of CobiT called "QuickStart" for small and medium-sized businesses. This special version will contain a subset of the CobiT standard and focus on elements that are viewed as most critical for organisations that lack the resources to pursue the full standard.

For IT managers, CobiT is just "an IT governance tool" to help them understand what controls are needed and how to measure the effectiveness of those controls. The audit tool, which is part of the standard, help auditors to audit against those same criteria.

In many applications, CobiT is found to be demanding in the way that it takes considerable effort to integrate into an organisation's processes. Since organisations find the statements in CobiT very generic; within the organisation, appropriate personnel—who are usually throughout the technology group that own the controls specified within CobiT—were determined and educated in CobiT.

2.3.3 ITIL/ ITSM

IT service management (ITSM) began as a project undertaken by the government of the United Kingdom in the early 1980s. In the midst of a serious economic downturn, the government was forced to lower costs and better manage the IT service delivery. The government knew it needed to develop innovative ways to

improve IT service efficiency (OGC, ITSMF and ITILcollege websites; Euclid, 2004).

The government put the British Central Computer and Telecommunications Agency (CCTA) in charge of the project (CCTA is currently known as Office of Government Communications - OGC). The CCTA knew it could increase the efficiency quickly by focusing on improving IT processes. The team recruited consultants, vendors and users to design a set of best practice-based IT processes, which were then documented using a common glossary of terms and published in an integrated series of 40 books. This series, recently updated and repackaged as seven books, is now referred to as the IT Infrastructure Library (ITIL).

ITIL is regarded as one of the most comprehensive and respected source of information about IT processes ever written for organisations seeking to implement IT **service** management (ITSMF website, 2004). Successful companies and governments worldwide have adopted ITIL. Organisations such as the IT Service Management Forum (ITSMF), an independent, international ITIL users group, help to share ITIL best practices. And many consulting and educational firms around the world now offer ITIL training and certification programs for IT. For example, ITIL provides the foundation for the Microsoft Operations Framework (MOF) and for the HP IT Service Management Reference Model.

According to ITIL, "IT service management is concerned with delivering and supporting IT services that are appropriate to the business requirements of the organisation. ITIL provides a comprehensive, consistent and coherent set of best practices to achieving business effectiveness and efficiency in the use of information systems."

While the functional groups within IT are focused on developing and deploying best in class applications, operating data centers for peak performance and providing ongoing support, it is important to tie all the deliverables and activities that the IT functional groups perform around how they support business mission, processes, functions and activities.

"Service" (or IT service/ business service) is the most meaningful and effective linkage between business and IT. This helps package the IT functional groups' deliverables into a set of logical associations that are consumed by business to enable business users to accomplish their business activities, functions, processes and the overall mission.

IT service management is about managing the business services that IT provides proactively to deliver high-quality IT services at an optimal cost. Because the focus here is on the service delivered to the business as opposed to managing IT function, IT service management aids in achieving business-IT alignment. However, the guidelines describe "what" rather than "how". Service management is tailored to the size, the internal culture and the requirements of the organisation. An important focus is the provision of quality IT services (Niessink, Clerc, and Van Vliet, 2002).

Challenges in Implementing ITSM

- Articulating the business value of ITSM
- Getting quick hits
- Management commitment
- ITSM champion
- Culture/ customer orientation
- Existing ad hoc processes
- Too much data in some areas, too little in others

Business Value of ITIL/ITSM

Empirical research shows that implementing IT service management/ ITIL processes and methodologies helps prevent problems before they occur within the IT environment. This results in a significant reduction in the number, resolution time, level and business impact of service incidents, and leads to significant labor savings in resolving incidents. For instance, by achieving about a 10 percent reduction in incidents, Fortune 1000 organisations can typically save over one million dollars per year.

While CMM is the de facto quality standard for software development processes, ITIL for many is the tool of choice for the operations and infrastructure side of IT, particularly for IT services (Anthes, 2004).

ITIL tracks problems in IT service areas such as help desk, applications support, software distribution and customer-contact system support, and it overlaps CMM in certain areas such as configuration management. For example, ITIL tracks the changes made to operational systems, but the quality of those changes—in terms of the number and severity of problems resulting from them—is more a CMM metric.

ITIL facilitates root-cause analysis of problems, but does not offer solutions, i.e. does not attempt to fix the problem.

It has also been realized that ITIL shall not be taken as a substitute for ISO 9000. One of the reasons to this is because ISO 9000 is more relevant to certification of processes. Other quality frameworks such as Six Sigma, Baldridge, etc. are more business focused where ITIL is IT focused.

2.3.4 Merging of CobiT and ITIL

There has been an ongoing debate among IT researchers and practitioners on the possibility of merging of CobiT and ITIL frameworks. In regard to IT governance, it is well known that strong framework tools are essential for ensuring IT resources are aligned with an enterprise's business objectives, and for ensuring that services and information meet quality, fiduciary and security needs. So, why not combine CobiT and ITIL for powerful IT governance? (Özkan and Bilgen, 2005; Özkan, 2005; Mingay, Furlonger, Magee, and Andren, 1998; Mingay and Bittinger, 2002, 1998; Salle, 2004).

We know a lot about CobiT, we know a lot about ITIL and IT Service Management. But, has research been done on the fit of these two frameworks, the success of combining ITIL and CobiT, or even the choice for one or the other by

an organisation. And on what basis is that choice then being made? (Blodjik, 2002).

It has also been argued that since CobiT consists of a full set of information, Critical Success Factors (CSF's) and Key Process Indicators (KPI's) and automated audit-tooling, more than ITIL delivers; and that combining the best of both worlds would stimulate and drive the alignment of IT Services process optimization efforts throughout the world.

However, merging of CobiT and ITIL is not realistic: the two are entirely different. John W. Lainhart (Lainhart, 2000), one of the developers of CobiT, states that CobiT and ITIL should be seen as complementary and not competitive. ITIL describes the Service Management processes and recommends security and control practices but does not have a standard for them which is where CobiT comes in because it provides a framework to perform audits on a particular organisation's ITIL processes. So rather than compete, CobiT and ITIL complement each other. A brief comparison of CobiT, ITIL and CMMs is given in Table 2.3.

Table 2.3 Comparison of CobiT, ITIL and CMMs

Framework	**CobiT (Control Objectives for Information Related Technology)**	**ITIL (Information Technology Infrastructure Library)**	**CMMs (Capability Maturity Models)**
Sponsor	Information Systems Audit and Control Association and the IT Governance Institute	The UK Office of Government Commerce, Pink Elephant Inc., and others.	Software Engineering Institute (SEI), Carnegie Mellon University

Table 2.3 (continued)

What it is	An audit-oriented set of guidelines for IT processes, practices, and controls Geared to risk reduction, focusing on integrity, reliability, and security Addresses four domains: planning and organisation, acquisition and implementation, delivery and support, and monitoring Has six maturity levels, similar to the CMMs'	Best practices for IT service management and operations (such as service-desk, incident, change, capacity, service-level, and security management) Especially popular in Europe	A maturity growth model organized into five maturity levels Allow organisations to assess their practices and compare them to those of other organisations CMMs that the SEI is currently involved in developing, expanding, or maintaining are: • CMMI (Capability Maturity Model Integration) • P-CMM (People Capability Maturity Model) • SA-CMM (Software Acquisition Capability Maturity Model)
Strengths	Good checklists for IT Enables IT to address risks not explicitly addressed by other frameworks and to pass audits Can work well with other quality frameworks, especially ITIL	Well established, mature, detailed, and focused on IT production and operational quality issues Can combine with CMMI to cover all of IT	Most comprehensive process improvement models available for product and service development and maintenance Strong in organisational practices and provide a roadmap for continuous process improvement Build on and extend the best practices of CMMs and other process improvement models Can be used for self-assessment

Table 2.3 (continued)

Limitations	Says what to do but not how to do it (i.e., weak in processes) Doesn't deal directly with software development or IT services Doesn't provide road map for continuous process improvement	Doesn't address the development of quality management systems Not geared to software development processes Use is highly dependent on interpretation Limited in security and system development	Doesn't address IT operations issues, such as security, change and configuration management, capacity planning, troubleshooting and help desk functions Focused exclusively on software development processes Sets goals, but doesn't say how to meet them

2.3.5 CMM-ITIL-CobiT Process Alignment

Within the empirical research literature, there are complaints about the IT management frameworks, ITIL and CobiT. In most of the organisations these two frameworks (ITIL for IT Service Management and CobiT for IT management audit) are seen by senior IT managers as the *Holy Grail* of business-IT alignment. However, although they are not bad in themselves—just in the fact that they are "IT management frameworks" and not "business management frameworks" with IT in the middle and the business on the outside—as long as information technology runs with IT management frameworks and not with business management frameworks that are shared across the business (including IT), then there is poor chance of alignment and no chance of integration. The result is bad news for the business when it comes to agility and value for money.

There are various examples within the empirical research literature supporting the argument of "model alignment" and "model combination". It has been stated in various organisational cases that alignment of business processes with IT is already proven to be hard to achieve. Organisations are trying to find answers for the perfect alignment of their IT and business goals (Jahnke, 2004). It is a common strategy to align business processes in the Information Technology function with process models and methodologies, such as CMM, CobiT, and ITIL. These all are practical choices for achieving best practice performance; and

within the empirical research literature, there are many success stories reveal excellent benchmarks from CMM ITIL CobiT Process Alignment strategies.

Management agenda is different for each of the three value configurations, and the management agenda helps identify opportunities for new types of information systems for CMM ITIL CobiT Process Alignment strategies. The chains, shops and networks model also contributes to discussions of IT strategy, and its alignment with business strategy. For example, where a single business contains different configurations, the IT strategy must be aligned to the dominant value configuration of the business, and CMM ITIL CobiT Process Alignment strategies are no exception here.

As the pace of change in business increases, business risk is compounded by unaligned and rigid IT infrastructure. However, enterprises that incorporate business process fusion will see increased IT infrastructure flexibility that improves returns and risk (ITILcollege web site).

Business process fusion is the transformation of business activities achieved by integrating previously autonomous business processes to create a new scope of management capabilities such as CMM ITIL CobiT Process Alignment strategies. It will drive stronger alignment of IT with core business processes and provide linkage of operational and management processes with a true end-to-end scope. Business process fusion shall not be seen as just another IT integration project. The objective of CMM ITIL CobiT Process Alignment strategies is to integrate business processes to create value, regardless of how or even whether, the underlying technology is integrated.

None of the quality models or quality frameworks should be seen as a '*substitute'* or a *'competitor'* to another. In an organisation, for process alignment purposes, any two or three or more of these may be combined or may be used separately. For instance, the CobiT framework may be aligned with ITIL for IT service management, CMM for software development, ISO for general quality management. There are many examples of success stories of such alignments

within the empirical research literature. Such alignments (fusion models) taking the best of each model results with the most effective and efficient methods for the organisation. After determining which IT processes are relevant for a particular organisation it is recommended that the models and methods incorporated in an IT quality discipline (i.e. CobiT, ITIL) are used.

The IT quality models that have been briefly discussed here are most appropiate for use by organisations whose "organisational goals" are explicitly defined. In that regard, these models are good resources for organisations to re-define and optimise their IT processes. This requires that organisations willing to use such disciplines should have their processes defined with concrete definitions of inputs and outputs. This is usually the case for profit-oriented organisations where the organisational goals are explicit (i.e. cost, effort, return of investment, production, etc.). When organisation's business goals are well-defined, a top-down approach may be taken. Implementing such a top-down approach would commence with redefining and modifying the business processes of the organisation. These optimised business processes may then be aligned with an IT framework. Depending on the type of the organisation, only one framework on its own may not be sufficient and therefore two or more frameworks are applied together as complementary. For instance, very often CobiT is too generic to make the control objectives operational. Standards such as the following can be used in translating the control objectives to concrete measures: (1) CMM for software development, (2) ITIL for IT Service Management, (3) ISO for general quality management (Van Nijnatten, Dohmen and Broshuis, 2002).

This implementation approach supports the argument that "any system can be said to be effective as long as it adds value to the organisation's goals". However, it is important here to note that this could only be valid for profit-oriented organisations whose "organisational goals" are explicitly defined with measurable inputs and outputs.

It is also evident from the empirical research that once they are aligned with the organisation (please see ii. above) present IT quality disciplines, i.e. both CobiT

and ITIL, facilitate root-cause analysis of problems. They are well in identifying what needs to be done, but they do not provide much guidance on how to fix a problem nor on how to achieve the objectives. For instance, CobiT documentation provides definitions for all control objectives but does not guide the organisation towards the achievement of these documented objectives. It does not even provide any roadmap on how to align the organisational processes with the CobiT. This is one of the reasons why large IT organisations tend to develop their own IT quality frameworks. Only this way they can make an effective *and* efficient use of such a model which is well-suited to the organisation's goals and hence which can be aligned with the organisation's business objectives. There is much evidence within the empirical research supporting: Hewlett-Packard, Mastercard examples as explained here in this study.

It has been observed that present Information Technology Quality Frameworks/Models are highly sophisticated and comprehensive. However, in practice, due to this comprehensiveness these models are not as effective as they are intended in theory. As a consequence of this, organisations are either trying to (1) "build" their own quality framework, or (2) "merge" or "fuse" the available frameworks—taking the best of each model and hence making use of many models simultaneously. One of the underlying reasons for this is that whereas most early applications of IT were "discrete technologies" applied to specific or closely-related functions, these comprehensive IT frameworks attempt to integrate and link together the whole range of functions across organisation (Pollock and Cornford, 2004; Kallinikos, 2004).

Finally, it is important to emphasize the fact that quality disciplines for IT governance are solely *business oriented* (Farbey, Land and Targett, 1992; Özkan, 2005). They are based on management principles, and therefore they can not be beneficial at the operational level.

2.4 Discussion

This study is based on and supports the idea that *information systems success* must be visualized in a multi-dimensional manner in order to develop a framework for IS success assessment. Related literature has been reviewed focusing on evaluation techniques, paradigms, quality assessment disciplines in a comparative manner.

The guidelines listed in the next section have been identified during the literature review. While these guidelines generally match Cameron and Whetton's (1983) guidelines for measuring organisational effectiveness, summarised earlier in Section 2.1.5, they also address issues specific to information systems. These should be regarded as guidelines for any further work on IS success assessment. Following this section, the need for a new assessment model is elaborated in section 2.4.2.

2.4.1 Guidelines

2.4.1.1 Capture the human element

A model of IS success must capture the human element since factors such as information quality are only meaningful in relation to the user and their perception of usefulness. This has been realised as one of the fundamental concepts in IS assessment and as the main difference between the software evaluation and IS evaluation. The confusing question "From whose perspective is the assessment done?" should be eliminated. This may be achieved by means of clarifying the IS stakeholders and conducting an individual assessment from each perspective in order to observe the perception of usefulness depending on the IS user. For example, CobiT framework partially satisfies this criteria, being primarily intended for management, business users of IT and auditors. Although not directly, CobiT does depict the importance of multiple viewpoints in assessment. However, it should be strongly suggested that IS assessments should be conducted

from each IS stakeholder's perspective individually for the overall assessment to be more realistic.

In parallel with these, agile development methodologies, with increasing world-wide popularity, suggest that the focus should be more on people; emphasizing the importance of the human element.

2.4.1.2 Start from first principles

Models of IS success should firmly stand upon the first principles of related theory, even if they are derived via reviews of previous research to avoid repeating historical mistakes. This is partially achieved with CobiT for example. It stands solely on the very first principles of management. The four CobiT domains can be projected almost seamlessly onto the management cycle proposed by Hopstaken and Kranendonk (1988). Similarly, DeLone and McLean begin by pointing out the serial nature of information, which can be said to flow through an organisation. The underlying model for communication which they used as a basis when deriving IS success factors of their IS success model was originally developed by Mason in 1978, as asserted in section 2.1.1. A similar understanding is observed within software process evaluation literature. As mentioned in section 2.2.3, they are based on one of the first principles of organisational theory: Crosby's maturity matrix. An IS assessment model should be developed from previous models by examining the logic of IS success from first principles.

2.4.1.3 Do not disregard the complementary nature of the frameworks

None of the quality models or frameworks should be seen as a substitute for or a competitor to another. For process alignment purposes, any two, three, or more of these may be combined, or they may be used separately. For instance, as explained in section 2.3.4, the CobiT framework may be aligned with ITIL, CMM, and ISO 9000.

ITIL tracks problems in IT service areas such as help desk, applications support, software distribution, and customer-contact system support, and it overlaps CMM in certain areas such as configuration management. For example, ITIL tracks the changes made to operational systems, but the quality of those changes — in terms of the number and severity of problems resulting from them — is more a CMM metric (ITIL college). Similarly, John Lainhart (Lainhart, 2000), one of the developers of CobiT, states that CobiT and ITIL should be seen as complementary and not competitive. ITIL describes service management processes and recommends security and control practices, but it does not have a standard for them. This is where CobiT comes in, because it provides a framework to perform audits on a particular organisation's ITIL processes. So rather than compete, CobiT and ITIL complement each other.

One of the many examples of such successful alignments is the Philips' IT performance measurement strategy (ISACA web site). The Philips International BV internal audit department has a long-standing tradition of using CobiT along with the company's performance measurement program. In addition to extensive internal audit implementations, the corporate IT department of Philips International used the CobiT framework when participating in two company-wide initiatives:

- **The BEST [Business Excellence through Speed and Teamwork] quality improvement program.** This program has strong, visible support from senior management and is one of the five top items on the management agenda. As part of this program, Philips developed a process survey tool for IT, which is completely based on the CobiT model.
- **The Statement on Business Controls program.** This formal statement is issued by each organisational unit within Philips. It is consolidated into the annual report's internal controls statement and therefore has complete support of senior management. The IT section of the Statement on Business Controls is also based on the CobiT control objectives.

As a consequence, a new model should fit with existing theories of IS success, should not conflict with the IS research but serve as a complement.

2.4.1.4 Do not disregard the subjectiveness of effectiveness measurement and regard information system as a multiperspective and a multidimensional entity

Information systems are more than mere technical artifacts. Information systems evaluation and its impact on organisation cannot be done in isolation, but needs an integrated approach that monitors the information systems from various views (Özkan and Bilgen, 2003). Therefore, *success* should be interpreted from the perspectives of IS stakeholders, and not an objective entity; success emerges from the social and technical interplay within the organisation (i.e. the organisational context and the technical context).

A number of indicators of information systems implementation success can be found in the literature; however there is little agreement as to what they ought to be (Coe, 1996). One of the reasons is that the concept of success/effectiveness is very value laden and subjective. Therefore groups involved in an implementation process may disagree about assessments of a system's effectiveness. For example, the word "performance" has different meaning for users, managers and IS developer. Users want an information system to run when they need it and to produce what they want. Managers are mostly concerned with fulfilling business objectives at low costs, whereas IS developers see their mission in ensuring the smooth technical operation of the system (Mende, Brecht, and Österle, 1994). In other words, organisations typically have many IS stakeholders with multiple and conflicting objectives of varying time horizons (Pitt, et.al. 1995; Serafeimidis and Smithson, 2003). Therefore, in order to minimize the subjectivity, a multiperspective approach shall be taken. By means of such an assessment, the interpretation of user perception of effectiveness shall be more constructive for the organisation.

2.4.1.5 Aim to achieve synergy

Synergistic use of multiple evaluation studies need to be communicated in ways that other researchers will be able to understand and relate to. It has been observed that IS, SW process and IT literature all suggest this kind of combination of

models since only with the help of such an understanding, the assessment methodologies can be most focused and hence beneficial.

2.4.1.6 Preserve that components interact and that they are integrated

DeLone and McLean claim that their model of IS success provides "a logic as to how these categories interact". However, their proposed taxonomy has been presented without significant discussion of its underlying epistemology and logic. As researchers assert (Ballantine, Galliers, and Stray, 1998; Garrity and Sanders, 1998; DeLone and McLean, 2003), success is more than a categorical accumulation. It is a result of integration of multiple components. In addition, components that constitute an information system are not mutually exclusive and they interact. For example, the categories proposed by DeLone and McLean (i.e. six dimensions defined previously in section 2.1.2 and 2.1.3) interact and they are only meaningful for the understanding of information systems success if they are perceived integrally.

2.4.1.7 Aim to achieve standardization, applicability and alignment

DeLone and McLean claim that a validated measuring instrument shall provide a standardized evaluation mechanism that enables comparisons across departments, systems, users, organisations; and such formal measurement shall help to build a cumulative research tradition in order to clarify effectiveness variables. This is, however, not fully achieved by DeLone and McLean since they were unable to suggest a standardised and such an applicable model. On the other hand, CobiT, ISO/IEC 15504, SW-CMM, for example, fulfill this criteria successfully since they offer totally structured and standardised evaluation for the domains they comprise. Practical choices for achieving best practice performance today are to align organisational IT and business goals with one of these process models and methodologies. However, most of the time alignment of organisation's business processes with information technology is hard to achieve (resulting with a rigid IT infrastructure).

Consequently, as the pace of change in business increases, there is an increasing need for more flexible, and more easily adoptable models and methodologies that are independent from organisation, department and system.

2.4.1.8 Do not disregard the process maturity model

Although in most of the cases, IS stakeholders, in particular software developers and managers, often know their problems in great detail; they may disagree on which improvements are most important. Without an organized strategy for improvement, it is difficult to achieve consensus between management and the professional staff on what improvement activities to undertake first. To achieve lasting results from process improvement efforts, it is necessary to design an evolutionary path that increases an organisation's software process maturity in stages. The software process maturity framework (Humphrey and Kitson, 1987) orders these stages so that improvements at each stage provide the foundation on which to build improvements undertaken at the next stage. Thus, an improvement strategy drawn from a software process maturity framework shall provide a roadmap for continuous process improvement. It shall guide advancement and identifies deficiencies in the organisation; it is not intended to provide a quick fix for projects in trouble (Paulk, et al., 1993). The staged structure of the capability maturity model for SW is based on principles of product quality that have existed for the last sixty years (Juran, 1988 and 1989). The maturity framework into which the quality principles have been adapted was first inspired by Philip Crosby of in his book *Quality is Free* (Crosby, 1979). Crosby's quality management maturity grid describes five stages in adopting quality practices. This maturity framework was adapted to the software process by Watts Humphrey at IBM (Paulk, et al., 1993).

2.4.1.9 Aim to achieve reduced complexity

Primary technique for improving software economics is: reducing complexity and the volume of human-generated "stuff" (Royce, 2001, 2002). For example SW-CMM fail to meet this since CMMs motivate organisations to produce more documents, more checkpoints, more artifacts, more traceability, more reviews,

and more plans. Consequently, in order to be better, thicker documents, more detailed information and longer meetings are considered (Royce, 2002). Furthermore, in the case of CobiT, a similar behaviour is expected. Organisations concerned about real improvement should consider the intermediate level of impact of information systems rather than relating directly to tangible output variables.

Similar to the above argument, as mentioned in section 2.2.6, major principles of "agile software development" or "agility" in general, complies with aiming reduced complexity. For example, "working software over comprehensive documentation" supports reduced complexity in the sense that it means producing no document unless its need is immediate and significant.

2.4.1.10 Promote proactivity

Assessment disciplines promote proactive approaches. This is not surprising since the first principles of "quality" are based on proactivity. CobiT, for example, defines "control" in three groups (i.e. preventive, detective and corrective) and for an IT organisation, CobiT encourages "preventive controls". Similarly, the People CMM was designed to integrate workforce practices into a system and involve management early in their deployment. SW-CMM, again, highlights the importance of defect prevention at the initial stages.

2.4.1.11 Do not disregard the importance of the organisational context

The 'information and transformation age' is characterised by the fact that information systems are no longer solely used to support or automate operational (i.e. low level) or peripheral organisational functions. Instead, they must be seen as a central feature of an organisation's mainstream products or services, or of their delivery system, playing a strategic and infrastructural role as part of the core business processes of the organisation. Today, IS are critical components of business, taking part in increasingly complex organisational changes, redefining whole markets and industries. Most not all of the previous approaches (software

oriented technical and business oriented) consider an IS as a single product/project/investment isolated from its organisational and social context. Such a view would be one-dimensional, deterministic, linear, largely ahistorical and non-dialectical (Serafeimidis, 1997; Serafeimidis and Smithson, 2003; Von Hellens, 1997). IS evaluation cannot be limited to the IT component ot to the narrow financial impacts (e.g. one department, one user group). A broader view investigating its multiple effects (i.e. technical, financial, social) within and outside the organisation; and an extensive consideration of all the elements comprising the broader IS context and their interactions is required.

The instability of the context influences the role of evaluation, the ways it is carried out, the utilisation of its outcomes and its participants. Therefore, IS evaluation should adopt to changes. An 'emergent' evaluation should be developed incrementally and dynamically in order to identify potentials and contsraints which arise from changes in the contexts (i.e. organisational context, environmental context). Even within the same organisation, different IS are related to different contexts. For all these reasons a 'contingency' view of IS evaluation is required. The functional (i.e. SW-CMM, and other software based) and economic (i.e. CobiT and other IT based) approaches clearly lack the necessary flexibility and adjustability to the changing requirements. This implies that researchers need to consider a more extensive context as well as 'emergent' and 'contingency' views of IS evaluation (Serafeimidis, 1997; Symons, 1991).

2.4.1.12 Observe the parallelism of organisational effectiveness and information systems effectiveness

Cameron and Whetton's seven guidelines for measuring organisational effectiveness (see section 2.1.5) are relevant for IS effectiveness evaluation (Seddon, 1999; Kappelman et al., 1997; Myers, 2003). Therefore based on the literature, the following working definition of IS evaluation is deduced (DeLone and McLean, 1992; Seddon, 1999; Serafeimidis, 1997; Symons, 1990; Hawgood and Land, 1988.):

"Information systems evaluation is a judgment of worth carried out by one or more people in an organisation, with a particular objective, at a particular stage of the system's life cycle, and using a particular method."

2.4.1.13 Do not disregard interactions among information systems

Global pressures re-shaping businesses can not be neglected in today's world. Information Technology in general and the Internet in particular, is having a dramatic effect on business operations. Communication is easier and we all have access to vastly greater amount of data. World wide web also dramatically ratchets up the speed of business (Nolan, Pollock, and Ware, 1988). Since the early 1990s, the Internet has been heralded as a new life force changing the world of business. In that regard, it is not only the contiued growth of use of the Internet that is astonishing, nor the way it seems to transform business models and create new opportunities in virtually every industry. What is most surprising is that many of the world's largest best established enterprises are also among the most successful proponents of doing business on the web (i.e. e-business) (Schmidt, 2000). Technological progress has increased the variety of possible web-based business activities (i.e. e-business, including the Internet-enabled order and payment functions known as e-commerce) from the provision of information or advertising to sophisticated transaction processing and distance education, offering a great number of services, e.g. in e-government, e-health, e-learning. It has also been realised that assessing impact and potential value of electronic business is one of the most important issues for all organisations regardless of the industry sector. Organisations are making large investments in e-commerce applications but are pushed to evaluate the success of their e-commerce systems. In that regard, IS researchers have to focus on developing, testing and applying e-commerce success measures.

In all of the quality disciplines it has been realised that there is a "gap" in which effects of the global enablers (indirect effects as well as the direct ones of the technology and the Internet) should be captured. The evaluation models try to fill

this gap in different ways. DeLone and McLean, for example, realise and suggest that the "net benefits" are the most important success measures as they should involve all positive and negative impacts of the e-business on the customers, suppliers, employees, organisations, markets, industries, economies, and societies. They raise questions such as "Have Internet purchases (or transactions or doing business on the Internet) saved individual consumers time and money? Have the benefits such as larger markets, supply chain efficiencies and customer responsiveness produced positive net benefits for an organisation? Have societal investments in e-business infrastructure and education produced poverty?" They additionally assert that "Net benefits" measures must be determined by context and objectives for each e-business investment, which will result with a variety of e-business "net benefits" measures (e.g. cost savings, expanded markets, incremental additional sales, reduced search cost, time savings, etc.)

However, since IT disciplines are management oriented with all the processes predefined, they do not specifically focus on the effects of global enablers in this manner. Besides, they are not flexible enough to adopt to organisations doing businesses on the world wide web. On the other hand, software process assessment models and standards are "software" oriented that it is hard to position "global effects" within these models.

Being a powerful communications medium, the Internet and the world wide web brings another dimension of "communication quality at the technical level". In today's Network and Content centric era, it is inevitable that IS effectiveness within an organisation is directly or indirectly affected by the effectiveness of another information system on the network (e.g. two or more ISs working over the world wide web at different locations further apart on the globe). A common example for this could be the "google" search engine. More effective "google" has the potential of increasing the effectiveness of many information systems around the world. Novel concepts such as "imported effectiveness" or " global IS effectiveness" can be introduced and studied in this context. This will be elaborated in Chapter 3 below. Also, the information economy, brought about by the advancements in information and communications technologies has led to

significant changes in the work environment. The concepts of “teleworking”, “virtual office”, etc. are all consequences of these changes (Nortje, 2003). While these novelties provide grounds for substantial research, they will be considered as outside the scope of our study.

2.4.2 The need for a new assessment model

The author of this thesis claims that the guidelines elaborated above, derived from an extensive survey of the relevant literature; point in the direction of an integrated approach to the assessment of IS effectiveness.

Individual assessment frameworks considered in this chapter yield convenient solutions in practice within their specific contexts, but they do not comply with all of these guidelines.

In conformance with the regard for the complementary nature of the fundamental frameworks in the literature, the model to be proposed in Chapter 3 aims to follow the guidelines collectively, with proper adaptations according to the needs and characteristics of the individual systems being assessed.

CHAPTER 3

A NEW CONCEPTUAL MODEL FOR INFORMATION SYSTEMS EFFECTIVENESS

In Chapter 2, a number of approaches of evaluation associated with information systems effectiveness allowing to define the boundaries of the research presented in this study have been critically reviewed.

This chapter has two parts. The first part comprises objectives of a new conceptual model for IS effectiveness based on the literature review. It is built on a definitional approach to evaluation where model objectives are given in terms of (1) context and people, (2) purpose and time frame, and (3) content. Based on the model objectives, the second part of the chapter presents a conceptual model for IS effectiveness evaluation which shall drive the empirical research.

3.1 Model Objectives

It is widely recognised that information systems evaluation is a complicated phenomenon and the area has been investigated by many extensive studies addressing both its conceptual and operational aspects. In order to better

understand IS effectiveness evaluation, it is essential to employ a systematic approach. Therefore a framework based on a definitional approach is adopted.

Initially, a clear description of information systems evaluation is sought because the area is elusive and broad. It has been argued that evaluation is inevitably subjective and context dependent since IS are meaningful only when they are considered within a context. Moreover, IS effectiveness evaluation covers a wide area of situations and activities (i.e. Software processes, information technology management processes, etc.). Since IS are integrated into organisations, their evaluation is becoming more and more important everyday, and as a consequence, qualitatively and structurally different evaluation approaches are emerging. Evaluation involves a large number of stakeholders both internal and external to the organisation each with their own particular values and objectives.

In order to gain some insight into what constitutes appropriate objectives of the conceptual model, a systematic approach is taken. The working definition of IS evaluation given in section 2.4.1.12 is broken into seven closely interrelated constituents. Each of these respectively correspond to each of the seven guidelines developed by Cameron and Whetton. As stipulated in section 2.4.1.6, these evaluation constituents are not mutually exclusive and are determined in practice according to the demands of a particular situation:

1. Stakeholder
2. Content
3. Context
4. Purpose
5. Time frame
6. Data type
7. Aspect

Theoretically, model objectives could be more systematically identified with the help of these seven elements.

3.1.1 Stakeholder

The importance of the human element has not been recognised by the other evaluation approaches such as CobiT, or CMM. This is understandable for systems with tangible outputs, however in order to be able to capture intangible benefits of which are highly uncertain, a multiperspective approach is required. This could not be achieved by the available assessment disciplines where the identification, quantification and realisation of the outcomes and benefits are mostly subjective. This is understandable since different stakeholders in an organisation may validly come to different conclusions about the success of the same information system. Therefore, *the first objective of PB-ISAM is that different stakeholders' views should be combined in a study to assess IS effectiveness.*

3.1.2 Content

The technical/functional as well as the economic/financial evaluation disciplines (e.g. Information technology evaluation disciplines such as CobiT; software process evaluation methodologies such as CMM) are built upon rational and objective principles regarding the nature of the IS and its evaluation and they try to judge the achievement of well-determined goals. However, it is evident that these approaches are not sufficient nor are feasible when the information system outputs can not be explicitly defined. In both the functional/technical and economical/financial approaches the content (e.g. benefits, costs) is assumed to be well-defined, direct and short term and the measures used are relatively straightforward. A rational relationship between cause and effects is maintained. The changing role of information technology means that the content elements have changed considerably. This yields intangible benefits which are highly uncertain as elaborated in section 2.4.1.13. None of the traditional evaluation approaches explicitly address the benefits and challenges brought by the Internet.

The change in content for operational information systems, is mostly affected by the Internet. The effectiveness of an information system unavoidably affects

another information system on the network (i.e. the Internet). *Capturing these imported effects is another objective of PB-ISAM.*

3.1.3 Context

IS are meaningful only when they are considered within a context. On the other hand, it has been observed that there is a large number of IS effectiveness measures in the literature, making it difficult to determine what measures are appropriate in a particular context. Here the interest is in the subject of the evaluation; i.e. the entity that is being evaluated. This is concerned with determining boundaries of the evaluation. In this regard, *the third objective of the evaluation model is to focus on a particular system including the people involved.*

3.1.4 Purpose

The clear definition of the purpose of judgement helps to determine appropriate content, context and time frame. Based on the purpose, different data may be available, different sources may be appropriate. Hence *an objective of PB-ISAM is to assess the level of achievement of individual process goals, and to identify strengths and weaknesses.*

3.1.5 Time frame

The purpose and the time frame of evaluation are closely interrelated: formative evaluation (e.g. information technology evaluation disciplines such as CobiT; software process evaluation methodologies such as CMM) is concerned with *ex post* feedback by evaluating an existing system, or one recently developed (i.e. post-implementation stage); where the concern is with a rational approach to resource allocation and the successful achievement of predefined objectives/goals.

On the other hand, summative evaluation is concerned with *ex ante* selection of one course of action, or design, from a number of available alternatives; where the results of the evaluation provide information about the effectiveness of the product/system for the decision makers who are going adopt it. It is also evident

from the literature that *ex ante* evaluation would only be meaningful for *efficiency,* whereas *ex post* evaluation is most commonly observed for the case of *effectiveness*. For example, the maturity based methodologies such as CobiT and CMM as elaborated in Chapter 2 depend on *ex post* evaluation. They are basically based on three steps: (1) observe the present situation of the process/the system to be evaluated, (2) state the situation desired, (3) make a gap analysis, that is identifying the differences between the present and desired situation, and therefore making recommendations for improvement/ minimizing gaps.

In contrast, the economic/financial information systems evaluation requires an *ex ante* approach: management is most concerned with investigating the broader (organisational and environmental) context from where business opportunities and constraints for information systems investments will derive. Furthermore, the scope of the strategy and high-level goals, as well as potential alternatives and their costs, benefits and associated risks are examined. Hence, *ex post evaluation is another objective of PB-ISAM.* Economic/financial evaluation of information systems is out of the scope of this study.

This study has aimed to focus on the effectiveness of an information system where profit in financial terms is of secondary, if any, concern. This implies intangible information system outputs where the evaluation time frame may vary with the changing external environment and therefore changing content.

3.1.6 Data type

The evaluation is significantly dependent on the type of data being used for judgements of effectiveness. Objective data tend to be more reliable and more easily quantifiable. Whereas, subjective data allows assessment of a broader set of criteria, but can be biased, and lack validity and reliability [5]. *An objective of PB-ISAM is to utilize both subjective and perceptual data as well as objective factual information in assessing effectiveness.*

3.1.7 Aspect

Any evaluation involves the measurement of certain variables and the comparison of certain aspects of these measurements. These could be tangible measures such as technical measures (e.g. response time); financial measures (e.g. costs); measures of system quality or information quality; service quality; user satisfaction or some other form of impact measurement. Usually the measurement aspect is derived from the purpose of the evaluation but influential stakeholders also impose particular variables. The decision of 'what' to measure and 'what constitutes' an acceptable level of performance on each measure affects the evaluation process significantly (i.e. assessment methodology). Hence, *the last objective of PB-ISAM is comparing IS performance measures with proposed objectives in terms of success and capability/maturity.*

3.2 Model Relations

The following table (Table 3.1) has been prepared to compare the evaluation approaches with the objectives of the proposed model, hereafter referred as, Process Based Information Systems Assessment Model, PB-ISAM.

As elaborated in Chapter 2, there is no doubt on the fact that *information systems success* must be visualized in a multi-dimensional manner in order to develop a framework for IS success assessment. Based on the objectives of the conceptual model presented in the preceding section, it has been realized that the domains of measurement need to be explicitly defined. This is important because the new assessment model to be developed has to lie on a concrete basis. The proposed conceptual model for the assessment method (PB-ISAM) is not only an emerging model built upon the guidelines of Section 2.4.1, deduced from the literature; but it offers a new perspective to IS evaluation having strengths over the available assessment methods investigated in Chapter 2.

The underlying relations within PB-ISAM are explained in the following sections.

Table 3.1 Comparison of the evaluation approaches with the objectives of the proposed model, PB-ISAM

	IS	***SW Process***	***IT***	***PB-ISAM***
Evaluation stakeholders *From whose perspective is effectiveness being assessed?*	IS user	A certified software process assessor	A certified IT auditor	Organisational users of IS services and systems, namely: • IS planner/manager • IS developer • IS user
Evaluation content *On what domain of activity is the assessment focused?*	IS outputs	Operational software system processes	Organisational managed processes related with IT	IS processes capturing the changing content due to the Internet
Evaluation context *What level of analysis is being used?*	Varies depending on the IS understanding (could be as broad as the country or a single system)	Software system	IT organisation	Information system in an organisational context with environmental effects
Evaluation purpose *What is the purpose for judging effectiveness?*	• Quality and utilization of IS outputs	• Technical performance • Quality of operational software system • Operational software process improvement	• IT performance • IT improvement	Evaluation of effectiveness of IS processes in terms of the degree of meeting the process goals, and identifying strengths and weaknesses.
Evaluation time frame *What time frame is being employed?*	Ex ante and ex post in relation to the systems development life cycle	Ex post and periodically.	Continuous benefits management, i.e. periodically.	Ex post
Evaluation data type *What type of data are being used for judgments of effectiveness?*	Mostly subjective; perceptual data from individual. Common methods: Behavioral science driven (e.g. value analysis)	Both subjective and objective data is used Common methods: • CMMs • ISO/IEC 15504	Subjective; perceptual data from individual. Common methods: • CobiT • ITIL	Both subjective and objective data is used. Method: PB-ISAM
Evaluation aspect *What is the referent against which effectiveness is judged?*	Past performance measures and evaluating on the basis of characteristics the IS possesses with respect to • Effectiveness • Success	Comparing past performance measures with standards in terms of • Quality • Capability/Maturity	Comparing past performance measures with standards in terms of • Effectiveness • Efficiency • Confidentiality • Integrity • Availability • Compliances • Reliability	Comparing IS performance measures with proposed objectives in terms of • Success • Capability/Maturity

3.2.1 People demand resources

People create an information system, containing various features exhibiting various degrees of system and information quality. Systems quality and information quality are demanded by the IS stakeholders (i.e. people). System usage, or in other words, use and user satisfaction require more effective resources (i.e. the software system). Here, it is important to note that it is "*people"* who *demand resources*. This relation is often misinterpreted within other conceptual models where the human element is isolated and often mentioned as an external actor. However, as mentioned in Section 2.4.1.1, people can not be separated from an information system. In that regard, *people* should neither be confined into nor be perceived only as an IS user or an IT auditor or an IS manager nor as an assessor (see Table 3.1). This first argument gives the following relational statement:

"People demand resources"

3.2.2 Resources are used in services and benefits

It is evident from the literature that there is a positive causal relationship between the effectiveness of an information system and the impacts of that information system. This causal relationship has been elaborated extensively in sections 2.1.1, 2.1.3, and 2.1.5. A more effective information system will result with better services and increased services. This model recognizes the degree of this impact in terms of the individual and the organisation. For the latter, the impact on the fulfilment of the organisational objectives are to be measured at an intermediate level. This means rather than evaluating tangible output variables (the majority of these are for *efficiency* and therefore related to cost; but this is beyond the scope of this study), the proposed model shall capture intangible, uncertain measures. The Internet is a very good example of a resource, and the impact of the Internet on an organisation (or on an information system) can not be neglected. The extent to which this impact is influential varies depending on the type of the information system (i.e. for an online transaction system, the Internet platform is vital; for a lower level operational information system, an accounts management system for example, the Internet is not necessary. However, in this study Internet is to be

considered as a fundamental resource). In this regard, as it has been discussed in section 2.4.1.13, global enablers as well as the Internet are examples of the resources that are used in services in order to gain benefits. This second argument gives the following relational statement:

"Resources are used in services and benefits"

3.2.3 Services and benefits are for people

Increased benefits and better service has a positive effect on information system usage and on user satisfaction. In other words, an information system together with its resources serves for people. The definition of process understanding of an operational IS given by DeLone and McLean in Section 2.1.3 lacks this discussion since they neglect the services provided by an information system. This proposed model is built on the fact that *use of the system* means *use of the information system with its information products and services;* resulting with impacts of that system. The impacts of an information system overall (meaning all possible impacts such as individual user impact, consumer impact, societal impact, organisational impact, as elaborated in sections 2.1.1, 2.1.2 and 2.1.3) constitute benefits. This final argument gives the following relational statement:

"Services and benefits are for people"

3.3 Model Illustration

In order to better illustrate the evolution of the conceptual model, the tripod metaphor shall be used (see Figure 3.1). If it is assumed that *IS success* is placed on a tripod, the three legs of the tripod are (1) people, (2) resources, (3) services and benefits. This means all three legs of the tripod shall require success at the same time.

The three legs of the tripod are equally important for the success of an information system, independent from the organisation, department and system. However, although desired, we can not observe this flexibility within other conceptual models presented within the literature as discussed in section 2.4.1.7. Moreover,

reduced complexity is also desired as elaborated in section 2.4.1.9. These are important characteristics making this proposed model more applicable and therefore model alignment with the information system and the organisation turns out to be more straightforward due to its simplicity.

This tripod metaphor is consistent with the seven elements identified within the working definition of IS evaluation as discussed in the previous section (section 3.1) and with the process understanding of operational information systems as defined in section 2.1.3.

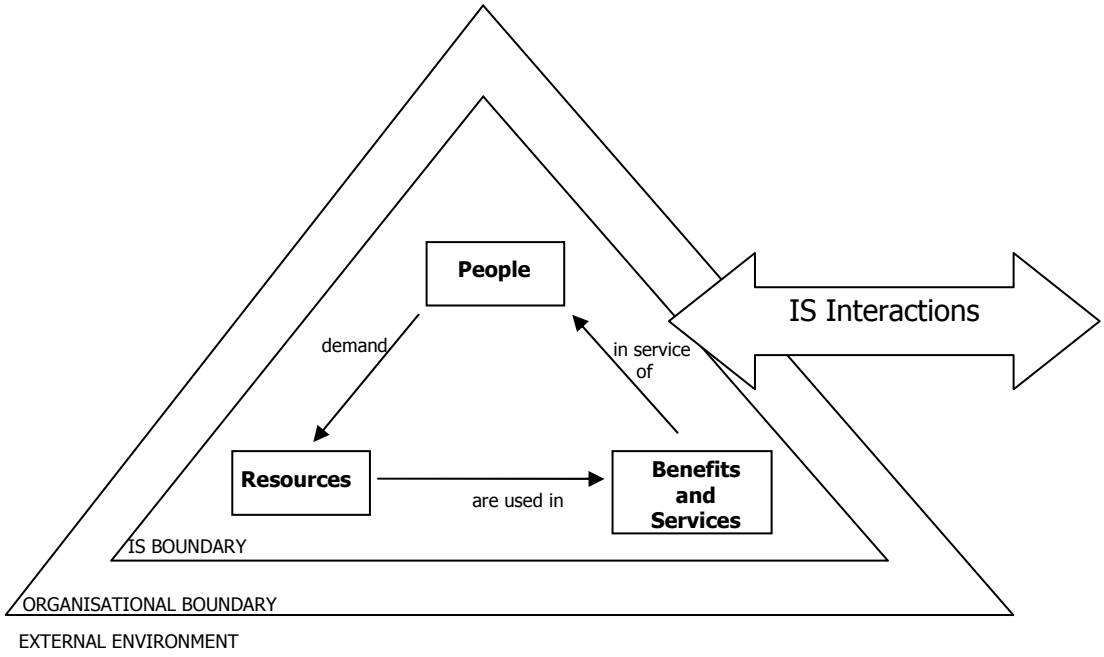


Figure 3.1 Conceptual Model of IS to be used for Effectiveness Assessment ("PB-ISAM Tripod")

The two boundaries shown on the figure, i.e. IS, organisational and the environment, aim to highlight that the three relationships of the proposed conceptual model shall be conceived within the IS boundary. However, organisational boundary comprises the IS since IS is internal to the organisation and the organisation is located within the environment. The figure additionally aims to point out that IS can not be isolated from its natural context of organisation and the environment, as discussed in Section 2.1.5 and stipulated in Section 2.4.1.11. These three components (i.e. three legs of the tripod) are held together via the processes within the information systems.

It is important to emphasize that this representation is only an illustration of the specific contexts that have been discussed in the literature review. It is clear that a practically applicable assessment method is needed to complement this conceptual model. An assessment method based on this conceptual model shall be developed in Chapter 4.

Table 3.2 summarizes where the 13 guidelines for IS assessment presented in section 2.4.1, overlap with the proposed model.

3.4 Model Components

Following are definitions and descriptions of the three components: people, resources, and benefits and services. A detailed framework for the assessment of the maturity of these components will be the subject of Chapter 4.

3.4.1 People

In the proposed conceptual model (PB-ISAM), "people" is the first leg of the tripod that represents the IS stakeholder. PB-ISAM takes the process understanding of an operational information system as a basis (see section 2.1.3, 2.4.1.2), and it is to be used for information systems effectiveness evaluation. In this regard, an evaluation information system stakeholder is defined by Seddon (1999) as mentioned in Section 2.1.4:

> *a person or group in whose interest the evaluation of IS success is being performed.*

Following this definition, five different stakeholders might be considered when evaluating IS success. These five points of view could be classified as:

1. The independent observer who is not directly involved as a stakeholder,
2. The individual who wants to be better off,
3. The group, which also wants to be better off,

Table 3.2 Mapping the IS evaluation guidelines to PB-ISAM

Referred in the conceptual model (sections 3.1-3.4) → **Guidelines for IS assessment (sections 2.4.1.1-2.4.1.13)** ↓	Model objective 1: Stakeholder	Model objective 2: Content	Model objective 3: Context	Model objective 4: Purpose	Model objective 5: Time frame	Model objective 6: Data type	Model objective 7: Aspect	Model relation 1: People demand resources	Model Relation 2: Resources are used in services & benefits	Model relation 3: Services & benefits are for people	Model component 1: people	Model component 2: resources	Model component 3: services and benefits
1. Capture the human element	√			√				√		√	√		
2. Start from first principles	√	√	√	√	√								
3. Do not disregard the complementary nature of the frameworks	√	√	√	√	√								√
4. Do not disregard the subjectiveness of "effectiveness measurement" and regard information system as a multiperspective and a multidimensional entity	√			√		√	√				√		
5. Aim to achieve synergy	√	√	√	√	√								
6. Preserve that components interact and that they are integrated.	√	√	√	√	√	√	√						
7. Aim to achieve standardization, applicability and alignment.	√	√	√	√	√								
8. Do not disregard the "Process Maturity Model"				√								√	√
9. Aim to achieve reduced complexity				√	√								
10. Promote proactivity				√	√								
11. Do not disregard the importance of the organisational context	√	√	√			√	√						
12. Observe the parallelism of organisational effectiveness and information systems effectiveness	√	√	√	√	√	√	√		√				√
13. Do not disregard interactions among information systems		√	√	√		√			√			√	√

4. The managers or owners who want the organisation to be better off,
5. Society which collectively wishes.

Clearly, this sort of a classification helps to view the overall picture when evaluating IS success. However, it would not be feasible to consider all five views in one single assessment study since each requires a different evaluation context. For example, the fifth category would require a broader evaluation context (a much larger context than the organisation) when compared with other perspectives.

If considered within the organisational context as mentioned in Section 2.4.1.12 and within the model objectives boundary defined in section 3.1.1; in PB-ISAM, there are the three IS stakeholders: (1) IS Planner/Manager, (2) IS Developer, and (3) IS User. Here, IS planner/manager is the person involved in the process of identifying IS that could be used to maintain and support a business strategy. IS developer is the person/s involved in development of the Software object and the quality focus is technical. IS user is the user's view of IS effectiveness.

To summarise, this first leg of the tripod is ***people.*** It is clear that any IS process directly or indirectly involves one or more of these three IS stakeholders defined in this section. Direct involvement of people is observed when defining the IS organisation. There must be an IS organisation with specific staff, function, roles and responsibilities, accountability and authority. A planning or steering committee should exist to oversee the IS function and its activities. Specific responsibility for quality assurance, logical and physical security, and data and system ownership must be assigned. Therefore ***people*** should be assessed following the process:

*"definition of the IS organisation and relationships"……..**P1***

Management has a responsibility to identify the training needs of all staff making use of information services. This provision should include training and awareness

of security principles. In order to accomplish this, an IS training organisation needs to exist. Therefore ***people*** should also be assessed following the process:

*"education and training of IS users"……..****P2***

Generally referred to as the "user support" or "help desk" function, there is direct involvement of people observed in processes which include providing answers to user questions and solutions to problems. Formal registration of problems, resolution, monitoring, trend analysis, and escalation procedures are also included. Therefore ***people*** should also be assessed following the process:

*"provision of assistance and advice to IS users"……..****P3***

3.4.2 Resources

"Resources" is the second leg of the tripod that represents the system itself and the information it possesses. Evaluation of resources shall mean assessing the system maturity/capability and the information quality. This component additionally comprises the imported effects since such effects, namely global enablers as mentioned in Section 2.4.1.13, could be regarded as resources for the information system overall. In other words, any measure to assess the success of a single information system is recognised under this component as discussed in Section 3.2.2.

Under the above mentioned assumptions, it can be argued that any IS process involves a set of resources required to support that IS process. For example, a process that is related with web-based information system use shall require specific resources such as certain information/data, hardware, application software, operating system, network requirements, the Internet, etc. Models that have been investigated in Chapter 2 lack extensive and detailed consideration and are therefore incomplete with respect to definition of resources. CobiT for example, over-simplifies this second leg of the tripod, and takes resources as very general terms in five groups: technology, people, application system, facilities,

data. This may be acceptable for an IT organisation. However, for a single operational IS, resources that are required to support IS processes can not be confined into such broad areas, and therefore more precise and distinct set of resources is required. Resources related to data, can be either internal data or external data, structured or non-structured, in the widest sense "objects within an information system" may form a group of resources comprising the atomic elements of the system.

It can also be argued that an information system, directly or indirectly, makes use of the technology. For the case of a single operational information system, such technology related resources can be named as hardware, an operating system for hardware and networks, database management system, network, multimedia, the Internet, application system (meaning programmed procedures for users), etc. On the other hand, for the case of a computer based information system, it would be an oversimplification to narrow all these technology related resources into one single group. This is because each specific IS process uses a combination of these resources.

Internet being the network of networks that spans the globe, forms a major resource group. Since the Internet is the global backbone of the largest public network, it extends to universities, government organisations, corporations, and private homes. Therefore impacts of the Internet on an operational information system are to be investigated. Because a direct consequence of the Internet is the interactions among ISs where an IS could be a resource for another IS. This has been elaborated as the content of the model in section 3.1.3 and as a driver of the global enablers in section 2.4.1.13. Therefore ***resources*** related with the Internet and other ISs should be assessed following the process:

*"IS interactions"……..****P4***

Controls must be in place to ensure that only authorised and identifiable configuration items are recorded in inventory records, and a regular verification program confirms the existence of these items. The "configuration" is comprised

of all the hardware, software, peripherals, and communications infrastructure within the organisation and remote distributed processing locations, including desktop PCs. Configuration baselines need to be determined for components making up the configuration, and maintenance of the environment is necessary. Software must be checked periodically for authorization and proper storage should be ensured. Therefore ***resources*** related with configuration should be assessed following the process:

*"configuration management"……..****P5***

Information system needs are identified regarding availability and performance of information services. Performance of all IS resources must be continually monitored, reported upon, and compared to capacity load limits, so that corrective actions can be taken prior to affecting system performance. Capacity of all IS resources must be determined and managed, and plans for resource modifications (increases or decreases) made. Workload forecasts must be prepared to identify trends and provide information needed for the capacity plan. Therefore ***resources*** should be assessed following the process:

*"performance and capacity management"……..****P6***

In order to ensure the effective and efficient management of IS resources, procedures for IS operations (including network operations) should be established, documented and used. Job scheduling, processing continuity, operations logs─including all remote or stand-alone operations─should be addressed. Controls are relevant to any "operations" facility. Therefore management of ***resources*** should be assessed following the process:

*"operations management"……..****P7***

3.4.3 Services and benefits

"Services and benefits" is the third leg of the tripod that represents the services and benefits provided to people by the information system.

The very basic expectation from an IS is "continuous service". This includes disaster recovery/contingency planning for all IS resources, internal and external. It includes user department alternative processing and back-up procedures, identification of critical IS applications, program and data file back-ups, back-up sites and hardware, as well as procedures for maintaining, testing and training of the continuity plan. Therefore the third leg of the tripod, ***services and benefits*** should be assessed following the process:

"continuous service"……***P8***

Services provided by a computer based IS are directly affected by changes in the technology. Managing software changes, systems maintenance and supplier maintenance is required to ensure processing integrity between versions, and for consistency of results period-to-period. Change must be formally managed via change control request, impact assessment, documentation, authorisation, software release and software distribution policies and procedures. Therefore ***services and benefits*** should be assessed following the process:

"change management"……***P9***

Services to be delivered by the IS function should be measured and be compared with target levels. Customer satisfaction should also be assessed. At regular intervals, customer satisfaction regarding the services delivered by the IS function should be measured to identify shortfalls in service levels and establish improvement objectives. Relevant performance indicators (e.g., benchmarks) from both internal and external sources, should be defined, and that data should be collected for the creation of management information reports and exception

reports regarding these indicators. Therefore ***services and benefits*** should be assessed following the process:

"monitoring services"…….**P10**

3.5 Summary

Table 3.3 summarizes the three parts of the conceptual model of IS effectiveness and the processes to be focused on for assessment.

Chapter 4 will present a framework for the assessment of the maturity of these processes.

Table 3.3 Model components and corresponding assessment processes

Component of the conceptual model	**assessed with the processes**
People	P1 Definition of the IS organisation and relationships P2 Education and training of users P3 Provision of assistance and advice to IS users
Resources	P4 IS interactions P5 Configuration management P6 Performance and capacity management P7 Operations management
Services and benefits	P8 Continuous Service P9 Change management P10 Monitoring services

CHAPTER 4

PB-ISAM ASSESSMENT FRAMEWORK

In Chapter 3, a new conceptual model for IS effectiveness has been proposed. This chapter will present a framework for the evaluation of the processes to be focused on for assessment of IS effectiveness, according to this model.

In section 2.4.1.8, the use of a process maturity model is explicitly elaborated, where a level-based assessment is strongly recommended. The maturity framework into which the organisational quality principles (principles by Deming, 1986 and Juran, 1988, 1989) have been adapted was first inspired by Philip Crosby (Crosby, 1979), where Crosby describes five stages in adopting quality practices. Based on organisational literature, the notion of *maturity* was adopted to the software process by Watts Humphrey at IBM in 1985 and later Humphrey brought this maturity framework to the Software Engineering Institute in 1986 (Paulk, et al, 1993). Based on the first principles and the traditional approach, the PB-ISAM assessment framework presented in this chapter provides five maturity levels which define an ordinal scale for measuring the maturity of an information system in regard to its effectiveness. Unlike as seen in the CMM assessment, where the maturity level of the organisation is determined by assessment aggregation, separate assessment of processes will be done. Aggregation of the

assessment of multiple processes will not be attempted within the scope of this study. Such an aggregation may, in time, be possible if the method is applied on a multitude of cases so that a single aggregated indication of the level of IS effectiveness would acquire a significant meaning.

In congruence with the literature, each of the ten processes shall be assessed according to the scale of the following maturity levels:

Level 0 Non-existent
Level 1 Initial/ Ad hoc
Level 2 Repeatable but intiuitive
Level 3 Defined process
Level 4 Managed and measurable
Level 5 Optimised.

4.1 The Assessment Procedure

The suggested assessment procedure is as follows:

1. Present the overview (Appendix A) to the staff in the organisation to be assessed.
2. Preliminary assessment of the ten processes. Fill the performance and imporatnce checklist (Appendix B) through interviews with organisation managers.
3. Fill the responsibility checklist (Appendix C) through interviews with top and middle level staff, with possible corroboration via cross-checks.
4. Assessment of individual process objectives. Fill in the findings and observations relevant to each individual process (Appendix D) through interviews with and observations of responsible staff, as well as examination of relevant documentation and supporting material.

Below (1) maturity level descriptions, (2) objectives and (3) assessment metrics for the processes to be considered in assessing the components of the conceptual model will be proposed. Each model component was described in detail previously in Section 3.4, where the elaboration of how each of these three

components could be evaluated was carried out. In addition, the evaluation aspects for that particular component were grouped under “processes”. Finally, as a result of the extensive literature survey and the model development, a group of ten processes relavant for the assessment of the three components of the conceptual framework of IS effectiveness were proposed. The maturity level descriptions, process objectives and assessment metrics proposed in the next section are either

- applied directly as specified in CMM, CobiT or ITIL, or
- modified from standard assessment methodologies according to the guidelines in Section 2.4.1, or
- selected according to applicability on the model components to which the associated process pertains, or
- originally established to respond to the requirements of the guidelines in Section 2.4.1.

It should be noted that these proposals do not constitute a *definitive* framework for assessment but rather they constitute a starting point for the assessment to be applied in each individual case. These proposals will be evaluated via case studies in Chapter 5.

4.2 P1 Definition of the IS organisation and relationships

4.2.1 Maturity level descriptions

0 Non-existent.

The IS organisation is not effectively established to focus on the achievement of organisational objectives.

1 Initial/Ad Hoc

IS activities and functions are reactive and inconsistently implemented. There is no defined organisational structure, roles and responsibilities are informally assigned, and no clear lines of responsibilities exist. The IS function is considered a support function, without an overall organisation perspective.

2 Repeatable but Intuitive

There is an implicit understanding of the need for of an IS organisation; however, roles and responsibilities are neither formalised nor enforced. The IS function is organised to respond tactically, but inconsistently, to customer needs and vendor relationships. The need for a structured organisation and vendor management is communicated, but decisions are still dependent on the knowledge and skills of key individuals. There is an emergence of common techniques to manage the IS organisation and vendor relationships.

3 Defined Process

Defined roles and responsibilities for the IS organisation and third parties exist. The IS organisation is developed, documented, communicated and aligned with the organisational strategy. Organisational design and the internal control environment are defined. There is formalisation of relationships with other parties, including steering committees, internal audit and vendor management. The IS organisation is functionally complete; however, IS is still more focused on technological solutions rather than on using technology to solve business problems. There are definitions of the functions to be performed by personnel and of those which will be performed by users.

4 Managed and Measurable

The IS organisation is sophisticated, proactively responds to change and includes all roles necessary to meet business requirements. IS management, process

ownership, accountability and responsibility are defined and balanced. Essential IS staffing requirements and expertise needs are satisfied. Internal best practices have been applied in the organisation of the IS. IS management has the appropriate expertise and skills to define, implement and monitor the preferred organisation and relationships. Measurable metrics to support organisational objectives and user defined critical success factors are standardised. Skill inventories are available to support project staffing and professional development. The balance between the skills and resources available internally and those needed from external organisations is defined and enforced.

5 Optimised

The IS structure appropriately reflects the organisational needs by providing services aligned with strategic business processes, rather than with isolated technologies. The IS organisational structure is flexible and adaptive. There is a formal definition of relationships with users and third parties. Industry best practices are deployed. The process to develop and manage the organisational structure is sophisticated, followed and well managed. Extensive internal and external technical knowledge is utilised. There is extensive use of technology to assist in the monitoring of organisational roles and responsibilities. IS leverages technology to support complex, geographically distributed and virtual organisations. There is a continuous improvement process in place.

4.2.2 Objectives

- The IS organisation communicates its goals and results at all levels
- IS is organised to be involved in all decision processes, respond to key organisation initiatives and focus on all corporate automation needs
- The IS organisational model is aligned with the organisation functions and adapts rapidly to changes in the organisation environment
- Through encouraging and promoting the taking of responsibility, an IS organisation develops and grows individuals and heightens collaboration
- There are clear command and control processes, with segregation where needed, specialisation where required and empowerment where beneficial

- The IS organisation properly positions security, internal control and quality functions, and adequately balances supervision and empowerment
- The IS organisation is flexible to adapt to risk and crisis situations and moves from a hierarchical model, when all is well, to a team-based model when pressure mounts, empowering individuals in times of crisis
- Strong management control is established over the outsourcing of IS services, with a clear policy, and awareness of the total cost of outsourcing
- Essential IS functions are explicitly identified in the organisation model, with clearly specified roles and responsibilities

4.2.3 Assessment metrics

1. Number of delayed projects due to IS organisational inertia or unavailability of necessary capabilities
2. Number of core IS activities outside of the IS organisation that are not approved or are not subject to IS organisational standards
3. Number of organisational units supported by the IS organisation
4. Survey rating of IS staff's, morale and job satisfaction
5. Percent utilisation of IS personnel on IS processes that produce direct organisational benefits
6. Age of organisational change, including reorganisation or organisational reassessment
7. Number of organisational assessment recommendations not acted upon
8. Percent of IS organisational functions which are mapped into the organisational structure
9. Number of organisational units with organisational objectives directly cascaded into individual roles and responsibilities
10. Percent of roles with documented position descriptions
11. Average lag time between change in organisation direction and the reflection of the change in the IS organisational structure
12. Percent of essential functions which are explicitly identified in the organisational model with clear roles and responsibilities

4.3 P2 Education and training of users

4.3.1 Maturity level descriptions

0 Non-existent.

There is a complete lack of any training and education program. The organisation has not even recognised there is an issue to be addressed with respect to training and there is no communication on the issue.

1 Initial/Ad Hoc

There is evidence that the organisation has recognised the need for a training and education program, but there are no standardised processes. In the absence of an organised program, employees have been identifying and attending training courses on their own. Some of these training courses have addressed the issues of ethical conduct, system security awareness and security practices. The overall management approach lacks any cohesion and there is only sporadic and inconsistent communication on issues and approaches to address training and education.

2 Repeatable but Intuitive

There is awareness of the need for a training and education program and for associated processes throughout the organisation. Training is beginning to be identified in the individual performance plans of employees. Processes have developed to the stage where informal training and education classes are taught by different instructors, while covering the same subject matter with different approaches. Some of the classes address the issues of ethical conduct and system security awareness and practices. There is high reliance on the knowledge of individuals. However, there is consistent communication on the overall issues and the need to address them.

3 Defined Process

The training and education program has been institutionalised and communicated, and employees and managers identify and document training needs. Training and education processes have been standardised and documented. Budgets, resources, facilities and trainers are being established to support the training and education program. Formal classes are given to employees in ethical conduct and in system security awareness and practices. Most training and education processes are monitored, but not all deviations are likely to be detected by management. Analysis of training and education problems is only occasionally applied.

4 Managed and Measurable

There is a comprehensive training and education program that is focused on individual and corporate needs and yields measurable results. Responsibilities are clear and process ownership is established. Training and education is a component of employee career paths. Management supports and attends training and educational sessions. All employees receive ethical conduct and system security awareness training. All employees receive the appropriate level of system security practices training in protecting against harm from failures affecting availability, confidentiality and integrity. Management monitors compliance by constantly reviewing and updating the training and education program and processes. Processes are under improvement and enforce best internal practices.

5 Optimised

Training and education result in an improvement of individual performance. Training and education are critical components of the employee career paths. Sufficient budgets, resources, facilities and instructors are provided for the training and education programs. Processes have been refined and are under continuous improvement, taking advantage of best external practices and maturity modelling with other organisations. All problems and deviations are analysed for root causes and efficient action is expediently identified and taken. There is a

positive attitude with respect to ethical conduct and system security principles. IS is used in an extensive, integrated and optimised manner to automate and provide tools for the training and education program. External training experts are leveraged and benchmarks are used for guidance.

4.3.2 Objectives

- A comprehensive education and training program, focused on individual and corporate needs, is in place
- The education and training programs are supported by budgets, resources, facilities and trainers
- Training and education are critical components of the employee career paths
- Employees and managers identify and document training needs
- Needed training is provided in a timely manner
- There is senior management support to ensure that employees perform their duties in an ethical and secure manner
- Employees receive system security practices training in protecting against harm from failures affecting availability, confidentiality and integrity
- Corporate policy requires that all employees receive a basic training program covering ethical conducts, system security practices and permitted use of IS resources
- There is management acceptance that training costs are investments in lowering the total costs of technology ownership

4.3.3 Assessment metrics

1. Number of help desk calls for training or to answer questions
2. Increased user satisfaction with roll out of new technologies
3. Percentage of employees trained
4. Age of employee training curricula
5. Time lag between identification of training need and the delivery of the training

6. Number of training alternatives available to employees from in-house and third-party sources
7. Percentage of employees trained in ethical conduct requirements
8. Number of identified employee ethical violations
9. Percentage of employees trained in security practices
10. Number of identified security incidents related to employees
11. Increased identification and documentation of training needs and delivery of timely training

4.4 P3 Provision of assistance and advice to IS users

4.4.1 Maturity level descriptions

0 Non-existent.

There is no support to resolve user questions and problems. There is a complete lack of a help desk function. The organisation has not recognised there is an issue to be addressed.

1 Initial/Ad Hoc

The organisation has recognised that a process supported by tools and personnel is required in order to respond to user queries and manage problem resolution. There is, however, no standardised process and only reactive support is provided. Management does not monitor user queries, problems or trends. There is no escalation process to ensure that problems are resolved.

2 Repeatable but Intuitive

There is organisational awareness of the need for a help desk function. Assistance is available on an informal basis through a network of knowledgeable individuals. These individuals have some common tools available to assist in problem resolution. There is no formal training and communication on standard

procedures, and responsibility is left to the individual. However, there is consistent communication on the overall issues and the need to address them.

3 Defined Process

The need for a help desk function is recognised and accepted. Procedures have been standardised and documented and informal training is occurring. It is, however, left to the individual to get training and to follow the standards. Frequently Asked Questions (FAQs) and user guidelines are developed, but individuals must find them and may not follow them. Queries and problems are tracked on a manual basis and individually monitored, but a formal reporting system does not exist. Problem escalation is just emerging. The timely response to queries and problems is not measured and problems may go unresolved.

4 Managed and Measurable

There is a full understanding of the benefits of a help desk at all levels of the organisation and the function has been established in appropriate organisational units. The tools and techniques are automated with a centralised knowledge base of problems and solutions. The help desk staff closely interacts with the problem management staff. The responsibilities are clear and effectiveness is monitored. Procedures for communicating, escalating, and resolving problems are established and communicated. Help desk personnel are trained and processes are improved through the use of task-specific software. Root causes of problems are identified and trends are reported, resulting in timely correction of problems. Processes are under improvement and enforce best internal practice.

5 Optimised

The help desk function is established, well organised and takes on a customer service orientation, by being knowledgeable, customer focussed and helpful. Extensive, comprehensive FAQs are an integral part of the knowledge base. Tools are in place to enable a user to self-diagnose and resolve problems. IS is used to

create, manage and improve access to automated knowledge bases that support problem resolution. Advice is consistent and problems are resolved quickly within a structured escalation process. Management utilises a pro-active notification process and trend analysis to prevent and monitor problems. Processes have been refined to the level of best external practices, based on the results of continuous improvement and maturity modelling with other organisations.

4.4.2 Objectives

- Up-to-date and easily accessible Frequently Asked Questions (FAQs) and their answers are available
- Knowledgeable and customer-oriented support staff resolve problems in close co-operation with the problem management staff
- All user inquiries are consistently and thoroughly registered by the help desk
- User inquiries that cannot be resolved in a timely manner are appropriately escalated
- The clearance of user inquiries is monitored
- User questions are resolved in a timely manner
- Those user inquiries that cannot be resolved in a timely manner are investigated and acted upon
- Management monitors trends to identify root causes in a proactive manner and follows up with analysis and the development of sustainable solutions
- Corporate policies and programs are defined for training users in technology use and security practices
- There is management awareness of the cost of support services and user downtime and of the need to take action on root-cause issues
- Support costs are charged back to the business using simple tools and clear policies

4.4.3 Assessment metrics

1. Reduced average time to resolve problems

2. Reduced repetitive inquiries on solved problems
3. Increased user satisfaction with the effectiveness and efficiency of the help desk
4. Increased user confidence in the services of the help desk
5. Improved efficiency measured by reduced help desk resources in relation to systems supported
6. Percent of problems resolved at first contact
7. Elapsed time per call
8. Number of repeat inquiries
9. Number of escalations
10. Number of inquiries
11. Time to resolve inquiries
12. Reduced trends in user inquiries requiring problem resolution
13. Cost per call

4.5 P4 IS interactions

4.5.1 Maturity level descriptions

0 Non-existent.

There is a complete lack of any recognisable interactions with other ISs. The organisation has not even recognised that there is an issue to be addressed and hence there is no communication about the issue.

1 Initial / Ad Hoc

There is evidence that the organisation has recognised the importance of interactions among ISs and that they need to be addressed. There are, however, no standardised processes, but instead there are ad hoc approaches applied on an individual or case-by-case basis. Management's approach is chaotic and there is only sporadic and inconsistent communication on the necessity of interactions among ISs. There is no standard assessment process. Monitoring of the IS and its

interaction with other ISs is only implemented reactively to an incident that has caused some loss or embarrassment to the organisation.

2 Repeatable but Intuitive

There is organisational awareness of the need for enabing the organisational IS interact with other ISs. Responsibility for determining IS interactions is assigned. Reporting on IS interactions is incomplete and does not take organisational impact into account. There are no documented user plans, although the principles of IS interactions are known. There is no formal training and the communication on standard procedures and responsibilities is left to the individual. There is high reliance on the knowledge of individuals and errors are, therefore, likely.

3 Defined Process

The need for other information systems is recognised and accepted. Procedures have been standardised and documented. There is training available, however it is left to the individual to get the available training and documents, there is no formal organisational enforcement. The use of other information systems is done at an individual level.

4 Managed and Measurable

There is a full understanding of the benefits of interactions with other information systems at all levels of the information system. The tools and techniques are automated with the knowledge of which outside information system to refer to when needed. There are established sub-processes, and these sub-processes are under improvement for better utilisation of other information systems. All of the personnel receives formal training.

5 Optimised

Interactions with other information systems is very well organised. The use of the Internet as a communications medium is at an optimum level. Processes have been refined to the level of best external practices, based on the results of continuous improvement.

4.5.2 Objectives

- Communication with the customers is done via the Internet medium.
- There is an extensive use of the other information systems web pages.
- There is an extensive interaction with the customer via the Internet.
- The use of other information systems is documented.
- There is extensive use of similar information systems for improvement.

4.5.3 Assessment metrics

1. Number of completed contracts which made use of the Internet as a communications medium.
2. Reduced average development time of contractual work/projects.
3. Number of Internet resources available.
4. Reduced average time to resolve problems (i.e. to diagnose an incident and decide on to use the available IS resource).
5. A measured reduction in delays and deviations from schedules by means of other ISs.
6. Number of measured completion of the IS output delivered to the proper destination via the Internet.

4.6 P5 Configuration management

4.6.1 Maturity level descriptions

0 Non-existent.

Management does not have an appreciation of the benefits of having a process in place that is capable of reporting on and managing the IS infrastructure, for either hardware or software configurations.

1 Initial/Ad Hoc

The need for configuration management is recognised. Basic configuration management tasks, such as maintaining inventories of hardware and software, are performed on an individual basis. No standard practices are applied.

2 Repeatable but Intuitive

Management is aware of the benefits of controlling the IS configuration but there is implicit reliance on technical personnel knowledge and expertise. Configuration management tools are being employed to a certain degree, but differ among platforms. Moreover, no standard working practices have been defined. Configuration data content is limited and not used by interrelated processes, such as change management and problem management.

3 Defined Process

The need for accurate and complete configuration information is understood and enforced. The procedures and working practices have been documented, standardised and communicated, but training and application of the standards is up to the individual. In addition, similar configuration management tools are being implemented across platforms. Deviations from procedures are unlikely to be detected and physical verifications are performed inconsistently. Some

automation occurs to assist in tracking equipment and software changes. Configuration data is being used by interrelated processes.

4 Managed and Measurable

The need to manage the configuration is recognised at all levels of the organisation and best practices continue to evolve. Procedures and standards are communicated and incorporated into training and deviations are monitored, tracked and reported. Automated tools are utilised, such as 'push' technology, to enforce standards and improve stability. Configuration management systems do cover most of the IS infrastructure and allow for proper release management and distribution control. Exception analysis, as well as physical verifications, are consistently applied and their root causes are investigated.

5 Optimised

All infrastructure components are managed within the configuration management system, which contains all necessary information about components and their interrelationships. The configuration data is aligned with vendor catalogues. Interrelated processes are fully integrated and use as well as update configuration data. Baseline audit reports provide essential hardware and software data for repair, service, warranty, upgrade and technical assessments of each individual unit. Authorised software installation rules are enforced. Management forecasts repairs and upgrades from analysis reports providing scheduled upgrades and technology refreshment capabilities. Asset tracking and monitoring of individual workstations protects assets and prevents theft, misuse and abuse.

4.6.2 Objectives

- Owners are established for all configuration elements and are responsible for maintaining the inventory and controlling change
- Configuration information is maintained and accessible, based on up-to-date inventories and a comprehensive naming convention

- An appropriate software library structure is in place, addressing the needs of development, testing and production environments
- There exists a release management policy and a system to enforce it
- Record keeping and physical custody duties are kept segregated
- There is integration with procurement and change management processes
- Vendor catalogues and configuration are aligned
- Configuration baselines exist, identifying the minimum standard components and integration requirements, consistency and integration criteria
- An automatic configuration detection and checking mechanism is available
- An automatic distribution and upgrade process is implemented
- There is zero tolerance for illegal software

4.6.3 Assessment metrics

1. Percent of IS configuration identified and accounted for
2. Reduction in number of variances between accounts and physical situation
3. Quality index of information, including interrelationships, age, changes applied, status and related problems criteria
4. Usage index of information for proactive actions, including preventive maintenance and upgrade criteria
5. Percent of configuration components for which data is kept and updated automatically
6. Frequency of physical verifications
7. Frequency of exception analysis, addressing redundancy, obsolescence and correction of configuration
8. Time lag between modification to the configuration and the update of records
9. Number of releases
10. Percent of reactionary changes

4.7 P6 Performance and capacity management

4.7.1 Maturity level descriptions

0 Non-existent.

Management has not recognised that key business processes may require high levels of performance from IS or that the overall organisational need for IS services may exceed capacity. There is no capacity planning process in place.

1 Initial/Ad Hoc

Performance and capacity management is reactive and sporadic. Users often have to devise work-arounds for performance and capacity constraints. There is very little appreciation of the IS service needs by the IS management. IS management is aware of the need for performance and capacity management, but the action taken is usually reactive or incomplete. The planning process is informal.

2 Repeatable but Intuitive

Management is aware of the impact of not managing performance and capacity. For critical areas, performance needs are generally catered for, based on assessment of individual systems and the knowledge of support and project teams. Some individual tools may be used to diagnose performance and capacity problems, but the consistency of results is dependent on the expertise of key individuals. There is no overall assessment of the IS infrastructure's performance capability or consideration of peak and worst-case loading situations. Availability problems are likely to occur in an unexpected and random fashion and take considerable time to diagnose and correct.

3 Defined Process

Performance and capacity requirements are defined as steps to be addressed at all stages of the systems acquisition and deployment methodology. There are defined service level requirements and metrics that can be used to measure operational performance. It is possible to model and forecast future performance requirements. Reports can be produced giving performance statistics. Problems are still likely to occur and be time consuming to correct. Despite published service levels, end users will occasionally feel sceptical about the service capability.

4 Managed and Measurable

Processes and tools are available to measure system usage and compare it to defined service levels. Up-to-date information is available, giving standardised performance statistics and alerting incidents such as insufficient capacity or throughput. Incidents caused by capacity and performance failures are dealt with according to defined and standardised procedures. Automated tools are used to monitor specific resources such as disk storage, network servers and network gateways. There is some attempt to report performance statistics in organisational process terms, so that end users can understand IS service levels. Users feel generally satisfied with current service capability and are demanding new and improved availability levels.

5 Optimised

The performance and capacity plans are fully synchronised with the organisational forecasts and the operational plans and objectives. The IS infrastructure is subject to regular reviews to ensure that optimum capacity is achieved at the lowest possible cost. Advances in technology are closely monitored to take advantage of improved product performance. Tools for monitoring critical IS resources have been standardised, wherever possible, across platforms and linked to a single organisation-wide incident management system. Monitoring tools increasingly

can detect and automatically correct performance problems, e.g., allocating increased storage space or re-routing network traffic. Trends are detected showing imminent performance problems caused by increased business volumes, enabling planning and avoidance of unexpected incidents. Users expect 24x7x365 availability.

4.7.2 Objectives

- The performance and capacity implications of IS service requirements for all critical business processes are clearly understood
- Performance requirements are included in all IS development and maintenance projects
- Capacity and performance issues are dealt with at all appropriate stages in the system acquisition and deployment methodology
- The technology infrastructure is regularly reviewed to take advantage of cost/performance ratios and enable the acquisition of resources providing maximum performance capability at the lowest price
- Skills and tools are available to analyse current and forecasted capacity
- Current and projected capacity and usage information is made available to users and management in an understandable and usable form

4.7.3 Assessment metrics

1. Number of end-business processes suffering interruptions or outages caused by inadequate IS capacity and performance
2. Number of critical business processes not covered by a defined service availability plan
3. Percent of critical IS resources with adequate capacity and performance capability, taking account of peak loads
4. Number of down-time incidents caused by insufficient capacity or processing performance
5. Percent of capacity remaining at normal and peak loads
6. Time taken to resolve capacity problems

7. Percent of unplanned upgrades compared with total number of upgrades
8. Frequency of capacity adjustments to meet changing demands

4.8 P7 Operations management

4.8.1 Maturity level descriptions

0 Non-existent.

The organisation does not devote time and resources to the establishment of basic IS support and operations activities.

1 Initial/Ad Hoc

The organisation recognises the need for structuring the IS support functions. However, no standard procedures are established and the operations activities are reactive in nature. The majority of operations are not formally scheduled and processing requests are accepted without prior validation. Computers supporting the business processes are frequently interrupted, delayed and unavailable. Time is lost while employees wait for resources. Systems are not stable or available and output media sometimes show up in unexpected places or not at all.

2 Repeatable but Intuitive

The organisation is fully aware of the key role that IS operations activities play in providing IS support functions. In addition, the organisation communicates the need for co-ordination between users and systems operations. Budgets for tools are being allocated on a case-by-case basis. IS support operations are informal and intuitive. There is a high dependence on the skills and abilities of individuals. The instructions of what to do, when and in what order, are not documented. There are no operating standards and no formal operator training exists. Management does not measure the meeting of schedules by IS operations or analyse delays.

3 Defined Process

The need for computer operations management is understood and accepted within the organisation. Resources have been allocated and some on-the-job training occurs. The repeatable functions are formally defined, standardised, documented and communicated to operations and customer personnel. The events and completed task results are recorded, but reporting to management is limited or non-existent. The use of automated scheduling and other tools is extended and standardised in order to limit operator intervention. Other regular IS support activities are also identified and related tasks are being defined. Strict controls are exercised over putting new jobs in operation and a formal policy is used to reduce the number of unscheduled events. Maintenance and service agreements with vendors are still informal in nature.

4 Managed and Measurable

The computer operations and support responsibilities are clearly defined and ownership is assigned. Operations are supported through resource budgets for capital expenditures and human resources. Training is formalised and ongoing, as part of career development. Schedules and tasks are documented and communicated, both internal to the IS function and to the business client. It is possible to measure and monitor the daily activities with standardised performance agreements and established service levels. Any deviations from established norms are quickly addressed and corrected. Management monitors the use of computing resources and completion of work or assigned tasks. An on-going effort exists to increase the level of process automation as a means of ensuring continuous improvement. Formal maintenance and service agreements are established with vendors. There is full alignment with problem and availability management processes, supported by an analysis of the causes of errors and failures.

5 Optimised

IS support operations are effective, efficient and sufficiently flexible to meet service level needs quickly and without loss of productivity. Operational IS management processes are standardised and documented in a knowledge base and is subject to continuous improvement. Automated processes that support systems operate seamlessly and contribute to a stable environment that is transparent to and usable by the user. This allows users to maximise alignment of IS operations with their needs. All problems and failures are analysed to identify the root cause. Regular meetings with change management ensure timely inclusion of changes in production schedules. In co-operation with the vendor, equipment is analysed for age and malfunction symptoms and maintenance is mainly preventive in nature.

4.8.2 Objectives

- Operations instructions are well defined, according to standards, and with provision of clear cut-off and restart points
- There is a high degree of standardisation of operations
- There is close co-ordination with related processes, including problem and change management functions, and availability and continuity management
- There is a high degree of automation of operations tasks
- Operational processes are re-engineered to work effectively with automated tools
- Rationalisation and standardisation of systems management tools is implemented
- Input and output handling is, as much as possible, confined to the users
- Changes to job schedules are strictly controlled
- There are strict acceptance procedures for new job schedules, including documentation delivered
- Preventive maintenance schemes are in place
- Service support agreements with vendors are defined and enforced

- Clear and concise detection, inspection and escalation procedures are established

4.8.3 Assessment metrics

1. A measured reduction in delays and deviations from schedules
2. A measured completion of output media produced and delivered to the proper destination
3. A measure of resources available on time and on schedule
4. A measured reduction in operations related errors
5. A reduced amount of scheduled as well as unscheduled downtime due to operations interventions
6. A reduced overall cost of operation in relation to the overall processing load
7. A measured completion of the computing process at various stages
8. A measured reduction in operator intervention
9. Reduced number of problems, delays and deviations
10. Reduced number of reruns and restarts
11. Reduced amount of unplanned maintenance
12. Reduced number of unscheduled jobs and events
13. Increased number of user controlled parameter settings
14. Measured congruence between user demand and availability of resource capacity
15. Frequency of analysis and reporting conducted to monitor operations performance
16. Frequency of back-up check-ups
17. Average age of equipment

4.9 P8 Continuous Service

4.9.1 Maturity level descriptions

0 Non-existent.

There is no understanding of the risks, vulnerabilities and threats to IS operations or the impact of loss of IS services to the organisation. Service continuity is not considered as needing management attention.

1 Initial/Ad Hoc

Responsibilities for continuous service are informal, with limited authority. Management is becoming aware of the risks related to and the need for continuous service. The focus is on the IS function, rather than on the organisation function. Users are implementing work-arounds. The response to major disruptions is reactive and prepared. Planned outages are scheduled to meet IS needs, rather than to accommodate organisation requirements.

2 Repeatable

Responsibility for continuous service is assigned. The approaches to continuous service are fragmented. Reporting on system availability is incomplete and does not take organisation impact into account. There are no documented user or continuity plans, although there is commitment to continuous service availability and its major principles are known. A reasonably reliable inventory of critical systems and components exists. Standardisation of continuous service practices and monitoring of the process is emerging, but success relies on individuals.

3 Defined Process

Accountability is unambiguous and responsibilities for continuous service planning and testing are clearly defined and assigned. Plans are documented and

based on system criticality and organisation impact. There is periodic reporting of continuous service testing. Individuals take the initiative for following standards and receiving training. Management communicates consistently the need for continuous service. High-availability components and system redundancy are being applied gradually. An inventory of critical systems and components is rigorously maintained.

4 Managed and Measurable

Responsibilities and standards for continuous service are enforced. Responsibility for maintaining the continuous service plan is assigned. Maintenance activities take into account the changing organisation environment, the results of continuous service testing and best internal practices. Structured data about continuous service is being gathered, analysed, reported and acted upon. Training is provided for continuous service processes. System redundancy practices, including use of high-availability components, are being consistently deployed. Redundancy practices and continuous service planning influence each other. Discontinuity incidents are classified and the increasing escalation path for each is well known to all involved.

5 Optimised

Integrated continuous service processes are proactive, self-adjusting, automated and self-analytical and take into account benchmarking and best external practices. Continuous service plans and organisation continuity plans are integrated, aligned and routinely maintained. Buy-in for continuous service needs is secured from vendors and major suppliers. Global testing occurs and test results are fed back as part of the maintenance process. Continuous service cost effectiveness is optimised through innovation and integration. Gathering and analysis of data is used to identify opportunities for improvement. Redundancy practices and continuous service planning are fully aligned. Management does not allow single points of failure and provides support for their remedy. Escalation practices are understood and thoroughly enforced.

4.9.2 Objectives

- A no-break power system is installed and regularly tested
- Potential availability risks are proactively detected and addressed
- Critical infrastructure components are identified and continuously monitored
- Continuous service provision is a continuum of advance capacity planning, acquisition of high-availability components, needed redundancy, existence of tested contingency plans and the removal of single points of failure
- Action is taken on the lessons learned from actual downtime incidents and test executions of contingency plans
- Availability requirements analysis is performed regularly
- Agreements are used to raise awareness and increase cooperation with suppliers for continuity needs
- The escalation process is clearly understood and based on a classification of availability incidents
- The costs of interrupted service are specified and quantified where possible, providing the motivation to develop appropriate plans and arrange for contingency facilities

4.9.3 Assessment metrics

1. Number of critical organisation processes relying on IS that have adequate continuity plans
2. Reduced downtime
3. Number of critical infrastructure components with automatic availability monitoring
4. Number of outstanding continuous service issues not resolved or addressed
5. Number and extent of breaches of continuous service, using duration and impact criteria
6. Time lag between organisational change and continuity plan update

7. Time to diagnose an incident and decide on continuity plan execution
8. Time to normalise the service level after execution of the continuity plan
9. Number of proactive availability fixes implemented
10. Lead time to address continuous service shortfalls
11. Frequency of continuous service training provided
12. Frequency of continuous service testing

4.10 P9 Change management

4.10.1 Maturity level descriptions

0 Non-existent.

There is no defined change management process and changes can be made with virtually no control. There is no awareness that change can be disruptive for IS operations, and no awareness of the benefits of good change management.

1 Initial/Ad Hoc

It is recognised that changes should be managed and controlled, but there is no consistent process to follow. Practices vary and it is likely that unauthorised changes will take place. There is poor or non-existent documentation of change and configuration documentation is incomplete and unreliable. Errors are likely to occur together with interruptions to the production environment caused by poor change management.

2 Repeatable but Intuitive

There is an informal change management process in place and most changes follow this approach; however, it is unstructured, rudimentary and prone to error. Configuration documentation accuracy is inconsistent and only limited planning and impact assessment takes place prior to a change. There is considerable inefficiency and rework.

3 Defined Process

There is a defined formal change management process in place, including categorisation, prioritisation, emergency procedures, change authorisation and release management, but compliance is not enforced. The defined process is not always seen as suitable or practical and, as a result, workarounds take place and processes are bypassed. Errors are likely to occur and unauthorised changes will occasionally occur. The analysis of the impact of IS changes on organisational operations is becoming formalised, to support new applications and technologies.

4 Managed and Measurable

The change management process is well developed and consistently followed for all changes and management is confident that there are no exceptions. The process is efficient and effective, but relies on considerable manual procedures and controls to ensure that quality is achieved. All changes are subject to thorough planning and impact assessment to minimise the likelihood of post-production problems. An approval process for changes is in place. Change management documentation is current and correct, with changes formally tracked. Configuration documentation is generally accurate. IS change management planning and implementation is becoming more integrated with changes in the organisational processes, to ensure that training, organisational changes and business continuity issues are addressed. There is increased co-ordination between IS change management and business process redesign.

5 Optimised

The change management process is regularly reviewed and updated to keep in line with best practices. Configuration information is computer based and provides version control. Software distribution is automated and remote monitoring capabilities are available. Configuration and release management and tracking of changes is sophisticated and includes tools to detect unauthorised and unlicensed software. IS change management is integrated with business change management

to ensure that IS is an enabler in increasing productivity and creating new business opportunities for the organisation.

4.10.2 Objectives

- Change policies are clear and known and they are rigorously and systematically implemented
- Change management is strongly integrated with release management and is an integral part of configuration management
- There is a rapid and efficient planning, approval and initiation process covering identification, categorisation, impact assessment and prioritisation of changes
- Automated process tools are available to support workflow definition, pro-forma workplans, approval templates, testing, configuration and distribution
- Expedient and comprehensive acceptance test procedures are applied prior to making the change
- A system for tracking and following individual changes, as well as change process parameters, is in place
- A formal process for hand-over from development to operations is defined
- Changes take the impact on capacity and performance requirements into account
- Complete and up-to-date application and configuration documentation is available
- A process is in place to manage co-ordination between changes, recognising interdependencies
- An independent process for verification of the success or failure of change is implemented
- There is segregation of duties between development and production

4.10.3 Assessment metrics

1. Reduced number of errors introduced into systems due to changes
2. Reduced number of disruptions (loss of availability) caused by poorly managed change
3. Reduced impact of disruptions caused by change
4. Reduced level of resources and time required as a ratio to number of changes
5. Number of emergency fixes
6. Number of different versions installed at the same time
7. Number of software release and distribution methods per platform
8. Number of deviations from the standard configuration
9. Number of emergency fixes for which the normal change management process was not applied retroactively
10. Time lag between the availability of the fix and its implementation
11. Ratio of accepted to refused change implementation requests

4.11 P10 Monitoring services

4.11.1 Maturity level descriptions

0 Non-existent.

The organisation has no monitoring process implemented. IS does not independently perform monitoring of projects or processes. Useful, timely and accurate reports are not available. The need for clearly understood process objectives is not recognised.

1 Initial/Ad Hoc

Management recognises a need to collect and assess information about monitoring processes. Standard collection and assessment processes have not been identified. Monitoring is implemented and metrics are chosen on a case-by-case basis,

according to the needs of specific IS projects. Monitoring is generally implemented reactively to an incident that has caused some loss or embarrassment to the organisation. Monitoring is implemented by the information services function for the benefit of other departments, but is not implemented over IS processes. Process definition and monitoring measures follow traditional financial, operations and internal control approaches, without specifically addressing the needs of the information services function.

2 Repeatable but Intuitive

Basic measurements to be monitored have been identified. Collection and assessment methods and techniques have been defined, but the processes have not been adopted across the entire organisation. Planning and management functions are created for assessing monitoring processes, but decisions are made based on the expertise of key individuals. Limited tools are chosen and implemented for gathering information, but may not be used to their full capacity due to a lack of expertise in their functionality. The information services function is managed as a cost centre, without assessing its contribution to the revenue generating entities of the organisation.

3 Defined Process

Management has communicated and institutionalised standard monitoring processes. Educational and training programs for monitoring have been implemented. A formalised knowledge base of historical performance information has been developed. Assessment is still performed at the individual IS process and project level and is not integrated among all processes. Tools for monitoring internal IS processes and service levels are being implemented. Measurements of the contribution of the information services function to the performance of the organisation have been defined, using traditional financial and operational criteria. IS specific performance measurements are defined and implemented, but the non-financial and strategic measurements are still informal. Measures of customer

satisfaction and service levels provided to the operating entities of the organisation are being implemented.

4 Managed and Measurable

Management has defined the tolerances under which processes must operate. Base-lining of monitoring results is being standardised and normalised. There is integration of metrics across all IS projects and processes. The information services function management reporting systems are formalised and fully automated. Automated tools are integrated and leveraged organisation-wide to collect and monitor operational information on applications, systems and processes. Criteria for evaluating organisational development based on Maturity Models have been defined. Measurements of the information services function performance include financial, operational, customer and organisational learning criteria that ensure alignment with organisation-wide goals.

5 Optimised

A continuous quality improvement process is developed for updating organisation-wide monitoring standards and policies and incorporating industry best practices. All monitoring processes are optimised and support organisation-wide objectives. Performance is routinely measured. Process monitoring and ongoing re-design are consistent with plans developed based on process maturity models and with organisation-wide business process improvement plans. Benchmarking against industry and key competitors has become formalised, with well-understood comparison criteria.

4.11.2 Objectives

- Useful, accurate and timely management reports are available
- Processes have defined and understood what the targets are and how to achieve them

- Measurements of IS performance include financial, operational, customer and organisational learning criteria that ensure alignment with organisation-wide goals
- There are clearly understood and communicated process objectives
- A framework is established for defining and implementing IS management reporting requirements
- A knowledge base of historical performance is established
- Consistent application of the right limited number of performance indicators
- Increased number of process improvement opportunities detected and acted upon
- Satisfaction of management entity with performance reporting
- Reduced number of outstanding process deficiencies

4.11.3 Assessment metrics

1. Time lag between the process deficiency occurrence and reporting
2. Time lag between the reporting of a deficiency and action initiated
3. Ratio between process deficiencies reported and deficiencies subsequently accepted as requiring management attention follow-up (noise index)
4. Number of processes monitored
5. Number of cause and effect relations identified and incorporated in monitoring
6. Number of external benchmarks of process effectiveness
7. Time lag between business changes and any associated changes to performance indicators
8. Number of changes to the set of performance indicators without the organisational goals changing

CHAPTER 5

ADOPTION OF PB-ISAM: THREE CASES

This chapter comprises five major sections. In the first two sections, qualitative versus quantitative research methods and case study research in information systems will be discussed. Following that, the empirical work is described. In conducting the empirical work, the method of multiple case studies was adopted. Three organisations were selected and in-depth investigation was carried out. The descriptions of the three cases are presented in the fourth section of this chapter where for each organisation, (1) a background, (2) findings from the organisation, and (3) a discussion of the findings are given. The chapter concludes with an analysis of the three case studies where a comparison of findings regarding the model and also regarding the information systems evaluation guidelines is elaborated.

5.1 Qualitative versus Quantitative Research Methods in Information Systems

Research methods can be classified in various ways, however there is a major distinction between qualitative and quantitative ones.

Quantitative research methods were originally developed in the natural sciences to study natural phenomena. Examples of quantitative methods now well accepted in the social sciences include survey methods, laboratory experiments, formal methods (e.g. econometrics) and numerical methods such as mathematical modeling.

Qualitative research methods were developed in the social sciences to enable researchers to study social and cultural phenomena. Examples of qualitative methods are action research, case study research and ethnography. Qualitative data sources include observation and participant observation (fieldwork), interviews and questionnaires, documents and texts, and the researcher's impressions and reactions.

Myers (1997) asserts that the motivation for doing qualitative as opposed to quantitative research, comes from the observation that, if there is one thing which distinguishes humans from the natural world, it is our ability to talk. Qualitative research methods are designed to help researchers understand people and the social and cultural contexts within which they live. Kaplan and Maxwell (1994) argue that the goal of understanding a phenomenon from the point of view of the participants and its particular social and institutional context is largely lost when textual data are quantified. IS is an interdisciplinary area, and a social system, that requires context dependent research since social systems include so many uncontrolled variables, and applying statistical or experimenting methods can remove the context and understanding of what actually is happening (Garcia and Quek, 1997; Galliers, 1994; Kaplan and Dennis, 1988; Baskerville and Myers, 2004). Benbasat, Goldstein, and Mead (1987) support the above discussion: "The IS field has seen a shift from technological to managerial and organisational questions, and consequently more interest in how context and innovations interact". To summarize, IS studies require more organisational related issues to be searched; and qualitative research can provide context and human based research more than a quantitative research can provide.

Nonetheless, all research, whether quantitative or qualitative, is based on some underlying assumptions about what constitutes "valid" research and which

research methods are appropriate. In order to conduct qualitative research, it is therefore important to know what these assumptions are. For the case of IS research, according to Myers (1997) the most pertinent philosophical assumptions are those which relate to the underlying epistemology which guides the research (i.e. “epistemology” refers to the assumptions about knowledge and how it can be obtained). Myers (1997) classifies this underlying epistemology as: (1) *positivist* research, (2) *interpretive* research and (3) *critical* research. Positivists generally assume that reality is objectively given and can be described by measurable properties which are independent of the observer (researcher) and his or her instruments. *Positivist* studies generally attempt to test theory, in an attempt to increase the predictive understanding of phenomena. *Interpretive* studies generally attempt to understand phenomena through the meanings that people assign to them and interpretive methods of research in IS are "aimed at producing an understanding of the context of the information system, and the process whereby the information system influences and is influenced by the context" (Walsham, 1993; Mumford, Hirschheim, Fitzgerald, and Wood-Harper, 1984). *Critical* research focuses on the oppositions, conflicts and contradictions in contemporary society, and tries to eliminate the causes of these. It should be clear from the above discussion that the word “qualitative” should not be perceived as a synonym for *interpretive* since qualitative research can be *positivist, interpretive,* or *critical*. Similarly, the choice of a specific qualitative research method, such as the case study method, would be independent of the underlying philosophical perspective adopted: case study research can be positivist, interpretive or critical based on the objectives of the researcher and the nature of the research topic (Myers, 1997; Benbasat, 1987).

5.2 Case Study Research in Information Systems

There are various qualitative research methods. Myers (1997) defines a research method as a strategy of inquiry which moves from the underlying philosophical assumptions to research design and data collection. Therefore, the choice of research method influences the way in which the researcher collects data. In that, specific research methods imply different skills, assumptions and research practices.

Myers (1997) identifies four types of qualitative research methods: (1) action research, (2) case study research, (3) ethnography, and (4) grounded theory. *Action* research aims to contribute both to the practical concerns of people in an immediate problematic situation and to the goals of social science by joint collaboration within a mutually acceptable ethical framework (Rapoport, 1970 as cited in Myers, 1997). *Ethnographic* research comes from the discipline of social and cultural anthropology where an ethnographer is required to spend a significant amount of time in the field. Ethnographers immerse themselves in the lives of the people they study and seek to place the phenomena studied in their social and cultural context. *Grounded theory* is a research method that seeks to develop theory that is grounded in data systematically gathered and analyzed. ***Case study research*** is the most common qualitative method used in information systems (Myers, 1997). Although there are numerous definitions, Yin (1984) defines the scope of a case study as follows:

"A case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident."

Clearly, the case study research method is particularly well-suited to IS research, since the object of information systems discipline is the study of information systems in organisations, and "interest has shifted to organisational rather than technical issues" (Benbasat et al. 1987).

Benbasat (1987) points out three reasons why case study research is a practical IS research strategy:

i. The IS researcher can study the IS in a natural setting, learn about the state of the art, and generate theories from practice.
ii. Case method allows the IS researcher to answer "how" and "why" questions, that is to understand the nature and complexity of IS processes.
iii. Since there is a rapid pace of change in the IS field, many new topics emerge each year for which valuable insights can be gained through the use of case research.

In addition, for situations when

- research and theory are at their early and establishment stages; and
- the actors and the context are important and the researcher wants to understand the practice based problems,

case study research method gives the best results (Benbasat, et al., 1987).

5.3 Research Design

This section consists of two subsections. The first subsection, Sec. 5.3.1, elaborates the underlying assumptions made when choosing and designing the multiple-case research method and when selecting the three sites. The second subsection, Sec. 5.3.2 gives a detailed description of data collection and data analysis.

5.3.1 Multiple-Case Studies: Selection of Cases

Benbasat (1987) argues that most research efforts require multiple-case studies, and that multiple-case studies are suitable when the aim of the research is description, theory building or theory testing. In addition, multiple-case studies allow cross-case analysis and extension of theory.

Figure 5.1 illustrates the multiple-case studies approach deployed in the current research. This figure has been adapted from Yin's Case Study Method (1984, p.51) The figure indicates that the initial step in designing the study is theory development; and then shows that case selection and the definition of specific measures are important steps in the design and data collection process. Each individual case study consists of a "whole" study, in which convergent evidence is sought regarding the facts and findings from the case. Both the individual case and the multiple-case results are the focus of the overall study. For each individual case, the findings are written indicating how the conceptual model was adopted and why the model is appropriate. Following that, cross-discussion findings are

elaborated, which indicates why a certain case had certain results, whereas another case had different results.

In this study, three cases were selected. In order to respect their privacy, throughout the thesis, the organisations are represented with letters A, B and C. In the Section 5.4, more information on these cases is given. These three cases are summarized below in Table 5.1:

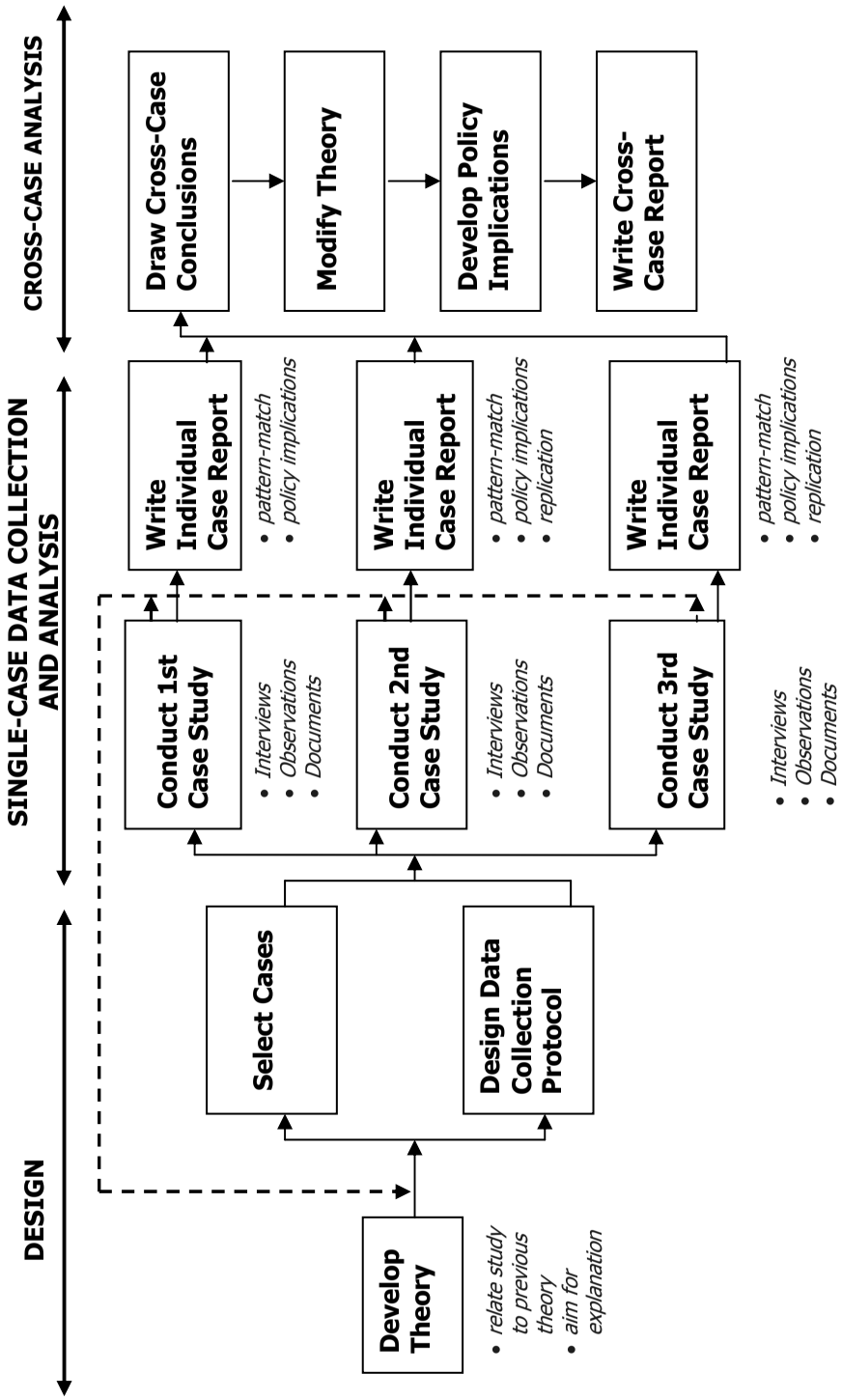
Table 5.1 Summary of three case organisations

Case	Public/Private	Business Sector	Model adopted on processes within:
Organisation A	private	IT	overall IT organisation
Organisation B	public	Banking	IT department
Organisation C	public	University	a specific IS workgroup

5.3.2 Assessment: Data Collection and Analysis

In order to obtain a rich set of data surrounding the specific research issue, as well as capturing the contextual complexity, the case study method uses multiple methods for data collection (Benbasat, et al., 1987; Pozzebon, 2004). In the current research study, semi-structured, open-ended ***interview***s were mainly used in order to allow participants to give their personal experience and interpretation. Prior to organisation visits, the data to be gathered was outlined in detail. For this purpose, questionnaire-like lists of focused questions, and sequentially and logically ordered assessment tables were prepared for every interview. These templates are given in the Appendices. The duration of each interview was one to one and a half hours. All the interviews were recorded and transcribed within a week, so a follow-up telephone conversation or a further interview could be arranged in order to resolve any unclear matter. In addition, since the achievement of multiple perspectives was important for the particular research, more ***comprehensive meetings*** with related personnel within the organisation were held. In some cases, these meetings were in the form of a ***presentation of the findings*** given to the organisation. Also in some cases, feedback was posted via e-

Figure 5.1 Case Study Method (Adapted from Yin, 1984, p. 51)



mail to the person upon request. The selection of the interviewees was based on their direct involvement with the processes considered for IS effectiveness assessment. There were the "strategists", who usually had a senior position in the organisation with a lot of responsibilities, knowledge and experience in establishing the processes and formulating procedures. And the other informants were usually at a lower level than senior, who are responsible for applying and following some specific procedures. In each case, the interviews commenced with staff at senior levels (i.e. the "strategists"). Following that initial meeting, the rest of the interviewees were gradually developed by personal recommendations. In each organisation one person, usually quite senior, was identified to validate the final findings. This was particularly useful to eliminate any inconsistent and conflicting data.

In order to increase the coherence of the information gathered, in addition to the interviews, ***company documents*** (written material ranging from internal reports, internal audit reports, technical reports, external audit reports, training materials and related publications), and ***archival records*** (e.g. organisational charts, budgets, organisational/departmental performance reports, organisational qualifying theses documents) were used extensively. In addition, ***electronically documented publications*** (e.g. organisations' web sites, other data available via organisations' intranets) provided an extra source of information. Moreover, ***direct observation*** helped to capture details.

Having multiple data sources enabled triangulation (i.e. collecting information from a diverse range of individuals and settings, using a variety of methods) and cross-checking of the data achieved, which has provided greater support in order to reach more robust conclusions.

This study adopts an interpretive epistemology for which a theory or a conceptual model is necessary to drive the study and the analysis of its findings. Towards this direction, in the current study, data collection and analysis were conducted based on the conceptual model for IS effectiveness (see Figure 3.1).

In addition, according to the qualitative research literature, the relationship between data collection and the data analysis phases are either "disconnected" or "integrated" (Ezzy, 2002). "Disconnected" analysis commences only after data collection is completed. In the current study, data collection and data analysis were integrated processes because during the adoption of each case study, after every interview, the data collected was transcribed before conducting the subsequent interview. Moreover, after each case before moving onto the subsequent case; in the light of the findings of the particular case studied, the conceptual model was interrogated systematically within the framework of a set of questions (see Table 5.2). Each of these six questions corresponds to one of the three components of the conceptual model. Therefore, the conceptual model was questioned upon the completion of each case study.

5.4 Three cases

The assessment framework presented in Chapter 4 is applied to all three organisations (i.e. Case A, Case B and Case C). The assessment templates for each organisation are given in Appendices.

Below, a brief background for each is case will be provided. Following this, the data collected for each organisation will be elaborated in terms of the processes proposed, where a "level assessment" for each process of that particular case will be done. Finally, findings of each case will be discussed. The findings are evaluated following the questions presented in Table 5.2. With the help of this structured discussion, we are able to criticise the three main points of the conceptual model and the assessment framework, PB-ISAM: (1) maturity levels, (2) processes, and (3) three components (i.e. people, resources, and services & benefits).

Table 5.2 Questions for discussion of the PB-ISAM for three case studies

Maturity Level	1. For each of the ten processes of the proposed assessment framework, is it possible to make a level assessment for that particular organisation? Is this method applicable?
	2. How does this assessment corroborate any other assessment carried out for the organisation studied?
	3. Is a five level assessment appropriate?
Processes	4. Are the processes defined under the three components (i.e. people, resources and services and benefits) sufficient to evaluate IS effectiveness in the organisation?
	5. Can other processes be defined or are there any processes that are redundant for that particular organisation?
Three components	6. Is the tripod structure appropriate in the light of the case study?

5.4.1 Case A

5.4.1.1 Background

Organisation A is a high technology software and electronics company, with its most distinctive expertise in the field of real time software engineering and hardware/software systems integration. Organisation A also has major business in custom manufacturing involving electronic assembly, metalwork fabrication, ruggedizing equipment, communications hardware, shelterization, radar data integration, real time command, control, and communications (C3) and avionic systems, data fusion, and command center design and installation. Organisation A is licensed to manufacture the electronic equipment and products of a major

shareholder based in the USA, benefiting from its research and development department and overall capabilities. The organisation was established in 1990.

Organisation A holds National and NATO Secret Level Secure Facility certificates, ISO-9001:2000, AQAP-150/160 (November 2003) and CMM Level 3 (May 2003) certificates. Total number of personnel is 180, including 75 highly qualified software and hardware engineers.

The interviews have been conducted with:

a. Quality Department Director
b. Software Department Manager
c. Software Quality Engineer

In addition to the interviews, departmental reports associated with the process assessed helped to verify the accomplishment of an objective of that particular process. Related with the processes, interviewees provided some company documents such as internal and external audit reports, some technical reports, certifications, etc. Moreover, the organisation's web-site provided electronically documented publications. The feedback of findings was posted via e-mail to the interviewees. These, altogether, helped to fill in the gaps between interviews and observations as well as to cross-check the data achieved. Findings from these multiple resources (i.e. interviews, observations, documents) concerning organisation A are given under each process in the subsequent sections.

5.4.1.2 Findings

P1 Definition of the IS organisation and relationships

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

The organisation's senior management have appointed committees which meet regularly and report to the senior management. All the personnel in the organisation have and know their roles and responsibilities in relation to

information systems. However, placing the "information systems" term and the IS function in this particular organisation was difficult because the organisation itself is an IT organisation, therefore, most of the time, terms such as IS (or IT) function were redundant. Nonetheless, the segregation of duties between the organisation's functions such as quality management, network management, help-desk management, etc. was maintained successfully. In this respect, job or position descriptions for the personnel were found to be clearly established including definitions of skills and experience needed in the relevant position, and these are suitable for use in performance evaluation. In addition, the organisation has a skills/CV database composed of details of each personnel. It has been observed that these were documented electronically, available on the organisational intranet. The interviewees pointed out that keeping an electronic record of each employee enabled them allocate roles and responsibilities more effectively and efficiently; and whenever required. Electronic recording also provides ease and flexibility when reaching any desired data. One final point that has been observed is the flexibility of role and responsibility allocation within the organisation. Although this is apparent in low level personnel, i.e. a programmer, a person who had been trained in one specific area, etc., where allocation of personnel may be done depending on the skills needed. This is one of the results of the organisation being an IT organisation itself.

Level assessment

Organisation A is found to be at Level 5 for the process P1 Definition of the IS organisation and relationships

There is defined organisational structure, roles and responsibilities are informally assigned; lines of responsibilities are clear [Level 3 requirement]. Within the organisation, best practices are applied. The organisation is a CMM3 organisation. IS management has the appropriate skills and expertise to define, implement and monitor the preferred organisation and relationships. The organisation is currently developing a tool which would help them to improve themselves for CMM Level 5 certification, which is a part of their business continuity plan. There is continuous improvement in place [Level 5 requirement].

P2 Education and training of users

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "very good" level in terms of the accomplishment of each of the objectives.

In line with the long-range plan, management was found to have established and maintained procedures for identifying and documenting the training needs of the personnel. Based on the identified needs, management defines the target groups, identifies, appoints and organises trainers. The management establishes a yearly education plan. When needed, there are external technical training opportunities available. For example, trainings on special tools (i.e. Primavera, etc) are made available to the personnel. The training needs are identified by the senior management, and there is organisational budget allocated for this purpose. The interviewees additionally mentioned that the organisation runs a yearly education program.

Level assessment

Organisation A is found to be at Level 5 for the process P2 Education and training of users

The organisation is aware of the need for a training and education program and for associated processes throughout the organisation [Level 2 requirement]. This training and education program has been institutionalised and communicated; employees and managers identify and document training needs; budgets, resources and facilities are established [Level 3 requirement]. Processes associated under improvement [Level 5 requirement] and there is a comprehensive training and education program that is focused on individual and corporate needs [Level 4 requirement].

P3 Provision of assistance and advice to IS users

The interviewees found the objectives defined for the success of this process somewhat important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of

each of the objectives. Within the organisation, user support is established within a "call centre" function via the organisational intranet. Individuals responsible for performing this function closely interact with other personnel. Procedures are in place to ensure that all user queries are adequately registered by the call centre. The interviewees pointed out that, this function best works via e-mail rather than via telephone, i.e. queries sent to the call centre via e-mail are responded on a strictly timely manner whereas ad hoc telephone queries are not allowed to take the priority over the other formally registered queries. Procedures ensure that user queries which cannot immediately be resolved are appropriately escalated to the right personnel. Since electronically tracked, timely monitoring and clearance of user queries is observed, with no long outstanding queries. The call centre reports to a responsible person with authority, which helps to improve service.

Level assessment

Organisation A is found to be at Level 5 for the process P3 Provision of assistance and advice to IS users

The organisation recognises that a process supported by tools and personnel is required in order to respond to user queries and manage problem resolution, and is aware of the need for a help desk function [Level 1 and Level 2 requirement]. A standardised and documented (in this case it is electronically documented) call centre is available [Level 3 requirement]. There is a full understanding of this call centre at all levels of the organisation [Level 4 requirement]. The call centre is well organised where IT is used extensively. The need for continuous improvement is recognised and the call centre processes are refined accordingly [Level 5 requirement].

P4 IS Interactions

The interviewees found the objectives defined for the success of this process somewhat important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

Because it is an IT organisation, the need for interactions with other information systems is very well recognised. IS interactions are realised as a result of the

Internet medium. Common IS interactions include extensive use of Software/ CASE tools' web pages, use of customer's information systems, online IEEE membership, and other remote operations similar to online memberships. These are seen as a vital part of the organisational processes, for example, being able to access to a customer's information system throughout the development life cycle of a project provides many benefits such as the flexibility of work, reduced development time, etc. There is no evidence of documentation on the use of other ISs.

Level assessment

Organisation A is found to be at Level 3 for the process P4 IS interactions

The organisation is aware of the need for interactions among ISs [Level 1 and Level 2 requirement]. It is left to the individual to find and use other ISs whenever needed [Level 3 requirement]. There are neither standardised nor documented procedures. There is not a full understanding of interactions among ISs at all levels of the organisation [Level 4 requirement]. There is no evidence showing that there is any work done on continuous improvement for spreading the use of other ISs throughout the organisation [Level 5 requirement].

P5 Configuration Management

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at an "excellent" level in terms of the accomplishment of each of the objectives.

Within the organisation, procedures are in place to ensure that only authorised and identifiable configuration items are recorded in inventory upon acquisition. These procedures provide for the authorised disposal of the configuration items. Changes to the configuration, for example new item, status change from development to prototype, are tracked. There is a configuration recording system which includes reviews of changed records. The IT management ensures that these records reflect the actual status of all configuration items including the history of changes, and that they are periodically checked. There are clear policies

restricting the use of personal and unlicensed software. The organisation uses virus detection software. Personal computers are checked automatically for unauthorised software. Compliance with the requirements of software and hardware license agreements is reviewed regularly. All software is labelled, inventoried and properly licensed. A bar-code tracking system for the configuration is being developed.

Level assessment

Organisation A is found to be at Level 4 for the process P5 Configuration Management

The organisation is aware of the need for configuration management [Level 1 and Level 2 requirement]. A standardised and documented configuration management is operational [Level 3 requirement]. The need to manage the configuration is recognised at all levels of the organisation; automated tools are utilised [Level 4 requirement]. All infrastructure components are managed within the configuration management system. The system is well organised and is currently under improvement to be upgraded to a bar-code tracking system. There is no evidence of alignment of configuration data with vendor catalogues [Level 5 requirement].

P6 Performance and Capacity Management

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

Within the organisation, business needs are identified regarding availability and performance of information services. For that, an availability plan exists, is current and it reflects requirements. The performance of all equipment and capacity is continuously monitored. There is a forecasting capability to enable problems to be corrected before they affect system performance. Both users and operational performance groups are proactively reviewing capacity and performance and workload schedule modifications occur. However, within the IT department, there are no analysis conducted on system failures and irregularities pertaining to frequency, degree of impact and amount of damage. An organisation wide planning process for the review of hardware performance and capacity to

ensure that cost-justifiable capacity to process the agreed workloads exists. In addition, timely acquisition of required capacity, taking into account resilience, contingency, workloads and storage plans is in place.

Level assessment

Organisation A is found to be at Level 4 for the process P6 Performance and Capacity Management

The organisation is aware of the need for performance and capacity management [Level 1 and Level 2 requirement]. A standardised and documented performance and capacity management is operational where steps to be addressed at all stages of the systems acquisition and deployment methodology is in place; reports can be produced giving performance statistics; etc. [Level 3 requirement]. Processes and tools are available to measure system usage. Automated tools are used to monitor specific resources such as disk storage, network servers and networks gateways [Level 4 requirement]. There is no evidence of synchronisation of the performance and capacity plans with the business forecasts and the operational plans and objectives. Advances in technology are closely monitored to take advantage of improved product performance [Level 5 requirement].

P7 Operations Management

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

There are established and documented procedures for operations such as network operations, project level operations. All solutions and platforms in place are operated using these procedures, which are reviewed and tested regularly by management to ensure effectiveness. New project start-up procedures are clearly established and well-known and well-operated by the management. There are procedures established for service-level agreements with the customers. Management also ensures that continuous scheduling of workload according to skills, processes and tasks is organised efficiently. Procedures are also in place for departures from standard job schedules. To ensure continuity, formal handover of activity is well-managed via procedures with the help of, for example, well-

documented reports, etc. Sufficient chronological information is being stored in operations logs to enable the reconstruction, review and examination of the time sequences of processing.

Level assessment

Organisation A is found to be at Level 5 for the process P7 Operations Management

The organisation is fully aware of the key role of operations management [Level 1 and Level 2 requirement]. Repeatable functions are clearly defined and documented. It is possible to monitor daily activities [Level 3 and Level 4 requirement]. The operations are effective, efficient and sufficiently flexible to meet needs quickly and without loss of productivity. Automated processes are in place [Level 5 requirement].

P8 Continuous Service

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a satisfactory level in terms of the accomplishment of each of the objectives.

The organisation has an established and documented "business continuity plan" which defines the roles, responsibilities and the risk-based approach to be adopted. In the plan the following are included: (1) emergency procedures to ensure the safety of all affected personnel, (2) response and recovery procedures which would bring the business back to the state it was in before the incident, (3) procedures to safeguard and reconstruct the site, (4) coordination procedures with public authorities, communication procedures with stakeholders, employees, key customers, critical suppliers and management. The telephone system, voicemail, fax systems, image systems, paper documents are part of the continuity plan. The critical application programs, third-party services, operating systems, personnel and supplies, data files and time frames needed for recovery after a disaster occurs are identified. Critical data and operations are identified, documented and prioritised. Alternatives regarding the back-up site and hardware are ensured. Off-site storage of critical back-up resources has been established.

Level assessment

Organisation A is found to be at Level 5 for the process P8 Continuous Service

Responsibility for continuous service is assigned [Level 1 and Level 2 requirement]. A standardised and documented business continuity plan is operational [Level 3 requirement]. Responsibilities and standards for continuous service are enforced [Level 4 requirement]. Continuous service plans and business continuity plans are integrated [Level 5 requirement].

P9 Change Management

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at an excellent level in terms of the accomplishment of each of the objectives.

The management has ensured that all requests for changes, system maintenance are standardised; they can be categorised and prioritised to be handled. Methodology for prioritising system change requests from the personnel exists; all requests for change are structurally assessed. The change process ensures that whenever system changes are implemented, the associated documentation and procedures are updated accordingly. Maintenance personnel's, i.e. network system personnel's, access rights are controlled to avoid risks of unauthorised access. The release of software is governed by formal procedures ensuring sign-off, packaging, handover, etc.

Level assessment

Organisation A is found to be at Level 4 for the process P9 Change Management

There is a defined formal change management process in place, including categorisation, prioritisation, emergency procedures, change authorisation and release management [Level 3 requirement]. The process is efficient and effective but relies on considerable manual procedures to ensure that quality is achieved [Level 4 requirement]. There is awareness but no evidence showing that application of IT change management is integrated with business change management [Level 5 requirement].

P10 Monitoring Services

The interviewees found the objectives defined for the success of this process very

important to their organisation and they have come to a consensus that their organisation is at an excellent level in terms of the accomplishment of each of the objectives.

Relevant performance indicators from both internal and external sources are being defined, and data is being collected. Both organisational and individual performance measures and indicators are collected. There is a continuous performance assessment observed since the organisation aims for CMM Level 5 certification. In addition, the organisation has to keep its performance to the optimum level in order to operate therefore improvement objectives are clearly established. Customer satisfaction regarding the services delivered by the organisation is measured. Activities including internal reports, internal audit reports, external audit reports, user reports, system development plans and status reports and any other assessments are reported. These are communicated with the related personnel or division within the organisation.

Level assessment

Organisation A is found to be at Level 5 for the process P10 Monitoring Services

Management recognises a need to collect and assess information about monitoring services [Level 1 requirement]. Basic measurements to be monitored are identified [Level 2 requirement]. A formalised knowledge base of historical performance information has been developed [Level 3 requirement]. Criteria for evaluating organisational development based on maturity models have been defined. Measurements of the services function performance include financial, operational, customer and organisational learning criteria [Level 4 requirement]. A continuous quality improvement process is in place [Level 5 requirement].

5.4.1.3 Discussion

According to the proposed assessment framework, PB-ISAM, the organisation A's process-maturity chart is as depicted above in Figure 5.2 *[answer to question 1 of Table 5.2]*. A five level assessment is found to be appropriate for organisation A *[answer to question 3 of Table 5.2]* since the organisation is very familiar with terms like "maturity"; as a consequence, it was straightforward to position the processes into levels with convincing arguments as elaborated in the previous

section for each process. During the assessment, it has been observed that for an IT organisation, the three major components were people, resources and services & benefits, which validates the three components of PB-ISAM *[answer to question 6 of Table 5.2]*. However, it has also been realised that for an IT organisation, "people" could also be regarded as a "resource". For instance, a "programmer of one specific language", would normally be put under the people component because a programmer is a human being, is conceived as a "resource" by the IT organisation. They are faced with many similar situations like this since such a "resource" is allocated to only one specific project or task of a project, and with the completion of the task, the resource is assumed as it has been "used" just like any other resource. With these in mind, another process in which this could be assessed was found to be appropriate for this organisation. A new process could be defined and added. This process will comprise objectives related with the skills, etc. of these people who are taken as "resources" within the organisation. This new process could be named as "human resources management". There is, however, no evidence that such a process should be added for the assessment of a non-IT organisation. Hence, in cases B and C, the original set of processes (Table 3.3, section 3.5) has been maintained.

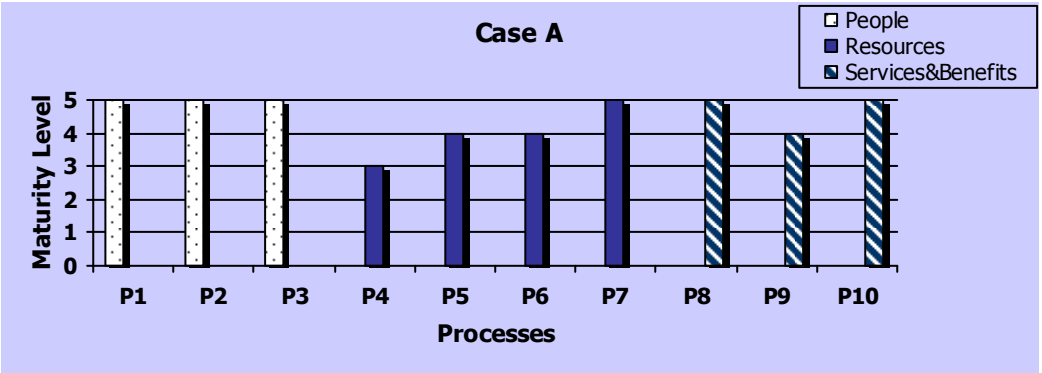


Figure 5.2 Process-maturity chart of Case A

Nonetheless, it has been observed that all the processes were totally relevant to the organisation *[answers to question 4 and partially to question 5 of Table 5.2]* and they are trying to improve themselves in most of these processes: improvement efforts are in processes P1, P2, P3, P7, P8 and P10 where they are found to be at Level 5 according to PB-ISAM. This is not surprising for this organisation since it

is a CMM Level 3 organisation and they are aiming to receive CMM Level 5 certification. These processes are the ones that mostly overlap with the CMM processes in the sense that for improvement in the application domain in regard to these processes; a higher level i.e. an organisational level improvement is vital and is to be established first *[answer to question 2 of Table 5.2]*.

5.4.2 Case B

5.4.2.1 Background

Organisation B is a large public bank in Turkey. The state of the art hardware and software technologies deployed throughout the organisation compliment the bank's on line real time operations. The bank's Information Technology Department has six divisions:

1. Application Development Division
2. Informatics Security and Quality Control Division
3. Payment Systems Division
4. Systems Operation Division
5. System Research and Planning Division
6. Systems Technical Support Division

Within the bank, the IT department:

- Determines the strategies for ICT (Information and Communication Technologies) and automation needs of the bank and sets mid/long term plans following technological improvements in the field of ICT,
- Selects and assembles the most appropriate hardware, software and communication solutions to enhance the effectiveness of ICT systems,
- Installs, maintains and develops the ICT systems of the bank,

- Defines and applies the standards, rules and procedures for the usage of ICT systems,
- Sets contingency plans and installs the systems to ensure the availability with continuous operation in case of failures or disasters,
- Determines, announces and applies the security policy and strengthenes the security of the systems,
- Checks the quality of ICT systems to improve the effectiveness,
- Develops the applications according to the needs of the bank,
- Develops, maintains and enhances interbank payment and securities settlement systems and their international connections; coordinates the banks as well as the related departments of the bank for technical and operational matters; operates the existing real-time gross settlement payment system, the securities settlement system and the dedicated communication network,
- Carries out the budgeting plans and ICT procuring processes in collaboration with the Construction and Procurement Department,
- Provides support to e-Government and e-Europe vision and studies of Turkey.

Organisation B's IT department holds ISO-9001:2000 certificate. The department has undergone a major re-structuring in year 1988. Total number of personnel involved in the IT department is 190, including 110 hardware and software engineers. 65 of these engineers work at the application development division, and 24 at the technical support division, and the rest 21 engineers work at the payment systems division, and system research and planning division.

The interviews have been conducted with:

a. Director of the Information Technology Department
b. Deputy Director of the Information Technology Department
c. Application Development Division Manager
d. System Research and Planning Division Manager

In addition to the interviews, departmental reports associated with the process assessed were helpful when verifying the accomplishment of an objective of that particular process. Interviewees provided the internal reports such as internal audit reports, annually written technical performance reports, documents showing training procedures. Moreover, the interviewees were supportive that they allowed the researcher to access to the organisation's intranet where electronically documented publications were available, i.e. qualifying theses documents and other on-line information sought. Furthermore, in addition to feedback posted via e-mail to the interviewees and meetings held within the department; organisation B asked the researcher to do a presentation of the findings. Therefore a feedback presentation was given to the IT department. These, altogether, helped to fill in the gaps between interviews and observations as well as to cross-check the data achieved. Findings from these multiple resources (i.e. interviews, observations, documents) regarding organisation B are given under each process in the subsequent sections.

5.4.2.2 Findings

P1 Definition of the IS organisation and relationships

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

The organisation's senior management have appointed committees which meet regularly and report to the senior management. All the personnel in the IT department have and know their roles and responsibilities in relation to information systems. Nonetheless, the segregation of duties between the department's functions such as quality management, network management, help-desk management, etc. was maintained successfully in six divisions. In this respect, job or position descriptions for the personnel were found to be clearly established including definitions of skills and experience needed in the relevant position, and these are suitable for use in performance evaluation. Roles and

responsibilities are well-defined and there is no flexibility of role and responsibility allocation within the department. There is an established hierarchical order. This is one of the results of the organisation being a public organisation itself.

Level assessment

Organisation B is found to be at Level 5 for the process P1 Definition of the IS organisation and relationships

There is defined organisational structure, roles and responsibilities are informally assigned; lines of responsibilities are clear [Level 3 requirement]. Within the organisation, best practices are applied. The organisation is a CMM3 organisation. IS management has the appropriate skills and expertise to define, implement and monitor the preferred organisation and relationships. There is continuous improvement in place [Level 5 requirement].

P2 Education and training of users

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "very good" level in terms of the accomplishment of each of the objectives.

In line with the long-range plan, the IT management establishes and maintains procedures for identifying and documenting the training needs of the personnel. Based on the identified needs, management defines the target groups, identifies, appoints and organises trainers. The management establishes a yearly education plan. When needed, there are external technical training opportunities available. For example, trainings on special tools are made available to the technical personnel. The training needs are identified by the senior management, and there is organisational budget allocated for this purpose. The interviewees additionally mentioned that the organisation runs a yearly education program.

Level assessment

Organisation B is found to be at Level 5 for the process P2 Education and training of users

The organisation is aware of the need for a training and education program and for associated processes throughout the organisation [Level 2 requirement]. This training and education program has been institutionalised and communicated; employees and managers identify and document training needs; budgets, resources and facilities are established [Level 3 requirement]. Processes associated under improvement and there is a comprehensive training and education program that is focused on individual and corporate needs [Level 4 and Level 5 requirement].

P3 Provision of assistance and advice to IS users

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "very good level" in terms of the accomplishment of each of the objectives.

Within the organisation, there is user support established operational as a "call centre" function via the organisational intranet. Individuals responsible for performing this function closely interact with other personnel where escalation procedures are very well defined. Procedures ensure that user queries which cannot immediately be resolved are appropriately escalated to the right personnel. Procedures are in place to ensure that all user queries are adequately registered. The interviewees pointed out that, since electronically tracked, timely monitoring and clearance of user queries is observed, with no long outstanding queries. The help desk and the call centre reports to a responsible person with authority, which helps to improve service.

Level assessment

Organisation B is found to be at Level 5 for the process P3 Provision of assistance and advice to IS users

The organisation recognises that a process supported by tools and personnel is required in order to respond to user queries and manage problem resolution, and is aware of the need for a help desk function [Level 1 and Level 2 requirement]. A standardised and documented (in this case it is electronically documented) help desk and call centre are

available [Level 3 requirement]. There is a full understanding of the help desk function and the call centre at all levels of the organisation [Level 4 requirement]. The call centre is well organised where IT is used extensively. The need for continuous improvement is recognised and the call centre processes are refined accordingly [Level 5 requirement].

P4 IS Interactions

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "very good" level in terms of the accomplishment of each of the objectives.

Because there is the vital need of information technology in the banking industry, the need for interactions with other information systems is very well recognised. IS interactions are realised as a result of the Internet medium. Common IS interactions include extensive use of several online memberships (i.e. Gartner, etc.), software tools' web pages, use of customer's web pages, and other remote operations similar to online memberships. These are seen as a vital part of the organisational processes, for example, being able to receive information from another system is most of the times the most crucial part of an operation of the organisation. There is evidence of documentation on the use of other ISs, such as results to be compared with Gartner data, interbank money market operations, etc.

Level assessment

Organisation B is found to be at Level 5 for the process P4 IS interactions

The organisation is aware of the need for interactions among ISs [Level 1 and Level 2 requirement]. It is left to the individual to find and use other ISs whenever needed [Level 3 requirement]. There are neither standardised nor documented procedures. There is not a full understanding of interactions among ISs at all levels of the organisation [Level 4 requirement]. There are improvement efforts on spreading the use of other ISs throughout the organisation [Level 5 requirement].

P5 Configuration Management

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at an "excellent" level in terms of the accomplishment of each of the objectives.

Within the organisation, procedures are in place to ensure that only authorised and identifiable configuration items are recorded in inventory upon acquisition. These procedures provide for the authorised disposal of the configuration items. Changes to the configuration, for example new item, status change from development to prototype, are tracked. There is a configuration recording system which includes reviews of changed records. The management of the IT department ensures that these records reflect the actual status of all configuration items including the history of changes, and that they are periodically checked. There are clear policies restricting the use of personal and unlicensed software. The organisation uses virus detection software. Personal computers are checked automatically for unauthorised software. Compliance with the requirements of software and hardware license agreements is reviewed regularly. All software is labelled, inventoried and properly licensed on an autonomous basis.

Level assessment

Organisation B is found to be at Level 5 for the process P5 Configuration Management

The organisation is aware of the need for configuration management [Level 1 and Level 2 requirement]. A standardised and documented configuration management is operational [Level 3 requirement]. The need to manage the configuration is recognised at all levels of the organisation; automated tools are utilised [Level 4 requirement]. All infrastructure components are managed within the configuration management system. There are procedures established for the alignment of configuration data with vendor catalogues [Level 5 requirement].

P6 Performance and Capacity Management

The interviewees found the objectives defined for the success of this process very

important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

Within the IT department, business needs are identified regarding availability and performance of information services. For that, an availability plan exists, is current and it reflects requirements. The performance of all equipment and capacity is continuously monitored. However, due to the organisation being in the banking sector of Turkey, the forecasting capability to enable problems to be corrected before they affect system performance is only at the superficial level. In that regard, both users and operational performance groups are proactively reviewing capacity and performance and workload schedule modifications occur. However, most of the times there is a reactive response to problems which cannot be detected proactively. In addition, within the IT department, there are no analyses conducted on system failures and irregularities pertaining to frequency, degree of impact and amount of damage. An organisation wide planning process for the review of hardware performance and capacity to ensure that cost-justifiable capacity to process the agreed workloads exists. In addition, timely acquisition of required capacity, taking into account resilience, contingency, workloads and storage plans is in place.

Level assessment

Organisation B is found to be at Level 4 for the process P6 Performance and Capacity Management

The organisation is aware of the need for performance and capacity management [Level 1 and Level 2 requirement]. A standardised and documented performance and capacity management is operational where steps to be addressed at all stages of the systems acquisition and deployment methodology is in place; reports can be produced giving performance statistics; etc. [Level 3 requirement]. Processes and tools are available to measure system usage. Automated tools are used to monitor specific resources such as disk storage, network servers and networks gateways [Level 4 requirement]. There is synchronisation of the performance and capacity plans with the business forecasts and the operational plans and objectives in place. However, pro-active problem resolving needs to be established. Advances in technology are closely monitored to take advantage of improved product performance [Level 5 requirement].

P7 Operations Management

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

There are established and documented procedures for operations such as network operations, project level operations. All solutions and platforms in place are operated using these procedures, which are reviewed and tested regularly by management to ensure effectiveness. New project start-up procedures are clearly established and well-known and well-operated by the management. There are procedures established for service-level agreements with the customers and with other banks. Management also ensures that continuous scheduling of workload according to skills, processes and tasks is organised efficiently. Procedures are also in place for departures from standard job schedules. To ensure continuity, formal handover of activity is well-managed via procedures with the help of, for example, well-documented reports, etc. Sufficient chronological information is being stored in operations logs to enable the reconstruction, review and examination of the time sequences of processing.

Level assessment

Organisation B is found to be at Level 5 for the process P7 Operations Management

The organisation is fully aware of the key role of operations management [Level 1 and Level 2 requirement]. Repeatable functions are clearly defined and documented. It is possible to monitor daily activities [Level 3 and Level 4 requirement]. The operations are effective, efficient and sufficiently flexible to meet needs quickly and without loss of productivity. Automated processes are in place [Level 5 requirement].

P8 Continuous Service

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at a "excellent" level in terms of the accomplishment of each of the

objectives. The organisation has an established and documented "business continuity plan" which defines the roles, responsibilities and the risk-based approach to be adopted. In the plan the following are included: (1) emergency procedures to ensure the safety of all affected personnel, (2) response and recovery procedures which would bring the business back to the state it was in before the incident, (3) procedures to safeguard and reconstruct the site, (4) coordination procedures with public authorities, communication procedures with stakeholders, employees, key customers, critical suppliers and management. The telephone system, voicemail, fax systems, image systems, paper documents are part of the continuity plan. The critical application programs, third-party services, operating systems, personnel and supplies, data files and time frames needed for recovery after a disaster occurs are identified. Critical data and operations are identified, documented and prioritised. Alternatives regarding the back-up site and hardware are ensured. Off-site storage of critical back-up resources has been established.

Level assessment

Organisation B is found to be at Level 5 for the process P8 Continuous Service

Responsibility for continuous service is assigned [Level 1 and Level 2 requirement]. A standardised and documented business continuity plan is operational [Level 3 requirement]. Responsibilities and standards for continuous service are enforced [Level 4 requirement]. Continuous service plans and business continuity plans of the IT department are integrated with the organisation's [Level 5 requirement].

P9 Change Management

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at an "very good" level in terms of the accomplishment of each of the objectives.

The management has ensured that all requests for changes, system maintenance are standardised; they can be categorised and prioritised to be handled. Methodology for prioritising system change requests from the personnel does not

exist; but all requests for change are structurally assessed. The realisation is mostly within the divisions. The change process ensures that whenever system changes are implemented, the associated documentation and procedures are updated accordingly. Maintenance personnel's, i.e. network system personnel's, access rights are controlled to avoid risks of unauthorised access. The release of software is governed by formal procedures ensuring sign-off, packaging, handover, etc.

Level assessment

Organisation B is found to be at Level 4 for the process P9 Change Management

There is a defined formal change management process in place, including categorisation, prioritisation, emergency procedures, change authorisation and release management [Level 3 requirement]. The process is efficient and effective but relies on considerable manual procedures and individual personnel within divisions of the IT department to ensure that quality is achieved [Level 4 requirement]. There is awareness but no evidence showing that application of IT change management is integrated with business change management [Level 5 requirement].

P10 Monitoring Services

The interviewees found the objectives defined for the success of this process very important to their organisation and they have come to a consensus that their organisation is at an "excellent" level in terms of the accomplishment of each of the objectives.

Relevant performance indicators from both internal and external sources are being defined, and data is being collected. Both organisational and individual performance measures and indicators are collected. There is a continuous performance evaluation done regularly. In addition, customer satisfaction regarding the services delivered by the organisation is measured via external audits. Activities including internal reports, internal audit reports, external audit reports, user reports, system development plans and status reports and any other assessments are reported. These are communicated with the related personnel or division within the organisation.

Level assessment

Organisation B is found to be at Level 5 for the process P10 Monitoring Services

Management recognises a need to collect and assess information about monitoring services [Level 1 requirement]. Basic measurements to be monitored are identified [Level 2 requirement]. A formalised knowledge base of historical performance information has been developed [Level 3 requirement]. Criteria for evaluating organisational development based on maturity models have been defined. Measurements of the services function performance include financial, operational, customer and organisational learning criteria [Level 4 requirement]. A continuous quality improvement process is in place [Level 5 requirement].

5.4.2.3 Discussion

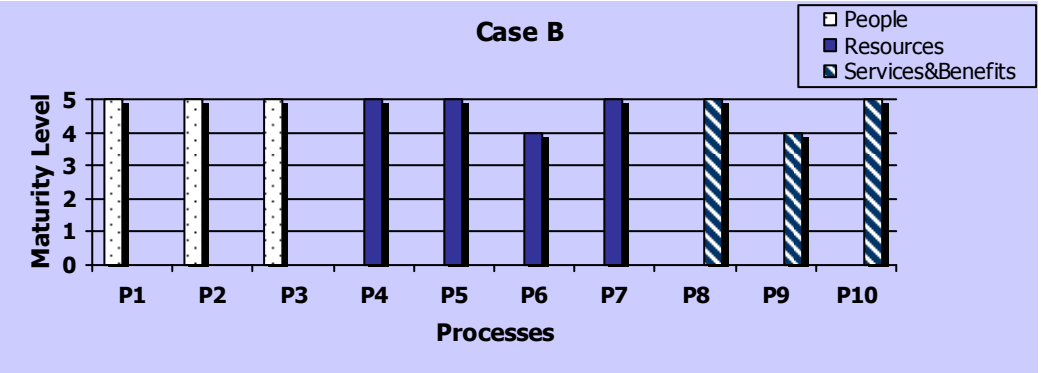


Figure 5.3 Process-maturity chart of Case B

According to the proposed assessment framework, PB-ISAM, the organisation B's process-maturity chart is as depicted above in Figure 5.3 *[answer to question 1 of Table 5.2]*. A five level assessment is found to be appropriate for organisation B *[answer to question 3 of Table 5.2]* since the organisation, being in the banking sector, is very familiar with terms like "performance evaluation", "internal assessment", "audits", etc. It was straightforward to position the processes into levels with convincing arguments as elaborated in the previous section for each process.

During the data collection and analysis, it has been observed that for an IT department of a bank, the three major components were people, resources and services & benefits, which validates the three components of PB-ISAM *[answer*

to question 6 of Table 5.2]. Within this IT department, the "people" component refers to individuals working for the organisation. Therefore there was not any confusion of positioning "people" as "resources". There was a clear distinction of "people" and "resources" in this sense, unlike Case A, where a "programmer" was regarded as a resource. This is due to the strict hierarchical order of roles and responsibilities. In addition, the IT department is part of a larger organisation, where human resources department is a separate department. It has been observed that all the processes were totally relevant to the organisation *[answers to question 4 and partially to question 5 of Table 5.2]* and they are trying to improve themselves in most of these processes: continuous improvement efforts are observed in all of the processes but particularly in processes P8, P9, and P10 which lie under the services & benefits component of PB-ISAM. This is because the organisation sees itself as a "service provider" functioning in the banking sector. In addition, one of objectives of the IT department is found to be establishing improvement plans for CMM and CobiT certifications. Therefore, it was observed that the processes of PB-ISAM overlap with the departmental improvement domains.

In addition, both internal and external performance evaluations (i.e. internal organisational performance evaluations carried out by the IT department and by the organisation as a whole; and other evaluations carried out by external independent audits) that are currently in use within the department (and within the organisation) did not conflict but they were complementary to the PB-ISAM *[answer to question 2 of Table 5.2]*. The IT department assessed was in a preparation stage for the CMM certification. In addition, the senior management was trying to adapt CobiT framework within the IT department. In that regard, PB-ISAM evaluation has given the IT department of Case B, a comprehensive insight for their improvement plans since they have found the results convenient and appropriate for their use. It needs to be emphasized that the level assessment of PB-ISAM would only provide the IT department with a direction towards CMM certification and for the adaptation of CobiT. This is because each of the models is expected to yield different results in terms of levels for the processes assessed. For instance, CMM looks into the help desk function at a lower application level where all the respond times, etc. are clear-cut. The process where

the evaluation of the help desk is done is P3 of PB-ISAM where the assessment is at a departmental level, and identifying precise response times would not be a critical success determinant at that level.

5.4.3 Case C

5.4.3.1 Background

Case C is the information system work-group of an academic institution. The institution is one of the largest public universities in Turkey. The university employs 700 faculty (professors, associates professors etc.), 300 academic instructors, over 1.000 research assistants, and has over 20.000 students. The total number of the university alumni is above 60.000. Operational throughout a university of such high educational potential, Case C provides an online educational service for students and instructors in the university aimed to support regular, online and partially-online courses.

Case C uses a locally developed distance education infrastructure. It is a learning management system that provides an asynchronous learning environment for instructors and students alike. It allows the instructors to manage their courses electronically without the need of extensive technical knowledge and it provides opportunity to students for life long learning. It also involves features for system administrators in order to conduct an effective administration over the system.

The tool can be used as a platform for online courses or it can be used as a support tool for regular face-to-face classroom courses. The system is reusable and transportable to other platforms.

All components of the information system are being developed by the work group of the university since 1997, by taking into account the faculty and student feedback in campus wide ALN (Asynchronous Learning Network) courses. The tool is in continuous development and new features are constantly added.

All accesses to the system are authorized by the system and related view is presented to the user. There are three users: (1) student, (2) instructor, and (3)

administrator. The system allows both students and instructors to follow and manage web-based asynchronous courses using standard web interfaces. It provides administrators to manage users, courses and overall structure of the system.

The major features of the system for instructors and students include forum, e-mail, test tools (online exam), gradebook, student tracking, assignments and lecture notes. The system provides these utilities using graphical user interfaces. It also includes some powerful and necessary functions and features for administrator in order to administer the system effectively. These features are adding, listing, modifying users, adding, listing, modifying course, getting course request from instructors, getting user applications to the system and managing general forum etc.

The system provides a secure environment for creating and managing courses. However, it is not an authoring tool. One cannot prepare lecture notes using the information system. Lecture notes should be prepared using standard HTML editors such as *frontpage* or *composer*, and *java* or *flash* for animation/interactive examples. prepared notes are uploaded to the system using file transfer programs like *ssh*.

The institution does not hold any internationally certified/recognised certificates (apart from the education related ones such as ABET). Total number of personnel involved in the information system work group is 7 of four software engineers, one system administrator, one graphical designer and one group director.

The interviews have been conducted with:

i. Director of the information system workgroup
ii. Former director of the information system workgroup
iii. Three software and system development engineers
iv. System administrator

In addition to the interviews, where available, reports such as the software requirements specification (SRS) documents, software design documents (SDD),

user feedback survey documents, etc., associated with the process assessed were examined which helped to verify the accomplishment of an objective of that particular process. Moreover, the IS work-group's web-site provided electronically documented publications. The feedback of findings for case C was posted via e-mail to the interviewees. These, altogether, helped to fill in the gaps between interviews and observations as well as to cross-check the data achieved. In the following sections, under each process, findings from these multiple resources (i.e. interviews, observations, documents) concerning case C are given.

5.4.3.2 Findings

P1 Definition of the IS organisation and relationships

The interviewees found the objectives defined for the success of this process very important to the work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

The senior management have appointed committees which meet regularly and report to institute. However, although these meetings are held regularly, there is no regular form of reporting. All the personnel in the work group have and know their roles and responsibilities in relation to information systems. Nonetheless, the segregation of duties between the personnel is not maintained strictly. In this respect, job or position descriptions for the personnel were not clearly established including definitions of skills and experience needed in the relevant position. Therefore it was difficult to carry out a performance evaluation. The work group uses a groupware tool for collaboration. There is a flexibility of role and responsibility allocation within the work group. Although the organisation is a public organisation where a strict hierarchical order was expected, there is not an established hierarchical order within the work group. However the group leader is strictly obeyed.

Level assessment

Case C is found to be at Level 3 for the process P1 Definition of the IS organisation and relationships

There is defined organisational structure, roles and responsibilities are informally assigned [Level 2 requirement]; lines of responsibilities are clear [Level 3 requirement]. Both within the institute and within the work group, no best practices are applied. IS management has the appropriate skills and expertise to define, implement and monitor the preferred organisation and relationships. However, there is no documented, measurable evidence showing that these skills and expertise are implemented. There is continuous improvement in place only informally [Level 5 requirement].

P2 Education and training of users

The interviewees found the objectives defined for the success of this process "important" to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

The IS work group is composed of software engineers who are graduate students at the university. Therefore, the system runs dependent mainly on individuals' skills and experience. There is no evidence of procedures for identifying the training needs of the personnel. There is neither related documentation nor budget allocation for this purpose. Training is done at an individual level, that is, when any one of the technical personnel needs a specific training; he/she has to search for that training in order to improve himself/herself.

Level assessment

Case C is found to be at Level 2 for the process P1 Definition of the IS organisation and relationships

The work group is aware of the need for a training and education program and for associated processes [Level 2 requirement]. The training efforts are at an individual level. There is no training and education program that has been institutionalised and communicated; there is no evidence showing that work group management identifies and documents training needs; budgets, resources and facilities are established [Level 3 requirement]. Processes associated under improvement and there is no evidence of a comprehensive training and education program that is focused on individual and information system needs [Level 4 and Level 5 requirement].

P3 Provision of assistance and advice to IS users

The interviewees found the objectives defined for the success of this process "very important" to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

Within the organisation, there is user support established operational by the system administration. Individuals responsible for performing this function closely interact with other personnel where escalation procedures are very well done. However, there is no documentation for this escalation process that it works completely dependent on individuals. There are no procedures ensuring that user queries which cannot immediately be resolved are appropriately escalated to the right personnel but since the majority of the workgroup is working in the same location, only the director is located somewhere else, problems are tackled promptly. There are no procedures in place to ensure that all user queries are adequately registered. There is an annual meeting which aims to provide the system users with sufficient training. However, this meeting is not documented or established. Assistance to users is done at an individual level, i.e. face-to-face, via e-mail etc.

Level assessment

Case C is found to be at Level 2 for the process P3 Provision of assistance and advice to IS users

The organisation recognises that a process supported by tools and personnel is required in order to respond to user queries and manage problem resolution, and is aware of the need for a help desk function [Level 1 and Level 2 requirement]. However, there is no evidence showing that there is a standardised and documented help desk and call centre are available [Level 3 requirement]. The call centre is not well organised, and is dependent on individuals. The need for continuous improvement is recognised and the call centre processes are refined accordingly [Level 4 and Level 5 requirement].

P4 IS Interactions

The interviewees found the objectives defined for the success of this process very

important to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

There is realisation of the need for interactions with other information systems. This is mainly due to the system, being a system which needs to be up-to-date with the most current technology available. IS interactions are realised as a result of the Internet medium. Common IS interactions include extensive use of similar distance education tools' web pages, online test pages prepared for the system users (i.e. students and teachers). There is evidence of informal documentation on the use of other ISs.

Level assessment

Case C is found to be at Level 3 for the process P4 IS interactions

The organisation is aware of the need for interactions among ISs [Level 1 and Level 2 requirement]. It is left to the individual to find and use other ISs whenever needed [Level 3 requirement]. There are neither standardised nor documented procedures. There is not a full understanding of interactions among ISs at all levels of the work group [Level 4 requirement]. There are no improvement efforts on spreading the use of other ISs within the IS work group [Level 5 requirement].

P5 Configuration Management

The interviewees found the objectives defined for the success of this process "very important" to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

Within the institute where the work group operates, there are procedures in place to ensure that only authorised and identifiable configuration items are recorded in inventory upon acquisition. Changes to the configuration, for example new item, status change from development to prototype, are tracked. There is a configuration recording system which includes reviews of changed records. The management checks these records regularly, and ensures that they reflect the

actual status of all configuration items including the history of changes. There are clear policies restricting the use of personal and unlicensed software. The organisation uses virus detection software. There is no evidence that personal computers are checked automatically for unauthorised software. Also, there is no evidence that compliance with the requirements of software and hardware license agreements is reviewed regularly. All software is labelled, inventoried and properly licensed.

Level assessment

Case C is found to be at Level 3 for the process P5 Configuration Management

The organisation is aware of the need for configuration management [Level 1 and Level 2 requirement]. There is a standardised and documented configuration management is operational [Level 3 requirement]. The need to manage the configuration is not recognised by all personnel within the IS group; there are no automated tools are utilised [Level 4 requirement]. There is no evidence of alignment of configuration data with vendor catalogues and no evidence showing that all infrastructure components are managed within the configuration management system. [Level 5 requirement].

P6 Performance and Capacity Management

The interviewees found the objectives defined for the success of this process "very important" to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

Within the work group, needs are identified regarding availability and performance of information services. For that, an availability plan exists, is up-to-date and it reflects requirements with the help of the feedback from the system users. The performance of all equipment and capacity is continuously monitored. However, due to the system being operational since 1997, similar problems which repeat themselves are detected. Therefore, the forecasting capability to enable problems to be corrected before they affect system performance is handled by the individuals. However there is no evidence showing that users and operational performance groups are proactively reviewing capacity and performance and

workload schedule modifications occur. As a result, most of the times there is a reactive response to problems. In addition, within the work group, there are no analyses conducted on system failures and irregularities pertaining to frequency, degree of impact and amount of damage. There is an informal institute wide planning process for the review of hardware performance and capacity to ensure that cost-justifiable capacity to process the agreed workloads exists.

Level assessment

Case C is found to be at Level 4 for the process P6 Performance and Capacity Management

The institute and the work group are aware of the need for performance and capacity management [Level 1 and Level 2 requirement]. There is a standardised and documented performance and capacity management operational where steps to be addressed at all stages of the systems acquisition and deployment methodology is in place; reports can be produced giving performance statistics; etc. [Level 3 requirement]. Processes and tools are available to measure system usage. Automated tools are used to monitor specific resources such as disk storage, network servers and networks gateways [Level 4 requirement]. There are no procedures established for pro-active problem resolving. Advances in technology are closely monitored to take advantage of improved product performance [Level 5 requirement].

P7 Operations Management

The interviewees found the objectives defined for the success of this process very important to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

There are established and documented procedures for operations such as network operations, project level operations. All solutions and platforms in place are operated using these procedures, which are reviewed and tested regularly by work group management to ensure effectiveness. There are no procedures established for new project start-up; however, continuous improvement of the system is well-carried out and well-operated by the work group management. There are no procedures established for service-level agreements with the system users. There

are no procedures in place for departures from standard job schedules; this is handled on an individual basis. To ensure continuity, although there are no formal procedures established, formal handover of activity is managed with the help of, for example, documented reports, etc. Sufficient chronological information is being stored in operations logs to enable the reconstruction, review and examination of the time sequences of processing.

Level assessment

Case C is found to be at Level 3 for the process P7 Operations Management

The work group is fully aware of the key role of operations management [Level 1 and Level 2 requirement]. Repeatable functions are clearly defined and documented [Level 3 requirement]. It is not possible to monitor daily activities [Level 4 requirement]. The operations are mostly carried out by individuals; decreasing their effectiveness, efficiency and flexibility to meet needs quickly and without loss of productivity. There are no automated processes for the management of operations in place [Level 5 requirement].

P8 Continuous Service

The interviewees found the objectives defined for the success of this process very important to their work group and they have come to a consensus that their work group is at a satisfactory level in terms of the accomplishment of each of the objectives.

There is no established and documented "business continuity plan" which defines the roles, responsibilities and the risk-based approach to be adopted. In case of a disaster within the system, main server is checked for operations logs for recovery. The critical application programs, operating systems, personnel and supplies, data files and time frames needed for recovery after a disaster occurs are not formally identified. Critical data and operations are not formally identified, documented or prioritised; all these are left to individuals within the work group. There is no evidence of alternatives regarding the back-up site and hardware. There is no off-site storage of critical back-up resources.

Level assessment

Case C is found to be at Level 2 for the process P8 Continuous Service

Responsibility for continuous service is assigned [Level 1 and Level 2 requirement]. There is no evidence of a standardised and documented business continuity plan operational [Level 3 requirement]. There are no responsibilities and standards for continuous service enforced [Level 4 requirement]. There is no evidence showing that continuous service plans and information system continuity plans are integrated [Level 5 requirement].

P9 Change Management

The interviewees found the objectives defined for the success of this process very important to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

The work group management has *only informally* ensured that all requests for changes, system maintenance are standardised; they can be categorised and prioritised to be handled. There is no evidence of documentation. There is no formal methodology for prioritising system change requests from the personnel; all requests for change are assessed informally. The change process ensures that whenever system changes are implemented, the associated documentation and procedures are updated accordingly; however, for Case C, these rely on individuals. Responsibilities are assigned so that maintenance personnel's, i.e. system administrator personnel's, access rights are controlled to avoid risks of unauthorised access.

Level assessment

Case C is found to be at Level 2 for the process P9 Change Management

There is a realisation of formal change management process in place [Level 2 requirement], including categorisation, prioritisation, emergency procedures, change authorisation and release management. However, these are not formally established, nor documented [Level 3 requirement]. The process is sufficiently efficient and effective but relies on individuals to ensure that quality is achieved [Level 4 requirement]. There is no evidence showing that application of information system change management is integrated with the institute's change management [Level 5 requirement].

P10 Monitoring Services

The interviewees found the objectives defined for the success of this process very important to their work group and they have come to a consensus that their work group is at a "satisfactory" level in terms of the accomplishment of each of the objectives.

There is a "system monitoring" tool developed which is flexible to adjust for monitoring and tracking the required features of the system for the time periods desired. There is however no formally established performance analysis conducted; this relies on considerable manual procedures. There is no evidence that work group and individual performance measures and indicators are collected. There is not a continuous performance assessment observed. In addition, the improvement objectives are not clearly established. Customer satisfaction regarding the services delivered by the work group is measured via feedbacks. There is no evidence of activities including internal reports, internal audit reports, external audit reports, user reports, system development plans and status reports and any other assessments are reported.

Level assessment

Case C is found to be at Level 2 for the process P10 Monitoring Services

The work group management recognises a need to collect and assess information about monitoring services [Level 1 requirement]. Basic measurements to be monitored are identified, and scripts are written according to needs [Level 2 requirement]. There is no formalised, documented knowledge base of historical performance information has been developed [Level 3 requirement]. Criteria for evaluating work group development based on maturity models have not been defined. Measurements of the services function performance include operational, customer and organisational learning criteria; however these are not formally established, they are only informally carried out [Level 4 requirement]. There is no evidence of a continuous quality improvement process in place [Level 5 requirement].

5.4.3.3 Discussion

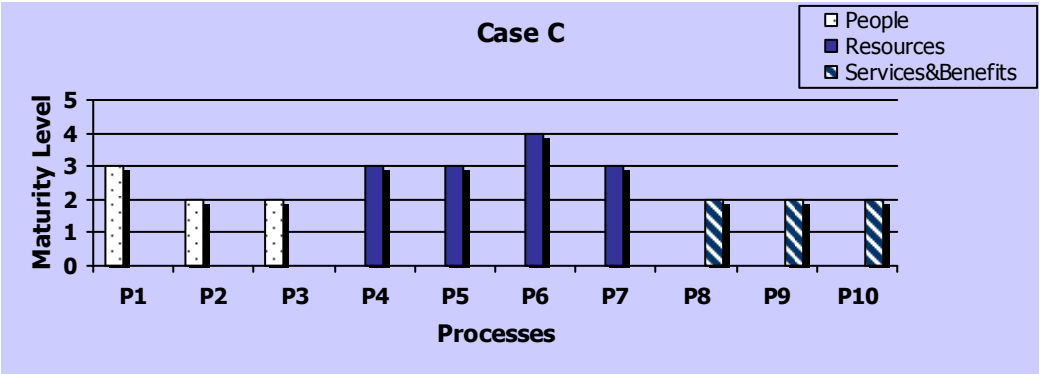


Figure 5.4 Process-maturity chart of Case C

According to the proposed assessment framework, PB-ISAM, Case C's process-maturity chart is as depicted above in Figure 5.4 *[answer to question 1 of Table 5.2]*. The IS work group has not previously experienced any performance evaluation, therefore it was not possible to find out if this assessment corroborates other assessment *[answer to question 2 of Table 5.2]*. However, a five level assessment was found to be appropriate for Case C *[answer to question 3 of Table 5.2]* because the objectives of each process were totally relevant to the work group *[answer to question 4 and 5 of Table 5.2]* and it was straightforward to position the IS work group within these levels. During the assessment, it has been observed that for a public organisation and for an IS work group within this organisation, the three major components were people, resources and services & benefits, which validates the three components of PB-ISAM *[answer to question 6 of Table 5.2]*. In this Case C, these three components are more relevant since the IS work group is not profit oriented but is primarily aiming to gain the most benefit out of the service it provides. Similar to Case B, within the institute (and within the university), the "people" component refers to individuals working. There is an informal hierarchy of roles and responsibilities that each individual person is responsible for his/her job only, and there is the flexibility of allocation of persons between tasks. Although in Case C, the maturity level of each process assessed is rather low (see Fig 5.3), this is not surprising since the IS work group belongs to a public organisation and this public organisation is a university where the primary importance is the service provided. There is a greater flexibility when

compared to private organisations: there are more flexible deadlines; and graduate students who are not full time employees are assigned to tasks.

5.5 Comparison of Findings

This section brings together the key issues and insights from the three case studies with a view of the relevant literature presented in Chapter 2 and with a view of the detailed model description presented in Chapter 3. The objective is to highlight conclusions and recommendations concerning information systems effectiveness assessment. The major findings from each of the three case studies in terms of the research framework of the thesis have been presented separately at the end of each case study adoption. Therefore, in this section, the analysis focuses on the cross-discussion of the empirical research findings from the three cases studied.

In this section, the discussion has been carried out in parallel with Chapter 3, where the process of developing the proposed model has been explained. Chapter 3 commences with stating the objectives of the model; following model relations and model components are described respectively. However, this section will be in the reverse order: first, (1) the three components and the processes of the model *[corresponding to section 3.4 and chapter 4]*; following (2) the model relations *[corresponding to section 3.2]*; and finally (3) the model objectives *[corresponding to section 3.1]*. In addition, within these three parts, the guidelines for IS evaluation are discussed *[corresponding to section 2.4.1]*. This discussion takes place in parallel with Table 3.2 where these guidelines are mapped to PB-ISAM.

5.5.1 Model components and processes

In the light of the three case studies, it has been observed that for an IT/IS organisation, the proposal for specifiying the three major components as (1) people, (2) resources, and (3) services and benefits has been justified. The proposed conceptual approach extends previous work on information systems success evaluation by focusing on the processes related with these three major

components. All three components were found to be equally important for the cases studied. In addition, this argument is found to be valid independent from the organisation, department or system. This independence has been verified by the three cases studied: one of the cases was an IT department, one an IT organisation and the third was an IS work group. One of the reasons for this independence is that these three components were initially derived from the working definition of IS evaluation as elaborated previously in Section 3.1.

The minimum of the maturity levels for each of the three components of PB-ISAM for cases A, B and C are presented in Figure 5.5.

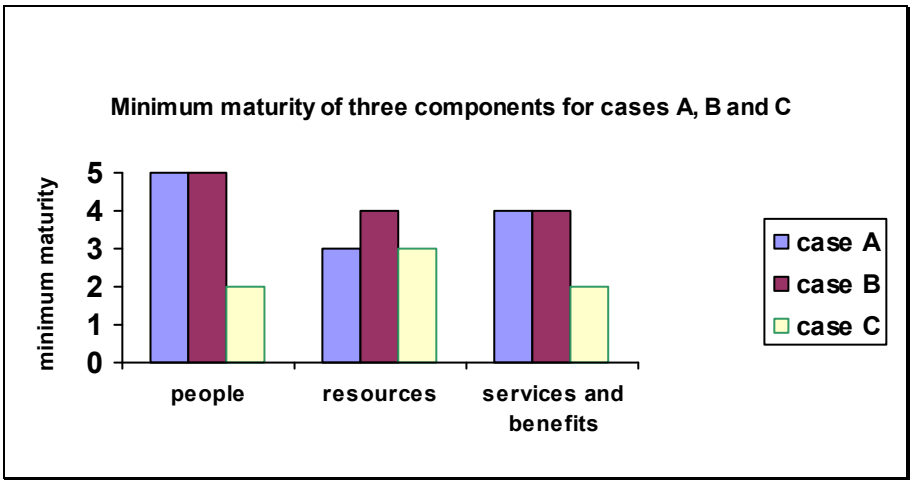


Figure 5.5 Chart depicting the minimum maturity of three components of PB-ISAM for cases A, B and C.

It can be observed that for case C, the "resources" component was relatively more mature than the other two. This is not surprising because case C is a small IS work-group operational in an established institution, making use of the resources of that institution. While taking the minimum level among all processes as an aggregation method seems plausible, as indeed is done within the CMM framework, other approaches may be considered. This, however, is beyond the scope of the current study, and could be devised after extensive experience is gained within the proposed assessment method.

The processes of the proposed model PB-ISAM were found to be relevant to the cases studied. The maturity levels of each process for cases A, B and C altogether

are depicted in Figure 5.6. Although the components and their processes were set as distinctive entities, it has been observed that in some situations, these interact (e.g. in Case A, when perceiving "people" and "resources" components, some overlaps were explored) and they are meaningful only when integrated. This matches directly with the guideline "2.4.1.6 Preserve that components interact and that they are integrated". In addition, the processes within the components as well as the three components altogether form a synergy, constructing the whole model, as indicated by the guideline "2.4.1.5 Aim to achieve synergy".

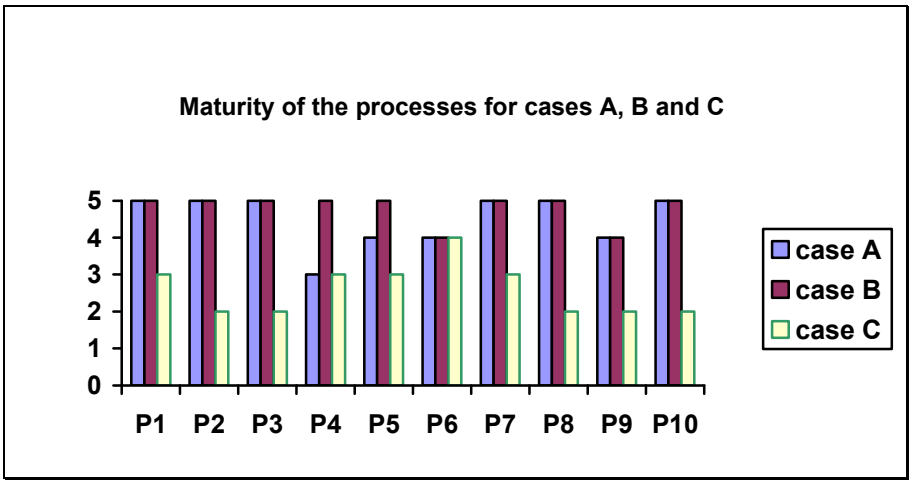


Figure 5.6 Maturity chart of the ten processes of PB-ISAM for cases A, B and C.

5.5.2 Model relations

The three model relations have been interpreted via three case studies as follows:

i. People demand resources

It has become evident that the "people" element could not be isolated from an information system as stipulated by the guideline "2.4.1.1 Capture the human element". For each of the case studies the stakeholders of an IS were clarified; and the processes positioned under the "people" component enabled to better identify the roles and responsibilities of "people". Furthermore, although the processes helped to distinguish between these two domains; in one of the cases (e.g. Case A) the interpretation of "people" as a "resource" was faced. This supports the argument that components that build an information system interact in agreement

with the guideline "2.4.1.6 Preserve that components interact and that they are integrated".

ii. Resources are used in services and benefits

The positive correlation between the effectiveness of an information system and the impacts of that information system has been confirmed by the three case studies. In all the cases, parallel with the guideline "2.4.1.13 Do not disregard interactions among information systems", it has been observed that the tangible resources (e.g. configuration) as well as the intangible resources (e.g. the Internet, other information systems) were found to be critical for the services and benefits provided by that information system.

iii. Services and benefits are for people

In all the cases, it has been observed that there is a positive impact of improved service and benefits on people. This is because processes defined under the services and benefits component were only meaningful if they were interpreted from the IS stakeholder perspective as specified by the guideline "2.4.1.1 Capture the human element".

5.5.3 Model objectives

The objectives of the proposed model of IS effectiveness, PB-ISAM, were previously stated in seven constituents in Section 3.1: (1) stakeholder, (2) content, (3) context, (4) purpose, (5) time frame, (6) data type, and (7) aspect. Within these seven constituents of objectives, the case studies have achieved the following points:

i. Context, stakeholder and data type

In congruence with the guideline "2.4.1.8 Do not disregard the process maturity model", the maturity level approach of PB-ISAM enabled a thorough coverage of the information system assessed, where strengths and weaknesses for each

component were investigated. In addition, despite significant resource demands, the maturity level assessment approach provided consistent and repeatable results. Moreover, the maturity level approach also enabled to compare and contrast three cases.

Furthermore, an evaluation of the information system against the model helped to determine the level at which the information system currently stands. It indicated the information system's maturity in the area (i.e. in the specific process) concerned, and the objectives on which the organisation needs to focus in order to see the improvement for effectiveness of the information system.

Subjective opinions of different stakeholders were combined by means of PB-ISAM assessment. This was carried out according to guidelines "2.4.1.1 Capture the human element" and "2.4.1.4 Do not disregard the subjectiveness of effectiveness measurement and regard information system as a multiperspective and multidimensional entity".

ii. Purpose and time frame

The study focused on the assessment of the information systems where profit in terms of financial gain was of no concern. An *ex post* evaluation has been accomplished. In two of the case studies (i.e. cases that have undergone other assessments either externally or internally), it has been observed that the current research was complementary to other assessments carried out in agreement with guideline "2.4.1.3 Do not disregard the complementary nature of the frameworks".

iii. Content and aspect

PB-ISAM judged the achievement of pre-determined objectives. These objectives were meaningful within the organisational context as stipulated by the guideline "2.4.1.11 Do not disregard the importance of the organisational context". Moreover, in congruence with the guideline "2.4.1.12 Observe the parallelism of organisational effectiveness and information systems effectiveness", all three case

studies have revealed the analogy between organisational effectiveness and information systems effectiveness. Interactions among information systems have been examined in three case studies and it has been observed that this was significant to the information system in parallel with the guideline “2.4.1.13 Do not disregard interactions among information systems”.

PB-ISAM is a flexible model in the sense that it can be altered easily if adoption to various information systems is desired. The three different case organisations studied have revealed that the model is easily applicable to the cases provided that the information system outputs can be explicitly defined, independent of the organisation, department or system. This matches with the guidelines “2.4.1.7 Aim to achieve standardization, applicability and alignment” and “2.4.1.9 Aim to achieve reduced complexity”.

CHAPTER 6

CONCLUSIONS

This chapter commences with an overview of the research. Following, theoretical and practical contributions of the research are presented. Next, limitations of the study in terms of the research paradigm adopted and in terms of the research design are given. The chapter concludes with recommendations for further research.

6.1 Summary of Work Done

This thesis has investigated the subject of evaluation of information systems effectiveness. The study of IS success evaluation as part of the overall IS management and IS development has become very important. However, IS effectiveness assessment is complicated with many conceptual and operational difficulties.

From the extensive literature review presented in Chapter 2, it became clear that IS effectiveness is an area that needs to take into account different contexts. This research merged different contexts as presented in the conceptual model. In addition, the study combined perspectives of different information system

stakeholders. The main focus was on the assessment of the "effectiveness" of the information system where profit in terms of financial gain was of no concern.
The accumulation and discussion of the research findings was presented in Chapter 5. The analysis of the cases clarified the importance of the (1) people, (2) resources, (3) services and benefits components of, in addition to the processes involved in an information system.

6.2 Research Contribution

The current study provides a deep consideration of the conceptual and operational issues of information systems effectiveness evaluation. Both the academic community and practitioners will benefit from the research contributions.

Walsham (1993) argues that there are four types of contributions of interpretive case studies: the development of concepts, the generation of a theory, the drawing of specific implications, and the contribution of rich insight in the subject matter. The contribution of this research to concept development can be seen in the introduction of the "conceptual framework for information systems effectiveness" (see chapter 3), and in the introduction of the "assessment methodology" (see chapter 4) as well as work on IS evaluation guidelines (see section 2.4.1). A novel model of information systems effectiveness was proposed and an associated process based assessment method was elaborated. Specific implications were drawn concerning the relationships between processes and the information system assessed. The three in-depth case studies provided rich insight into the IS effectiveness field.

6.1.1 Implications of the research for researchers – theoretical contribution

The main theoretical contributions lie in the understanding of the conceptual foundation of the phenomenon of IS effectiveness evaluation.

Critical review of the literature:

The existing literature has been reviewed critically from a different perspective emphasising on the need for "understanding" and "comparing" the three contexts of effectiveness: (1) information systems, (2) software development process, and (3) information technology. This has provided a solid starting point for new researchers in the area.

Development of theoretical constructs:

Research on information systems effectiveness evaluation has been characterized here as context and process-driven. Previous research (e.g. DeLone and McLean, 2003) which did not focus on the "process" did not move further than the static definitions of the contexts identified for information systems success. The conceptual model proposed in this study has provided a solid basis for the IS processes. In addition, the proposed conceptual approach extends previous work on information systems success evaluation by focusing on the processes related with three major components that construct an information system: people, resources, services and benefits. The experience acquired can assist in the understanding of IS effectiveness assessment in an organisational context and the understanding of the processes related with IS effectiveness as well as understanding of the assessment roles assigned and performed by different stakeholders. This knowledge can further facilitate the design and implementation of methodological approaches on other information systems to fill in the gaps in the operational front of IS evaluation in general.

Insight and specific implications of information systems effectiveness assessment:

The experience from the three cases studies was aligned to the literature (i.e. guidelines deduced, see section 5.5). A number of lessons learnt about information systems effectiveness evaluation will be valuable to any stakeholders and researchers involved in such assessment.

6.1.3 Implications of the research for practitioners – practical contribution

For the community of managers, information systems developers and decision makers who often face information systems effectiveness evaluation, a number of practical contributions are offered. In general, they would benefit from the research deliverables through a deep understanding of the processes related with information systems effectiveness.

Indications of the positive practical contributions derived from the initial feedback received from the case study participants. Some of the research findings (i.e. the maturity descriptions) have been used in Case B for the department's future information technology evaluation programme (i.e. adoption of CMMI and CobiT). For the Case A, the thesis findings were perceived as an objective external assessment complementary to their organisation-wide evaluation efforts (i.e. efforts for CMMI Level 5). In the last case, the thesis work will be beneficial to their overall improvement plans. However, the utilisation of the findings has so far been restricted to the individuals involved in the case studies.

6.3 Limitations and Further Research

6.3.1 Critique of the adopted research paradigm

The underlying epistemology of this thesis has been broadly *interpretive.* The suitability of this philosophy as well as the suitability of the qualitative research for the investigation of information systems evaluation has been justified extensively in Section 5.1 and 5.2. However, the interpretive research philosophy has its own deficiencies. The weaknesses of interpretive studies can be summarised as follows (Orlikowski and Baroudi, 1991):

- Lack of consideration of the external conditions that give rise to meanings and experiences.
- Omission of any explanation of the unintended consequences of actions.
- Structural conflicts within an organisation and contradictions are ignored.

This study focused particularly in the effectiveness of three components via processes identified. Roles and responsibilities of the individuals with whom the interviews have been conducted are inherently intangible, and their observed elements and the information they provide may have been influenced by other factors (e.g. 'local' politics, organisational privacy) for which the researcher was unaware. This might have affected the objectivity.

All the above weaknesses were known in advance, and experience and recommendations from previous interpretive studies (e.g. Walsham, 1993; Yin, 1984) were taken into consideration to overcome them. A number of interpretive cases (e.g. Yin, 1993; ISACA web site; SEI web site) were critically examined. In addition, the research design (see section 5.3) was carefully developed.

The conceptual model has been developed based on the discussion carried out in regard to model (1) objectives, (2) relations and (3) components (see chapter 3); which has drawn the boundary of the research. The components of the conceptual model identified separately for analytical purposes, are highly interlinked and in some cases overlapped in real life situations. Their study in isolation might question the credibility of the findings. However, aggregation of the assessment of components and their multiple processes is out of the scope of this study. Neither has any proposal been put forward regarding the relative weights of the assessed processes. Rather, individual assessment of processes has been accomplished. It was then important not to attempt to fit the data to a generalised framework, but seek to interpret the findings as encountered in the empirical research. This was facilitated by the assessment framework adopted in Chapters 4 and 5.

6.3.2 Limitations of the work done

The research adopts the case study methodology, which has also experienced critiques. Benbasat *et al.* (1987) focus on the non-representativeness and the credibility of the results, in terms of generalisability. The limited number (three) of case studies limited the general validity of the conclusions. Furthermore, the diversity of the three participant organisations limited the generalisability of the findings as the study focused on particular divisions/departments which might not

represent the entire organisation (e.g. the large size of Case B, a small information systems workgroup as in Case C). In addition, the participant organisation being a public or a private one also restricted the generalisation of the findings.

From an interpretive epistemological attitude, the validity of the results does not depend on a positivistic sense, but on the credibility of the analysis of the case study findings and drawing conclusions from them (Lee, 1989). In order to compensate for this, while designing the research, an informal triangulation of drawing on other literature and empirical research material (e.g. case studies on assessment of software process development projects, on organisational quality assessments, etc.) has been carried out.

In addition, in some situations, problems in gathering the empirical data were experienced. The access provided was not always at the level of a problem, but it was concerned in general as a way of exploring the strengths of the case organisation. Moreover, in some situations, communication problems such as the ignorance of the academic literature, and the lack of understanding of the needs of the particular research were faced.

6.3.3 Future Work

Recommendations for future research in this area are closely connected to the limitations mentioned above. In the short term, this research study can be enriched with adoption of the assessment model on other information systems within specific contexts. This could be a stream for further research that would concentrate on exploring the situation of the effectiveness of information systems within specific contexts. In that regard, effectiveness assessment frameworks specific to a variety of case organisations could be developed. Such a further work could strengthen the findings of the information systems assessment method proposed in this study.

Furthermore, a new assessment method associated with the conceptual model proposed in this study might be studied. In that, other research methodologies could be utilised, for example a positivistic quantitative research methodology

where the correlations of the model components might be examined on similar case organisations; and the results could be compared with the findings of this research.

Perhaps it could be advisable to include additional processes that explore each of the model components of the conceptual model more deeply in a future study. Another option might be to address other set of components, than that examined in this study, that could construct an information system.

In addition, a further development of the idea of "an emerging framework for IS effectiveness assessment" would be a possible research area. Further research would also be directed towards the area of "information systems processes". This could include the enhancement of the processes of the model components investigated here. Besides process refinement, it is left to the future research to continue mapping information systems effectiveness measures to organisational effectiveness measures.

Another area of research may be related to the scope, sufficiency and relative significance of the ten processes defined under the three components of PB-ISAM. This study has not attempted to attribute weights to the processes, nor has it aimed to derive a combined unique measure of IS effectiveness. Such work may, possibly, establish a direct functional relationship between a quantitative measure of IS effectiveness and the maturity levels of constituent processes.

To conclude, this study was designed to be only a step in the field of ever evolving information systems success research.

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APPENDICES

Appendix A. Method presentation

Bilişim sistemlerinin değerlendirilmesinde, İnsanlar, Kaynaklar ve Hizmetler üçgenini oluşturan süreçlerin ayrı ayrı değerlendirilecegi yeni bir yaklaşım önerisi

Modelin her bir ayağı (Insanlar, Kaynaklar ve Hizmetler) geniş bir literatür taraması (IS, IT ve SW) sonucu belirlenmiş süreçler ile değerlendirilecek. Değerlendirme herbir processin olgunluğunun belirlenmesi şeklinde olacak. Yani organizasyonel kalite/performans değerlendirilmesi, CMM, CobiT, ve diğerlerine benzer şekilde 5 olgunluk seviyesi tanımlandı. Herbir süreç altında hedefler belirlendi, hedeflere yakınlık o sürecin olgunluğunun işareti olacak. Bunları uygulamak ve bu modelin kullanılabilirliğini test etmek istiyoruz.

Modelin parçası	Ölçülecek süreçler
İnsanlar	P1 Bilgi teknolojisi organizasyonunun ve ilişkilerinin tanımlanması P2 Kullanıcıların eğitimi P3 Kullanıcılara destek verilmesi ve öneri sunulması
Kaynaklar	P4 Bilgi sistemlerinin etkileşimi P5 Tesis ve ekipman yönetimi P6 Performans ve kapasite yönetimi P7 Operasyon yönetimi
Hizmetler	P8 Hizmet sürekliliğinin sağlanması P9 Değişiklik yönetimi P10 Hizmet süreçlerin izlenmesi

Appendix B. Preliminary importance and performance checklist

Importance							Performance											
Very Important	Somewhat Important	Not Important	Not Sure	Not Applicable		IS Process	Excellent	Very Good	Satisfactory	Poor	Not Sure	Formally Rated	Not Rated	Not Applicable	documented	Not documented	Not sure	Partially documented/e-documented
					P1	Definition of the IS organisation and relationships *(to ensure the right people deliver the right services)*												
					P2	Education and training of users *(to ensure that users are making effective use of technology and are aware of the responsibilities involved)*												
					P3	Provision of assistance and advice to IS users *(to ensure that any problem experienced by the user is appropriately solved)*												
					P4	IS interactions *(to ensure that there is awareness/policy of the use of other ISs as a resource)*												
					P5	Configuration management *(to account for all the IS components, prevent unauthorised alterations, verify physical existence and adopting changes)*												
					P6	Performance and capacity management *(to ensure that adequate capacity is available and that best and optimal use is made of it to meet required performance needs)*												
					P7	Operations management *(to ensure that important IS support functions are performed regularly)*												
					P8	Continuous Service *(to make sure IS services are available as required and to ensure a minimum organisational impact in the case of a major disruption)*												
					P9	Change management *(to minimise the possibility of disruption and unauthorised alterations and errors)*												
					P10	Monitoring services *(to ensure the achievement of the objectives related with services)*												

Appendix C. Responsibility checklist

Component of the conceptual model	assessed with the IS processes		Performed by				Responsible person
			IS/IT department	Within organisation	Outsourced	Not sure	
People	P1	Definition of the IS organisation and relationships *(to ensure the right people deliver the right services)*					
	P2	Education and training of users *(to ensure that users are making effective use of technology and are aware of the responsibilities involved)*					
	P3	Provision of assistance and advice to IS users *(to ensure that any problem experienced by the user is appropriately solved)*					
Resources	P4	IS interactions *(to ensure that there is awareness/policy of the use of other ISs as a resource)*					
	P5	Configuration management *(to account for all the IS components, prevent unauthorised alterations, verify physical existence and adopting changes)*					
	P6	Performance and capacity management *(to ensure that adequate capacity is available and that best and optimal use is made of it to meet required performance needs)*					
	P7	Operations management *(to ensure that important IS support functions are performed regularly)*					
Services and benefits	P8	Continuous Service *(to make sure IS services are available as required and to ensure a minimum organisational impact in the case of a major disruption)*					
	P9	Change management *(to minimise the possibility of disruption and unauthorised alterations and errors)*					
	P10	Monitoring services *(to ensure the achievement of the objectives related with services)*					

Appendix D. Process evaluation questionnaires

Case:	**Organisation A/B/C**
Process:	**P1 Definition of the IS organisation and relationships**
Component of the conceptual model:	**People**

Key findings:

Objective	**Findings/observations**
Does the IS organisation communicate its goals and results at all levels?	
Is the IS organised to be involved in all decision processes, respond to key organisation initiatives and focus on all corporate automation needs?	
Is the IS organisational model aligned with the organisation functions and does is adapt rapidly to changes in the organisation environment?	
Through encouraging and promoting the taking of responsibility, does the IS organisation develop and grow individuals and heightens collaboration?	
Are there clear command and control processes, with segregation where needed, specialisation where required and empowerment where beneficial?	
Does the IS organisation properly position security, internal control and quality functions, and adequately balances supervision and empowerment?	
Is the IS organisation flexible to adapt to risk and crisis situations and moves from a hierarchical model, when all is well, to a team-based model when pressure mounts, empowering individuals in times of crisis?	
Can a strong management control be established over the outsourcing of IS services, with a clear policy, and awareness of the total cost of outsourcing?	
Are essential IS functions explicitly identified in the organisation model, with clearly specified roles and responsibilities?	

Case:	**Organisation A/B/C**
Process:	**P2 Education and training of users**
Component of the conceptual model:	**People**

Key findings:

Objective	**Findings/observations**
Is there a comprehensive education and training program, focused on individual and corporate needs in place?	
Are these education and training programs supported by budgets, resources, facilities and trainers?	
Are training and education critical components of the employee career paths?	
Do employees and managers identify and document training needs?	
Is the needed training provided in a timely manner?	
Is there senior management support to ensure that employees perform their duties in an ethical and secure manner?	
Do employees receive system security practices training in protecting against harm from failures affecting availability, confidentiality and integrity?	
Does the corporate policy require that all employees receive a basic training program covering ethical conducts, system security practices and permitted use of IS resources?	
Is there management acceptance that training costs are investments in lowering the total costs of technology ownership?	

Case:	**Organisation A/B/C**
Process:	**P3 Provision of assistance advice to IS users**
Component of the conceptual model:	**People**

Key findings:

Objective	**Findings/observations**
Are there up-to-date and easily accessible Frequently Asked Questions (FAQs) and their answers available?	
Do knowledgeable and customer-oriented support staff resolve problems in close co-operation with the problem management staff?	
Are all user inquiries consistently and thoroughly registered by the help desk?	
Are the user inquiries that cannot be resolved in a timely manner appropriately escalated?	
Is the clearance of user inquiries monitored?	
Are user questions resolved in a timely manner?	
Are those user inquiries that cannot be resolved in a timely manner investigated and acted upon?	
Does the management monitor trends to identify root causes in a proactive manner and follow up with analysis and the development of sustainable solutions?	
Are there corporate policies and programs defined for training users in technology use and security practices?	
Is there management awareness of the cost of support services and user downtime and of the need to take action on root-cause issues?	

Case:	**Organisation A/B/C**
Process:	**P4 IS Interactions**
Component of the conceptual model:	**Resources**

Key findings:

Objective	**Findings/observations**
Are communication with the customers done via the Internet medium ?	
Is there an extensive use of the other information systems web pages?	
Is there an extensive interaction with the customer via the Internet?	
Is the use of other information systems documented?	
Is there an extensive use of similar information systems for improvement?	

Case:	**Organisation A/B/C**
Process:	**P5 Configuration Management**
Component of the conceptual model:	**Resources**

Key findings:

Objective	**Findings/observations**
Are there owners established for all configuration elements who responsible for maintaining the inventory and controlling change?	
Is the configuration information maintained and accessible, based on up-to-date inventories and a comprehensive naming convention?	
Is there an appropriate software library structure in place, addressing the needs of development, testing and production environments?	
Is there a release management policy and a system to enforce it?	
Are record keeping and physical custody duties kept segregated?	
Is there an integration with procurement and change management processes?	
Are vendor catalogues and configuration aligned?	
Do configuration baselines exist, identifying the minimum standard components and integration requirements, consistency and integration criteria?	
Is there an automatic configuration detection and checking mechanism available?	
Is there an automatic distribution and upgrade process implemented?	
Is there zero tolerance for illegal software?	

Case:	**Organisation A/B/C**
Process:	**P6 Performance and capacity management**
Component of the conceptual model:	**Resources**

Key findings:

Objective	**Findings/observations**
Are the performance and capacity implications of IS service requirements for all critical business processes clearly understood?	
Are the performance requirements included in all IS development and maintenance projects?	
Are the capacity and performance issues dealt with at all appropriate stages in the system acquisition and deployment methodology?	
Is the technology infrastructure regularly reviewed to take advantage of cost/performance ratios and enable the acquisition of resources providing maximum performance capability at the lowest price?	
Are skills and tools available to analyse current and forecasted capacity?	
Is the current and projected capacity and usage information made available to users and management in an understandable and usable form?	

Case:	**Organisation A/B/C**
Process:	**P7 Operations Management**
Component of the conceptual model:	**Resources**

Key findings:

Objective	**Findings/observations**
Are operations instructions well defined, according to standards, and with provision of clear cut-off and restart points?	
Is there a high degree of standardisation of operations?	
Is there close co-ordination with related processes, including problem and change management functions, and availability and continuity management?	
Is there a high degree of automation of operations tasks?	
Are operational processes re-engineered to work effectively with automated tools?	
Is rationalisation and standardisation of systems management tools implemented?	
Is the input and output handling, as much as possible, confined to the users?	
Are changes to job schedules strictly controlled?	
Are there strict acceptance procedures for new job schedules, including documentation delivered?	
Are there preventive maintenance schemes in place?	
Are the service support agreements with vendors defined and enforced?	
Are there clear and concise detection, inspection and escalation procedures established?	

Case:	**Organisation A/B/C**
Process:	**P8 Continuous Service**
Component of the conceptual model:	**Services and Benefits**

Key findings:

Objective	Findings/observations
Is there a no-break power system installed and regularly tested?	
Are potential availability risks proactively detected and addressed?	
Are the critical infrastructure components identified and continuously monitored?	
Is the continuous service provision a continuum of advance capacity planning, acquisition of high-availability components, needed redundancy, existence of tested contingency plans and the removal of single points of failure?	
Is there a procedural action taken on the lessons learned from actual downtime incidents and test executions of contingency plans?	
Is the availability requirements analysis performed regularly?	
Are the agreements used to raise awareness and increase cooperation with suppliers for continuity needs?	
Is the escalation process clearly understood and based on a classification of availability incidents?	
Are the costs of interrupted service specified and quantified where possible, providing the motivation to develop appropriate plans and arrange for contingency facilities?	

Case:	**Organisation A/B/C**
Process:	**P9 Change Management**
Component of the conceptual model:	**Services and Benefits**

Key findings:

Objective	**Findings/observations**
Are change policies clear and known and are they rigorously and systematically implemented?	
Is the change management strongly integrated with release management and is it an integral part of configuration management?	
Is there a rapid and efficient planning, approval and initiation process covering identification, categorisation, impact assessment and prioritisation of changes?	
Are there automated process tools available to support workflow definition, pro-forma workplans, approval templates, testing, configuration and distribution?	
Are there expedient and comprehensive acceptance test procedures applied prior to making the change?	
Is there a system for tracking and following individual changes, as well as change process parameters, in place?	
Is there a formal process for hand-over from development to operations defined?	
Do the changes take the impact on capacity and performance requirements into account?	
Is there a complete and up-to-date application and configuration documentation available?	
Is there a process in place to manage co-ordination between changes, recognising interdependencies?	
Is there an independent process for verification of the success or failure of change implemented?	
Is there segregation of duties between development and production?	

Case:	**Organisation A/B/C**
Process:	**P10 Monitoring services**
Component of the conceptual model:	**Services and Benefits**

Key findings:

Objective	**Findings/observations**
Are there useful, accurate and timely management reports available?	
Have the processes been defined and understood what the targets are and how to achieve them?	
Do the measurements of IS performance include financial, operational, customer and organisational learning criteria that ensure alignment with organisation-wide goals ?	
Are there clearly understood and communicated process objectives?	
Is there a framework established for defining and implementing IS management reporting requirements?	
Is there a knowledge base of historical performance established?	
Is there a consistent application of the right limited number of performance indicators?	
Is there an increased number of process improvement opportunities detected and acted upon?	
Is the management satisfied with performance reporting?	
Is there reduced number of outstanding process deficiencies observed?	

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PUBLICATIONS AND CONFERENCE PRESENTATIONS

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Özkan, S. (1999) *"Pressures Re-shaping Businesses: Globalisation, Technology Innovation, the Internet"*, MSc. Thesis, University of London, UK. Supervisor: Prof. Duska Rosenberg

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September 1993	Sabancı Conglomerate Merit Scholarship
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1991-1993	Participant of the International Mathematics Olympic Team of Turkey preparatory studies

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