Rick Klompé

The Alignment of Operational ICT

Organisation Model

Service Provision
Model

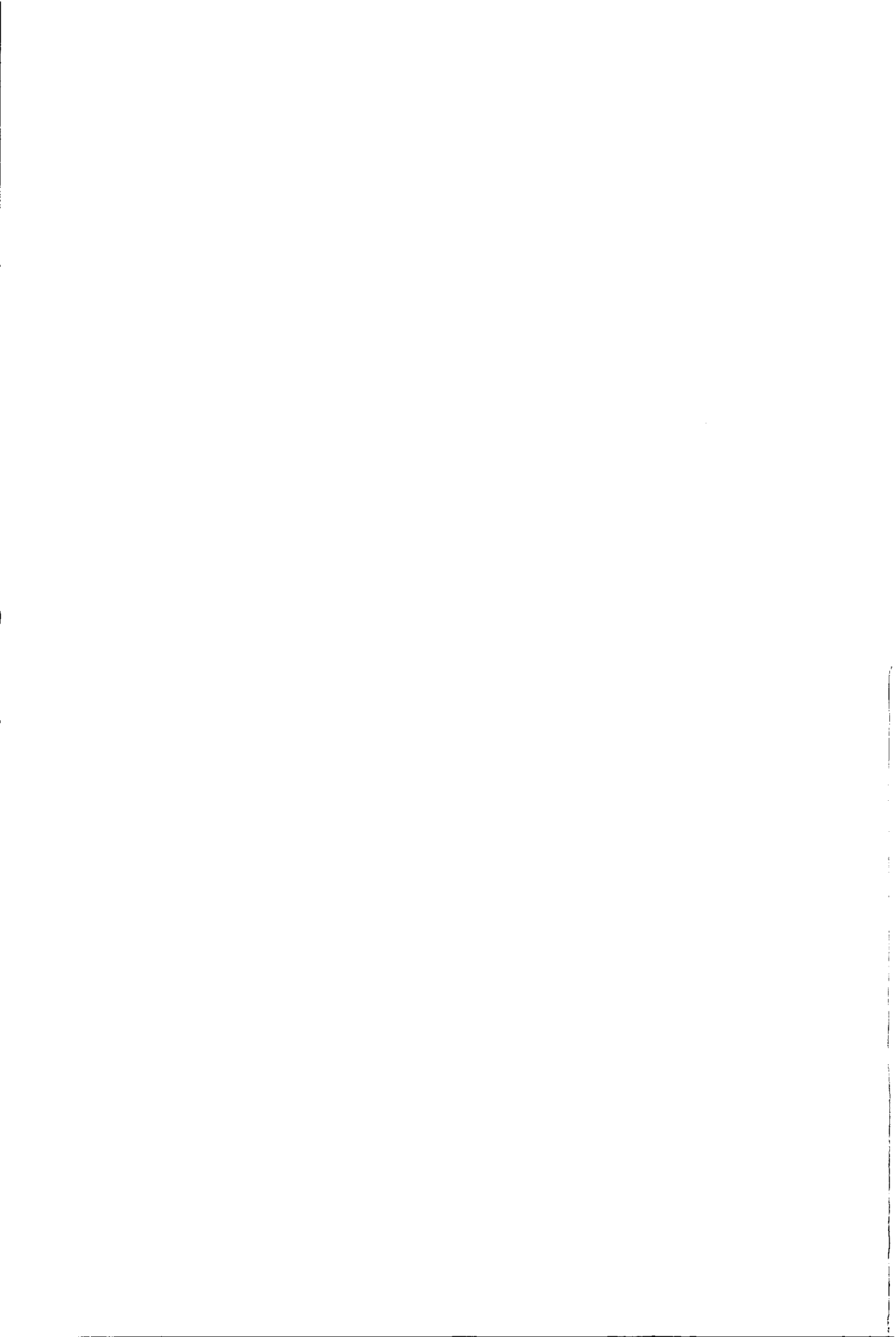Responsibility
Centre Model

Information Model

Cost Allocation
Model

Service Quality
Model

Stellingen
behorend bij het proefschrift
"The Alignment of Operational ICT"

1. De verhouding tussen directe en indirecte kosten wordt bepaald door de gekozen methode van kostenallocatie en biedt daarom geen stuurmiddel voor kostenbeheer (paragraaf 4.2.4. van dit proefschrift).

2. Wanneer eindgebruikerafdelingen niet verantwoordelijk zijn voor de kosten van ICT zullen de benodigde financiële middelen altijd meer bedragen dan het budget van de ICT afdeling (paragraaf 4.2.6 van dit proefschrift).

3. Bij het opstellen van dienstenniveau-overeenkomsten is de klant te passief, waardoor de inhoud van de overeenkomsten meer wordt bepaald door wat de ICT afdeling levert dan door wat de klant nodig heeft (paragraaf 4.4 van dit proefschrift).

4. Het percentage van de totale kosten van een organisatie dat aan ICT zou moeten worden besteed hangt af van de branche waarin de organisatie opereert en de gekozen strategie (paragraaf 4.2.2 van dit proefschrift)

5. De mate waarin een balanced scorecard in balans is, wordt op voorhand niet bepaald door het aantal prestatie-indicatoren per perspectief, maar door hoe men deze indicatoren tegen elkaar afweegt.

6. De eenvoud van een methode is een goede indicator voor de mate van toepasbaarheid ervan.

7. Het ontbreken van competentiemanagement in ICT management impliceert onvoldoende aandacht voor menselijke aspecten.

8. Bij het in de praktijk bestuderen van management processen dient men te kijken naar welke activiteiten door wie worden uitgevoerd en speelt het organisatiemodel dat wordt gekozen om verschillende organisaties te kunnen vergelijken derhalve een ondergeschikte rol.

9. Pas als men weet wat men wil meten en men meet wat men wil weten komt men door meten te weten.

Deze stellingen worden verdedigbaar geacht en zijn als zodanig goedgekeurd door de promotor, Prof. dr. ir. M. Looijen.

List of acronyms

A1	Business unit 1 of case-organisation A (entailing BM1, FM1/AM1)
A2	Business unit 2 of case-organisation A (entailing TM1)
ABC	Activity-based costing
AM	Application Management
AM1	The department performing the application management activities of organisation A
AM2	The department performing the application management activities of organisation B
AM5	The department performing the application management activities of organisation E
B1	Business unit 1 of case-organisation B (entailing BM2, FM2 and AM2)
B2	Business unit 2 of case-organisation B (entailing TM2)
BM	Business Management
BM1	The department performing the business management activities of organisation A
BM2	The department performing the business management activities of organisation B
BM3	The department performing the business management activities of organisation C
BM5	The department performing the business management activities of organisation E
BSC	Balanced Scorecard
C1	Business unit 1 of case-organisation C (entailing BM3, FM3 and AM3)
C2	Business unit 2 of case-organisation C (entailing TM3)
CIW	Cost model for ICT Workplaces
CMM	Capability Maturity Model
CMS	Cost Management System
CNO	Cost of Network Ownership model
CPU	Central Processing Unit
CVP	Cost-Volume-Profit

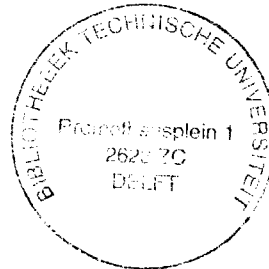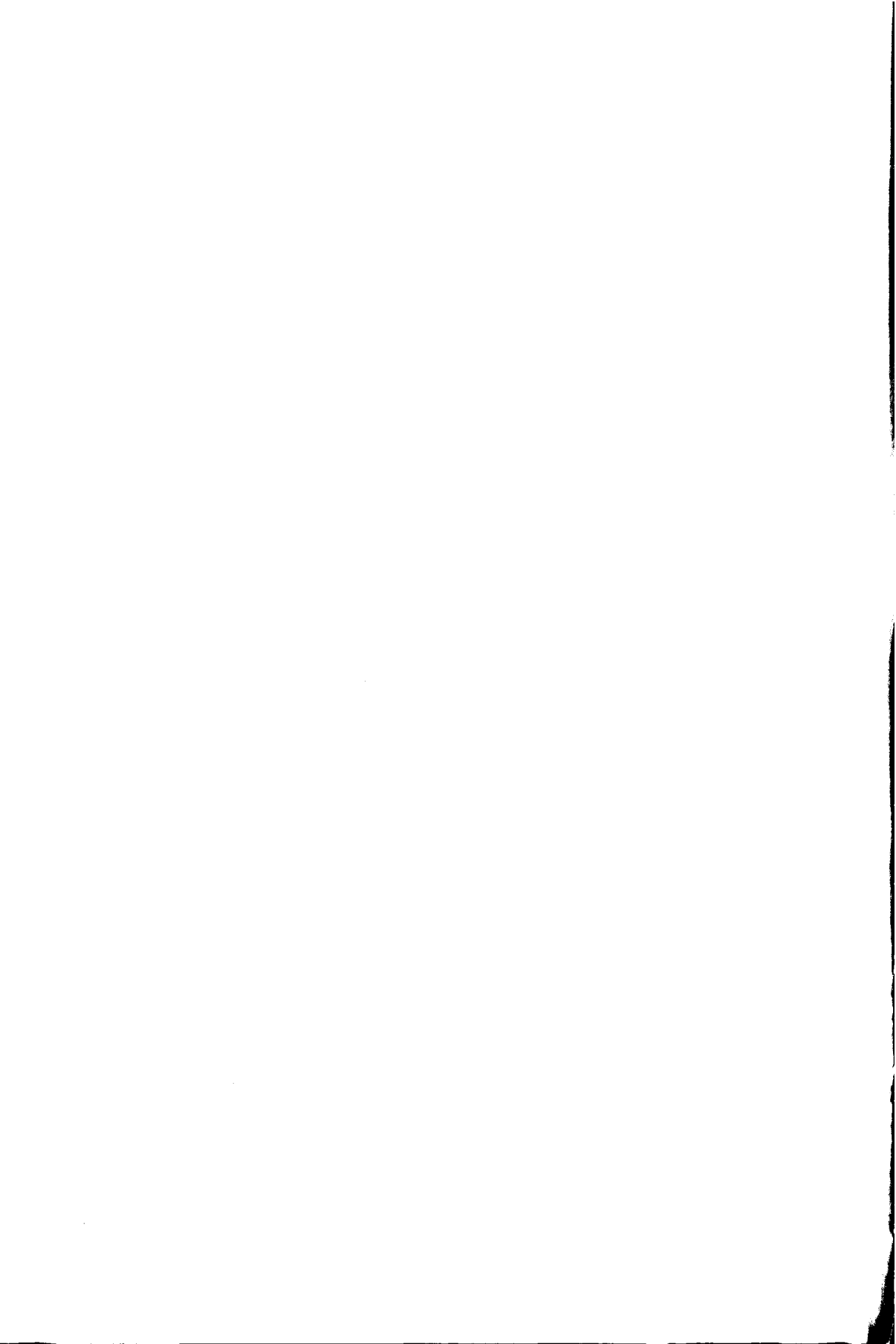|	
E1	Business unit 1 of organisation E
E2	Business unit 2 of organisation E
EFQM	European Foundation for Quality Management
EUC	End user Computing Cost of Ownership model
FM	Functional Management
FM1	The department performing the functional management activities of organisation A
FM2	The department performing the functional management activities of organisation B
FM5	The department performing the functional management activities of organisation E
GQM	Goal/Question/Metric method
ICT	Information and Communication Technology
ICTM3	The department performing the ICT management activities (functional, application and technical management) of organisation C
INK	Dutch Quality Institute ("Instituut Nederlandse Kwaliteit")
ITIL	Information Technology Infrastructure Library
NCO	Network Cost of Ownership model
P&L	Profit-and-Loss account
RCO	Real Cost of Ownership model
SLA	Service Level Agreement
SLM	Service Level Management
TCO	Total Cost of Ownership
TM	Technical Management
TM1	The department performing the technical management activities of organisation A
TM2	The department performing the technical management activities of organisation B
TM5	The department performing the technical management activities of organisation E

THE ALIGNMENT OF OPERATIONAL ICT

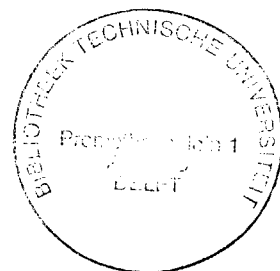## Management of Benefits and Burdens

THE ALIGNMENT OF OPERATIONAL ICT

Management of Benefits and Burdens

Proefschrift

ter verkrijging van de graad van doctor
aan de Technische Universiteit Delft,
op gezag van de Rector Magnificus prof. dr. ir. J.T. Fokkema,
in het openbaar te verdedigen ten overstaan van een commissie,
door het College van Promoties aangewezen,
op maandag 23 juni 2003 te 16:00 uur

door

Roderick Harald KLOMPÉ

informatica ingenieur

geboren te Delft

Dit proefschrift is goedgekeurd door de promotor:

Prof. dr. ir. M. Looijen

Samenstelling promotiecommissie:

Rector Magnificus, voorzitter
Prof. dr. ir. M. Looijen, Technische Universiteit Delft, promotor
Prof. drs. B.K. Brussaard, Technische Universiteit Delft
Prof. dr. W. Gerhardt, Technische Universiteit Delft
Prof. dr. A.A.I. Holtgrefe, Vrije Universiteit Amsterdam
Prof. dr. F.A. Lootsma, Technische Universiteit Delft
Prof. dr. P.M.A. Ribbers, Universiteit van Tilburg
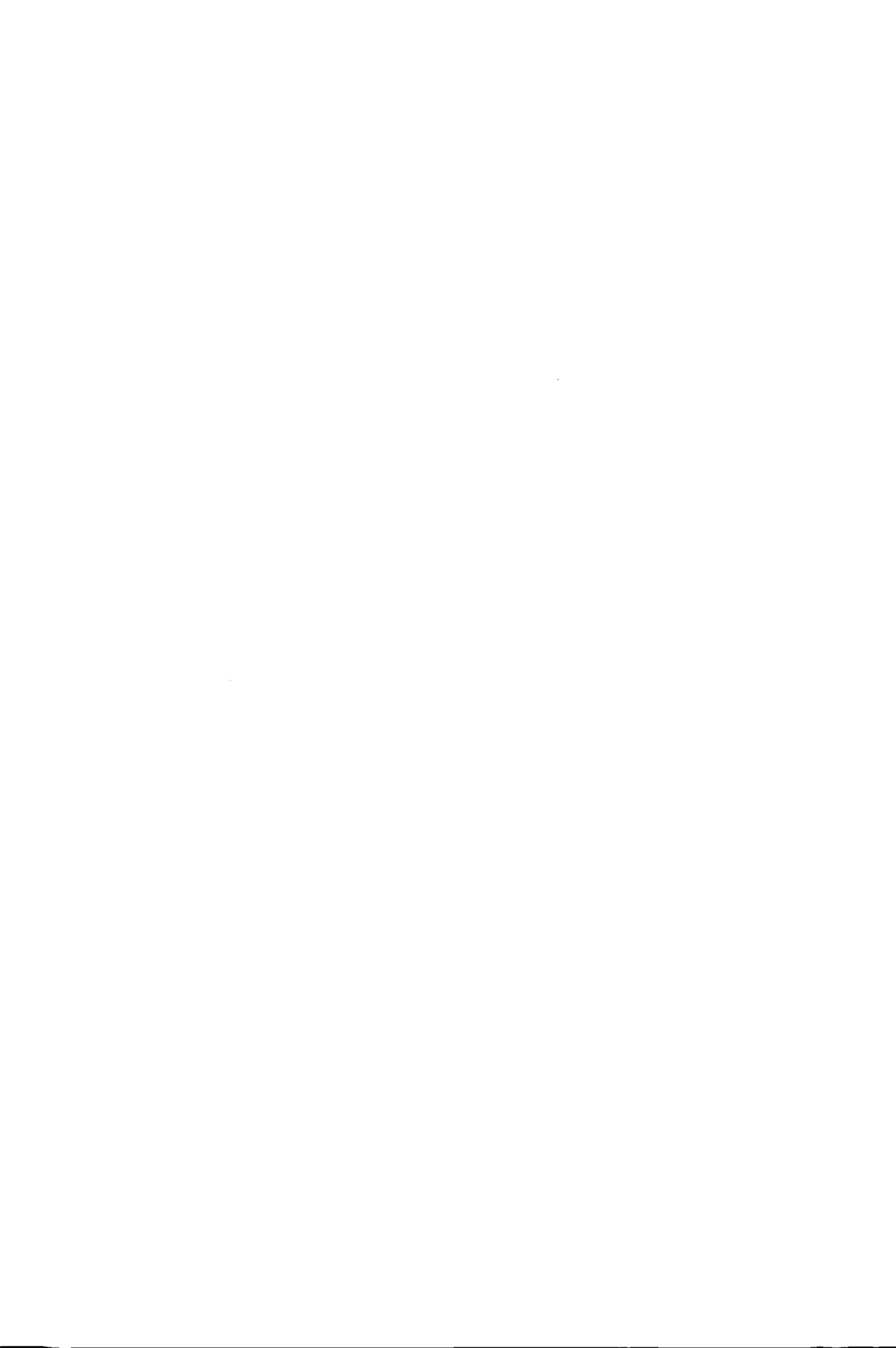Prof. dr. ir. P. van der Veer, Technische Universiteit Delft

Preface

This thesis discusses the problems and solutions of aligning the costs and benefits of operational ICT. During the past decades, the contribution of ICT to business performance has received growing attention. Organisations want to know whether the large investments in ICT did pay off. A lot of effort is spent on the ex ante evaluation of investment proposals and both academics and practitioners concentrate on the estimation and evaluation of the expected costs and benefits of an ICT application. The evaluation of costs and benefits of ICT that is operational and that is actually currently supporting the organisation's business processes has received very little attention. Because ICT can only affect the organisation's business performance through its application and that operational ICT still leads to costs, this is considered to be a gap in scientific research.

The research presented here aims to fill up this gap and to design a method to support organisations to align the costs and benefits of operational ICT. Current practice is studied in three case studies at three different financial institutions in the Netherlands. A method is designed based on the findings from the case studies and the results of a literature study. The applicability of the method and its contribution to solve the key problems identified in the case studies is validated in two concluding case studies.

The research presented in this thesis is carried out at the Information Systems department of the Faculty Information Technology and Systems of the Delft University of Technology. The research is carried out within the research theme *"Economic aspects of ICT management"* of the chair Information Strategy and Management of Information Systems. Research in this typical field does not end with the research on the alignment of costs and benefits of operational ICT presented here. On the contrary: considering that this thesis claims to pioneer this new field, it is just a start. Although this research provides an overview of the research area, it mostly concentrates on just two main problems identified in practice. More research is necessary to study other aspects of the research area in more detail and also to develop further the ideas on how to align the costs and benefits of operational ICT. With this thesis a first step is made to identify the research area and to improve understanding on the alignment of operational ICT. Thus I hope to contribute, be it modestly, towards a situation in which organisations can identify, manage and align the costs and benefits of their operational ICT. I hope that other people, both practitioners and academics, will adopt the work presented here so that the work towards achieving this long-term objective will be continued.

Rick Klompé
Berkel en Rodenrijs, April 2003

Table of Contents

1 Alignment of operational ICT

1.1   Introduction

"*Operations is what happens while everyone else is making plans.*[1]" Business benefits are realised only when information and communication technology (ICT) is in its operational state. After all, only the business application of technology can deliver value (Thorp, 1998). All other ICT activities carried out by the organisation, like decision-making, design and realisation, do not affect the organisation's business performance and thus do not generate benefits. These activities can be defined as making plans to improve business performance. Costs arise from both operations and making plans. Making plans involves costs as, for example, management spends time on decision making, programmers spend time on the development of the application, and hardware or software is purchased. On the other hand, when ICT is in the operational state, costs have to be made to keep it running, for example for personnel, accommodation, depreciation of hardware and software and for support from external suppliers. From a cost-benefit perspective, management of operational ICT is therefore an important area of ICT management.

The management teams of organisations have realized the importance of managing the benefits and burdens of ICT. In the past decade, the attention of business management has shifted to the impact of ICT and the maximisation of the return on ICT investments, focusing more and more on the added value of ICT and the costs of providing ICT resources (Bakos and Kemerer, 1992). Research shows that more than 70% of top management are most concerned about getting value from ICT investments (Butler Cox, 1990). A problem is that benefits of ICT are not always clear and sometimes even questionable (McKeen and Parent, 1996; Brynjolfsson, 1993; Powell, 1992), because of the strong integration of the ICT in the business processes and services. Moreover, ICT is seen to account for a large and increasing proportion of corporate operating costs (Schalk du Toit, 1997). Research indicates that in some industries, organisations spend around 9% of their revenues on ICT (Rayner, 1995) or around 5% or more of their capital (Brynjolfsson and Hitt, 1995). As a result of that, there is an increasing desire for hard facts and figures on the benefits and burdens of ICT (Drury,

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[1] Quote of an ICT manager of a Dutch banking corporation, based on the song text of John Lennon: "*Life is what happens when you're making other plans*".

1997; Hinton and Kaye, 1996). Organisations want to be reassured that the increasing ICT costs lead to an appropriate contribution to business performance (Schalk du Toit, 1997). ICT departments are asked to take more responsibilities, not only for the systems they support, but also for the impact of these systems on the business processes that they support (Markus and Keil, 1994).

As a result of these developments, the evaluation of ICT gained much attention of both management and academics the last decade. For some time now its has been clear that ICT evaluation is problematic (Bannister and Remenyi, 2000; Remenyi *et al.*, 1998; Willcocks and Lester, 1996). Many studies have been carried out to increase understanding of the relation between ICT investments and business performance and to devise methods to support ICT investment decision making (e.g. Brown and Remenyi, 2000, 1999, 1998; Berghout and Remenyi, 1997). Far most effort is spent on evaluating ICT to decide whether or not to invest in it. The number of studies on the benefits and burdens of operational ICT is very limited. Most studies known on the evaluation of operational ICT try to identify the effects of a single implemented ICT application (micro level) or of the overall impact of ICT on the productivity (macro level). No studies were found among the literature on how organisations can influence and manage the benefits and burdens of operational ICT (meso level). A large part of the ICT costs is caused by the management of operational ICT (Hinton and Kaye, 1996) and benefits are realised only by business application of ICT (Thorp, 1998). Therefore we claim that the absence of studies on the management of benefits and burdens of operational ICT is a gap in scientific research.

The research presented in this thesis deals with the alignment of benefits and burdens of operational ICT to fill this gap. The aim of this thesis is to gather empirical knowledge on the alignment of operational ICT, to identify the main problems that the organisations studied are faced with and to provide a solution to these problems by presenting a method for the alignment of operational ICT. In this chapter, operational ICT is defined as the object of the alignment studied in this thesis. The research area of information economics is introduced and its basic concepts, like value, benefits and burdens, are defined. The alignment of operational ICT is defined and finally the research question and research approach are discussed.

1.2   Operational ICT

Information and communication technology (ICT) is defined as all hardware, software, communication facilities and procedures to process, store and transfer data in the scope of automated data processing (Looijen, 1998). The ICT means of an organisation can be characterised according to its complexity (Looijen, 1998). The concept of complexity is determined by eight factors, according to Looijen (2001), being quantity, heterogeneousness, distribution, dynamics, functionality, coherence, ownership and usage.
Operational ICT comprises those ICT components that have already been implemented and are actually utilised for automated data processing. The definition of operational ICT is illustrated through the state model of Looijen (1998) presented in figure 1.1.

1.2.1   State model

The State model describes the states of the life cycle of an ICT component and the relationships between these states. The life cycle starts with the *Policy and planning* (PP) state, in which new ICT components are planned, to be built in the *Development* (D) state. New ICT is then tested and if *accepted* it is *implemented* (AI). It then continues to the *Utilisation* (U) and *Exploitation* (E) states, in which the functionality is used and the ICT is
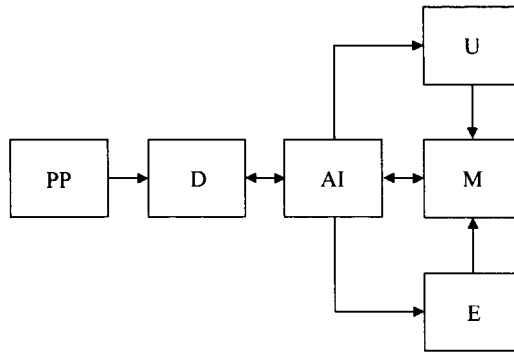
Figure 1.1 State model (Looijen, 1998)

exploited and operated technically, respectively. Modifications to the ICT initiated from these two states are realised in the *Maintenance* (M) state. Before the ICT components can return to these states, they have to pass the AI state again. The state model can be extended by adding the states U' and E' to illustrate the advancing character of ICT (see figure 1.2). For when it has passed the maintenance state, it is a new (version of the) ICT component that is utilised and exploited. Furthermore, state M is divided into two sub-states, indicating changes with minor or no impact (M1) and changes with a major impact (M2). Only major changes cause the ICT component to progress to a new AI state, AI' or AI" and so on. Operational ICT covers all ICT components that have passed the state of acceptance and implementation once (AI in figure 1.1).

1.2.2 Management of ICT

Based on Looijen (2001), the management of ICT is defined as *the planning, control and maintenance of implemented ICT in accordance with the requirements and preconditions imposed by the utilisation, the situational factors and the characteristics of the ICT components*. Management of ICT offers service in the most effective and efficient way and it influences the goals of the organisation in a positive way (Looijen, 2001).

The ICT components identified in this definition include hardware, software, databases, procedures and people (Looijen, 1998). Management of ICT entails several tasks and
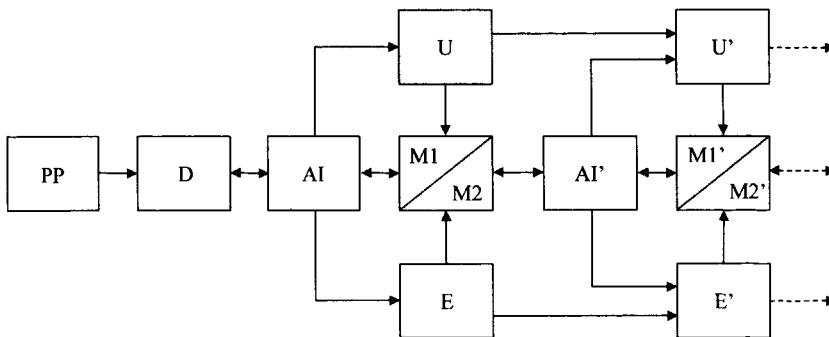
Figure 1.2 Extended State model (Looijen, 1998)

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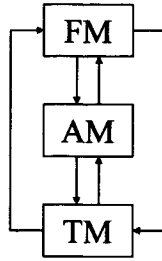
Figure 1.3 Three forms of ICT management (Looijen, 1998)

activities that have to be carried out by the organisation. Looijen (1998) describes the activities and tasks to be performed for the management of ICT in detail, identifying three categories to classify these activities and tasks that are labelled Functional Management, Application Management and Technical Management (figure 1.3).

Functional Management (FM) is responsible for the maintenance and control of the ICT functionality. It supports and evaluates the utilisation and responds to deficiencies and new requirements, which may lead to modifications. Maintenance and control of application software and databases, including all software different from basic software, database management software and programming tools is a responsibility of the *Application Management* (AM). The *Technical Management* (TM) is responsible for maintenance and control of the hardware, software, and data sets which, in relation to practical applications, have to be available for utilisation. With respect to the State model presented in figure 1.2, one can say that the FM is responsible for the tasks part of the Utilisation state and the TM for those of the Exploitation state. Tasks of the state Maintenance are a divided responsibility of FM (functional maintenance), AM (application maintenance) and TM (technical support and changes in technical infrastructure).

Each of these three kinds of ICT management has its own tasks and responsibilities (Looijen, 1998). Together, they have to provide operational ICT to the business. TM, for example, provides the technical infrastructure, AM develops the application software to run on this infrastructure and FM is responsible for managing the functionality of this combination of hardware and software. It can be stated that TM and AM provide a service to FM, which in turn provides a service to the business by enabling its utilisation for the purpose of gaining benefits.

1.3   Information Economics

This research is carried out within the research area called "information economics". Information economics is the discipline that studies the evaluation of benefits and burdens of information technology (Swinkels, 2000). This field of research gained increasing attention in the past decade. One of the first publications in this field is the Information Economics approach of Parker *et al.* (1988). Although this approach focused mainly on the process of ICT investment decision making, the research area has expanded over time, now including the whole ICT life cycle. The Dutch Workgroup for Information Economics (WIE, 1994) developed a framework to position the various economic problems with respect to the life cycle of an information system. This framework, presented in figure 1.4, identifies four stages in the ICT life cycle. In the *Identification* stage, new opportunities for investments in ICT are

How can we control costs
and benefits of operational
information systems?

What new information systems
are appropriate to invest in?

Exploitation

Identification

Realization

Justification

How can we manage benefits
and burdens during development?

What is the impact of the
proposals and which should
be proceeded?
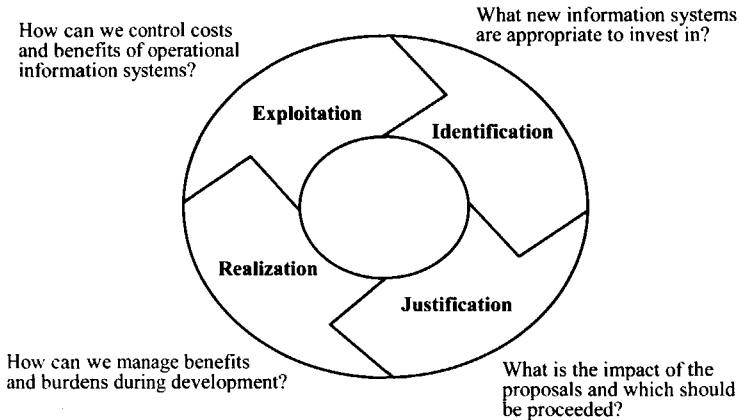
Figure 1.4 Information Economics framework (WIE, 1994)

identified, based on the analyses of business processes and the current ICT environment. In the *Justification* stage, the resulting list of ICT investment proposals is prioritised and it is decided which proposals are to be realised. After the *Realisation* of the selected proposals, the new ICT becomes operational and then needs to be *Exploited*.

To study the evaluation of benefits and burdens of information technology, Renkema and Berghout (1997; 1995) defined the elementary concepts as given in figure 1.5. Their terminology discerns financial and non-financial consequences. Financial consequences are defined as all consequences that can be expressed in monetary terms; non-financial consequences cannot. Consequences are identified as events arising from the introduction of ICT. According to Renkema and Berghout, the value of ICT is determined by the sum of the benefits and burdens. The benefits refer to all positive consequences, and the burdens to all negative consequences.

For the financial consequences of ICT, return and profitability are discerned. The return represents the cash flows arising from the introduction of ICT. Positive, incoming cash flows are earnings, while negative, outgoing cash flows are expenditures. The profitability represents the accounting registration of revenues and costs. A cost is defined as all financial sacrifices an organisation makes for certain activities, products or services (Blox *et al.*, 1992). A positive margin between revenues and costs is referred to as profits, and a negative margin as losses.

	Sum	**Positive**	**Negative**
Financial/Non-financial	Value	Benefits	Burdens
Financial	Profitability	Revenues	Costs
	Return	Earnings	Expenditures
Non-financial	Contribution	Positive contribution	Negative contribution

Figure 1.5 Terminology of financial and non-financial consequences (Renkema and Berghout, 1995)

1.4 Alignment of operational ICT

The management of benefits and burdens of operational ICT has not yet gained much attention from academics, regardless of the fact that a large part of the ICT costs of organisations is caused by operational ICT (Hinton and Kaye, 1996), and that benefits of ICT are realised only in the operational stage (Thorp, 1998). Literature on the benefits and burdens of operational ICT concentrates on the costs or benefits separately, so a proper evaluation of both the benefits and burdens of operational ICT has never been done. This thesis presents a first attempt to fill this gap.

The research problem addressed in this thesis is the problem of the alignment of operational ICT. Operational ICT is defined as all ICT components that have been implemented and that are actually used for automated data processing, i.e. to support the organisation's business processes (paragraph 1.2). The alignment of operational ICT is defined as optimising the value of operational ICT to meet the organisation's requirements for ICT[2]. These requirements can differ per organisation and per application, depending on the organisation's business, the market it operates in and the strategies of the competition. For example, to be profitable, each organisation has to have benefits to compensate its costs. The organisation will search for ways to improve its performance through for example ICT to increase its profitability. If a certain application or activity is not profitable enough, it can be stopped. However, this does not mean that another application with high costs and little benefits will be stopped as well. If, for example, the application supports a product or service that the organisation needs to supply to offer the customer a complete portfolio, the organisation can decide to maintain it.

The management of an organisation has to evaluate the costs and benefits of an ICT application in the light of its business strategy and market position to determine whether the value is satisfactory or not. We deliberately speak of a *satisfactory* value instead of an *optimum* value as be we base ourselves on the assumption that decision makers are bounded rational. The concept of bounded rationality implies that decision makers in practice do not make fully rational[3] choices (Simon, 1979). Koopman and Pool (1992) give several causes for this, including economic motives and limited intellectual capacities. Managers do not have unlimited time and money to search for and evaluate all information and alternatives. One has to weigh the investment in time and money against the chance of finding a better alternative. Moreover, an apparently optimal decision at one point in time is generally sub-optimal in subsequent times (Simon, 1979).
Furthermore, managers cannot process all information, as their capacities are limited. Therefore, managers will try to simplify problems and leave out details that they consider less important.

1.5 Research question

This thesis addresses the alignment of operational ICT, defined as realising the balance between benefits and burdens of operational ICT that meets the organisation's requirement to support its business processes. The management of benefits and burdens of ICT requires continuous evaluation during the entire life cycle of information systems (Berghout, 1997). However, when the ICT is operational, this evaluation is usually neglected. We claim

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[2] The benefits and burdens of operational ICT are defined as the positive and negative consequences, respectively, and can be both financial and non-financial (paragraph 1.3).
[3] Fully rational decisions are based on selecting the *optimum* solution with *full* knowledge of *all* alternatives and *all* their consequences (Harrison, 1987).

therefore that more attention should be paid to evaluating this phase of the ICT life cycle. After all, the costs of operational ICT make up a major and increasing part of ICT budgets (Hinton and Kaye, 1996) and the benefits are gained only by the business application of ICT (Thorp, 1998). The research discussed in this thesis is carried out to fill this gap in scientific research.

The central research question of this research is:
> *How should we align the benefits and burdens of operational ICT?*

To find the answer to this question, we defined a number of sub-questions:
- What benefits and burdens of operational ICT have to be identified?
- To what extent can benefits and burdens of operational ICT be influenced?
- What methods are available to support the alignment of operational ICT?

As the alignment of operational ICT has been studied to a limited extent, the objective of this research is twofold. First, this thesis aims to gain an understanding of the alignment of operational ICT and second, it aims to design a method to support organisations in aligning their operational ICT.

1.6   Research approach

Based on different theoretical foundations, many different approaches have been designed in the past couple of decades to study ICT management (Van Waes, 1991). Van der Zwaan (1990) identifies four types of research according to their goal and position within the overall research program, being explorative, descriptive, interpreting and validating research. *Explorative* research focuses on the definition of hypotheses based on observations and assumptions. *Descriptive* research is carried out to describe a certain phenomenon, while *interpreting* research tries to build causal relations to clarify a certain phenomenon. *Validating* research, at last, tries to validate or reject hypotheses.

The research discussed in this thesis can be characterised as both descriptive, interpreting and validating. As no studies on the alignment of operational ICT are known, we first have to gain empirical knowledge by describing current practice. The understanding gained from practice will be the starting point to identify the key problem areas in this field (interpreting). After the design of a method to solve these key problems, the applicability and utility of the method is validated.

As this research focuses mainly on studying an object in practice, within its natural setting, it is characterised as empirical research. De Looff and Berghout (1994) identify four types of research approaches for gathering empirical knowledge:
- *Case study research*, in which a large number of variables and mutual relationships are studied in a small number of situations;
- *Experiments*, in which in one or a small number of situations a limited number of variables and mutual relationships are studied and independent variables are controlled steadily;
- *Statistical research*, in which a limited number of variables are studied in a large number of situations;
- *Historical analyses*, in which the object of research is studied based on existing, historical data.
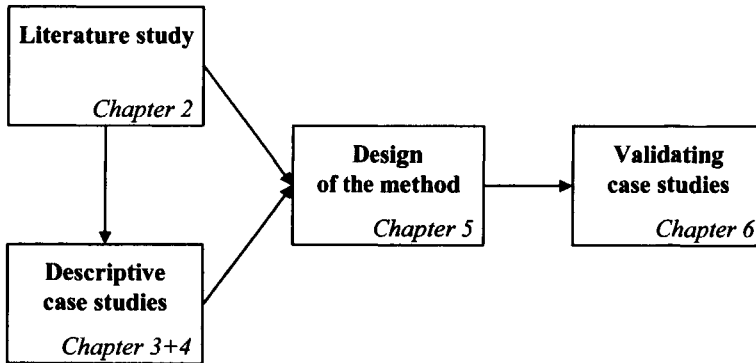
Figure 1.6 Research design

Case study research is the only type of research approach that is claimed to be suitable for the research discussed in this thesis. The other three approaches all require a much better understanding of the object of research than available at the start of the research. Without this body of knowledge, a limited set of variables cannot be identified nor controlled, thus eliminating experiments and statistical research. If available, historical data can be used to complete the data obtained from case study observations, but it is expected to be insufficient as the main research approach.

A case study is an empirical study where one uses multiple sources of evidence are used that investigates a contemporary phenomenon within its real-life context when the boundaries between the studied phenomenon and its context are not clearly evident (Yin, 1984). In case study research, various methods are employed to gather information from relevant people, groups or organisations (Benbasat *et al.*, 1987). Case study research is justified when the object of research must be studied in practice, the research emphasises '*how*' and '*why*' questions and there are no previous studies and detailed theories on the research object (Wierda, 1991). According to Yin (1994), case studies are most useful to perform research by focusing on contemporary events when behavioural events do not have to be controlled. Furthermore, according to Van Waes (1991), a case study strategy is extremely useful for appraising a situation if the boundaries of the phenomenon under investigation are not clearly evident at the start of the study. Therefore, case study research is claimed to be the most suitable research approach for describing current practice and identifying the key problem areas.

Case studies are mainly performed either for discovery purposes or for validation (Van der Zwaan, 1990). In this research, case studies are applied for both purposes, but not at the same time. The first series of case studies is carried out to explore the phenomenon in practice, so these case studies will be mainly descriptive and interpretative. The results of the case studies will then be used in combination with findings from the literature study to identify the key problems in practice and to design a method to support organisations in solving these problems. The second series of case studies is conducted to validate the research findings and the method designed.

The research design of the study described in this thesis is illustrated in figure 1.6. Before the descriptive case studies, a literature study is carried out to identify current literature on the benefits and burdens of operational ICT (chapter 2). The results of the literature study are

used to design the descriptive case studies. Three case studies are carried out at three different financial institutions to study the alignment of operational ICT in practice (chapter 3). The observations of these case studies are analysed in order to increase understanding of the object of research and to identify the main problems that organisations are faced with in practice (chapter 4). Based on the results of both the literature study and the descriptive case studies, a method is designed to support organisations in the alignment of operational ICT (chapter 5). Finally, the applicability and usability of the method is tested in practice through two validating case studies (chapter 6).

Both in the descriptive and validating case studies, the three forms of ICT management are studied. Figure 1.7 gives an overview of the ICT management forms identified in the case studies (case studies C and D were carried out in the same organisation).[4]

1.7   Summary

The alignment of operational ICT is defined as realising the optimal balance between benefits and burdens of operational ICT. The benefits and burdens of ICT represent all positive and negative consequences respectively, both the financial and non-financial terms. ICT refers to all hardware, software, data and communication facilities to process, store and transfer data (Looijen, 1998). Operational ICT comprises those ICT components that have already been implemented and that are actually utilised for automated data processing to support the organisation's business processes. In terms of the State model of Looijen (1998), operational ICT concerns all ICT components that have passed the state of acceptance and implementation once and thus can be categorised under the states Utilisation, Exploitation and Maintenance. All other activities related to ICT management or Information economics, that is, the identification, justification and realisation stages in the WIE framework, are not considered in this thesis.
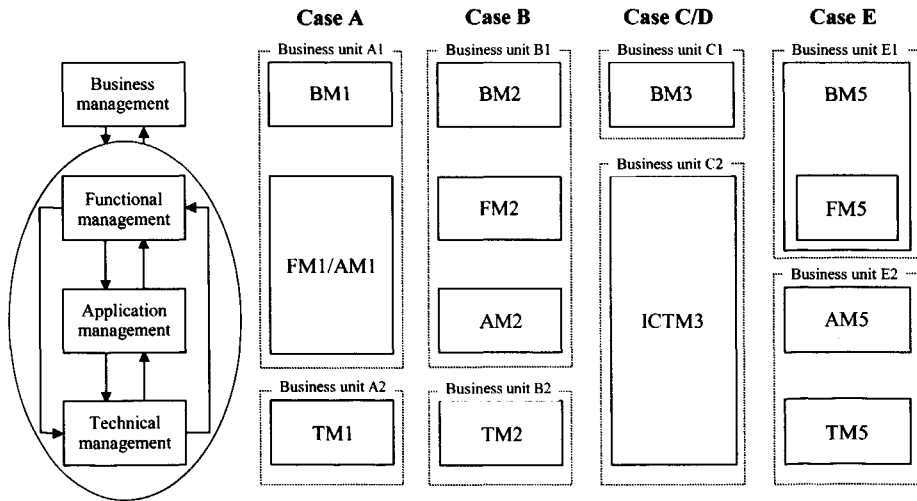
Figure 1.7 Overview of the ICT management forms studied in each case study

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[4] The organisations where the descriptive and validating case studies were carried out are described in detail in chapter 3 and 6, respectively.

We claim that, although the alignment of operational ICT has not received much attention from academics, the operational stage is an important stage in the management cycle. This thesis focuses on this specific stage to fill a gap in scientific research and to help organisations in the alignment of operational ICT.

2 Theoretical perspectives

2.1 Introduction

In this chapter a number of aspects related to the alignment of operational ICT are discussed. In chapter 1, the alignment of operational ICT is defined as realising the optimal balance between benefits and burdens of operational ICT to support the organisation's business processes optimally. Literature on the various terms and concepts related to this subject is discussed. The field of accounting is introduced and the difference between fixed and variable costs is defined. We deal with the process of cost allocation, including related topics as direct and indirect costs, product costing and allocation techniques and ICT cost models. Benefit management is presented, discussing the benefits of ICT and the problems of measuring ICT benefits. As many benefits of ICT are non-financial, quality-management literature is discussed in search of methods and techniques to support benefit management. The concepts of planning and control are discussed as well, and the principles of the Balanced Scorecard as a main tool for planning and control of both financial and non-financial performance indicators. Literature presented in this chapter will be used to describe and analyse the case studies in chapter 3 and 4. For this, an analytical framework is constructed based on the findings of the literature studied in this chapter.

Although many people associate economic problems with money, an economist identifies an economic problem as any situation where needs may not be met as a result of scarcity of resources (Douma and Schreuder, 1992). The economic problem is defined as *what is the optimal allocation of the scarce resources*[5] *over the alternative uses that can be made of them?* From this perspective, the alignment of operational ICT as defined in chapter 1 can be defined as an economic problem. Both costs and the ICT means that incur these costs are scarce resources and have to be allocated optimally to realise the highest (financial and non-financial) benefits. Since the 1970s, several economic approaches have been developed that analyse and describe how organisations deal with the economic problem of allocating scarce resources (Douma and Schreuder, 1992). De Looff (1996) showed that these approaches are useful in studies of outsourcing decisions and relationships. It is claimed that these

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[5] A resource is defined as any means that may contribute to the satisfaction of human needs (Douma and Schreuder, 1992).

approaches can be of use for studying other ICT problems in an organisational context as well. Therefore, the most common and important approaches are discussed first.

2.2 Economic approaches to organisations

This paragraph discusses the major kinds of economic approaches to organisations, being *division of labour, the behavioural theory of the firm, agency theory* and *transaction cost economics*. As these relations can both be applied to relations between firms and the relations between departments of business units within a firm, they can be of use for studying the alignment of operational ICT. The descriptions of the economic approaches presented in this paragraph are based on Douma and Schreuder (1992), unless referenced otherwise.

2.2.1 Division of labour

Adam Smith founded the theory on division of labour. He claimed that the division of labour has the most effect on improvements in the productive powers of labour, and the skill, dexterity, and judgement with which labour is directed or applied.

The principle of the Division of Labour is that composite tasks are split into their component parts and that these tasks are performed separately. This leads to specialisation, through which economies of specialisation can be gained as a greater amount of output can be produced with the same level of (human) resources. Specialised production is thus more efficient.
The advantage of specialisation for the individual employees is that higher performance is made possible, but the disadvantage is that their choices are restricted. Specialisation reaches its limitations when an employee's satisfaction with the job that is caused by its increased importance is outweighed by dissatisfaction because the person can apply too few of his/her skills.

Specialisation creates a need for co-ordination. This can be realised in markets or in organisations. In the ideal type of market, the price system is the co-ordination device taking care of the allocation of scarce resources as the price contains all information needed to base the transaction on. However, using a price system entails costs. Costs for finding out what the relevant prices are and costs to draw up a contract providing the basis for a transaction. Models studying the co-ordination by the market mechanism are based on the principle that firms are viewed as holistic entities having a single objective, that there is perfect information and that behaviour of producers and consumers is described as maximising behaviour. A perfect market requires a large number of small buyers and sellers, a free entry and exit of firms and industries that are all characterised by standardised products.

Within organisations, authority replaces the pricing system as a co-ordinating device. Mintzberg (1979, 1989) defines six types of co-ordination mechanisms:
- Mutual adjustment   (co-ordination through informal communication)
- Direct supervision   (when one person commands or instructs others)
- Standardisation of work processes   (defining the work processes to be performed)
- Standardisation of outputs   (defining the results of the activities)
- Standardisation of skills   (related training for all employees)
- Standardisation of norms   (defining the norms and beliefs)

All co-ordination requires information. The economics of information is a relatively young branch of economics. One of the basic concepts is that one has never complete or perfect

information or knowledge. Furthermore, the value of information can only be revealed to another party by disclosing the information, while such disclosure destroys its value.

When the available information is unevenly distributed over the entities concerned, this is called *information asymmetry*. Information asymmetry may give rise to opportunistic behaviour.

2.2.2 Behavioural theory of the firm

The behavioural theory of the firm was developed by March, Simon and Cyert (e.g. Cyert and March, 1963; Simon, 1960), and describes how business firms make economic decisions. It postulates the firm as a coalition of participants that receive inducements for the contributions they make to the organisation. Each participant has his own goals and aspirations. These goals will ordinarily not coincide and in general it is expected that the goals of the different parties are in conflict.

The behavioural theory of the firm assumes that not everybody has the same information, i.e. there is an information asymmetry. It further assumes bounded rationality. That is, at the moment the decision is made, not all information is available and firms are not able to compare all alternatives and select the best one. According to behavioural theory, firms search for the optimal alternative and in that way they show satisfying instead of maximising behaviour.

2.2.3 Agency Theory

In its simplest form, the agency theory discusses the relationship between two people, a principal and an agent who makes decisions on behalf of the principal. Agency relations can be found both within firms (owner-manager relations) and between firms.

Literature describes two main streams within agency theory. On the one hand there is the *positive theory of agency*, that views the firm as a nexus of contracts and looks at how contracts affect the behaviour of the participants. It assumes that existing organisational forms are efficient and thus tries to explain why these forms are as they are.

On the other hand there is the *theory of principal and agent*, which looks at how the principal should design the agent's reward structure by applying formal mathematical models. A critical question in the mathematical models is whether the principal can observe the agent's behaviour (symmetric information) or not (asymmetric information).

2.2.4 Transaction Cost Economics

The fundamental unit of analysis in *transaction cost economics* is the transaction. Transactions can take place across markets and within organisations. The choice between both alternatives is a matter of cost minimisation.

Transaction cost economics emphasises that not only traditional production costs, but also transaction costs should be taken into account. Transaction costs include both costs of market transactions and costs of internal transactions. The existence of firms is explained by the fact that in some cases the costs of internal co-ordination are lower than the costs of market transactions.

The basic, behavioural assumptions of transaction cost economics are that human beings are bounded rational agents, that they sometimes display opportunistic behaviour and that the factor atmosphere influences the transactions.

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A transaction can be identified according to three critical dimensions, being asset specificity, uncertainty and complexity, and frequency. The *asset specificity* identifies the degree to which transaction-specific means are needed for the transaction; i.e. whether or not a means can be re-deployed for a different task without a significant reduction of its value. When the asset specificity is high, it is expected that transactions are carried out within organisations rather than across markets. Likewise, the degree of *uncertainty and complexity* influences the transaction costs, as transaction parties are bounded rational. When the *frequency* of transactions is high, the fixed costs of specialised means and governance structures that are required for asset-specific transactions are recovered more easily.

Applying transaction cost economics, one can explain the existence of different organisational forms. Each form has its own specific advantages like economies of scale, risk-bearing advantages, associate gains and economies of communication.

2.3 Accounting systems

The field of accounting is concerned with the provision of information to management. An accounting system is a formal system that gathers data to aid and co-ordinate collective decisions with respect to the overall goals or objectives of an organisation (Horngren, 1984). Accounting systems can provide information for internal purposes like strategic planning and planning and control of routine operations and for external purposes like giving information to shareholders and the government. Information for internal reporting is taken care of by management accounting, whereas the provision of information for external reporting is referred to as financial accounting. Financial accounting is driven by the needs of constituencies that are external to the organisation, like investors, creditors, regulators and tax authorities (Cooper and Kaplan, 1999).

Management accounting is the process of identifying, measuring, accumulating, analysing, interpreting, and communicating information that assists executives in fulfilling organisational objectives (Horngren, 1984). The management accounting system is the major overall quantitative information system in almost every organisation (Horngren, 1984). Cost-Volume-Profit (CVP) analysis is the most fundamental management accounting tool (Louderback and Hirsch, 1984). CVP examines the relationships between revenue (sales), expenses (cost) and net income (net profit) (Horngren, 1984). Although revenues are equally important in the CVP analysis, most management accounting literature concentrates on cost accounting systems.

2.3.1 Cost accounting

Cost accounting is driven by the needs of managers internal to the organisation for accurate and timely cost information for strategic decisions and operational improvements that will enhance profitability (Cooper and Kaplan, 1999). A cost accounting system typically accumulates costs by some 'natural' classification as materials or labour, and allocates these costs to any activity, product or service if separate measurement of costs is desired (Horngren, 1984). Cost accounting systems vary in complexity: they tend to be more detailed as the management seeks more accurate data for decision making. As more detailed and accurate cost systems will lead to higher costs, the design of a cost system reflects a cost-benefit trade-off between the costs of errors caused by relying on inaccurate cost estimates and the costs of measurements (Cooper and Kaplan, 1999).

A typical cost accounting system attempts to serve two purposes simultaneously, being planning and control, and product costing (Horngren, 1984). The primary functions of cost management systems are (Cooper and Kaplan, 1999):
- Measure cost of goods sold and value inventory for the financial reporting function;
- Estimate costs of activities, products, services and customers;
- Provide economic feedback to employees and operators about process efficiency.

2.3.2 Fixed and variable costs

To understand the changes in costs in relation to the fluctuations in the quantity of an activity, fixed and variable costs are discerned (Horngren, 1984). Costs are variable if their dimension changes in response to changes in the level of the activity for which these costs are incurred (Louderback and Hirsch, 1982). These costs are uniform per unit so their total fluctuates in direct proportion to the total of the related activity or volume (Horngren, 1984). Fixed costs do not change, so that they become progressively smaller per unit as the volume increases (Horngren, 1984). They remain about the same throughout wide ranges of activity (Louderback and Hirsch, 1982). Costs are fixed for a given period of time – *the budget period* - and for a given, though wide range of activities – *the relevant range* (Horngren, 1984). Fixed costs indicate the costs of providing the capability to operate at a particular capacity, reflecting the capability for sustaining a planned volume of activity (Horngren, 1984). Fixed costs are related to the production capacity available, whereas variable costs are related to the production volume.

Cooper and Kaplan (1999) identify a similar difference when defining committed and flexible resources. Committed resources are resources for which the organisation makes a commitment or actual cash outlay to acquire such resources that will be used for current and future activities, like employees, buildings and equipment. The related (*'fixed'*) expenses will be recognised in each period during the lifetime of the resource.
Variable costs represent only those resources that are acquired as needed by the organisation. These flexible resources include materials, energy and temporary workers that are hired on a daily basis.

According to Cooper and Kaplan (1999), committed costs become variable over longer periods if the demand for resources applied changes as a result of changes in activity levels and if the organisation changes the volume of committed resources to meet the changed demands. If the available capacity is exceeded, bottlenecks will occur, shortages, increased pace of activity, delays, or poor-quality work.

If the demand declines, the costs of resources used will decrease, but the increase in costs of unused resources will outweigh this saving. Cooper and Kaplan (1999) identify three ways to make committed costs variable with a decreasing demand, namely:
- increasing the revenues: the level of activity will also increase, and then more resources will be required
- re-allocating resources: for example by finding new activities to deploy the unused capacity
- making someone responsible for the costs of unused capacity.

Costs of unused capacity should not be ignored and it should remain someone's or some department's responsibility (Cooper and Kaplan, 1999). Usually, unused capacity can be assigned after analysing the decisions incurring this capacity.

2.4 Cost allocation[6]

This paragraph discusses the main concepts related to cost allocation. First the concepts of direct and indirect costs are discussed. Second, different approaches to determining the costs of a product or service are described. Allocation based on direct costing and a full costing approach is considered and specific attention is paid to allocation strategies for fixed and variable costs and for service department costs. At last, cost models developed for ICT are identified and analysed.

Cost allocation includes the assignment and reassignment of a cost or group of costs to one or more cost objectives (Horngren, 1984). It is used as a general label for tracing the various costs to cost objectives such as departments or products (Horngren, 1984). Cost accounting systems typically accumulate costs by some 'natural' classification as materials or labour, and allocate or trace these costs to cost objectives (Horngren, 1984). The main purposes of cost allocation are to predict the effects of planning and control decisions, to compute income and asset valuations, to obtain a mutually agreed price and to motivate management to control costs (Horngren, 1984).

Costs are often allocated not only to divisions or departments, but also to the outputs of these departments – being their products or services (Horngren, 1984). The main goal of product costing is to determine the unit manufacturing cost (Louderback and Hirsch, 1982). Product costs are determined for inventory valuation purposes and for decision purposes as pricing, adding products, and promoting products. Cost allocation is also performed for cost reimbursement purposes (Horngren, 1984).

2.4.1 Direct and indirect costs

Horngren (1984) identifies three major elements in the cost of a manufactured product, being *direct materials, direct labour* and *overhead*. Direct materials are all materials that are physically identified as a part of the finished goods. Direct labour entails all labour that is physically traceable to the finished goods. All costs other than direct materials and direct labour that are associated with the manufacturing process are referred to as overhead, also referred to as indirect costs.

Historically, the costs for direct materials and direct labour accounted for the majority of the product costs. For al other costs, the costs of estimation were considered greater than its benefits, so these costs were designated as overhead and allocated to products indirectly (Cooper and Kaplan, 1999).
Direct costs are allocated based on the costs of the resources consumed, determined by the product of the purchase price or acquisition costs per unit and the quantity of the resource consumed (Cooper and Kaplan, 1999). Direct allocation can be a complex, costly process because of the difficulty of estimating *price* and *quantity*. Indirect allocation avoids these high measurement costs but at the risk of reducing the accuracy of the resulting cost estimates.

Generally, direct costs are considered to be more easily manageable than indirect costs. So, the relation between direct and indirect costs is a measure to determine the manageability of an organisation's costs.

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[6] Literature on cost allocation is not consistent in the use of terms, resulting in a variety of synonyms like allocate, reallocate, trace, assign, distribute, redistribute, load, proportion and reapportion (Horngren, 1984). In this thesis only the term *cost allocation* is applied.

2.4.2 Product costing

Two contrasting forms of product costing are *job-order costing* and *process costing* (Horngren, 1984). Job-order costing is found in industries like printing or construction industries, where each unit or batch is unique and easily identifiable. Process costing is characterised by mass production of identical units through a sequence of several processes. The process costing approach divides the accumulated costs for a period of time by the quantities produced during that period. Job-order costing accumulates costs by job, by specific unit, or by specific batch of units (Louderback and Hirsch, 1982).

The basic distinction between job-order costing and process costing is the size of the denominator. For job-order costing it is small, like one painting or one hundred advertising circulars. For process costing it is large, like thousands of pounds, gallons or board feet (Horngren, 1984).

As a lot of central costs, like management salaries and related costs, are difficult to allocate, many companies do not allocate these costs (Horngren, 1984). Others allocate these costs based on the revenues of each division, the costs of the products sold, their total costs or the number of staff. Obviously there is a widespread belief that all costs must somehow be fully allocated to parts of the organisation.

These two different methods to allocate costs to products are expressed in two major methods, being direct costing and full costing. The difference between both methods lies in the purpose of the required reports. Full costing is applied for financial reporting and inventory purposes, whereas direct costing is meant for managerial purposes (Louderback and Hirsch, 1982). Direct costing excludes fixed manufacturing overhead from the product costs, but when the product costs are calculated according to the principles of full costing, all costs are included (Horngren, 1984).

2.4.3 Direct costing and full costing

Direct costing, more properly referred to as marginal or variable costing, allocates only short-term variable costs to products (Cooper and Kaplan, 1999). The costs of a product determined through direct costing include all direct costs and the variable manufacturing overhead and excludes fixed production costs from the inventory flow and valuation (Louderback and Hirsch, 1982).

Full costing, also known as absorption costing, allocates all costs to products, including fixed overhead costs that cannot easily be allocated to products. To allocate indirect costs one must first identify a cost driver. Then the costs per cost driver unit must be calculated to allocate the costs based on this price and the quantity of the cost driver consumed (Cooper and Kaplan, 1999).

Indirect allocation produces less accurate cost estimates. To improve the accuracy multiple cost drivers are used, each cost driver capturing a different pattern of resource consumption (Cooper and Kaplan, 1999). More cost drivers lead to a more accurate cost system, but each additional cost driver increases the costs of measurement (Cooper and Kaplan, 1999). So the design of a cost system reflects a trade-off between the cost of errors caused by relying upon inaccurate cost estimates (when using less cost drivers) and the cost of measurement (which increases with the number of cost drivers used).

Activity-based costing (ABC) is an example of a full costing approach. Allocating indirect costs through volume-based cost drivers such as direct labour, machine hours and material dollars leads to distortions as many costs incurred for products are not in proportion to their

production volume (Cooper and Kaplan, 1999). ABC systems avoid these distortions by allocating costs to activities first. The basic assumptions underlying the ABC principles are that resources are consumed only to perform activities and that these activities are performed to produce products. These resources are supposed to be the cost drivers of producing these products. If resources decay over time, no activity can be traced to the consumption of the depleting resource (Cooper and Kaplan, 1999). This is overcome by including time-based depreciation in the ABC system.

ABC has its origin in manufacturing companies, but many service organisations today are obtaining great benefits from this approach as well. After all, the ABC system focuses on the 'service' component of the company (Cooper and Kaplan, 1999).

2.4.4   Allocating variable and fixed costs

Variable costs should be allocated based on the product of the budgeted unit rate and the actual quantities used (Horngren, 1984). Fixed costs can be allocated based on the actual resource usage or on budgeted usage. Allocation based on the actual resource usage can only be done afterwards. When the actual total volume of resources used is known, costs can be allocated based on the costs per unit that are calculated by dividing the total fixed costs by the actual volume. Allocation based on the budgeted usage, also known as the available-capacity approach, is based on the budgeted fraction of the capacity available for use and the total, budgeted fixed costs.

In practice, actual usage is generally employed, and the use of the available-capacity as a base on which to allocate fixed costs hardly ever (Horngren, 1984). As a result the short-run costs of one department depend on the consumption of another department. As the total costs have to be allocated, the price per unit will rise if another department uses less capacity. So, a department may then be faced with higher costs, although it used the same capacity. Therefore, a budgeted allocation base is preferred, as at least on the short term these costs are not affected by other departments (Horngren, 1984). It also protects the consuming departments from intervening price fluctuations and it often protects them from inefficiencies as well (Horngren, 1984). Furthermore, allocation of actual cost fails to provide the buying sub-unit with a reliable basis for planning and fails to provide the supplying division with an incentive to control its costs (Horngren, 1984). Costs of inefficiencies should not be rolled forward into product costs as then the sales and marketing personnel may attempt to recover these costs by raising prices to customers (Cooper & Kaplan, 1999).
Despite all this, companies or departments allocating central costs by actual usage tend to generate less resentment (Horngren, 1984).

2.4.5   Allocating service department costs

Not all costs can be easily allocated directly or indirectly. Costs of service and support departments have to be allocated to production departments first and subsequently to the products (Cooper and Kaplan, 1999). As service departments can provide services both to production departments and to other service departments, an interacting or reciprocal situation can arise. These reciprocal relationships can be modelled in input-output models available in macro economic literature. These models consist of matrices in which the percentage of the activities each department performs for each other is expressed. The impact of changes to the system can be analysed through linear programming techniques. However, as these models are very time-consuming and require a lot of measurements and assumptions they are rarely applied in practice.

Cooper and Kaplan (1999) identify three practical alternatives to solve this problem. First, service departments can allocate costs only to production departments. This approach, referred to as the direct method, ignores the provision of services by one service department to another. Second, following the so-called step-down method, one service department after another can allocate all costs to other departments. After it has allocated its costs, a service department cannot receive any allocated costs anymore. Third, the reciprocal method can be used, which models the reciprocal relationships among service departments exactly.

Considering ICT departments as service departments, Earl (1989) defines four ideal types of ICT cost allocation, being:
- Service centre: ICT costs are not allocated, as non-financial objectives are more important than financial objectives. ICT is not financed through revenues or allocation but treated as overhead.
- Cost centre: ICT costs are allocated to end users to create cost awareness and to make both end users and the ICT department cost responsible.
- Profit centre: ICT costs are allocated through rates based on market prices to create a market mechanism and supplier-customer relationships. The ICT department operates as business unit or risk-bearing concern.
- Hybrid concept: Costs of certain ICT services are allocated, but those of others are not in order to meet the financial and non-financial objectives set for the ICT department.

2.4.6   ICT cost models

ICT management literature provides a number of ICT cost models to identify and allocate costs of ICT. Although many companies claim to have developed an ICT cost model, literature describing these models is limited (Van Maanen, 2000a; Klompé and Van den Brink, 1999). Most models have been developed by commercial research and consulting organisations exploit these models commercially, so it is not in their interest to publish on the exact structure of their models.

In the literature available on ICT cost models, four main models can be identified, being:
- Total Cost of Ownership model (TCO) of the Gartner Group[7]
- Cost of Network Ownership model (CNO) of the Index Group[8]
- Real Cost of Ownership model (RCO) of the Meta Group[9]
- Cost model for ICT Workplaces (CIW) of the Dutch Scientific Technical Council[10]

Other ICT cost models found in literature are the Network Cost of Ownership (NCO) model of Van Eekeren and Heinen (1996) and the End user Computing Cost of Ownership (EUC-CO) model of Hillegersberg and Korthals Altes (1995). Both are variants of the CNO model. The NCO provides a more detailed cost structure and the EUC-CO provides an extension by including end-user computing costs, for example, caused by training and learning, and the non-availability of ICT functionality (Van Maanen, 2000a; Van den Brink, 1999). Figure 2.1 gives an overview of the main characteristics of the four models, based on Van Maanen (2000a) and Klompé and Van den Brink (1999).

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[7] Gartner Group, 1998
[8] Treacy, 1989
[9] Meta Group, 1997
[10] Looijen and Van der Vorst, 1998

	TCO	CNO	RCO	CIW
Cost objective	Workshop	Network	Organisation	Workplace
Purpose	Establishing, controlling and reducing long-term ICT costs	Establishing costs of ICT networks	Establishing ICT costs of an organisation	Defining and identifying costs of an ICT workplaces
Application	Assessment and benchmarking	Assessment and benchmarking	Assessment and benchmarking	Assessment and cost allocation
Cost categories	• Hardware • Software • Management • Support • Development • Communication • End-user costs • Downtime costs	• Hardware • Software • Personnel • Communication • Facilities	• Applications • Infrastructure • Operations	• Workshop • Hardware and software • Local area network • Connectivity • Management • Tele-work • Legislative costs
Directives for use	• Establish scope, assumptions and calculations • Establish research methods • Trace costs • Import in cost database • Perform measurements and simulations	• Trace cost components • Specify costs for the entire lifecycle	• None	• Establish cost components • Trace costs

Figure 2.1 Comparison of ICT cost models based on Van Maanen (2000a) and Klompé and Van den Brink (1999)

All four ICT cost models identified consist mainly of a comprehensive enumeration of cost categories (Van Maanen, 2000a; Klompé and Van den Brink, 1999). The object of cost estimation differs per model from the ICT workshop (TCO and CIW), the ICT network (NCO) and the organisation considered (RCO). Although the purpose of the models suggests otherwise, the models are most useful for assessments and benchmarking. According to Van Maanen (2000a), in their current forms these models are less suitable for cost control and cost allocation. A case study among ten ICT organisations indeed showed that ICT cost models like the ones discussed above are applied only for assessments and benchmarks, not for planning and control of ICT costs (Van Maanen, 2000b).

2.4.7 Benchmarking

Benchmarking is the process of continuously measuring the performance of an organisation and comparing it to those of other organisations to gain information that can help the organisation in actions to improve its performance (American Productivity and Quality Centre, 1992). Benchmarking could be defined as the search for best practices that will lead to superior performance (Camp, 1995). According to the Webster's Dictionary a benchmark is a standard by which something can be measured or judged (Pfaffenberger, 2001). It is a reference point to measure other organisations (Camp, 1989). The fundamental purpose of benchmarking is to break the paradigm of not being able to learn from other organisations (Camp, 1995). Schalk du Toit (1997) gives two reasons why ICT departments may not apply benchmarking. First, benchmarking requires measurements and few ICT divisions have mature measurement systems in place. This is caused partly by the fact that ICT measures are seen as overhead and not as something that adds value to ICT. Second, ICT departments are under pressure to reduce costs while producing more work, whereas benchmarking will increase the workload, introduce higher costs and no directly visible output. However,

benchmarking can teach organisations how to improve business processes and to increase competitiveness (Schalk du Toit, 1997).

2.5 ICT value creation

The question how business value is created from investments in ICT has received a lot of attention. Many studies have examined the relationship between ICT investments and organisational performance (e.g., Graeser *et al.*, 1998; Rai *et al.*, 1997; Willcocks and Lester, 1997; Ragowsky *et al.*, 1996; Brynjolfsson and Hitt, 1993). Many of them did not find a positive relation between both variables, and the term 'productivity paradox' was introduced as the results showed falling productivity figures. The first studies focused on the impact of ICT on an organisation's productivity, as this was the fundamental economic measure of a technology's contribution (Brynjolfsson, 1993; Loveman, 1994). The most fundamental cause of these disappointing results was pointed out to be an incomplete understanding of the creation of value by ICT (McKeen and Parent, 1996).

Several models have been designed to describe the process of ICT value creation and the transformation of ICT investments into improved business performance (Soh and Markus, 1995; Mooney *et al.*, 1995; Weill, 1992). Hoogeveen (1997) concludes that process models are most comprehensive, as they take into account both time and context. Based on several of these models, Soh and Markus (1995) developed a comprehensive, integrated process model that was further refined by Hoogeveen (1997). This model identifies a chain of three different sub-process models (figure 2.2).

The *competitive process* indicates that improved organisational performance requires an ICT impact. ICT impact can be new or improved products and services, transformed business processes, enriched organisational intelligence, and dynamic organisational structures (Sambamurthy and Zmud, 1994).

Hoogeveen (1997) states that an ICT impact is realised if an organisation has achieved one of the following situations:
- ICT has been incorporated into new products or services;
- Business processes have been redesigned using ICT;
- ICT has enabled organisational decision makers to improve their understanding of resource markets and of customers;
- ICT has enabled flexible and adaptive organisational structures among organisational members and with customers and suppliers.

Although essential, ICT impacts are not sufficient to realise improved business performance. IT investments blend with many other factors to produce business results (Thorp, 1998). To realise ICT impacts, the availability of ICT assets, defined as the ICT infrastructure and the portfolio of applications, are required, as described by the *ICT use* process. ICT assets are a necessary though not sufficient requirement to translate ICT assets into ICT impacts. The assets have to be utilised properly, so the skills and attitudes of the employees utilising the ICT assets are of influence as well.

The third process, the *ICT conversion process*, states that ICT expenditures are a necessary prerequisite to obtain ICT assets. As not all organisations are able to convert their money into assets with the same efficiency, adequate ICT management is required, too (Hoogeveen, 1997).
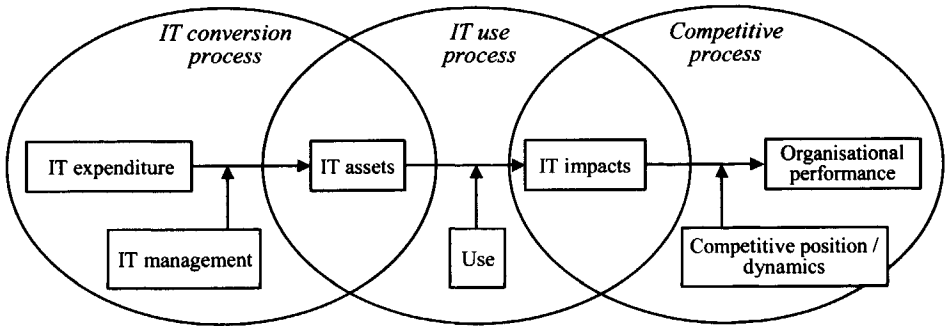
Figure 2.2 Process model for ICT value creation (Hoogeveen, 1997)

2.6   ICT benefit management

This paragraph discusses the concepts of benefit management as can be found in literature. First, the benefits of ICT are discussed, then, the problem of measuring benefits of ICT, and finally, literature on methods to manage ICT benefits.

2.6.1   Benefits of ICT

The literature provides numerous publications on benefits of ICT and as many classifications of ICT benefits. Hammer and Mangurian (1987) defined three types of ICT benefits, being efficiency, effectiveness and innovation benefits. Efficiency measures reduce the process input, whereas the output levels remain unchanged. Measures for effectiveness have consequences for both process input and process output. Efficiency and effectiveness benefits can often be quantified. Many techniques are available for this, like traditional business economics calculations such as return on investment and net present value. Innovation benefits are often described in more qualitative terms. Innovation benefits can be, among others, process renewals and new markets or new products, which are mostly hard to quantify (Van Eekeren and Heinen, 1996).

Another classification is given by Earl (1989), who identified four ways to deploy ICT as a strategic weapon, being:
- Obtaining an advantage over the competition
- Improving productivity and results
- Creating new ways for management and organisation
- Developing new business activities

By obtaining a strategic advantage over the competition, organisations should be able to increase their market share and sales volumes in order to improve their profitability. Other ways to realise this are improving the productivity (efficiency) or enabling new opportunities to organise and manage organisations. Finally, introducing new business activities can generate extra revenues.

Scott Morton (1991) defined six objectives or benefits that play a major role in the application of ICT within organisations, being cost reduction, quality improvement, risk reduction, service improvement, decreasing time to market and business alliances.

These classifications indicate that many different benefits of ICT can be identified, according to the different types of ICT investments. Van Reeken (1997) defined a typology of investment types that vary with respect to intentions, benefits and uncertainties. The typology identifies six types of ICT investments with different scores on these three dimensions, being *automation*, *informatisation*, *alignment*, *transformation*, *anticipation* and *venturing* (figure 2.3). The first computers were used to *automate* administrative work in order to improve efficiency. When application of ICT became more and more sophisticated, ICT was also used to do work that could not be done before. The term information system was introduced to illustrate that ICT was not meant to automate but to inform. This application of ICT did not lead to cost reduction, but to improved *effectiveness*.

Over time, it became no longer sufficient only to improve the efficiency and effectiveness of individual functions or departments, and such sub-optimisation led to higher costs. Information systems were then selected based on their ability to support several functions or departments; thus they were aligned to the business processes and strategy. The alignment type of systems, also known as strategic information systems, should provide organisations with a competitive advantage. To benefit more from ICT, one should also use the potential benefits of ICT as well and adjust the organisation's strategy to the opportunities of ICT. For this, the organisation has to be transformed and work processes have to be redesigned. ICT provides new ways of thinking, working, organising and managing and these have to be adopted to fully utilise the potential benefits of ICT. The first four types of investments, automation, informatisation, alignment and transformation, were aimed at the application of ICT to improve business processes. Through the next investment type, anticipation, the infrastructure of an organisation was improved to create a more flexible organisation that can respond quickly. Finally, in the ultimate type of ICT investments the mission, goals and the market and production programme of the organisation are subject to improvement. Now, ICT provides for example the opportunity to create new product/market combinations.

Types	Automation	Informatisation	Alignment	Transformation	Anticipation	Venturing
Result **Characteristics**	Automatic data processing	New activities: Transaction & Management information systems	Strategic information systems	Redesign of business processes and networks	Pro-active infrastructure	New product/market combinations
Intention	Substitution	Improvement	Strategic fit	Restructuring	Flexibility	Marketing
Benefits	Efficiency (cheaper)	Effectiveness (faster, better, more)	Competitive response Competitive advantage	Customer satisfaction (Quality)	Reaction capacity	PMC Profitability
Uncertainties	Technical uncertainty	Specification uncertainty	Organisational uncertainty	Organisational uncertainty Strategic IS architectural uncertainty	Strategic IS architectural uncertainty; IS Infrastructural uncertainty	Business uncertainty

Figure 2.3 Typology of ICT applications (Van Reeken, 1996)

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The above discussion of benefits indicates that although ICT benefits like increased productivity, reduced time to market, new orders and competitive advantages might be expressed in financial terms (because they will influence the organisational performance), most ICT benefits mentioned in literature are expressed in non-financial terms, particularly when the ICT investments are of a more advanced type. Most organisations find this very difficult, particularly when dealing with ICT that is in an early stage of its life cycle, where many consequences of the investment are still unknown. Furthermore, the benefits found in literature are all ICT impacts in terms of the process model for ICT value creation discussed in paragraph 2.5. This process model states that improved organisational performance is realised not only by ICT impact, but that it is also influenced by environmental factors like the competitive position and competitor response.

2.6.2   Measuring ICT benefits

In practice, measuring ICT benefits appears to be very difficult. A selection from the literature provides the following most commonly mentioned reasons for this (e.g., Economist, 1997; Ragowsky *et al.*, 1996; Brynjolfsson, 1993; Keen, 1991):
- Actual benefits can only be estimated (long) after the system has been installed.
- Comparison is difficult, as before-the-act performance data are usually unavailable.
- ICT has many less tangible benefits that cannot be measured precisely.
- The data used is incomplete as existing accounting systems do not show the value-added benefits of ICT which reveal themselves in improvements in quality and convenience instead of as cost savings.
- The variables measured are not only affected by ICT, but by other factors as well, like government policy, economic conditions, ICT and business management, organisational learning.

Economic literature provides theoretical models to describe how the various production means together influence business performance, taking into account that the contribution of a certain production mean is non-linear. This formula can be established for each production mean, provided that the relevant units can be measured exactly. However, this so-called approach of joint production is very difficult to put in practice, as the coefficients in the formula are very difficult to assess.

2.6.3   Methods for ICT benefit management

Literature on benefits of operational ICT is limited to the ex-post evaluation of ICT investments and to discussions on the contribution of ICT to productivity and other macroeconomic measures (e.g. Brown and Remenyi, 2000, 1998; Berghout and Remenyi, 1997). Most publications concentrate on ICT investments and the related decision-making process in order to define the best set of evaluation criteria for ICT investments. According to Hillam *et al.* (2000), most researchers focus on identifying the factors that influence the perceived success or failure of ICT because in practice data on formal post-implementation audits are missing. Methods to manage the benefits of operational ICT are not found in literature. On the other hand, business managers and executives obviously know intuitively that ICT returns value and that the business and human concept of value is deeper and wider than the narrow rationalism that economic and accounting models are able to identify (Bannister and Remenyi, 2000). According to Glazers (1993), managers themselves are the best judges of the variables with which they work.

Considering this, we refer to a recent publication of Ward and Peppard (2002). They state that any post-implementation review should focus not only on what has happened in terms of delivered benefits but should also consider what further benefits can now be gained. They identified an approach from a Wentworth Research report as one of the few that comprehensively addresses the range of management issues associated with maximising actual benefits delivered (Wentworth Research, 1998). This approach claims that if maximum value is to be gained from the overall investment in IT, benefit identification should be a continuing process, from which IS/IT projects are defined. The approach consists of a five-stage benefit management process, but the actual management of operational benefits is not worked out in detail.

As many benefits of operational ICT are expressed in non-financial terms, we consulted management literature on non-financial aspects. Literature on management of non-financial aspects of ICT is hard to find. By far, most literature concentrates on non-financial aspects from an investment decision-making perspective. Publications that can be positioned in this field concentrate on the evaluation of a specific information system within a specific organisational setting. Literature that might be useful to identify ways to manage non-financial aspects can be found in the field of quality management. Literature on quality management concentrates on identifying, measuring and managing quality aspects of products or services. As will be illustrated in the next paragraph, quality aspects are usually expressed in non-financial terms.

2.7   Quality management

Quality is defined as the set of properties and characteristics of interest of a product or service to meet explicit and implicit requirements (ISO-8402, 1986). Considering the quality of an ICT service provided to a customer by the supplier, the definition of Guaspari (1988) can be applied as well: "*Quality is what meets the customer's expectations*". Garvin (1984) identifies five different types of quality definitions to characterise the several perspectives on quality:

- Transcendent: "Quality cannot be defined; you know what it is"
- Product based: Creating product quality by defining objective measurable product attributes
- User based: "Quality is fitness for use"
- Manufacturing based: Conformance to requirements
- Value based: "Quality is the degree of excellence at an acceptable price and the control of variability at an acceptable cost"

Selecting just one of these definitions of quality will not work as different stakeholders may adopt different perspectives, so these definitions are used in parallel by the different stakeholders (Garvin, 1984). For example, the ICT department providing the ICT service will focus on a product-based quality definition. But providing a good product quality does not guarantee that the users deploying the ICT service to perform their activities experience the product as being of good quality. For the user, aspects like user friendliness and the way the ICT service supports his/her business processes will be more important. Finally, the organisation will be interested in a value-based quality definition, as the benefits to the organisation of all ICT services should be positive compared to their cost.

The European Foundation for Quality Management developed a model to identify the areas of attention for total quality. This EFQM model emphasises the fact that total quality adheres to integral management approaches (Hardjono *et al.*, 1996). The model tries to be as un-

prescriptive as possible. It identifies nine elements that should be seen as areas of attention, not as criteria for total quality, being *leadership, people management, policy and strategy, resource management, process management, staff satisfaction, customer satisfaction, impact on society* and *business results* (Hardjono *et al.*, 1996). The Dutch Quality Institute (INK) added to this model five phases of the evolution of an organisation, being *product-oriented, process-oriented, system-oriented, chain-oriented* and *total quality* (INK, 1998).

Literature on quality management in ICT concentrates mainly on software development. In this paragraph, concepts in this field are discussed to identify their applicability to quality management of operational ICT. Both the ICT product and the supporting ICT management processes determine the quality of operational ICT. Therefore, two different perspectives on quality are considered in this thesis, being the product orientation and the process orientation. The product orientation concentrates on the attributes of the product quality (product-based definition) and also addresses the quality perceived by the users (user-based definition). Second, the process orientation focuses on the improvement of the ICT management processes (manufacturing-based view). The optimal configuration of an ICT service will balance these two orientations against functionality and costs (value-based definition). This research does not consider models or best practices describing the ICT management processes that are subject to quality management, like ITIL (CCTA, 1989) and COBIT (ISACA, 1996).

2.7.1 Product quality

For the identification of product quality attributes, many models have been developed. The product orientation towards [software] product quality is based on refining quality into attributes and sub-attributes, using hierarchical product-quality models (Gillies, 1992). Literature provides several hierarchical quality trees, both general models and models specific for ICT (e.g. ISO-9126, 1998; Delen *et al.*, 1991; Mollema, 1991; Boehm, 1981; McCall, 1977). Based on literature, two different sets of quality attributes are identified in this thesis. First, a set of quality attributes for the information processed by the operational ICT is defined, representing the user-based quality definition. Second, the product-based quality definition is expressed in a set of quality attributes for the ICT product.

Based on literature, Van den Brink (1998) defined two sets of quality attributes. The first set is defined for information, and contains the following ten attributes:
- Effectiveness: The capability to correspond to the expectations of the defined function.
- Efficiency: The capability to provide the desired information at acceptable costs.
- Completeness: The capability to represent all relevant information over a certain period of time.
- Correctness: The capability to provide the right information.
- Timeliness: The capability to process the data in time.
- Exclusiveness: The capability to prevent unauthorised people to access and mutate the information.
- Availability: The capability to provide the desired information at the desired place and moment in time.
- Accuracy: The capability to provide detailed information.
- Controllability: The ability to trace the information provided to its sources.
- Presentation: The capability to fit the provided information to the needs and the imagination and interpreting abilities of the recipients.

The second set of quality attributes of Van den Brink (1998) describes the quality of information systems. This set is based on an extensive set of quality requirements retrieved from empirical research on the quality of information systems in banking environments and from at least five different models. In this set, costs is one of the quality requirements. In view of the distinction made in this research between financial and non-financial criteria (chapter 1), this set is not suitable for this research.

One of the quality models Van den Brink based his work on the ISO 9126 standard for software product quality (ISO-9126, 1991). This international standard distinguishes six quality attributes, being *Functionality*, *Reliability*, *Usability*, *Efficiency*, *Maintainability* and *Portability*. The quality attributes identified by the ISO 9126 standard consider the software product from the perspective of the end users. Van Zeist *et al.* (1996) extended this ISO standard by trying to incorporate the quality requirements of end users (demand) and ICT personnel (supply), as well as the requirements of evaluators (auditors). To create this multi-perspective model they added a number of requirements, like controllability, availability and reliability (see figure 2.4). According to Van den Brink (1998), these requirements should result from the requirements of the end users. However, by explicitly incorporating all three perspectives, the Extended ISO model supports all three stakeholders in the definition of the relevant quality requirements.

It is claimed that within an organisation, several parties play a role in the alignment of costs and benefits of operational ICT: the customers (demand), suppliers and auditors. The method that this research aims to develop should support all parties involved in performing their role in the alignment of operational ICT. Although it was initially defined for software products, it is claimed that this standard is applicable for ICT in general. Therefore, the Extended ISO model is adopted in this research as a set of quality attributes for ICT. For the quality of information, we adopted the set of quality attributes of Van den Brink (1998).

2.7.2 Process quality

Process quality and improvement have been studied for years in the field of software development. In development environments, the process orientation of quality is based on the assumption that a 'quality process' results in a 'quality product' (Humphrey, 1989). This assumption and the over-emphasis on the "process" have been criticised (Card, 1991; Bach, 1994; Herbsleb *et al.*, 1997).

Several standards for evaluating the quality of the software development process have been developed, like the ISO-9000/3 quality standard (ISO-9000/3, 1997) and the Capability Maturity Model (Paulk *et al.*, 1993) and the ISO-15504 standard for software process improvement (ISO-15504, 1998). The classification of the maturity levels of the Capability Maturity Model (CMM) has been a source of inspiration for several authors to define five levels of maturity for ICT management processes. Most of these models were developed by consulting organisations for auditing and consulting purposes, for example by Van Herwaarden and Grift (2000), Meijer *et al.* (2000) and Bosselaers *et al.* (2000).

Based on his task model for ICT Management and on the CMM, Looijen (2001) defined five levels of maturity of ICT management:
- *Initial level:*   ICT management processes do not exist. Operational authorities carry out management, deciding what actions to take. Work pressure is often high and work is uncoordinated.

Functionality – the capability to provide functions which meet stated and implied needs when used under specified conditions.
- Suitability – the capability to provide an appropriate set of functions for specific tasks and user objectives.
- Accuracy – the capability to provide right and agreed results or effects.
- Interoperability – the capability to interact with one or more specified products.
- Security – the capability to prevent unintended access and resist deliberate attacks intended to gain unauthorised access to confidential information, or to make unauthorised modifications to information or to the program so as to provide the attacker with some advantage or so as to deny service to legitimate users.
- Traceability – the capability to verify correctness of data processing on required points.
- Compliance – the capability to adhere to standards, conventions, or regulations in laws and similar prescriptions.

Reliability – the capability to maintain the level of performance of the product when used under specified conditions.
- Maturity – the capability to avoid failure as a result of faults in the product.
- Fault tolerance – the capability to maintain a specified level of performance in cases of software faults or of infringement of its specified interface.
- Recoverability – the capability to re-establish its level of performance and recover data directly affected in the case of a failure.
- Availability – the capability to be available to the user at the time it is needed.
- Degradability – the capability to establish the essential functionality after a breakdown.

Usability – the capability to be understood, learned, used and liked by the user when used under specified conditions.
- Understandability – the capability to enable the user to understand whether the product is suitable, and how it can be used to particular tasks and conditions of use.
- Learnability – the capability to enable the user to learn its application.
- Operability – the capability to enable the user to operate and control it.
- Attractiveness – the capability to be liked by the user.
- Customisability – the capability to be customised by the user to reduce the effort required for use and increase satisfaction with the product.
- Explicitness – the ability to clarify its status (for example progression bars, etceteras).
- Clarity – the capability to make the user aware of the functions the product can perform.
- Helpfulness – the capability to provide instructions to the user on how to interact with the product.
- User-friendliness – the capability to satisfy the user.

Efficiency – the capability to provide the required performance, relative to the amount of resources used under stated conditions.
- Time behaviour – the capability of the software to provide appropriate response and processing times and throughput rates when performing its function under stated conditions.
- Resource utilisation – the capability to use appropriate resources in an appropriate time when the software performs its function under stated conditions.

Maintainability – the capability to be modified.
- Analysability – the capability to be diagnosed for deficiencies or causes of failures, or for the parts to be modified to be identified.
- Changeability – the capability to enable a specified modification to be implemented.
- Stability – the capability to minimise unexpected effects from modifications.
- Testability – the capability to enable modified products to be validated.
- Manageability – the capability to (re)establish its running status.
- Reusability – the capability to reuse parts or the complete product in another product.

Portability – the capability to be transferred from one environment to another.
- Adaptability – the capability to be modified for different specified environments without applying actions or means other than those provided for this purpose for the product considered.
- Installability – the capability to be installed in a specified environment.
- Conformance – the capability to adhere the product to standards or conventions relating to portability.
- Replaceability – the capability to be used in place of other specified products in the environment of that product.

Figure 2.4 Overview of the extended ISO model (Van Zeist et al., 1996)

- *Repeatable level:* Work is carried out according to certain practices, but there are no formal descriptions. The importance of practices of the basic ICT management processes is known, and they are carried out in a practical manner.

- *Defined level:* Management processes are documented, standardised and related to service level agreements. Users consider the ICT management function a service organisation.

- *Managed level:* The management processes are understood, measured and controlled. This requires management information on internal management processes and external services.

- *Optimising level:* Management can continuously improve its management processes on the basis of feedback from the processes. Trends in use can be identified and one can act proactively on new technologies and applications.

Niessink (2000) followed the principles of the original CMM more closely and developed the ICT Service CMM. Similar to the software CMM, the ICT service CMM is a staged model comprising a number of maturity levels for each process or process area. Niessink (2000) did not only translate the definitions of these levels to ICT management, but is also working on specifying the key process areas for each level (Niessink, 2001). The objective of the model is to enable ICT service providers to assess how well they are capable of delivering certain ICT services and to provide them with directions and steps to improve their delivery (Niessink, 2000). The model identifies five maturity levels, each containing key process areas. The term *"key processes"* indicates that these processes are believed to be the key for reaching a certain maturity level. Non-key processes may also exist, being processes that are not strictly necessary to reach a certain maturity level.

The key process areas are divided into three categories, being management, enabling and delivery processes. The first category concerns the management of services. The second deals with enabling the delivery processes through support processes and standardisation of processes. The third category represents the processes that result in a consistent, efficient delivery of ICT services according to the appropriate quality levels. The key process areas are presented in figure 2.5. To reach a certain maturity level, an organisation must have implemented all key processes of that level and those of the lower levels. The key process areas in their turn are organised by common features, practices that indicate whether a process is implemented and institutionalised. Finally, the common features consist of key practices describing the activities that have to be performed or infrastructures that have to be present.

2.7.3 Measurement of product and process quality

A well-known statement is *"you cannot control what you cannot measure"* (DeMarco, 1982). So, in order to manage the quality of an ICT service, one has to measure the quality of both product and process. 'Measurement' is the process by which numbers or symbols are assigned to attributes of entities in the real world in such a way that they are described according to clearly defined rules (Fenton and Pfleeger, 1996). One can measure both the product and the process quality. The measurement outcomes can be represented on different measurement scales.

Process categories	Management	Enabling	Delivery
Levels	Service planning, management, etc.	Support and organisation	Actual service delivery
Optimising	Process Change Management	Technology Change Management	Problem Prevention
Managed	Quantitative Process Management		Service Quality Management
Defined	Integrated Service Management	Organisation Process Focus Organisation Process Definition Training Program	Service delivery
Repeatable	Service Commitment Management Service Delivery Planning Service Tracking and Oversight Subcontract Management	Configuration Management Event Management Service Quality Assurance	
Initial	Ad hoc processes		

Figure 2.5 Key process areas of the IT Service CMM (Niessink, 2000)

Fenton and Pfleeger (1996) identify five types of scales:

- *Nominal scale:* When items are assigned to groups or categories. No quantitative information is conveyed, no ordering of items implied. Variables measured on a nominal scale are also known as categorical or quantitative variables.
- *Ordinal scale:* When a ranking is added to the nominal scale, so that a certain class is higher or better than another. The ranges between two classes have no meaning.
- *Interval scale:* The interval scale is an ordinal scale with equal differences between the classes. As a true zero point is missing, statements indicating how many times higher one score is than the other cannot be made.
- *Ratio scale:* Ratio scales add an absolute zero point to the interval scale. This allows statements like 'x is two times more than y'.
- *Absolute scale:* This scale is based on counting the number of elements that need to be measured. The difference with the ratio scale is that for the absolute scale, the scale is unique, i.e. there is only one scale allowed for measurement. This scale is the most restrictive scale.

An example of a nominal scale is when incidents are categorised into classes like user mistake, hardware problem or software fault. On an ordinal scale, the required availability of ICT services can be categorised into classes like, for example, high availability, medium availability and low availability. The Celsius scale is an example of an interval scale. A

difference of 10 degrees has the same meaning all along the scale, but as the zero point is arbitrary, one cannot conclude that 20 degrees is twice as warm as 10 degrees. Such statements are allowed for ratio scales on the other hand, for example the number of transactions processed by a system every second. Here, 500 transactions per second can be claimed to be twice as much as 250.

Product measurements can be divided into external and internal product measurements (ISO-9126, 1998; Fenton and Pfleeger, 1996; Humphrey, 1989). An external product measurement measures the external behaviour of the product, like response times, time to add a feature and mean time between failures. An internal product measurement measures the internal structure of the software product, like the number of components, number of interfaces and the cyclomatic complexity.

The available methods to measure the external product quality are based on the evaluation of the product against its specification (Van Solingen, 2000). Specification of product quality in measurable terms is recommended as more objective and concrete specifications improve the evaluation (Gilb, 1994). With internal measurements one can compare product characteristics to predefined norms and standards to achieve a certain level of quality. The main benefit of internal and external product measurement is that objective numbers are provided to characterise a product (Van Solingen, 2000).

The quality of the processes influences the product quality. Measurement and analysis of processes and of the changes in product quality provides an instrument to determine the relation between the process and the product quality. De Wijs (1994), Luime (1996) and Weijers (1998) have studied measurement of ICT management processes. Both focus on the definition of performance indicators in their measurement process. Luime (1996) defines a performance indicator as a measurable quality attribute. Bonnet and Krens (1987) define it more extensively: an indicator measuring activities or developments that are crucial to the organisation. According to Gieskes (1996), a performance indicator is process related, it can be used to measure or register, and it can be compared with a predefined norm. This comparison may lead to corrective actions. De Wijs (1994) stated that a performance indicator must be valid, comparable, broad and precise and that the assessor's measurement prescription must be measurable, objective, reliable and economical (figure 2.6).

Performance indicator		Measurement prescription	
Validity	The indicator must be representative for the characteristic studied	Measurability	It must be able to collect the desired information through measurement
Comparability	The result must enable comparison with the results of the same indicator in comparable situations	Objectivity	The measurement results must be free from subjective influences; repeated measurement by different persons should lead to the same score
Span	The indicator must provide information that is broad enough to base important decisions on	Reliability	The indicator must provide stable, precise and timely results, independent of the frequency of measurement
Precision	The indicator represents the required level of detail and the nature of the indicator clarifies when things are critical or urgent	Economical	The identification and interpretation of the indicator must be cost effective, i.e. the costs must be justified by the usefulness of the data

Figure 2.6 Requirements for performance indicators (De Wijs, 1994)

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Luime (1996) and Weijers (1998) based their performance indicators for ICT management processes on the principle of input-process-output. For the process input, Weijers (1998) discerns primary and secondary input. The primary input consists of the items that are object to the process activities, like incident calls and change requests. The secondary input consists of the resources required to perform the process activities, like human resources. The output of the process can, for example, be expressed in the number of incidents solved or changes realised. The process itself can be measured by a number of state variables, like throughput time, number of items in stock or under construction (Weijers, 1998). The throughput time can be subdivided in process time, waiting time and inspection time. If more detailed information is required, each process can be defined as a set of sub-processes that can be treated as separate processes.

Grimberg (1994) discerns two different types of methods to define performance indicators, being top-down and bottom-up approaches. Top-down approaches translate business objectives into performance indicators, whereas bottom-up approaches consolidate operational performance indicators to aggregated indicators. Top-down approaches have the advantage that the indicators are linked to business objectives, but finding the right indicators or ones that are measurable is sometimes difficult. Bottom-up approaches do not have a measurement problem, as they are based on already existing measurement systems. However, as a link to the business objectives is missing, the suitability of the indicators for management purposes is sometimes questionable.

The Goal/Question/Metric (GQM) approach of Basili and Weiss (1984) is an example of an approach combining both a top-down and a bottom-up approach. Van Solingen and Berghout (1999) demonstrate that the GQM approach provides a useful method to measure process quality and it will therefore be described in the next paragraph.

2.7.4 Goal/Question/Metric Method

The Goal/Question/Metric (GQM) method was designed to support quality improvements in software development. It provides a systematic approach for tailoring and integrating goals to models of the software process, products and quality perspectives of interest, based upon the specific needs of the project and the organisation (Basili *et al.*, 1994). The result of the application of the GQM method is the specification of a measurement system targeting a particular set of rules for the interpretation of the measurement data (Van Solingen, 2000).

The GQM method starts with the definition of a specific goal (see figure 2.7). This goal is refined into questions, breaking down the issue in its major components. Each question is further refined into metrics that should provide the information to answer these questions. After this top-down definition of metrics, the measurement data is interpreted bottom up. The information provided by the metrics are interpreted and analysed in order to answer the questions defined and to conclude whether or not the goal has been attained.

GQM trees of goals, questions and metrics are built on knowledge of the experts in the organisation, being the software developers (Basili and Rombach, 1988). The implicit model of the developers concerned, built during years of experience, gives valuable input to the measurement programme and will often be more important than the valuable explicit process models.

Although the GQM approach is considered to be a process measurement approach, Van Solingen and Berghout (1999) argue that it can also be used to measure product quality. As
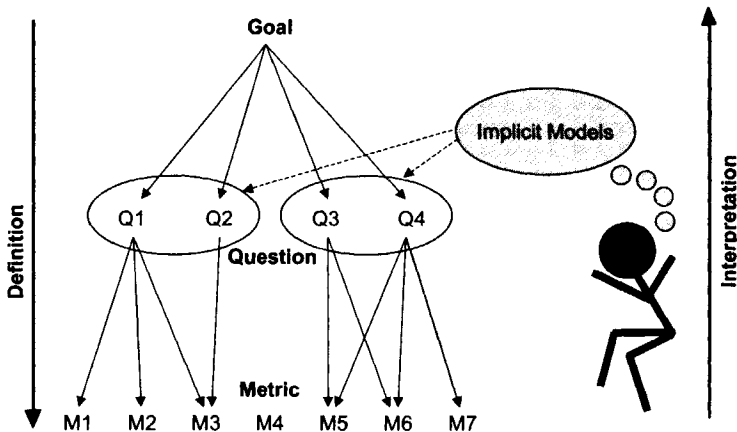
Figure 2.7 The Goal/Question/Metric Paradigm (Basili and Weiss, 1984)

the quality of operational ICT services is defined in chapter one as consisting if product quality and process quality, it is suggested that it is also of use for measuring and improving the quality of operational ICT. A more conceptual model to link measurement of product and process quality is the RPM model of Van Solingen (2000).

2.7.5 Linking product and process measurement

To link process and product quality measurement, Van Solingen (2000) developed the RPM model. The model, developed for software process improvement, consists of three work areas:

- *Requirements engineering: (RE)* — The process of defining a complete, consistent, unambiguous, and measurable product quality specification based on the requirements of all stakeholders

- *Process engineering: (PE)* — The process of designing a measurable process to provide a specific product that complies to the product quality specification

- *Measurement program engineering: (ME)* — The process of designing and implementing a set of process, product and resource metrics to evaluate product quality and product-process relationships

Furthermore the conceptual model identifies three work products, being:

- *Product quality specification:* — The documented product quality requirements, specified in a complete, consistent, unambiguous, and measurable way

- *Development process model:* — The project specific model of the steps performed to result in the specified product

- *Measurements:* — The collected data and their analysis regarding the conformance of the product to the product quality specification, or regarding to the effectiveness of specific process actions
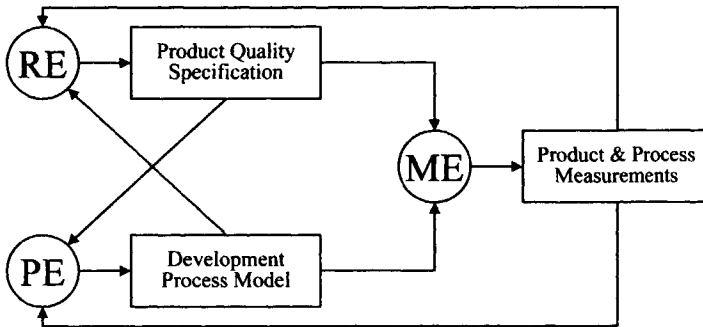
33

Figure 2.8 The RPM conceptual model for software process improvement (Van Solingen, 2000)

The work areas, their work products and interrelationships are represented in the conceptual model shown in figure 2.8.

2.8   Planning and control

Management is frequently referred to as planning and control. *Planning* stands for setting goals and devising ways to meet them, whereas *control* entails determining whether things are going according to plan, and if not, which remedies might be applied to achieve this (Louderback and Hirsch, 1982). Planning and control systems are one of the main co-ordinating mechanisms in organisations (Mintzberg, 1983). Mintzberg distinguishes two fundamentally different kinds of planning and control systems: one focuses on regulation of overall performance, and the other on regulation of specific actions. According to Mintzberg, the first control cycle is primarily concerned with after-the-fact monitoring of results: *performance control*, which can serve two purposes: *to measure* and *to motivate*. The second control cycle is oriented towards specific activities that will take place and is labelled *action planning*.

To study planning and control systems, Anthony (1965) defined three levels to classify the different aspects of these systems, being strategic planning, management control and operational control:
- *Strategic planning* entails the process of making decisions about the organisation's objectives, about changes in these objectives, the means utilised to meet these objectives and about the policy to acquire, utilise and manage these means.
- *Management control* entails the process in which management ensures that the required means are obtained and utilised effectively and efficiently to meet the organisation's objectives.
- *Operational control* is the process ensuring that specific tasks are carried out effectively and efficiently. This process concentrates on individual tasks or transactions like the definition of timetables and the control on individual activities.

The boundaries between these three categories are not quite clear. Anthony illustrates the levels by a list of activities that can be positioned within these three levels. Summarising he states that strategic planning includes mainly planning activities, management control a

mixture of planning and control activities and operational control mainly control activities (Anthony, 1965).

2.8.1 Planning

Planning involves setting goals and devising ways to meet them (Louderback and Hirsch, 1982). Accounting formalises plans by expressing them in the language of figures as *budgets* (Horngren, 1984). Budgets are formal plans for future periods (Louderback and Hirsch, 1982). They detail the firm's objectives and the means by which the firm expects to achieve them (Louderback and Hirsch, 1982).

Annually, financial managers conduct an analytical process to plan the expenses of each organisational unit. They establish monthly budgets for each cost component at each cost centre so that costs can be allocated to production centres (Cooper and Kaplan, 1999). A master budget consolidates the organisation's overall plans for a shorter span of time and is generally prepared annually (Horngren, 1984). It usually consists of a statement of expected future income, a balance sheet, a statement of cash receipts and disbursements, a statement of changes in the financial position and supporting schedules (Horngren, 1984). Other budget types that can be identified are operating budgets like those for sales, production and selling expenses, and financial budgets like capital budgets, cash budgets and budgeted balance sheets (Horngren, 1984).

Budgets can be static or flexible. A static budget is defined as a budget prepared for only one level of activity (Horngren, 1984). A flexible or variable budget is based on knowledge of cost behaviour patterns and is prepared for a range rather than for a single level of activity (Horngren, 1984). Essentially a flexible budget is a set of budgets that can be tailored to any level of activity. Flexible budgeting systems allocate budgeted fixed costs at a predetermined budgeted rate, which is calculated annually (Cooper and Kaplan, 1999). The variable costs are allocated based on actual usage and standard prices (Cooper and Kaplan, 1999).

Horngren (1984) identifies three major benefits of budgeting:
1. Budgeting compels managers to think ahead as budgets formalise the managers' responsibilities for planning;
2. Budgeting provides definite expectations that are the best framework for judging subsequent performance;
3. Budgeting aids managers in co-ordinating their efforts, so that the organisation's objectives as a whole harmonise with the objectives of its parts, as it obliges executives to visualise the relationship of their department to other departments, and to the company as a whole.

Conventional budgeting practice is an iterative, negotiating process between heads of responsibility centres and senior executives (Cooper and Kaplan, 1999). The budget for next year builds from the baseline of the previous year, plus or minus a few percent. Zero-based or activity-based budgeting can be characterised by reverse-performed activity-based costing (Cooper and Kaplan, 1999). Activity-based budgeting starts with estimating the expected production and sales volumes per individual product and customer. Based on this a forecast is made for the demand for organisational activities and the resource demands to perform these activities. Then the actual resource supply to meet these demands and the activity capacity are determined.

The resource supply pattern differs for different resources as each increases in a different way. Figure 2.9 illustrates this by representing four different patterns for four different resources. All four patterns show an increasing resource demand. The available resource capacity determines when the resources available are not sufficient to meet the demands. At that moment, extra capacity has to be acquired. In its turn, the dimension of the capacity units supplied determines the frequency of the capacity increases. Accommodation, for example, is a resource usually supplied in large dimensions. Extra supplies will therefore not be bought frequently. Labour, on the other hand, is supplied in smaller units, per employee, so the supplied capacity can meet the required capacity better.

2.8.2 Control

Control involves determining whether things are going according to plan and if not, what remedies might be applied (Louderback and Hirsch, 1982). Control is formalised through performance reports providing feedback by comparing results with plans and by highlighting variances, i.e. deviations from plans (Horngren, 1984). Performance reports generally represent a comparison of actual results with some budget (Horngren, 1984).

During the year, the cost system records and allocates actual expenses to all responsibility centres. The standard cost system records efficiency variances at the cost centre where they arise, rather than allocating the variances either from indirect centres to direct centres or from production centres to products (Cooper and Kaplan, 1999). In this way, managers are held accountable for costs they can control, like the spending and usage variances within their cost centre and quantities of services from other cost centres used (Cooper and Kaplan, 1999). Costs of inefficiencies should not be rolled forward into product costs as then the sales and marketing personnel may attempt to recover these costs by raising prices to customers (Cooper & Kaplan, 1999).
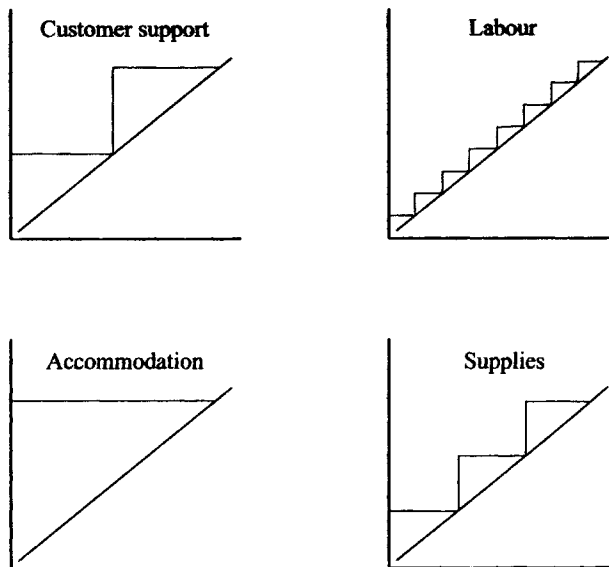
Figure 2.9 Resource supply pattern (Coopers and Kaplan, 1999)

2.8.3 Balanced Scorecard

Traditional financial performance measures no longer supply the information that today's executives need to manage the organisation's performance because the approaches by which they are obtained are inadequate; they rely primarily on financial accounting measures (Kaplan and Norton, 1992). Therefore, Kaplan and Norton developed the Balanced Scorecard (BSC) to provide managers with the instrumentation necessary to navigate to future competitive success.

The BSC complements the financial measures of past performance with measures of the drivers of future performance (Kaplan and Norton, 1996). The BSC identifies four perspectives being *financial, customer, internal business processes* and *learning and growth*, and for each perspective *objectives, measures, targets* and *initiatives* should be defined (see figure 2.10). The objectives and indicators defined for each perspective have to be based on the vision and strategy of the organisation. The BSC is therefore a strategic management tool that should be used as a communication, informing and learning system (Kaplan and Norton, 1996).

Concerning the financial perspective, the organisation should ask itself *how it should appear to its shareholders to be successful*. Financial objectives typically relate to profitability, for example measured by operating income, return on capital employed or economic value added. The following question should be answered from the customer's perspective: *how should we appear to our customers to achieve our vision?* Measures are for example customer satisfaction, customer retention, market share and new customer acquisition. The internal business processes perspective concerns the question *what business processes must we excel in to satisfy our shareholders and customers?* Measures in this perspective concentrate on the performance of the business processes, like response and throughput time or efficiency measures. Finally, for the perspective of learning and growth the organisation should answer
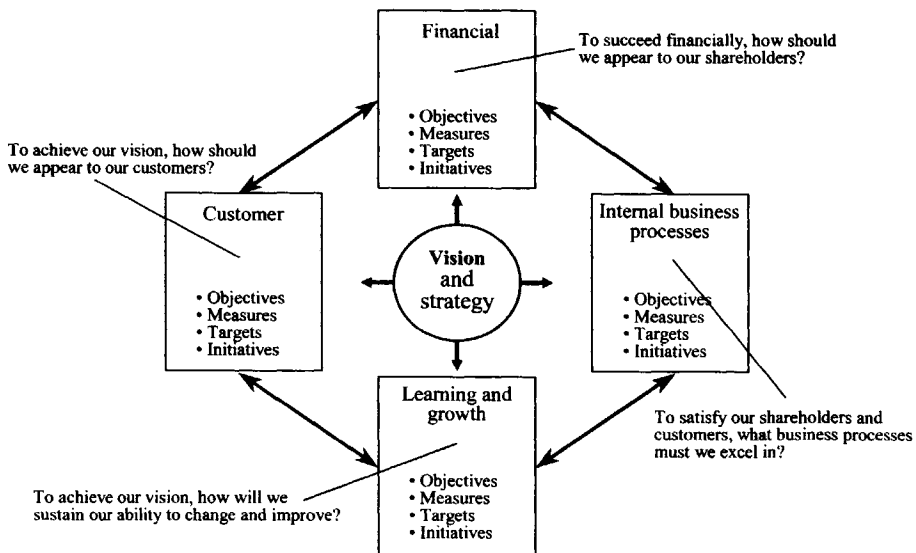

Figure 2.10 The Balanced Scorecard of Kaplan and Norton (1996)

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the question *how will we sustain our ability to change and improve to achieve our vision?* Measures for this perspective will concentrate on, for example, improving skills of employees, enhancing processes and ICT and aligning organisational procedures and routines.

The BSC is designed as a general accounting device that can be applied by any organisation or department. Van Grembergen and Van Bruggen (1997) demonstrated how the BSC could be applied to ICT organisations. However, they also concluded that there are only few organisations that have implemented a BSC for their ICT organisation, and that most of these scorecards do not meet the requirements for a strategic management system.

2.9   Summary and conclusions

In this chapter an overview was given of literature on the alignment of operational ICT. The literature study did not turn up any publication on this specific subject. There are many publications on only a part of the research area. In the literature much attention is paid to the costs of operational ICT, ICT cost models and charge-back systems for ICT costs. Furthermore, the identification and measurement of benefits of ICT is discussed widely in literature too, and there is a growing interest for ICT Balanced Scorecards and maturity models for ICT service organisations. The literature study also considered publications from other disciplines like management accounting and quality management. This brought a large variety of publications discussing many different items that might be connected to the alignment of operational ICT. Subjects discussed in this chapter include economic approaches to organisations, accounting systems, product costing and quality models for product and process quality.

With respect to the amount of literature available on this subject and related items, it is assumed that this body of knowledge should provide enough information for organisations to enable them to align the benefits and burdens of operational ICT. However, there are indications that in practice only very little of this knowledge is applied by organisations. For example, a study of Van Maanen (2000b) among 10 ICT departments of financial institutions concluded that no organisation applied one of the ICT cost models found in literature. Another study by Van Grembergen and Van Bruggen (1997) showed that few ICT organisations have implemented an ICT BSC, while most of them do not meet the requirements for a strategic management system. As no further research on this specific subject is known, it is unknown what problems organisations are faced with that might prevent them from adopting the available knowledge and methods.

To determine what problems organisations are faced with in practice, we conducted a series of descriptive case studies at three financial institutions in the Netherlands. To describe and analyse current practice on the alignment of costs and benefits of operational ICT, we defined an analytic framework based on the literature presented in this chapter (figure 2.11). This framework is applied to perform the case studies and to analyse the outcomes. The observations of the case studies are described in chapter 3; the outcomes are analysed in chapter 4. Furthermore, literature discussed in this chapter will be used to develop a method for the alignment of operational ICT in chapter 5.

- Costs
  - The cost information on operational ICT that management receives
  - The relation between fixed and variable costs
  - The cost allocation strategy
    - The relation between direct and indirect costs
    - The cost price calculation method applied
- Benefits
  - Identification of revenues of operational ICT
  - Quality aspects identified
  - Methods applied for measurement and management
- Supporting methods

Figure 2.11 Analytical framework for case studies

3 Three case studies

3.1 Introduction

A series of case studies was conducted to explore in practice the alignment of operational ICT, that is, the realisation of an optimal balance between the benefits and burdens of operational ICT to support the business processes of an organisation optimally. As concluded from the literature study described in chapter 2, no research has been carried out in this field before. So, the series of descriptive case studies was aimed at gaining knowledge about the processes that can be identified in practice regarding the alignment of the benefits and burdens of operational ICT, in the remainder of this thesis referred to as alignment of operational ICT.

The case study research focused on gathering information on how organisations manage the costs, revenues and non-financial aspects of operational ICT. To gather this information we formulated a number of sub-questions with respect to the costs, revenues and non-financial aspects of operational ICT:
- Which costs, revenues and non-financial aspects of operational ICT can be identified?
- Who manages them?
- To what extent can they be managed?
- What activities are carried out to manage them?

This chapter describes the observations from three organisations in detail. First, a general outline of the case study research is given, including the procedures followed during the case study research. Second, a framework is presented to structure the information for further analysis and to enable comparisons. Third, a number of general characteristics of the three organisations studied are given, after which the observations from the three case studies are described. The case study observations described in this chapter will be discussed and analysed in chapter 4.

3.2   General outline of the case study research

The case study research described in this chapter entails three case studies at three different organisations that explore the management processes with respect to the alignment of the operational ICT. The case organisations were selected according to their size, branch (finance) and the complexity of their ICT environment; large, diverse and dynamic ICT environments in a distributed environment owned, supported and utilised by different departments or business units. Each case study was conducted according to a particular outline in which the following activities can be discerned:

1. *Holding (a) preliminary session(s)*
2. *Gathering ICT information*
3. *Gathering financial information*
4. *Conducting interviews with the individuals involved*
5. *Validation of interview reports*
6. *Constructing case report*
7. *Validating case report*

Each case study started with a preliminary session with one or two representatives of the organisation involved, where we explained the purpose and design of the case study. During this session, the departments and people to participate in the case study were identified. The interviewees were selected based on their role and on their insight in the alignment process of operational ICT in the particular department or business unit. If necessary, additional preliminary sessions were held with individual departments or business units.

We then set the scope of the case study, made an inventory of the ICT environment managed by the departments involved and gathered financial information on the departments and related ICT. The ICT inventory identified the complexity of the ICT environment as defined by Looijen (1998) in terms of its quantity, diversity, distribution, dynamics, ownership and utilisation. The financial information was retrieved from existing financial reports, used by the departments or business units involved for management accounting and control. The financial reports gathered for this research concerned the cost and revenue budgets for 1997, 1998 and 1999, and the actual costs and revenues for 1997 and 1998. The information on the ICT and financials gathered, provided quantitative information on the costs and benefits of operational ICT. This information was used to identify the context in which the alignment processes take place.

Qualitative information was collected from a series of structured interviews with management of the department or business units involved. Each interview was carried out following the same outline. The interviewees were selected in consultation with the organisation and the managers playing a role in managing costs and benefits of the operational ICT. After an interviewee had been selected, an appointment was made. Each interviewee received a letter confirming the appointment and clarifying the goal of the interview and the subjects that would be discussed. The interviews started with a brief explanation of the research and the goal of the case studied and of the interview in particular. The questionnaires used for these interviews were based on the case study questions. We shortly explained each category of questions before starting with the corresponding questions. To ensure the confidentiality of the information retrieved during the interviews, we conducted each interview with one

individual and in a separate room. To be able to assure the quality and objectivity of reporting we recorded each interview was recorded on tape[11].

Within two weeks after the interview, we sent the interviewee an interview report to validate the interview results. This report had to be commentated, approved and returned. Based on the results of the interviews and the collected quantitative information, a concept case study report was written in which the individual contributions were kept anonymous. After approval of this concept by all participants, a final version of the report was made.

3.3   Framework to analyse case studies

To analyse the case studies, we applied an analytical framework that is based on the interpretative research approach which in particular attaches great value to the context, content and process (Walsham, 1993). According to Walsham, the *context* concerns the multilevel identification of the various systems and structures within which the object of research is embedded. The context includes for example the organisational department and the overall organisation, but also cultural, social and communication structures. The *content* refers to the products, processes and systems of the organisation and its information systems and their hardware and software, whereas the *process* represents the processes that are subject of research, namely those processes of transformation and change which take place over time. Although this framework was originally developed to study processes that occur during the implementation and utilisation of information systems, it can also be applied for analysing the case study results described here. To do so, we interpret Walsham's definitions in a more general way, such that:

- the *processes* represent the activities for alignment of operational ICT that are the subject of this research,
- the *content* refers to the objects that are subject to these processes and,
- the *context* represents the environment in which processes and context are studied.

Based on this interpretation, the items context, content and process are defined with respect to the object of research, being the alignment of operational ICT, as:

Context: In this research the context represents the context in which the alignment of operational ICT takes place. That is, the context refers to the organisation unit studied, its environment, the products or services it delivers and the ICT environment necessary to support these activities;

Content: The content is defined as the subject of the management processes studied, being the alignment of operational ICT, according to chapter 2 expressed in terms of costs, revenues and non-financial aspects.

Process: The process entails the processes or activities identified in the organisations studied to align the operational ICT.

3.4   General characteristics of the case organisations

The case studies were carried out at three major financial organisations in the Netherlands, selected on their size and willingness to co-operate in this research. All three organisations can be characterised by a divisional organisation structure, in which each division or business unit has its own profit and loss account. As all three organisations are far too large to cover in

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[11] The case study protocol guarantees that the interview tapes will be destroyed one month after approval of this thesis.

a case study research that is part of a four-year research project, only a part of each organisation was studied. To study the alignment processes within the organisation relevant for this research, we selected several departments in each organisation fulfilling different roles in ICT management as defined in the ICT management framework of Looijen, described in chapter 1. For each case study, a single line of functional, application and technical management was considered including the relevant supporting and staff departments and the relations with business management. The departments involved in the case study were selected in consultation with the organisations and are considered to be representative by the author.

All three organisations based their ICT management processes on the terminology and best practices of the IT Infrastructure Library (CCTA, 1989).

It appeared that in the organisations studied, the three ICT management functions were not one-to-one embodied by a department or business unit. Different departments performed the same management function or activities from different management functions were embodied in the same department. To enable mutual comparison of the case study results we translated the organisational structure of the case organisations into this model. Due to differences between the theoretical framework and the actual organisation structure of the organisations studied, certain information may be lost through this translation. We believe, however, that the advantages of being able to describe the case studies in a similar way and thus being able to compare the observations outweighs the concessions made for the conversion.

The quantitative information represented in this chapter concerns costs and revenues. Non-financial aspects are not reproduced here as these figures contribute to the research to a limited extent, as they appear not suited for comparison. The non-financial aspects are not measured in the same way by the case organisations. If measured, the different characteristics of the measured object are too diverse for comparison.

3.5   Case A[12]

3.5.1   Context

Case A was conducted in a Dutch banking multinational providing a variety of financial products like payment and savings accounts, loans, mortgages and insurances. Two business units were involved in the case study. Business unit A1 has the responsibility to provide payment products for the Dutch market such as payment accounts, electronic banking and supporting facilities like cash dispensers. The customers of business unit A1 are local branch offices, selling financial products to customers. Among others, business unit A1 is responsible for managing the functionality of the applications enabling these products. A1 consists of three commercial and two supporting departments including an ICT department. The case study focused on one of the commercial departments, which is responsible for all Dutch payments by giro (BM1). The activities of the ICT department concentrate on the information systems supporting the business processes of the commercial departments. The ICT department is organised in two main branches, being the technical application management (AM1) and functional application management (FM1). The activities of FM1 concentrate on functional management of more than 220 applications and on functional and technical

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[12] In order to improve the readability of the case study observations described in the paragraphs below, the organisational units and ICT management departments or functions identified are sometimes personified. For example, if the observation is described that *"department X determines...."*, it is actually meant that, *"the management responsible for department X determines...."*

management of the local ICT infrastructure consisting of a local-area network, around 900 PCs and accompanying office automation, 34 printers, 16 servers and 12 midrange computers. Business unit TM1 manages the central hardware platforms for the information systems of A1. TM1 is one of the business units of the central facilitating unit A2, which has divided its ICT activities over four separate and autonomic business units. TM1 takes care of central ICT environments including 5 IBM Mainframes, 38 Tandem machines, more than 230 midrange systems and around 45 Windows NT systems. For a number of mainly smaller customers with no local ICT department, TM1 also performs application management and functional management activities. The context of case A with respect to the applied model of Looijen is illustrated in figure 3.1.

3.5.2   Content

During the case study, information was collected on the costs of the departments involved. The cost data represented in figure 3.2 show the actual costs of the ICT departments studied over 1998 and how these costs are distributed over the various cost components identified in the financial reports. The budget performance shows the ratio between actual and budgeted costs, whereas the budget increase represents the increase in the cost budget in relation to that of the preceding year.

For the functional and application management departments no separate figures are available, as costs are managed for the whole ICT department (FM1 and AM1) of A1. The costs of FM1/AM1 include the costs allocated to A1 by TM1.

Financial information about the years 1997 through 1999 shows that although the budgets had increased, the actual costs were still higher than budgeted, as indicated by the performance figures. Increased volumes of commercial activities are the main cause of the budget growth for BM1. More commercial activities require more capacity with respect to the supporting ICT facilities leading to higher costs for FM1/AM1 and TM1. The costs of FM1/AM1 had
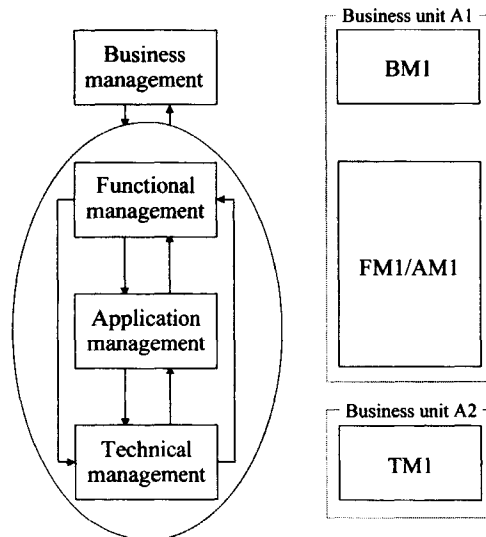
Case A

Figure 3.1 Context of Case A in relation to Looijen's model

	Actual costs	Budget performance		Budget increase		Main cost components and percentages actual costs
	1998	1997	1998	1998	1999	1998
BM1	€ 85.1 million	114.9%	96.2%	31.7%	2.3%	Personnel costs: 6.3% Other operating costs: 2.0% Allocated operating costs: 6.0% Allocated costs (internal): 21.6% Exploitation costs: 64.1%
FM1/ AM1	€ 81.9 million	101.5%	104.9%	28.7%	8.0%	Internal personnel: 11.3% External personnel: 19.8% Rent/maintenance costs: 0.5% ICT costs: 1.0% Allocated ICT costs: 41.8% Allocated costs (other): 19.3% Other costs: 0.5% Depreciation: 1.0% Internal allocations: 4.8%
TM1	€ 83.1 million	108.9%	105.9%	28.2%	21.9%	Personnel costs: 34.4% ICT costs: 54.4% Other costs: 7.7% Internal allocations: 3.5%

NA = Not Available; Actual costs over 1998 in Euro; Budget performance = ratio between budgeted and actual costs; Budget increase is increase in relation to the preceding year

Figure 3.2 Cost data of case A

mainly increased because this department had taken over a number of information systems and related personnel from other departments in 1997 and 1998. The main causes of differences between budget and realisation will be discussed in more detail in paragraph 3.5.3.

Figure 3.2 also represents the main cost categories applied by the departments in their financial reports and their relative size. Most costs of BM1 arise from external allocations for the exploitation of inter-organisational payments. ICT costs allocated by A2 make up most costs of FM1/AM1, together with costs for internal and external personnel and other (non-ITC) costs allocated by A2. The main cost categories for TM1 are personnel costs and ICT costs, including depreciation costs and costs for licenses and maintenance and support contracts. As FM1/AM1 takes care of all ICT activities of A1, the total ICT costs of A1 amount to €81.9 million. The financial reports of A1 do not make a distinction between costs for operational ICT and costs for development, so no exact figures on the former are available. The financial figures indicate that the costs of FM1 amount to €40.4 million, exclusive of the personnel costs. Furthermore, the personnel costs of FM1 can be estimated to be around €10.5 million based on the proportion of personnel between FM1 and AM1. This means that the costs of operational ICT amount to at least €50.9 million for A1. To what extent the activities of AM1 concern operational or new ICT is unknown. Considering the project portfolio and the definition of maintenance given in chapter 1, by far most of the activities of AM1 (>90%) can be considered to concern maintenance of operational ICT.

The total ICT costs of the central facilitating unit A2 were not investigated, as TM1 is one out of four business units responsible for ICT activities. TM1 does not discriminate between costs for operational ICT and for new ICT. As soon as new hardware or software is installed or implemented, it is operational for TM1 regardless of possible additional software development activities by the customer of TM1. As the time spent by TM1 personnel on this is limited compared to the total number of man hours, the total costs of TM1 are indicated to be costs of operational ICT.

Revenues appear in the financial reports of two departments, being BM1 and TM1. The revenues of BM1 consist mainly of allocations to its customers, internal allocations within A1 and revenues from other organisations. As the allocations of BM1 concern commercial (non-ICT) products, these revenues are not considered in this research.

The revenues of TM1 consist completely of allocations to other business units. The revenues of TM1 have grown significantly, with 26.3% budgeted in 1998 and 17.2% in 1999. For those years the actual revenues were considerably higher than budgeted, however, with 116.1% in 1997 and 119.1% in 1998. Possible causes for these differences are discussed in paragraph 3.5.3.

The non-financial aspects identified by organisation A focus on the quality of the ICT services provided and on customer satisfaction. The quality of the ICT services is expressed in terms of continuity, reliability, integrity, availability and performance. Furthermore, the quality of the ICT management processes is considered. Response times and solution times of the main ICT management processes[13] are part of the non-financial aspects considered. The non-financial aspects related to the quality of ICT components are measured per service, whereas those related to the quality of the ICT management processes are measured per process.

The information on the content presented in this paragraph provides insight in the objects and their dimension, of the processes identified and described in paragraph 3.5.3. This information will be analysed in chapter 4 to identify the dimension and composition of the costs, revenues and non-financial aspects managed. In combination with the information on the processes, this information will also be used to analyse how and to what extent the costs, revenues and non-financial aspects can be influenced.

3.5.3 Process

This paragraph describes the processes identified in organisation A on management of costs, revenues and non-financial aspects. The main processes identified during the case study are the budgeting process, budget control and cost allocation process. Furthermore, a number of activities were identified to reduce costs and to improve the non-financial aspects.

Budgeting process

The budgeting process is carried out in two cycles. The first cycle starts with an inventory of the expectations and plans for the next year, the expected sales volumes and the required investments and numbers of staff to realise that. Both A1 and A2 ask their customers for their plans and expected consumption. The total costs of a department are than estimated based on this information.

TM1 attributes these costs through Activity Based Costing (ABC) to product groups, so it can calculate the cost price per product based on the attributed costs and the expected sales volumes. The transfer price or rate TM1 will apply for the cost allocation process is fixed at the budgeted cost price and 5% extra to cover business risks. BM1 determines its rates based on the old rate and an analysis of the changes in the total costs. Compared to the ABC method applied by TM1, this calculation is less accurate as there is no clear description of what costs define the cost price of a certain product. Rates are also determined by market prices, as the customers of BM1 have to be competitive.

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[13] The main ICT management processes are defined by organisation A as the processes that bear a direct relation with the customer, like incident management, problem management and change management.

The first budgeting cycle ends in a rate proposal which must first be approved by the management team of A1 respectively TM1. Then, the rates are passed on to the corporate management for approval. The customers of A1 and TM1 receive the proposed rates so they can base their own budgets on this information. The second budget cycle reveals basically the same activities, although now the estimations can be made more accurate as more information on plans and rates is available from the first budget cycle. In this budget cycle, the exploitation and investment budgets are formalised. Again, budget proposals have to be approved by higher and corporate management.

In practice, the budget cycles are performed in a more iterative way than that described here. Over time, business plans can change, affecting the financial plans of the supplying or consuming business units. As higher or lower consumption leads to different rates, this will affect the revenues of the supplying business unit and the costs of the consuming business unit. Therefore, budget and rate proposals often go back and forth several times between customer and supplier.

Furthermore, higher management often returns budget proposals with the instruction for further cost reductions. Higher management frequently uses its authority in approving budgets to try to flatten the growing curve of the ICT costs. Again, this will lead to changes in business plans, consumption and rates resulting in new iterations between customer and supplier.

TM1 and BM1 identify revenues arising from costs passed on to customers. These revenues are budgeted according to budgeting process described above. Both A1 and A2 have to operate as a cost centre, which means that the revenues should level the costs, thus realising a 'zero' result. Higher costs or revenues than budgeted are less important. Minor positive or negative results are usually compensated by the results of other business units operating as cost centres. Large positive or negative results have to be straightened through an extra allocation or by allocation costs back to the customers of TM1 and BM1, being A1 and the local banking offices respectively. In practice, large positive results of TM1 were paid back to the local banking offices.

The budgeting process of TM1 focuses on realising this 'zero' result. The ICT department of A1 operates as a service centre, meaning that no costs are allocated to the commercial departments such as BM1, as is done by A2. So, FM1/AM1 always has a negative result whereas each BM department has a positive result. At business unit level, these results are joined and have to realise a 'zero' result for A1.

As A1 supplies financial products and ICT is one of the resources to produce these products, these products are not considered in the remainder of this case as our research focuses on the alignment of operational ICT and not of financial products.

The budgeting process of organisation A is standard for all business units and departments. Budget proposals have to be finished in September. Business units and departments are free to define the start date of the process, as long as this deadline is met. All budgets have to be approved by corporate management before the start of the budget period.

Budget control

By comparing budgets and realisation the management controls the costs and revenues during the budget period. For this purpose, responsible management receives monthly reports. It analyses deviations and, if necessary, takes corrective actions or adjusts the planning.

The financial figures presented in figure 3.2 state that in 1997 and 1998 the actual costs and revenues exceeded those budgeted. The management of the departments involved identifies a number of possible causes to explain the differences between the budget and realisation.

First, the budgeting process has to be finished several months before the budget period starts. This makes it hard to make accurate estimations, as a lot of developments in the organisation and in its environment are difficult to foresee. Commercial activities and developments have great impact on the ICT costs, for example changes in sales volumes, enhancements in commercial products, new applications supporting new products, preventive maintenance and innovations in ICT to improve the support provided to the business processes. As commercial activities and market developments are hard to estimate in advance, the effect on ICT costs is difficult to estimate as well.

Second, the budgeting process is quite difficult and more and more data is involved. By experience organisation A knows that the budget and its realisation will match more closely when more attention is paid to the budgeting process itself and to increasing its level of detail. So, a low-quality budgeting process can lead to budget deviations. This does not mean that large differences are excluded when budgets are made more carefully and accurately. If more knowledge is available through a more detailed budget, differences can be explained more easily when they are caused by unforeseen developments.

Third, sales volumes are sometimes budgeted low to reduce the risk of a negative result. As rates are defined based on both fixed and variable costs, a lower sales volume than budgeted will make that not all fixed costs are compensated and that the revenues will not level the costs. Higher sales volumes will lead to higher revenues and to higher costs to realise the extra services. The extra revenues will be higher than the extra costs, as the extra costs consist of variable costs and no fixed costs. As for a cost centre a positive result is more acceptable than a negative result as it suggests a better performance, one tries to exclude a negative result.

Fourth, exploitation costs of new systems and new functionality are hard to estimate, as historical data or reference sites are missing. The quality of the development project has a direct influence on the exploitation costs, in the first period after implementation. A lot of corrective maintenance and functional changes are frequently carried out when the system is already operational. These changes should be realised by the project, but are then part of the exploitation costs making these costs higher than expected. Furthermore, at the start of development projects the exploitation costs are often estimated. These estimations are usually not adjusted to changes in the design made during the project. In particular the development of new commercial products or major redesigns is in the beginning so complex and often many changes are made that it is hard to estimate the ICT means required and their exploitation costs.

Summarising, the business units and departments of organisation A control their budgets by periodically comparing them to actual, real figures and by analysing deviations. Common reasons for deviations are:

- the budgets were composed in a very early stage
- more accurate budgeting requires more data and more effort,
- the sales volumes were estimated conservatively, and
- difficulties have arisen in estimating the costs of exploiting new systems or new functionality.

Budget control of organisation A concentrates on being able to know in advance what the realisation will be and the timely identification of deviations, so that it can adjust the planning.

Cost allocation

Costs of TM1 and A1 are passed on to their customers, being A1 and the local banking offices respectively. Both allocations are aimed at allocating all costs through predefined rates. The allocation of A1 is related to the commercial products delivered, like payment transactions. Although these products are realised significantly through ICT, they are not identified as ICT products and therefore not discussed here.

TM1 allocates costs based on the ICT products and services delivered to other business units. For each product or service, rates are defined in the budgeting process as described previously. Different types of allocation are applied, being:
- Service units
- Rate per object
- Hourly rate
- Fixed price

Service units are established for large, shared environments like mainframes. As the costs of the entire environment have to be distributed over a large number of customers, the service is divided into a number of smaller services like computing and storage services. Consumption is measured for each customer in terms of required processor and storage capacity.

A *rate per object* is calculated for hardware systems that can be attributed to a single customer. TM1 applies this type for mini and midrange computers like Unix, Tandem and NT, and for some mainframe components that are deployed specifically for a particular customer.

Hourly rates are charged for specific activities like consultancy, support and maintenance. The costs allocated are then based on a pre-defined hourly rate and the number of hours spent by the personnel of TM1.

Finally, in a limited number of specific cases, products or services are delivered at a *fixed price*. The rate is based on the costs budgeted for that product or service.

Summarising, costs are only allocated between business units of organisation A. It aims to allocate all costs of support centres to the profit centres in order to be able to do a simple profit calculation by comparing costs and revenues. Costs are allocated based on a rate per service unit, per object or hour or based on a pre-calculated fixed price.

Cost reduction activities

Corporate management tries to restrict the increase in ICT costs by defining guidelines for the budgeting process. Examples of these guidelines are that rates of service units have to decrease with 10% each year, development costs or capacity must stay equal whereas the total ICT costs may grow with a given percentage. During the budgeting process additional budget cuts are sometimes imposed by corporate management. Furthermore, rates of TM1 should be subject to market prices. To check this, TM1 is benchmarked three times over a period of four years. All benchmarks showed that the rates of TM1 are conform market prices.

BM1 does not deploy explicit activities to reduce the costs of operational ICT. This may be caused by the fact that these costs do not appear in the financial results on the basis of which the performance of BM1 is assessed. FM1 reports to BM1 concerning the costs of the ICT supporting the processes of BM1. As BM1 has to realise a positive result to compensate for the ICT costs, BM1 focuses on the ICT revenues. During the development of new ICT functionality, BM1 focuses more on functionality, quality and time-to-market than on exploitation costs. Furthermore, it is the policy of organisation A to stimulate the use of cheaper payment products. As cheaper payments products are usually realised through a higher degree of automation, this will entail higher ICT costs.

The cost reduction activities of FM1 concentrate on reducing the use of ICT resources by improving the efficiency of resource usage and by reducing the number of staff. The efficiency of the resource usage is improved in several ways.

First, periodically programs or data that are not used anymore are identified and deleted if possible. This can sometimes lead to a reduction of up to 30% of historic data.

Second, an improvement of formulas and queries can reduce the resource usage of an application as well. The degree to which the efficiency of an application can be improved depends largely on the quality of the application. Although figures on this are not available, FM1 estimates that on average the resource usage can be decreased between 10% to 20% during the entire life cycle.

Third, decreasing the number of staff required for management and support of applications can reduce costs. This can be realised by improving the ICT management processes and supporting these processes with ICT. Furthermore, new applications require much effort shortly after implementation. This effort can be reduced for example through the participation of FM1 personnel in development projects.

Finally, by improving the quality of an application through corrective and preventive maintenance, the number of incidents will decrease, and as a result less staff will be required.

TM1 concentrates its activities for cost reduction mainly on reducing the number of staff by improving the efficiency of its ICT management processes. According to TM1, the costs of hardware and software are mainly determined by the services requested by its customers. So, the opportunities for TM1 to reduce costs are in the efficiency of its ICT management activities. The number of staff required for these activities can be reduced by improving the efficiency of the ICT management processes and by automating certain activities. Reductions in the required number of staff are often not actually realised. For this, three reasons can be found.

First, the production volume increases so much that the 'free' capacity is soon required to realise this higher volume. Second, the acquired capacity is usually invested directly to realise higher service levels. Although the numbers of products and services have increased strongly over the last couple of years, the number of staff have remained equal.

Other activities of TM1 to reduce costs focus on efficient use of the ICT resources. As the customers of TM1 influence the efficiency with which these resources are used the most, TM1 sometimes tries to help its customers how to use it more efficiently by advising them on opportunities to reduce costs. Furthermore, the costs of hardware and software can be reduced by negotiating about their purchase prices and about the fees for licences and maintenance and support contracts (MSL). MSL fees can also be negotiated on after acquisition. TM1 has experienced that sometimes it is possible to cut down fees with 50%.

Departments only define cost reduction activities for costs that determine their (financial) performance. Most cost reduction activities concentrate on improving the efficiency by reducing the required ICT and personnel resources. The extent to which these costs can be reduced depends among others on the time the ICT component is operational and the efficiency improvements are have already been realised. The management of BM1 believes that the usage of hardware and software resources during the lifetime of an application can be reduced with 10% to 20%. Figures on realised improvements are not available, as the efficiency improvements are not explicitly managed and measured.

Management of non-financial aspects

The management of non-financial aspects of the operational ICT by the departments involved in this case study focuses on the ICT quality. To ensure that the business processes of organisation A can go on, the ICT must be available during business hours and perform well. Availability and continuity are therefore important quality aspects next to reliability. Regarding the introduction of new financial products, the time to market is important with respect to the competition with other financial organisations. For this reason another important quality aspect is the time to market of changes in the functionality of operational ICT.

These non-financial aspects cannot easily be measured. Both TM1 and FM1 try to manage these aspects through a service level management process. Requirements of the customer regarding the norms for the non-financial aspects are identified as service levels. These service levels are discussed with the customer and written down in service level agreements. Periodically, the actual performance is discussed with the customer based on reports on the non-financial aspects as agreed in the service level agreements. The service level agreements between FM1 and BM1 cover availability and performance in quantitative and measurable figures. The integrity is discussed qualitatively. The agreements between TM1 and FM1 cover quality aspects as availability and performance, and response times.

Internally, TM1 tries to measure and manage the quality of its IT management processes. The quality of a number of processes is quantified in terms of the numbers of incidents, problems and change requests, and the percentage of incidents and problems solved within the time specified in the agreed service levels and the number of changes realised.

The activities for quality improvement by FM1 concentrate mainly (around 70% estimated by FM1) on the efficiency with which the hardware and software are used and on the ICT management processes. Each internal project requires a project plan. The realised improvements are rarely managed nor evaluated afterwards.

All departments involved in this case study claim that customer satisfaction is the most important non-financial aspect in addition to the quality. Both aspects are not quantified or measured and managed implicitly based on the number and seriousness of complaints.

Finally, TM1 participates in the periodic employee satisfaction research of A2. Based on the outcomes of that research, actions are defined to improve the employment circumstances in order to decrease the number of personnel changes.

Summarising, the availability, continuity, integrity and performance are the most important ICT quality characteristics that are managed as non-financial aspects, for the management of the departments involved in this research. The time to market can be added to this list for new ICT or functional changes to operational ICT. The departments studied experience difficulties in making these characteristics concrete and explicit and in measuring them. Requirements on the quality of the services provided by TM1 and A1 are formalised and recorded in service level agreements.

3.6   Case B

3.6.1   Context

Case B was carried out at a Dutch multinational providing a variety of financial products like payment and savings accounts, loans, mortgages and insurances. Two business units were studied in this case study. Business unit B1 provides insurance and financial products for the Dutch market. Most products are sold both directly and via independent agents, so both

private individuals and agents can be identified as the business unit's customers. The commercial departments (BM) are geographically orientated, so each BM provides all types of financial products to a specific geographic region. The products provided are divided into three categories. For each category of products a department of each BM is responsible and a central staff department is responsible for process design and product development. FM2 is part of such a staff department and is responsible for the design, implementation and improvement of the business processes providing insurance products of the product category *Private market*. Among others, FM2 is responsible for functional management of around 60 applications supporting the business processes. Functional requirements and changes are defined in co-operation with representatives of the BM departments concerned. As the business processes supported by FM2 are divided over several BMs, FM2 is responsible for management of the supporting ICT. Therefore, no BM department is involved in this case study.

Application software supporting the business processes is developed and maintained by the ICT department of B1. This department covers two main activities. Besides software development and maintenance (AM2), the ICT department is also responsible for managing the local infrastructure, including around 7600 PCs, 800 printers, 150 servers and accompanying software. As the case study focused on a number of applications operating on central computer facilities, the management of the local infrastructure is not considered.
Business unit B2 is the central ICT unit of the organisation, which takes care of all central computer facilities and networks. B2 also has a software development department that supports smaller business units without an ICT department of their own. TM2 is responsible for management of the three computer centres, hosting 9 mainframes, 8 AS/400 systems and a number of midrange and Windows NT systems. Other units of B2 take care of design, configuration and implementation activities.
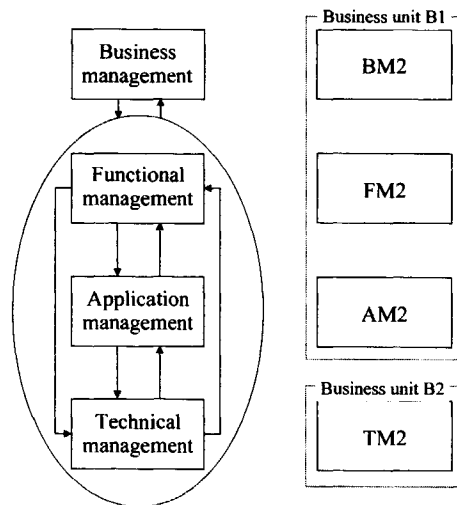The context of case study B is illustrated in figure 3.3 in relation to the model of Looijen.

Case B

Figure 3.3 Context of Case B in relation to Looijen's model

	Actual costs	Budget performance		Budget increase		Main cost components and percentages actual costs
	1998	1997	1998	1998	1999	1998
FM2	€2.3 million	NA	94.4%	NA	19.1%	Personnel costs: 98.3% Other costs: 1.7%
AM2	€77.6 million	59.9%	436.1%	-27.7%	276.5%	Internal personnel: 26.7% External personnel: 47.9% ICT costs: 23.9% Other costs: 1.5%
TM2	€145.1 million	NA	116.2%	NA	28.0%	Internal personnel: 16.6% External personnel: 13.1% Other costs: 42.7% Allocated costs: 27.6%

NA = Not Available; Actual costs over 1998 in Euro; Budget performance = ratio between budgeted and actual costs; Budget increase is increase in relation to the preceding year

Figure 3.4 Cost data of case B

3.6.2   Content

The information on ICT costs collected during the case study is represented in figure 3.4. As both B1 and B2 went through major reorganisations during 1997 and 1998, not all requested financial data was available. Figures on 1997 were missing for FM2 and TM2, whereas the figures for AM2 are composed manually from financial data from the three (1997) and two (1998) departments of which the current ICT department of A1 originated. The available information does not distinguish the costs of the software activities (AM2) and of the management of the local technical management activities.

The costs of FM2 consist of personnel costs and other costs. Although costs of the local infrastructure are allocated to all departments based on the number of staff, these costs do not appear in the budgets of FM2. Likewise, the ICT costs allocated by TM2 (€44.6 million) do not appear in the budgets of FM2 or AM2, although AM2 does budget and control these costs. Most costs of AM2 are incurred for internal and external personnel. Finally, the category *Other costs* of TM2 consists for almost 100% of hardware and software costs, whereas the allocated costs concern costs allocated by other departments of B2. Differences between budget and realisation and possible causes of these differences are discussed in more detail in paragraph 3.6.3, together with the budgeting and budget control processes.

The total ICT costs of B1 are estimated based on the costs for FM and AM, and the ICT costs allocated by TM2. As the FM department is distributed over three departments these costs have to be estimated. As figures on the costs of the other FM departments were not collected during the case study, the total FM costs of B1 are estimated based on the assumption that all three FM departments are of comparable size. So, the FM costs are estimated to be around €6.9 million. In total the ICT costs of B1 are calculated around €129.1 million. To what extent these costs are made for operational ICT or for new developments, cannot be indicated exactly. The costs of AM2 for the management of the local infrastructure constitute around 27% of its total costs. Based on the project portfolio defined by the project office, at least 67.7% of the development capacity is used for maintenance activities on operational ICT. As TM2 does not carry out software development activities, the costs allocated by TM2 are expected to be costs only for operational ICT. Based on this, the costs of operational ICT are estimated to be around to €110.7 million for B1.

The total costs of B2 are around to €268.4 million. As all exploitation activities are performed by TM2, the costs for the operational ICT of B2 are at least €145.1 million. As other departments of B2 were not studied in this case study, no figures are available on the extent to

which the activities of the application development departments of B2 are related to operational ICT.

Revenues from operational ICT are identified by TM2, not by FM2 of AM2. These revenues consist of cost allocations to the customers of TM2 for the services provided. The revenues for 1998 consisted of around €150.9 million, which was more than budgeted (115.7%) because the sales volumes were higher than expected. The budget for 1999 showed an increase of 21.6% with respect to 1998.

The non-financial aspects managed are the quality of the ICT services and the customer satisfaction. The ICT quality is expressed in terms of availability, continuity, stability and performance. TM2 has not quantified all these aspects and measures and reports on the realised quality in terms of numbers of incidents and the time required to solve an incident. The products of TM2 are diverse and the scores for the non-financial aspects measured fluctuate over time, making it impossible to present a brief and meaningful overview of the non-financial aspects.

FM2 focuses on the performance, the quality of the output and the number of dumps or system crashes. Quantitative data on this is obtained from reports from TM2. FM2 does not report on this to its customers. Customer satisfaction is most important for management of TM2, AM2 and FM2 and managed implicitly based on calls and complaints.

3.6.3 Process

This paragraph describes the processes regarding management of costs, revenues and non-financial aspects identified during the case study at organisation B. The main processes identified during the case study are the budgeting process, budget control and cost allocation process. Furthermore, a number of activities to reduce costs and to improve the non-financial aspects were identified.

Budgeting process

All financial plans of organisation B are described in a midterm plan covering the next three years, which is produced in a yearly planning process. The financial plans are formalised in budgets and this part of the planning process is referred to as the budgeting process. TM2 starts its budgeting process around March, whereas the departments of B1 start their budgeting process around May. All budgets have to be finished in September.

Departments of B1 have to plan the required number of staff and other costs, based on the activities that will be carried out next year. Furthermore, FM2 discusses the ICT needs with the BM departments. Based on this, investments in the PCs and other local infrastructures for B1 are budgeted. FM2 also identifies the projects it wants to carry out to introduce new products or to improve existing products and business processes it is responsible for. The development resources of AM2 are budgeted by a separate, central program management department, which allocates the resources based on the plans of the FM departments. The ICT costs are budgeted by AM2. This budget includes both the costs for hardware and software for the local infrastructure and the ICT costs allocated by B2. Budget proposals have to be approved by management B1 and subsequently by corporate management.

On the basis of budget guidelines of higher management and preliminary plans, the management of B1 decides on the total development capacity. For 1998 and 1999, the approved capacity was equal.

The development capacity available is divided into budgets per project and budgets per FM department. This allocation is based on the capacity required to realise a number of projects, the size and continuity of the commercial activities supported by a FM department, action points identified by management of B1 and on previous budgets and experiences. The development capacity requested by the FM departments usually exceeds the available capacity. In order to fit as many requests as possible into the available budget, all projects and maintenance requests are reconsidered.

Finally, the program management responsible for the ICT resource allocation submits a proposal to divide the available budget for approval to the management team of B1. The FM departments are free to decide what activities they want to realise with the development capacity attributed to them. FM2 divides its year budget into budgets per quarter. Together with representatives of the BM departments FM2 decides what maintenance activities will be realised using these budgets. FM2 also reserves a number of development hours for instant support to solve incidents.

The costs allocated to B1 by TM2 are budgeted by AM2. These costs do not appear in the reports used for the financial information presented in figure 3.4. These costs are budgeted based on historical data and on information from TM2, AM2 and the FM departments. This budget has to be approved by AM2, TM2 and finally by the management of B1.

Business unit B2 operates as a combined cost and service centre, which implies that most costs have to be allocated to its customers. Certain costs, usually high one-time costs from which the greater part of concern benefits, like costs of the Euro and millennium projects, are not allocated to customers of B2. These costs go directly to the overall profit-and-loss account. In this way, large infrastructure investments will not lead to one-time higher cost prices of the products or services of the business units. So, the financial plans of B2 aim at a conceded negative result, not a 'zero' result.

According to this, TM2 budgeted a minor positive result for 1998. As the last couple of years TM2 had more revenues than budgeted, it is expected that this will also occur in 1999. Therefore, for 1999 a small negative result is budgeted.

TM2 budgets its costs based on the expected demand from its customers, the activities it wants to carry out to improve its service and the costs allocated by other departments of the central ICT unit B2. The rates for each type of ICT product provided by TM2 are based on the total costs attributed to that product group based on activity based costing and the expected sales volume. These rates are communicated to the customers who can use this information for their own budgeting process.

Summarising, the budgeting process of organisation B is standard for all business units and departments. Budgets are embodied in midterm plans describing the financial and non-financial objectives for the next three years. The budgeting processes have to be finished in September. Business units and departments are free to define the start date of the process, as long as this deadline is met. All budgets have to be approved by corporate management before the start of the budget period. Higher and corporate management issue budget guidelines the budget proposals have to meet. Finally, departments budget only those costs they account for.

Budget control

The management of B1 and B2 controls budgets by periodically comparing cost and revenue budgets with actual figures. These reports are sent monthly to the management responsible. On request they are provided weekly. Besides financial reports, FM2 receives reports on the changes realised and the numbers of development hours spent on these changes.

Because of the major reorganisations, we could not recover the budgeting process of AM2 for 1997 and 1998 in order to analyse the budget performance, which appears to be significantly worse than the other performance figures gathered during the case research. The current management, which participated in this case study, could not explain the differences between budget and realisation over the period studied either. They attributed them to differences in the organisational structure at the time budgets were defined and the time the actual costs were booked.

Budget control in B2 focuses on cost budgets and investment budgets. Management of TM2 has control over the cost budget for all operational ICT means of the computer centres. Another department of B2 decides on replacements or major upgrades of the hardware and software managed by TM2. This department bears responsibility for the investment budget. This may lead to conflicts as for example cheaper or more expensive hardware may lead to higher or lower costs for TM2. To prevent conflicts, both departments have to approve purchases.

In 1998 the costs of TM2 were significantly higher than expected due to activities undertaken to solve the millennium problem. The revenues of TM2 were also higher as customers of TM2 purchased more ICT products than expected for their own millennium projects. The costs of the millennium project of TM2 were not allocated to the customers through rates. As the project costs were higher than expected, this led to a more negative result than budgeted.

Summarising, the budgets are controlled by periodically comparing them with the actual figures. Budgets include not only ICT costs but also investments in ICT. During the budget period, deviations are analysed and if necessary corrective actions are defined. As a result of major reorganisations in the period studied, it was not possible to identify causes of deviations for B1 others than differences in organisational structure between planning and realisation. Deviations for TM2 were caused by activities for the millennium project that were more extensive than expected and higher sales volumes caused mainly by millennium projects of customers.

Cost allocation

TM2 allocates costs to the consuming business units based on the number of products and services consumed and predefined rates. For the allocation of mainframe costs, rates are defined for a number of products, like CPU seconds and storage capacity. Other costs of TM2 are allocated through a rate per hardware system. The rates TM2 has defined are not always in accordance with the cost price. Some products are provided against a lower or higher rate, for example to stimulate or discourage usage or to reach other goals.

Cost prices can also be distorted as costs are sometimes administered wrongly. Due to the separate responsibilities for the cost and investment budget described above, it is not always clear to the financial department for what department, product or product group the costs are made. As the invoice has to be paid within a certain period of time, there is often no time to investigate the department responsible whereas no corrections can be made afterwards. So, these costs are allocated to the department that ordered the initial purchase.

B1 tries to attribute its ICT costs to applications. The mainframe costs allocated by TM2 are specified per system code, so they can be attributed to the application concerned. Costs allocated for other hardware platforms cannot easily be attributed to an application as several applications run on the same system. For this, a predefined key is applied.

The application development and maintenance activities of AM2 are allocated to the projects or applications concerned, based on the number of hours spent and predefined hour rates.

These hour rates include costs allocated to the development department of AM2 for accommodation, local infrastructure and the use of central computing facilities of TM2.

The costs per application are attributed to commercial products based on a table identifying which products make use of which applications. The ICT costs of these products are then allocated to the commercial departments based on their relative amount of turnover. These calculations are performed by an application developed specifically for B2. As a result of this, the people who are responsible for these allocations may not wholly understand the allocation process and the applied keys, also because they may be new to the post due to recent reorganisations and changes in responsibilities.

The costs of the local infrastructure managed by AM2 are allocated on the basis of the number of staff of each department of B1, both commercial and staff. The total costs of the central staff department of which FM2 is part, are allocated to the commercial departments as overhead costs. The costs of FM2 are not allocated separately.

Summarising, ICT costs are allocated by the central ICT department to enable cost control by the commercial units. The central ICT department B2 is an example of the hybrid concept of Earl (1989) as described in chapter 2. Most costs are allocated based on a rate per unit of the product identified, but some costs are not allocated and treated as overhead costs for the overall business concern. B1 allocates all costs to its products to manage the profitability of each product.

Cost reduction activities

During the case study several activities are identified that organisation B performs to reduce its costs. First, the business unit and corporate management issue guidelines for the budgeting process, indicating that costs are not allowed to grow with more than a given percentage. This actually does not lead to cost reduction, as the total ICT costs still increase. Organisation B experienced that without guidelines, the ICT costs will increase more rapidly. From this perspective, cost reduction is definitely realised.

Management of B1 applies this same strategy to the development capacity. This capacity is budgeted first, and then the available capacity is distributed over projects and the maintenance over operational services.

B1 learned that the costs allocated by TM2 are hard to influence. Cost reductions for mainframe applications have a limited effect as the costs of TM2 are fixed. In the short term, reductions in the use of mainframe products will lead to rate adjustments, as all fixed costs have to be compensated, so that the total allocated costs will remain equal. No cost reduction activities were identified other than that limitation of the allowed budget increases. For B1, it appears to be sufficient to know the ICT costs beforehand. AM2 and the FM departments use cost information for accounting purposes, not to manage or reduce costs. The defined efficiency improvements are initiated for quality improvement purposes, not to reduce costs.

As another department of B2 decides on the investments in hardware and software, the depreciation costs arising from these investments can hardly be influenced by TM2. TM2 learned that annual costs for licenses, maintenance and support of software are even more difficult to influence, as these are tied to certain suppliers. Once an application has been selected that requires for example a certain database management system, it is not easy to change to another system.

To reduce ICT costs, TM2 tries to press the purchasing department to select ICT means with lower maintenance and support costs, and even to replace means with higher maintenance and

support costs. For the realisation of these requests, TM2 is dependent on the department that controls the investment budget.

TM2 tries to reduce its personnel costs by automating manual activities, standardising ICT management processes, managing its capacity better and selecting better new personnel. To what extent these activities really lead to lower costs is by no means certain as the freed capacity is usually invested directly in new services or improved service quality.

TM2 applies benchmarks to check the market conformity of rates and to identify opportunities to reduce costs. Several types of benchmark researches are applied by TM2. First, the overall costs and the efficiency of TM2 can be subject to benchmarking, for example to identify the efficiency with which hardware is used. Other benchmark investigations focus on the quality of the products and services provided and the relation between price and quality. A third type of benchmark focuses on the efficiency and quality of the ICT management processes. Finally, TM2 also carries out internal benchmarks, in which new hardware or software is tested to compare their performance with for example the specifications of the supplier.

External parties benchmark TM2 once in every one or two years. Internal benchmarks are carried out ad hoc.

All these benchmarks enabled TM2 to reduce costs by improving the utilisation of hardware systems or by negotiating with suppliers on software licenses. As internal improvement projects are not managed explicitly, figures on realised improvements are not available. Benchmarks are also used to check the market conformity of rates. If rates are assessed to be too high, this is generally explained by differences between the design of the benchmark and the actual organisation of TM2. So, this type of benchmark has not led to cost reductions and is applied mainly to show the market conformity of rates to customers.

Summarising, most effort is spend on freezing ICT budgets or allowing a predefined increase. This effort concentrates in particular on the personnel capacity. Opportunities to reduce the personnel costs are automating manual activities, standardising ICT management processes, improving the management of the available ICT capacity and improving the selection procedures for new personnel.

Management of non-financial aspects

Non-financial aspects are planned as well. Objectives regarding non-financial aspects are recorded in the midterm plans of each department or business unit.

For organisation B, the quality of the ICT environment is the most important non-financial aspect and it is managed mainly implicitly based on personal contacts. FM2 was working on a customer satisfaction research at the time the case study was carried out. AM2 investigates the customer satisfaction regarding its helpdesk periodically. TM2 periodically sends AM2 questionnaires concerning the services it has provided.

FM2 does not focus on improving proactively the quality of the applications managed. Most activities are triggered by the occurrence of a problem. FM2 does try to optimise the applications in order to reduce the time of process throughput and to increase productivity. These improvements are not expressed in quantitative and measurable terms, nor managed explicitly, so figures on the realisation of this kind of improvements are not available.

The availability is by far the most important quality aspect for TM2. The customer always wants 100% availability. After all, 99% availability means that people cannot work during 3.5 days per year. Therefore, TM2 aims to realise the highest availability possible without incurring unreasonably high costs arising from, for example, installation of double equipment. Furthermore, the availability is guaranteed only during office hours. If the systems must be available beyond these hours, this must be requested separately. So, the aim of 100% availability does not apply 24 hours a day or 7 days a week. For each improvement in the availability during the required hours, costs and benefits are evaluated first. Improvements of tenths of a percentage are acceptable for TM2. Actions leading to less improvement are not considered.

For the central computing environments managed by TM2, performance is the most important quality aspect. Next to the performance, aspects like continuity, availability and stability are the most important quality aspects managed by TM2. For each service, the required quality is discussed with the customer and formalised in service level agreements. As not all quality aspects can be measured at present, TM2 works on improving the measurability of its services.

TM2 also works on improving the quality and efficiency of the ICT management processes and in particular on reducing the time required for solving incidents and problems. A lot of attention is paid to capacity management as the performance and availability will drop immediately if the available capacity is not enough.
Finally, organisation B also investigates the employee satisfaction through a questionnaire that has to be filled out periodically.

Summarising, non-financial aspects are an explicit part of the plans of organisation B and are formalised in its midterm plans. However, for managing the non-financial aspects business unit B1 has not identified concrete actions. Quality is identified as being most important, but it is mainly managed implicitly, based on personal contacts. For TM2 the availability and performance of the ICT resources it provides are the most important quality characteristics, followed by continuity and stability. TM2 has formalised the quality requirements of its services in service level agreements.

3.7   Case C

3.7.1   Context

Organisation C is a Dutch multinational providing a variety of financial products like payment and savings accounts, loans and mortgages. Business unit C1 operates in the field of investment banking. An important part of its activities concentrates on trading activities of dealers operating on the dealing room. This case study focused on the dealing room, operated by dealers from different departments. As several departments of C1 were involved in this case study, no particular business management department BM3 could be discerned. Therefore, the business management activities are indicated as C1.

The activities at the dealing room concentrate on the money market (short term), capital market (long term) and foreign exchange. These activities are part of the front office processes of C1, whereas the transactions closed by the dealers are processed in the back office of C1. The ICT environment of the dealing room includes workstations, local-area networks and applications for online market information and for processing and administering
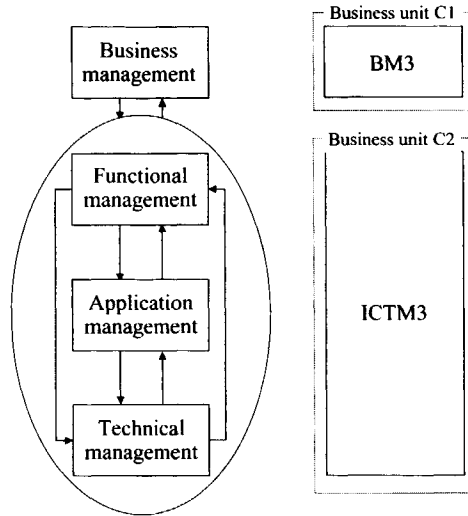
Case C

Figure 3.5 Context of case C in relation to Looijen's model

transactions. Besides the ICT environment for the dealing room, the ICT environment of C1 includes several applications for transaction processing by the back office departments of C1. The back office department of C1 manages and supports its own PC environment and related office equipment.

Business unit C2 is responsible for technical management of central computing environments like IBM mainframe and AS/400, midrange and NT systems, and for development and maintenance of application software. ICTM3 is the ICT management department of C2 that is responsible for functional, application and technical management of the ICT environment of the local dealing room and related (back office) processes departments of C1. ICTM3 manages more than 60 services. Besides a local-area network and around 600 desktops, it supplies a variety of PC and Unix based applications including around 150 midrange systems. The context of case study C is illustrated in figure 3.5.

3.7.2 Content

The financial information gathered during the case study is represented in figure 3.6. The dealing room is not an organisational unit. It is a physical location where dealers from several departments of C1 can rent facilities to perform their job. In the available information the costs and revenues from the dealing room are not considered separately. Therefore the case study identifies the financial information for C1 in total. The costs of C1 have grown, although for 1999 a lower cost level is budgeted. The actual costs were in 1997 and 1998 significantly higher than budgeted. The allocated expenses of C1 include ICT costs, whereas the allocated IT expenses concern an additional allocation for Euro and Millennium projects.

The financial reports on ICTM3 are available for 1998 and 1999, but not for 1997. Until recently, C2 limited its ICT cost management to budgeting and reporting actual costs. Its central purchasing department manages ICT costs like depreciation costs or costs of maintenance and support contracts. ICTM3 had the responsibility to carry out its activities while keeping within the allocated personnel capacity, and hence the costs of internal and

	Actual costs 1998	Budget performance		Budget increase		Main cost components and percentages of actual costs 1998	
		1997	1998	1998	1999		
C1	€237.1 million	118.3%	109.1%	27.5%	-0.9%	Personnel costs:	57.1%
						Other expenses:	32.6%
						Depreciation costs:	2.5%
						Allocated expenses:	5.4%
						Allocated IT expenses:	2.4%
ICTM3	€26.4 million	NA	122.9%	NA	76.5%	Internal personnel:	25.9%
						External personnel:	63.4%
						Allocated costs (other):	7.3%
						Common costs:	3.4%

NA = Not Available; Actual costs over 1998 in Euro; Budget performance = ratio between budgeted and actual costs; Budget increase is increase in relation to the preceding year

Figure 3.6 Cost data of case C

external personnel are by far the highest. The ICTM3 department has grown rapidly in the last couple of years, and budgets were exceeded frequently as a result of a growth of services that was higher than expected. For 1999 significantly lower costs are budgeted.

Differences between budget and realisation and possible causes of these differences are discussed in more detail in paragraph 3.7.3, where the budgeting and budget control processes are discussed.
The total ICT costs of C2 come to €365.2 million. As the case study focused on ICTM3 while the costs of development of ICT and operational ICT are distributed over several departments, no figures are available on the proportion of costs incurred by C2 for operational ICT. ICTM3 personnel spend most time on maintenance and support of operational ICT. A minor part of their time is spent on development projects to implement new components or services. As the time registration system was not used correctly and there was no information on what projects to identify as new developments, no figures are available to indicate what costs for operational ICT are incurred.

Revenues are identified at the commercial (front office) departments of C1 and these include revenues from investment banking activities, like buying and selling stocks. The total revenues of C1 amounted to more than €900 million in 1998. Revenues from operational ICT are not identified separately, as ICT is deployed to support the commercial activities that lead to revenues.

The non-financial aspects identified by ICTM3 focus on the availability of the services provided and particularly on customer satisfaction. Primarily, the availability is monitored through the number of incidents per service. The customer satisfaction is measured implicitly through daily contact with end users and periodic contact with their management. Reports on the availability of the operational ICT are not available.

3.7.3 Process
This paragraph describes the processes identified in organisation C on management of costs, revenues and non-financial aspects. The main processes identified during the case study were the budgeting process, budget control and cost allocation process. Furthermore, a number of activities to reduce costs were identified.

Budgeting process
The budgeting process of organisation C is carried out in a similar way by all business units and departments. Budget proposals have to be finished in September. Due to organisational

changes the directives are sometimes available in October, as a result of which this deadline cannot be met. In 1998, the departments studied started their budgeting process in August. Budgets for commercial departments have to contain both costs and revenues. Departments of C1 budget all direct costs and thus their budget proposals focus on the number of staff and other expenses. Indirect costs, like the costs allocated by the ICT division, are budgeted by the departments concerned whereas the central planning and control division defines the allocation keys. These allocated costs must be incorporated in the cost budget, to budget the overall financial result. C1 has to plan its ICT projects and investments to enable C2 to budget its costs.

Each department of business unit C2 budgets its costs based on the number of staff and other expenses, including office equipment, training and travelling expenses. Development capacity is budgeted based on the development projects requested by the customers of C2, including personnel capacity expressed in man years and an investment budget. ICTM3 also has to request an investment budget for its own ICT investments. The running costs for operational ICT, like depreciation costs and costs for maintenance and support contracts, are budgeted by the central purchasing department of C2 based on the asset database and the invoice administration.

Budget proposals have to be approved by higher management. Usually, not all requests are approved and a budget cut is applied. This may cause a difference between the number of staff requested and budgeted by the customers and the number of staff of allocated to ICTM3. Organisation C aims to approve all budgets before the start of the year. Frequently budgets are approved later on so that no purchases can be made before February.

Summarising, the budgeting process of organisation C is standard for all business units and departments. The budgeting processes have to be finished in September, but as the budget guidelines are sometimes available in October this deadline cannot be met. All departments budget their direct costs. All indirect costs, that is, all costs allocated by other departments or business units, are added to these calculations later. The budgeting process of C1 therefore concentrates on personnel costs and other expenses. ICT costs are budgeted by ICTM3 if they concern new expenses. All other, fixed expenses are budgeted by the central purchasing department of C2. Higher and corporate management issue budget guidelines that the budget proposals have to meet and these have to approve the budgets.

Budget control
Budgets are controlled during the year through monthly comparisons of budgets and realisation. The budget result over 1998 showed a considerable budget overrun. The main causes are extra staff for development activities and higher costs from more external personnel. The budget for management and support staff is fixed during the year, and hence overruns are prevented. As the budget of ICTM3 contains personnel costs and other costs, budget control focuses on the number of internal staff and the utilisation of the budget for external personnel. Furthermore, each department or business unit is only responsible for its direct costs, any exceeded indirect costs are not their responsibility.

In case investment budgets run out, the customers are asked to provide additional budget. As long as a budget owner from C1 can be found, the investment budget can be extended. The central purchasing department checks the available investment budget before the order is sent to the supplier.

Cost allocation

All costs of C2 are allocated to the commercial business units, in this case C1. This allocation is based on the total costs of C2 and allocation keys defined by the central planning and control division. Each of the commercial business units receives a predefined percentage of these costs. This percentage is determined arbitrarily and has no direct relation to the ICT services provided to the business units. The ICT division C2 provides some information on the services delivered to the other business units and the related costs. This information is limited to mainframe costs and development projects. In 1998, this information enabled C1 to trace just 50% of the allocated ICT costs. This information is used by C1 to distribute the ICT costs over its departments. All other costs are divided among all departments based on the number of staff.

C1 also allocates all costs to the profit centres, mainly in the front offices, to enable a comparison of costs and revenues. The keys applied for allocating the ICT costs are based on the mentioned cost information provided by C2. The remaining ICT costs are allocated to all departments based on the number of staff. All other costs of C1 are allocated to the front offices based on keys defined by the financial department of C1.

Cost reduction activities

ICTM3 hardly defines any cost reduction activities. As ICTM3 is responsible for its number of staff and not for other ICT costs, cost reduction activities are sought in automating manual ICT management activities and improving the efficiency of the ICT management processes. Realised improvements do not lead to lower personnel costs, but to more or higher-quality services. Improvements are not carried out based on a project plan but managed implicitly, so and hence figures on investments and efficiency improvements are not available.

The costs of the hardware and software managed by ICTM3 are not known. If known, ICTM3 assumes that these costs are incurred mainly by decision made during the development stage. The central purchasing department negotiates with suppliers about purchases during projects or about substitution of operational ICT means, so the ICTM3 personnel play a limited role in this respect.

Through benchmarking C2 tried to identify possibilities for cost reduction. This investigation never delivered any results, however as the requested quantitative and financial information could not be provided by ICTM3 nor by C1.

Management of non-financial aspects

ICTM3 puts most of its effort into improving the quality of the services and support provided to its customers. Customer satisfaction is the most important quality aspect according to ICTM3, followed by availability and the time to market. At the time this case study was carried out, no quantitative goals were identified to manage these quality aspects.
Customer satisfaction is measured implicitly and based on 'feeling' by ICTM3 during contacts with customers, whereas the availability of the services is measured through the number of incidents registered by the help desk.

For internal projects to improve the non-financial aspects no project plans exist and they are not managed explicitly. Therefore, figures on investments and results are not available.

3.8   Summary and conclusions

The observations about three case studies are discussed in this chapter. The case studies were done at three financial institutes in the Netherlands. All three can be characterised as very large organisations with a divisional organisation structure and highly complex ICT environments.

The case studies provide very much information on the management of costs and benefits of operational ICT and on how these organisations align their operational ICT. This information will be analysed in the next chapter.

4 Analysis of case study results

4.1 Introduction

The observations of the case studies described in chapter 3 are analysed in this chapter where we identify how the organisations studied manage the costs, revenues and non-financial aspects of operational ICT. Based on these analyses the problems these organisations are faced with are identified. The results described in this chapter will be the starting point for the design of a framework for aligning the costs and benefits of operational ICT in chapter 5.

The analysis starts with a discussion of the three aspects of the alignment of operational ICT identified in chapter 3, being the costs, revenues and non-financial aspects. Then, the utilisation of methods to support management of these aspects is discussed. Finally, the conclusions are combined and discussed, and a number of overall conclusions are drawn.

4.2 Costs of operational ICT

This section explains in more detail the costs of operational ICT as observed in the three case studies and how the organisations studied manage these costs. First, the costs arising from operational ICT are identified in terms of the components of which these costs consist and their dimension. Second, we analyse the nature of these costs in more detail by considering the relation between fixed and variable costs and between direct and indirect costs. With these classifications, which originate from cost management literature, one can understand the costs better, and identify cost drivers and opportunities for cost reduction more easily. Third, the cost management processes of the organisations involved are discussed according to the distribution of responsibilities and the observed activities for cost reduction. The results of analysing the case studies from these three perspectives are summarised at the end of this section.

4.2.1 Composition

This paragraph discusses the composition of the costs of operational ICT to identify the costs that are subject to the management processes studied in this research. The cost categories identified by the organisations studied based on existing financial reports are considered. The information presented here should improve the understanding of these costs.

Each organisation applies its own, usually historically evolved, cost model and definition of cost units to administer costs and to represent financial information for management accounting and control purposes. Costs of operational ICT are administered and categorised in different ways. When we study the main cost components identified in the cost data tables in chapter 3, a number of similarities can be identified. First, the personnel costs are always identified as a separate cost component. Only four of the eight departments studied discriminate between costs for internal and external personnel. ICT costs are identified as a separate cost component in three departments, whereas these costs are part of other cost components in two units. Costs allocated by other departments or other business units are discriminated by six departments and in three of these, even several kinds of allocations are discriminated.

The differences between the cost components represented in the tables of chapter 3 are not caused by differences in only the cost structure. Cost components are also not illustrated if the department involved never as has anything to do with these costs.
Most departments do not deal with anything that is subject to depreciation, like accommodation, technical installations or office furniture. So, depreciation costs do not appear in the financial data of BM1, FM/AM1, FM2 and ICTM3. Costs of hardware and software usually appear in the financial data of the supplying ICT department, being FM1/AM1, AM2, TM1 and TM2. For the other departments, these costs appear in their financial data as allocated ICT costs. BM1, FM2 and ICTM3 are exceptions in this respect. BM1 and FM2 do not own any ICT but have no allocated ICT costs either. For BM1 this is an explicit decision, as the proper cost drivers could not be identified. However, business unit B1 intends to allocate ICT costs to FM2 as well. ICTM3 has not the hardware and software costs of the ICT it supports, nor does it receive these costs as allocated ICT costs. Finally, indirect costs like those incurred by using the accommodation and the personnel department, are allocated to all departments except for FM2 and AM2. These costs appear as allocated other costs in the financial data. As mentioned, no other costs are allocated to FM2 and AM2. It is the intention to allocate these costs to FM2 as well. AM2 forms an exception, because B1 first allocates the indirect costs of the ICT costs and hence allocation of other costs to AM2 would lead to problems: some items would recur in the calculation.

Because of the different cost structures and allocation strategies it is difficult to compare the composition of the costs. To enable at least a superficial comparison, we defined a general set of cost components. The financial information of the organisations is translated into this set and the results are presented in figure 4.1. This financial information indicates that personnel costs make up a considerable part of the costs of each department studied. Large differences

	Internal personnel	External personnel	Depreciation	Hardware & software	Allocated ICT costs	Allocated other costs	Other costs
BM1	6.16%	0.0%	0.0%	0.0%	0.0%	92.08%	1.76%
BM2	No data available						
BM3	53.18%		2.29%	0.0%	8.65%	5.42%	30.46%
FM1/AM1	11.33%	19.83%	0.0%	0.99%	41.79%	24.08%	1.96%
FM2	96.35%	1.87%	0.0%	0.0%	0.0%	0.0%	1.78%
AM2	27.67%	54.07%	6.16%	10.23%	0.0%	0.0%	1.87%
ICTM3	25.86%	63.38%	0.0%	0.0%	0.0%	7.31%	3.45%
TM1	14.86%	19.54%	29.89%	24.54%	0.0%	3.52%	7.65%
TM2	16.55%	13.65%	11.62%	29.60%	0.0%	23.88%	4.70%

Figure 4.1 Composition of costs per department studied

can be identified between the compositions of the costs of these departments. For some departments, some cost categories are empty, as the department concerned is not responsible for these costs. FM2 and ICTM3 for example, bear no responsibilities regarding the hardware and software costs for the applications they manage.

Furthermore, the level of automation and outsourcing influences the financial information as well. If certain activities are automated or outsourced to an internal or external provider, the personnel costs will drop and be replaced by hardware and software costs in case of an external supplier or by allocated ICT costs if it concerns an internal supplier.

On the bases of the above we conclude that the composition of the costs of operational ICT identified during the case studies is determined by organisational settings like the activities and responsibilities of the departments studied. It is not possible to draw an overall picture of the composition of the costs of operational ICT for all departments studied.

4.2.2   Dimension

The cost dimension represents the costs of the operational ICT of the organisations studied. If one knows the dimension of these costs, one can determine whether it is worthwhile to manage these costs.

As the case studies dealt with just a limited part of each organisation, it is not possible to identify the total costs for the operational ICT of the entire organisation based on the information gathered. For example, all three organisations have a centralised ICT division taking care of most TM activities and several AM and FM departments at the different business units. The figures represented in chapter 3 show that it is also not easy to determine exactly the dimension of the costs for operational ICT per business unit, as the available data does not discern between costs of operational ICT and costs for new developments.

The differences between the compositions of the costs described in the preceding paragraph make it hard to compare the costs of the departments studied. Differences between the costs of the departments studied can be explained by organisational differences. Differences in responsibilities and allocation policies determine whether certain costs do or do not occur on a department's financial reports, thus directly influencing the costs of that department.
For a sound comparison of the costs of operational ICT, all relevant types of costs should be identified and quantified. The case studies did not yield enough information on this, because this relation, although very interesting, is beyond the scope of this research.

Nevertheless, we claim that the figures presented in chapter 3 justify the conclusion that the costs of the operational ICT are high, as these costs run into hundreds of millions of Euros per business unit studied. In relation to the total costs of an organisation or business unit, these costs may not be that high. In case A, the total ICT costs make up more than 22% of the total costs of business unit A1. As A1 is a cost centre providing services that are sold by its internal customers, the costs of A1 make up just part of the overall product costs: around 11% on average. For business units B1 and C1 who do supply a final product or service, the ICT costs make up around 12% and 8% of their total costs respectively. All three organisations do not consider these figures to be high, although they do worry about the increasing cost level.

The three case organisations studied justify the increased attention of the management responsible to ICT costs by the claim that ICT costs are increasing continuously both absolutely and relatively. To verify this claim, we considered historical data of the case organisations. However, historical data was not available for all cases. Figures for 1997 were

not available for FM2 and TM2 as these departments originated from recent reorganisations. We tried to determine the figures on AM2 based on figures of the departments that merged into AM2, but the budget differences observed make it likely that the data used is not complete or accurate enough. Figures for 1998 are also missing for ICTM3 as the ICT costs were then managed for the whole ICT division C2, not per department.

Organisation A was able to provide all historic cost data requested. This information does not supply one with enough evidence to subscribe to or reject the claim of continuously increasing costs by the management of the organisations involved. First, to justify this claim, data have to be considered from more than one organisation and over a longer period than the three-year period considered in this case research. Second, the increased costs identified are not only caused by autonomous growth. Organisational changes, like the take-over of ICT resources and personnel in 1997 and 1998 by FM1/AM1, influence the cost levels of a department and may lead to higher costs for that department.

On the other hand, the financial data represented in chapter 3 does not contradict this claim as the available data shows an increase in ICT costs. Only C1 shows a minor budget decline for 1999, but it is unknown to what extent this is caused by lower ICT costs or by lower personnel or other costs.

4.2.3   Fixed and variable costs

The cost management literature discussed in chapter 2 classifies costs as fixed or variable. This distinction is drawn to understand the changes in costs in relation to fluctuations in the quantity of an activity (Horngren, 1984). This paragraph tries to identify the relation between fixed and variable costs for the departments studied. The results of this analysis should provide understanding on the relation between ICT costs and the quantities of ICT activities or the activities supported by ICT. We claim that this understanding is essential for proper planning and control of costs.

Management of the three organisations participating in this case study research claimed that most of their costs for operational ICT are fixed. Internal personnel usually have permanent appointment, they argue, so that they cannot be laid off easily. For ICT departments, most hardware and software costs are fixed as well, as they are related directly to the demands of the business. BM on the other hand, experiences ICT costs as being fixed as well, as they have no control over them.

From this, we conclude that the management participating in the case studies considers fixed costs to be costs that cannot be influenced. However, in chapter 2 fixed costs are defined in the sense as used in the economic literature: costs that have no direct relation to the production volume.

Applying this definition, fixed costs can be identified from different perspectives within an organisation. This section will discuss the relation between fixed and variable costs from the perspective of each of the management units identified in this research, being business, functional, application and technical management.

Business management

Starting from business management (BM) perspective, the production volume is determined by the number of financial products or services the organisation has sold. ICT costs are allocated to BM according to a fixed percentage of the total ICT costs (organisation C) or a combination of a percentage based on the turnover size for business applications and a price per workplace for infrastructural costs (organisation B). Organisation A does not allocate ICT costs to BM.

For organisations A and C, all costs are fixed, as there is no relation between their production volume and the sum of the allocated ICT costs. There is even no relation between their demand for and use of ICT and the allocated ICT costs.

Part of the ICT costs of BM2 appear to be variable as the percentage is determined by the relative size of their turnover. Assuming that there is a direct relation between production volume and turnover, this suggests that these costs are variable. However, the production volume or turnover of the department studied and that of other departments determines the ICT costs allocated. If the turnover of these departments increases equally, the allocation percentages will not change. Besides, there is no indication that changes in production volume always affect the total ICT costs. The size of the allocated ICT costs will definitely vary over time as it is determined by two variables, being the relative size of turnover and the size of the total ICT costs. But this does not mean that there is a relation between the production volume and the size of the allocated ICT costs. So, all in all these costs are fixed and again there is no relation between the demand for ICT and the ICT costs allocated.

The other part of the ICT costs of BM2 is allocated according to the number of workplaces. These costs are fixed too, as within given boundaries there is no relation with the production volume. Naturally, if the production volume exceeds given boundaries more staff will be needed, and hence more workplaces. This allocation does include a relation between the allocated ICT costs and the demand for ICT, namely the number of workplaces.

Functional management

From the perspective of functional management (FM), the production volume can be defined as the number of services provided to the business, including their complexity and the requested service levels. Assuming that the complexity and service levels do not change significantly within a given period of time, most ICT costs are variable from the perspective of FM. After all, providing more services requires more hardware, software and ICT personnel. For example, if FM1/AM1 decides to end the contract for a midrange system provided by TM1, TM1 will still have depreciation costs and reserved personnel capacity. To solve this problem, TM1 and TM2 close service level agreements for the depreciation period of the ICT component concerned, usually three years. ICT costs allocated by TM1 or TM2 for mainframe use seem to be variable, as the allocation is based on the actual number of mainframe products consumed. More services requiring mainframe products will result in higher costs for FM, making these costs variable. The dimension of these costs has both a relation to the utilisation of the service by BM and the number of services managed by FM, for example when the service includes batches running automatically during the night. The first relation is more fixed, as the mainframe costs allocated for a single service may vary with its utilisation. The second relation is more linear with the number of services. All in all, costs are mostly variable due to the number of (mainframe) services managed by FM.

Costs of operational ICT managed by FM are not equally variable in all situations. Supporting more ICT will, for example, lead to extra costs for depreciation, maintenance and support contracts and personnel. Scaling profits make that this relation is not strictly linear. If, on the other hand, less services are demanded, costs like depreciation costs will remain, and personnel cannot easily be dismissed either. Sometimes ICT services bought from external or internal providers through contracts can not be terminated at once. These costs can only *'disappear'* if the resources can be deployed for other purposes.

So, ICT costs behave like variable costs if an increasing volume is considered, but more like fixed costs in case of a decreasing volume.

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Application management

The production volume of application management (AM) is defined as the number and size of changes made to the application software. From this perspective, all costs of AM are variable, as realising more or larger changes will require more resources like personnel and ICT.

Like the costs of FM, the costs of AM are partly fixed when the demand decreases. After all, not all resources like personnel or ICT can be dismissed easily. Particularly internal personnel cannot be dismissed immediately and depreciation costs of ICT owned by AM will persist unless resources can be deployed for other purposes.

Technical management

From technical management (TM) perspective, the production volume is defined as the number of ICT components provided to the business, like hardware platforms, network connections or processing capacity. Like the costs of FM, most costs of TM are variable, as there is a direct link between the costs and the number of components managed. Likewise, these costs are variable when an increasing production volume is concerned, whereas they can be characterised more as fixed if the volume decreases.

However, the production volume of TM is not always linked directly to the number of components managed. In case of hardware like midrange systems or personal computers this link exists, making these costs variable. Concerning shared infrastructural environments like a network and mainframe, costs are usually allocated to the customer based on a rate and the actual consumption. As services are defined in terms of network connections or CPU seconds, the production volume is expressed in these units of measure. However, within the boundaries of the existing capacity, the cost TM incurs for these services are fixed. Only when the total transportation or processing capacity required is likely to exceed this capacity, the capacity has to be expanded resulting in higher costs. The frequency of the increases depends on the growth in demand and the dimension of the extensions.

So, whether the costs of TM are variable or fixed depends on the definition of the services provided. When services are expressed in terms of network connections or CPU seconds, the costs of TM are fixed within the boundaries of the existing capacity. If the frequency with which extensions are introduced is high, these costs are more variable. When the service is defined in terms of a hardware platform, like a Unix-based midrange system, the costs of TM are variable.

Conclusion on fixed and variable costs

Based on the above discussion, we conclude that from the three ICT management perspectives most costs are variable as they are directly related to the number of ICT components requested by business management. We also conclude that these costs behave more like variable costs if an increasing volume is considered. In case of a decreasing volume, they have a fixed component, as resources cannot always easily be dismissed or deployed for other purposes. In economic literature, this principle is also known as the kinked cost curve (see figure 4.2) illustrating that costs may behave differently if different developments in production volumes are considered.

Based on the financial information gathered during the case studies, we find that for an increasing production volume all costs are variable except allocated costs and other costs. As ICT resources like hardware can be obtained in given units with a certain capacity, the graphics of the dimension of the ICT cost and the production volume is a discontinuous function. Only if the available capacity is insufficient, additional capacity will be needed resulting in a higher cost level. The dimension of the incremental increases in costs depends on the dimension of the units necessary to expand the available capacity and their costs. The
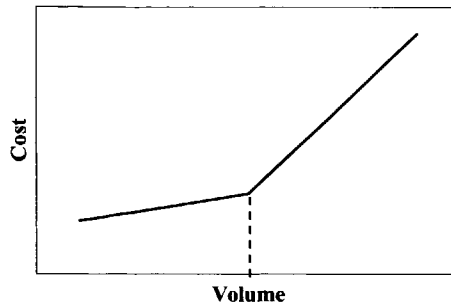
Figure 4.2 The Kinked Cost Curve

smaller the increments, the more the function can be considered to be a continuous function. For the ICT departments studied in the three case studies, more than 80% of the costs are variable.

For a decreasing production volume, fewer costs are variable. Costs of internal personnel and deprecation costs for example are then fixed as well. As the financial information gathered does not always discerns between ICT costs from depreciation and from maintenance and support contracts, it is not possible to determine what part of the ICT costs is variable for a decreasing production volume. However, based on the assumption that costs for internal personnel and part of the ICT costs are fixed, we expect that the percentage of fixed costs will be more than at least 50%. If resources like hardware and personnel can be deployed for other services, these costs are variable after all from the perspective of the ICT service.

From business management (BM) perspective, all ICT costs are fixed, as there is no direct relation to the product volume of BM. ICT costs only arise from the presence of ICT means, whether these means are used frequently or not at all. Mainframe costs are from a BM perspective more variable, as these costs are allocated according to their actual use. However, from the perspective of the FM, AM and TM departments the costs of a mainframe are fixed, so for BM these are fixed costs as well. After all, a decrease in the volume of mainframe use will, in the short term, lead to a higher rate, not to lower costs.

4.2.4 Direct and indirect costs

As mentioned in chapter 2, we distinguish between direct and indirect costs as a department can influence only its direct costs, not its indirect costs. With the analysis of direct and indirect costs described in this paragraph we try to determine the relation between direct and indirect costs for the organisations studied. A higher percentage of direct costs of an organisation assumes a more efficient organisation as overhead costs are not directly necessary to produce a product of provide a service. More insight into direct and indirect costs allows one to lead to understanding better how costs of operational ICT can be influenced. We assume that indirect costs cannot be influenced or at least not easily.

In chapter 2, costs are called direct if they can be allocated directly to the specific product, service or activity for which they are incurred. As in the discussion on fixed and variable costs, the relation between direct and indirect costs is analysed from the perspective of the four ICT management functions identified in this research, business, functional, application and technical management.

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Business Management

From BM perspective, the financial products can be defined as products to allocate ICT costs to. As no ICT costs are allocated to BM1, the ICT costs made for BM1 are indirect. The BM departments of B1 receive ICT costs based on their relative turnover size. There seems to be a direct relation between the amount of ICT costs and the number of products sold, assuming that that determines the size of turnover. However, the allocated ICT costs also depend on the size of turnover of the other BM departments, so for the BM departments of B1 the ICT costs are also indirect. As ICT costs are allocated to C1 based on a predefined percentage of the total ICT costs, for C1 the ICT costs are indirect as well. Based on this, we conclude that for the BM departments of this case research all ICT costs are indirect.

Functional Management

For FM, the products or services are defined to be the applications that are managed and supported. FM1 allocates all its costs to the services it provides to the BM departments. ICT costs allocated by TM1 are specified per product and for mainframe products also per application. These cost are largely allocated directly to a service, if the components are deployed for a specific application. A limited number of shared systems causes some trouble, as the costs of these systems cannot be allocated directly to a single application. Personnel costs are attributed to a service based on a predefined hourly rate and the number of hours spent on each service. All other costs and allocated costs cannot be allocated directly.
The costs of FM2 and ICTM3 are not allocated to the services it provides, so they are indirect.

So both the allocation strategy applied and the exclusiveness of the ICT means deployed for an application determine the extent to which costs are direct. As a result of this the proportions of direct and indirect costs differ per department and organisation. For FM2 and ICTM3 100% of the ICT costs are indirect, whereas FM1 shows that it can directly allocate around 70% of its costs.

Application Management

The costs of changes in application software consist of personnel costs and costs for development and test environments. Both AM1 and AM2 register hours spent on changes and apply an hourly rate to attribute these costs to applications. Besides all personnel costs, all other costs of AM1 and AM2 are incorporated in the hourly rate. As time is also spent on holidays, meetings, training and education not all hours can be attributed to applications. The proportion between these so-called non-productive hours to the productive hours differs per organisation. Due to the purpose of this study, we did not collect detailed information on the composition of the hourly rates of AM1 and AM2 and on the (non-) productive hours spent has not been gathered during the case studies. So no figures are available on the proportion between direct and indirect costs for AM1 and AM2.
ICTM3 does not allocate personnel costs to applications, nor does it have a specified time registration system.

Technical Management

As ICTM3 does not attribute costs to services, all costs are indirect. TM1 and TM2 do attribute costs in order to determine the cost price of products for the definition of rates. Costs of hardware and software can be allocated directly to for example midrange systems provided to a single customer. Personnel costs and all other and allocated costs are included in the hourly rate. So, part of the hourly rate is based on indirect costs. Furthermore, the rate is based on the number of productive hours, whereas time is also spent on non-productive

activities as holidays, meetings and training. A detailed analysis of the hourly rate is not part of the scope of this research.

The productive hours can directly be attributed to services provided to a single customer.

On the other hand, costs cannot be attributed directly to mainframe products like CPU cycles or storage capacity. TM1 and TM2 directly attribute costs for hardware and software to the mainframe environment, but personnel costs through hourly rates as described above. All other and allocated costs cannot be attributed directly and are incorporated into the hourly rate. Both TM1 and TM2 define the mainframe rates by dividing the overall costs allocated to the mainframe environment by the expected sales volume, as a result of which all these costs are indirect.

Based on this, we estimate the direct costs of TM1 to be around 50%. The information available about TM2 was not detailed enough to determine its percentage of direct costs. TM2 yearly estimates the cost price of its products through a system of arbitrary keys. As the structure applied for these calculations is not assimilated in the financial administrations, ex post calculations to determine actual cost prices are not possible.

Conclusion on direct and indirect costs

Based on the discussion on direct and indirect costs, we conclude that the cost allocation strategy and the cost price calculation method determine the proportion between direct and indirect costs. If ICT costs are not allocated to a department as for BM1, these costs are all indirect. On the other hand, if costs are allocated on the basis of other units than the number of ICT products used, the ICT costs are still indirect as for BM2 and C1.

The way cost prices of products or services are calculated also influences the proportion of direct and indirect costs. Costs are indirect if they are not attributed to products, as for FM2 and ICTM3. If costs are allocated to products through rates, not all costs can be attributed to products directly. First, rates do not completely consist of direct costs. Indirect costs like common costs and allocated costs are incorporated in the hourly rate of rates of FM1, AM1, AM2, TM1 and TM2. Rates for shared resources are based on the overall costs and the expected production volume, meaning that there is no direct relation between a single product and the costs incurred. Mainframe rates as applied by TM1 and TM2 for example, are calculated by estimating the total costs and dividing these by the expected number of CPU seconds that will be consumed by the customers.

On the other hand, FM1 and TM1 show that it is possible to allocate a significant part of their costs to products directly.

4.2.5   Cost management responsibilities

This paragraph describes the allocation of responsibilities for costs of operational ICT within the organisations studied. Based on the case study observations described in chapter 3, we discuss what management functions are responsible for which costs.

The case studies showed that in all three case organisations higher management and ultimately the board has to approve cost plans formalised in budgets. So higher management is responsible for the overall ICT costs and tries to influence these costs by issuing budget guidelines. During the budgeting process, higher management can also return budget proposals with instructions for additional cost reductions.

All three organisations have an authorisation structure, indicating that large investments have to be approved by higher management and eventually the board.

The BM departments involved have no responsibilities regarding the costs of operational ICT. BM1 is aware of the costs of the applications it utilises. As these costs are not allocated to BM1 this information does not affect the financial performance management of BM1 on which it is judged and thus it does not affect their demands for ICT services. BM2 and C1 are also not responsible for the ICT costs allocated. They even have no information about the costs of the ICT services provided.

All ICT departments are responsible for budgeting and controlling their own costs as shown in chapter 3. This means that departments are only responsible for the costs that appear on their financial reports. For example, FM2 and ICTM3 are not responsible for the hardware and software costs of the applications managed and supported. Departments that have to allocate their costs, like AM2, TM1 and TM2, also focus on the realisation of a 'zero' result by allocating all costs to their customers.

Furthermore, cost management of FM1 concentrates on managing the ICT costs allocated by TM1. FM1 has to check these costs per application and try to identify opportunities for cost reduction. The personnel costs are not managed specifically, as the allocated numbers of staff are fixed, and FM1 has to realise as much service to its customers as possible given this capacity. FM2 budgets and controls ICT resources like AM2 capacity and the purchase of new PCs for the BM departments it services, whereas ICTM3 has no further cost management responsibilities.

In addition to planning and controlling the costs, TM1 and TM2 focus on realising conform to the market prices and therefore on internal efficiency. The conformity of their rates with the market price is periodically evaluated through an external benchmark research.

In case actual costs exceed the budget, departments aiming at a 'zero' result have less problems. After all, extra costs usually arise from extra activities. As all activities are carried out for customers, the extra activities can be allocated as well, thus re-realising the 'zero' result. As all activities are carried out at the request of the customers, the responsibility for higher costs is transferred to these customers.

Other departments have to request permission for additional budget from higher management. ICTM3 can also accept additional budget from its customers. As all activities are at the request of the customers and eventually of the business, these requests are usually granted.

Based on the above discussion we conclude that higher and corporate management manages the total costs of operational ICT. BM has no responsibilities concerning managing costs of operational ICT. The responsibilities of ICT management units particularly focus on the realisation of the planned budget. These budgets do not include all cost categories, as not all departments are responsible for all operational ICT costs. If costs have to be allocated, these departments have to realise a 'zero' budget and charge rates that are in agreement with the market price.

4.2.6   Cost reduction activities

This section discusses the cost reduction activities identified in the cases. It analyses how the organisations involved try to reduce the costs of operational ICT and to what extent they succeed in reducing these costs.

The three case studies show that corporate and business unit management play an important role in cost reduction activities as these define guidelines for the budgeting process and approve all budgets. Thus, it does not have a clear role in reducing the costs of operational ICT. It does have a role in restricting the increase in costs, however.

The BM departments studied do not take explicit measures to reduce the costs of operational ICT. FM2 and ICTM3 do not deploy activities to reduce the costs of operational ICT either. The AM departments studied focus on realising the requested functionality or technical improvements. As the three organisations studied have frozen their development capacity, the internal efficiency is important. The exploitation costs of the products developed are not considered.

Through its cost reduction activities, FM1 focuses on trying to reduce the exploitation costs allocated by TM1. For this purpose it periodically analyses the use of programs and data, and cleans what is not used anymore. Furthermore it tries to improve the efficiency of the applications in terms of resource use and processing time by means of tuning. FM1 also examines to what extent certain applications influence each other's performance to determine the optimal division of logical partitions or midrange or mini systems. Lower resource usage will lead to lower costs for B1 if mainframe resources are considered, to less midrange or mini systems or to delayed purchases of extra capacity. Due to the decreasing prices of hardware and the time value of money, deferred purchases result in lower costs.

Through capacity management, FM1 tries to better tune the capacity provided by TM1 to the required capacity better. Moreover, the capacity it buys from TM1 is based on the average use. In case of peak loads a third party processes certain transactions.

Costs of data communication are reduced by FM1 through negotiating with suppliers. Likewise the costs of hardware and software can be reduced. As TM1 purchases all hardware and software, FM1 can only pass on some guidelines or price indications to TM1.

Finally, FM1 tries to reduce costs by reducing the required number of staff to manage and support the services provided. Particularly the maintenance activities directly after implementation of new functionality require a lot of effort. By participating in development projects, FM1 tries to improve the transition from project to exploitation and to decrease the amount of effort required for the maintenance shortly after implementation. Other options to decrease the required number of staff are improving the quality of applications, so less effort is required to solve incidents and problems. Improving the efficiency of internal ICT management processes, for example by automating certain activities, reduces the required effort of FM1 staff too.

The case study carried out at TM1 has identified a number of cost reduction activities. First, TM1 tries to advise its customers on the ICT services bought, as the costs of operational IT are determined largely by the hardware and software components selected by the clients of TM1. Second, TM1 tries to employ its resources efficiently to fulfil the customer's needs. As most midrange, mini and NT systems are dedicated for a single customer, this is only relevant for the mainframe environment. Third, the efficiency of internal processes of TM1 is improved to reduce the required number of staff and thus the personnel costs. Automating certain ICT management activities or supporting these with information systems is one way to realise efficiency improvements. Another way is to standardise the ICT components, so that less diverse knowledge and skills are required.

Fourth, standardisation leads to lower ICT costs as well as to higher discount rates. Fifth, negotiating with suppliers is still a lucrative activity for TM1 to reduce costs for both new purchases and running contracts.

TM2 has limited means to reduce the costs of hardware and software as another department of B2 makes investment decisions. Furthermore, these costs are determined by the prices on the supplier market and by the demands of its clients regarding capacity and hardware and software types. Therefore, TM2 focuses its cost reduction activities on reducing the personnel

costs. Measures for this are automating activities, standardisation of ICT management processes, more tight management and control of personnel, improved engagement of new personnel and improved scheduling of personnel. TM2 also tries to have a larger say in investment processes so that it can stress the importance of the exploitation costs in the decision-making process. Different alternatives may have different impact on the personnel required for management and support and hence involve higher or lower exploitation costs.

The financial reports do not provide enough information to determine to what extent the costs of operational ICT can be reduced through the measures identified here. The departments studied do not evaluate nor measure the cost reduction activities deployed. Therefore, limited figures are available on the cost reductions realised through these measures. Only TM2 could provide figures on the cost reductions realised from renegotiated software licenses and maintenance contracts. These figures show that certain fees can be cut back up to 50%, in total realising a 3% to 6% decrease of the total hardware and software costs of TM2.
The management of the departments studied believes that between 10% to 20% of the total ICT costs can be subject to cost reduction measures. So, cost reductions are expected to be limited to several percents.

Based on the discussion of cost reduction activities given above, we find that a lot of measures are available to reduce the costs of operational ICT. The fact that not all departments studied make use of these measures is caused by differences in responsibilities and in knowledge. FM2 and ICTM3 for example are not responsible for the costs of hardware and software costs, whereas the BM and AM departments are not responsible for any operational ICT costs at all. Corporate management just manages the total ICT costs. Whether its limited understanding of the operational ICT costs is a cause or a result of this is unknown. After all, if a certain department is not responsible for certain costs, it cannot profit from administering these costs and hence gain understanding about them. On the other hand, lack of understanding on how to control these costs could have been the reason why management has not allocated certain costs. FM1 indicated that costs are not allocated to BM1 as proper allocation keys or control variables could not be found. This would argue for the second reasoning. The other cases did not give any information on this, other than that better understanding of operational ICT costs is a prerequisite to being able to use more measures to reduce them.

4.2.7 Summary

The operational ICT costs of an organisation are considerable in absolute terms. In proportion to the total costs of the organisation, these costs are not that large. The composition of the costs as derived from the financial reports of the departments studied provides a diverse picture. The differences are caused by differences between the responsibilities and activities of the departments studied. Historic data is limited and organisational changes make it difficult to compare the available data.
From business perspective the costs of operational ICT are mainly fixed, although from ICT management perspective costs are mainly variable and based on the number of services provided. The relation between direct and indirect costs is determined by the cost allocation policy applied. For example, for the business management departments studied all costs are indirect, as well as for FM2 and ICTM3. On the other hand, FM1 and TM1 illustrate that it is possible to turn a significant part of the costs into direct costs.
BM has no responsibilities regarding the costs of operational ICT, whereas the responsibilities of the ICT management departments are limited to not exceeding the budget. Furthermore, several measures are available to reduce costs of operational ICT but not all departments

studied apply these measures. Departments that do, do not measure or evaluate any realised improvements.

4.3   Revenues of operational ICT

The revenues of operational ICT as identified during the case studies are analysed in this section to show what revenues are identified and how these revenues are managed by the organisations studied.

Revenues are defined in chapter 2 as gross increases in assets from goods or services (Horngren, 1984). In the case studies, the delivery of goods or services can be described from different perspectives. First, from the business management perspective, goods or services are delivered to customers and revenues arising from this transaction are characterised by a cash flow. Second, the delivery of services or goods among departments or business units is also observed between the ICT and BM departments in the case studies. These transactions are not characterised by a cash flow, but by an administrative transfer that only affects the books for internal accounts. This is usually indicated as cost allocation or charge back. Departments allocating costs to other departments have to realise a 'zero' result, so that all costs eventually appear on the profit and loss accounts of the commercial departments that actually generate revenues by selling products or services.
If we consider the definition of revenues, this administrative operation does not concern assets. Besides, this allocation is not intended to maximise revenues but to support cost management. In other words, cost allocation does not lead to revenues for the supplying department.

According to this statement, revenues can only be identified in the case studies at the level of business management. These revenues arise from selling financial products or services. The organisations studied do not identify separate revenues from operational ICT as ICT is just one of the resources deployed to deliver products or services. Based on this, we conclude that the revenues of operational ICT are not identified nor managed by the organisations studied.

4.4   Non-financial aspects of operational ICT

Besides financial indicators as costs and revenues, we studied a number of non-financial aspects in the case studies, in order to determine their role in the ICT management process. This paragraph discusses the aspects identified during the case studies, their dimension, the authorities responsible and the activities identified for improvement.

4.4.1   Identified non-financial aspects

The BM departments studied are most interested in the benefits of ICT in terms of its contribution to business processes and indirectly to commercial targets. The contributions identified during the case studies can be categorised in three main types, being:

- *Information provision:*   Providing information required to carry out business processes properly, like information on customers or market developments;
- *Information processing:*   Carrying out information processing activities;
- *Management information provision:*   Providing management with information on the status and performance of business processes and the realisation of goals.

None of the BM departments studied explicitly identifies or manages these contributions. A1 focuses on the continuity of the provided ICT, the quality and finally the costs, in that order. To concretise this, BM1 and FM1 have agreed on a number of non-financial aspects and formalised the norms for these aspects per application in service level agreements. The quality is expressed in business related terms like availability and timeliness, completeness, correctness and the quality of the output. Periodically, the realised quality is reported and numbers and consequences of the incidents occurred are discussed.

Apart from these non-financial aspects, FM1 identifies some other non-financial aspects, being a ratio to determine the relation between proactive and reactive activities of FM1 and the customer satisfaction, which it measures periodically among management of the BM departments through questionnaires.

FM1 and TM1 have also formalised their relation in service level agreements for each service. These agreements cover a number of quality characteristics, being the availability, the number of incidents and their consequences and the preventive measures taken. Other non-financial aspects identified by TM1 are the reliability and performance. Besides these more technical characteristics related to the quality of the ICT product managed, TM1 identifies a number of process quality aspects like response times and the time to solve incidents and problems. TM1 identifies customer satisfaction as an important non-financial aspect too, but does not manage or measure this explicitly.

FM2 identifies the quality of the ICT components managed in terms of their performance, the quality of the printer output, the input function and the number of dumps occurred. These aspects are not managed or measured explicitly. Actions are initiated when the number of complaints from customers is experienced to be too high, or if FM2 believes that will happen in the near future.

AM2 measures the satisfaction of customers with its helpdesk periodically, whereas FM2 was working on a customer satisfaction questionnaire at the moment the case study was carried out.

The services provided by TM2 are formalised in service level agreements with AM2. These agreements express the agreed service levels in a number of product-related aspects like availability, performance and quality of the printer output. Furthermore a number of process quality aspects are identified for ICT management processes like contingency management, capacity management, change management and cost management. Periodically the measured items are reported by TM2 and exceptions are discussed.

ICTM3 focuses mainly on customer satisfaction, service quality and time to market. These aspects are not discussed with customers and managed implicitly based on input from contacts with customer and a limited number of measurements. The items measured by ICTM3 concern the number of incidents and changes and the time to solve them.

The case studies showed that, if formulated explicitly, the functionality is expressed in natural language and not based on the quality attributes for functionality in the Extended ISO model. It is the responsibility of the customer who defines the functional specifications that the specifications meet these quality criteria.

Based on this we conclude that the departments studied consider it important to manage non-financial aspects as well as financial aspects. They mostly focus on aspects like availability, performance, and output quality. If they consider the information provided and processed by

the applications, the completeness and correctness are important aspects as well. However, not all non-financial aspects are measured and managed explicitly. The case studies indicate that it is difficult to translate the non-financial aspects identified into operational and measurable units.

4.4.2 Dimension

Data for the non-financial aspects could be gathered from FM1, TM1 and TM2. All three departments periodically report the realised quality to their customers, according to the service level agreements that were reached. The availability of the operational ICT is the most important aspect in these reports, as it is often the most important quality aspect for a customer and for all services it can be measured more easily than other aspects like performance, correctness etcetera. All three departments measured the availability of their ICT on the basis of the number of incidents, the time it took to solve them and the impact they had. In fact, they suppose that each service is available, performs well, operates correctly, et cetera unless an incident occurs. In addition to the incidents, TM1 and TM2 also measured the numbers of problems and changes and the time it took to solve them.

Based on the number of incidents and time required to solve them, the three departments calculate the availability and express it in a percentage. The algorithms for this calculation are not always well defined and differ per organisation and per service, according to the agreed service levels. If, for example, a service should be operational from 8:00 AM till 17:00 PM, an incident that appears during the night which can be solved before 8:00 AM does not effect the availability of a service. Other problems regarding the calculation of an availability percentage concern the approach to incidents that result in a situation where only part of the functionality of a service is not available or just part of the end users cannot make use of it. Neither FM1, TM1 nor TM2 compares the non-financial aspects of different services.

The figures collected during the case study, show that the scores for the non-financial aspects vary significantly, between organisations or services and over time. Based on this, we conclude that the figures for non-financial figures of different organisations or services cannot be compared. A comparison is useful within a single department or environment for similar services or for a single service over time.

4.4.3 Responsibilities

In all three organisations, the ICT management departments are responsible for the quality of the services provided. The responsibilities are based on the ICT components managed by the department concerned. If they purchase hardware or software from an external supplier, the supplier bears responsibility to provide and support the ICT components according to the agreed service levels as recorded in contracts.
The BM departments do not have any responsibilities regarding the non-financial aspects. If service level agreements are defined, like those between BM1 and FM1, the BM department just needs to define the requested quality in terms of the norms for the non-financial aspects.

4.4.4 Improvement activities

Improvement of the non-financial aspects, particularly the availability of the services provided, was identified by all ICT departments studied as being most important; it ranked even higher than cost reductions. FM1 and TM1 claim that they spend 30% of their personnel capacity on improving their internal efficiency and service quality.

Activities to improve the service quality are initiated mainly after the occurrence of an incident, or on the basis of a chance observation or personal insight and are therefore carried out ad hoc. All ICT departments take action to prevent future incidents. FM1, TM1 and TM2 have formalised these activities in a problem management process. All departments studied are working on the definition and implementation of ICT management processes based on the IT Infrastructure Library. Through this, they want to improve the quality of the activities carried out and to reduce the process time of certain activities and thus decrease the time required for solving problems, for example.

Despite this attention to improvement of the non-financial aspects, none of the departments studied can provide any figures expressing the improvements realised. Improvement plans are usually not formalised in project plans nor expressed in quantitative goals, and the required personnel capacity is rarely estimated. The results of the improvements is not determined, measured or evaluated.

4.4.5   Conclusions on non-financial aspects

We found that all departments studied consider the non-financial aspects of their ICT most important, particularly the quality of the service where it concerns availability. All three case organisations rank availability and continuity higher than costs.

We also conclude that despite the attention paid to non-financial aspects it appears to be difficult to quantify and measure these aspects. Moreover, improvement activities are not managed at all. As a result it is not clear to what extent the non-financial aspects can be improved and whether all efforts are worthwhile.

4.5   Utilisation of supporting methods

Budgeting is the common method used by the three case organisations to plan and control costs and revenues. Only commercial departments manage revenues. If costs are allocated to other business units or departments these allocations are budgeted as well, particularly when the allocations are made through predefined rates.

The budget processes of the organisations studied have a number of similarities. All budget proposals start bottom up, based on budget guidelines defined by the general board. Furthermore, higher management then has to approve the proposals and aggregate the budgets into a higher-level budget proposal. In the end, the general board has to approve the budgets of each business unit. From the corporate management perspective, the budgeting process includes an evaluation of ICT costs and revenues, as the allowed increase of ICT budgets is based on the budgeted revenues.

The time at which the budget cycle starts is different for each organisation. Some business units start in March, whereas others in August. In all three organisations the budget proposals have to be finished mid September. Then the proposals go from higher management to the board. Gaining final budget approval may take some time but the budgeting processes of the three organisations have to be finished before the year starts.

Other methods to manage costs, revenues or non-financial aspects are not applied by the departments studied. FM1, TM1 and TM2 apply an ITIL-based service level management process to manage the quality of the ICT services. They discuss the required service levels with the customer and record these in a service level agreement (planning). They manage the service quality by keeping an eye on the aspects mentioned in the agreement (control). As not all aspects can be measured, often some are managed implicitly.

4.6   Summary and conclusions

The dimension of the costs of operational ICT is considerable in absolute terms. Compared to the overall costs of the organisations studied, the relative dimension varies significantly per organisation. The structure of the organisations largely determines the operational ICT costs and due to organisational changes, historic data were limited. If such data were available, it was hard to compare them. As a result of this, no overall conclusions can be drawn on the dimension and composition of costs of operational ICT.

From BM perspective most costs of operational ICT are fixed, but from ICT management perspective most costs are variable as they include a direct relation with the number of operational ICT services provided. The proportion between the direct and indirect costs is determined especially by the applied cost allocation strategy.

The BM departments are not responsible for the costs of operational ICT. The cost responsibilities of the ICT management departments can be described as the obligation to keep within the budget. Not all departments are responsible for all costs related to the services provided; sometimes hardware and software costs or personnel costs are excluded. Because the demand for ICT services in the three case organisations exceeds the available capacity of the (financial) resources, ICT departments get caught between two forces. They have to satisfy their customer's demands as much as possible, and to remain within their budget. This forces them to improve their internal efficiency.

The organisations use several measures to reduce operational ICT costs, like:
• reducing the number of changes
• decreasing the required service level
• switching off the application
• improving the utilisation of the ICT capacity available
• concentrating ICT management activities
• improving the quality of the ICT managed
• standardising the ICT environment
• bargaining with suppliers
• improving the efficiency and quality of ICT management activities
• automating ICT management activities

Not all departments studied use all these measures to reduce costs, however. Moreover, the cost reduction activities are not managed or evaluated. As a result of this, empirical data indicating the manageability of the costs of operational ICT are missing. The management of the departments studied claims that between 10% and 20% of these costs can be subjected to cost reduction activities. By far the most costs are determined by the functionality and quality requested and by decisions made during development of new ICT services.

Revenues of operational ICT are not identified and therefore not managed. Non-financial aspects of operational ICT are ranked higher than costs, and the availability is the most important non-financial aspect by far. The BM departments define the required norms for the non-financial aspects in terms of service levels, whereas ICT management is responsible for meeting these demands. Non-financial aspects are difficult to quantify and measure. Furthermore, activities to improve the non-financial aspects are not managed.

The responsibility for realising benefits from the operational ICT lies with the BM departments. The BM departments studied manage the contribution of the operational ICT to business performance implicitly. Although it is difficult to quantify and measure benefits of BM's operational ICT, they have no problem with this. They are satisfied with the implicit way these benefits are managed.

Budgeting is the main supporting tool used to manage financial aspects of operational ICT while service level management is used to manage non-financial aspects of operational ICT. The case studies showed a number of initiatives to develop balanced scorecards (BSC) for ICT departments. Organisation B has a BSC at corporate level only, whereas the ICT department of organisation A is working on the development of an ICT-BSC.

In general, there is a discrepancy in the delegation of tasks to management of operational ICT. All activities at the ICT management departments are carried out on request of BM. So, conform to the supporting role of ICT to business activities, ICT costs are initiated by BM. BM has the competency to determine the required quality. The study did not show how the related responsibilities are controlled, however. The ICT departments are responsible for providing the requested ICT services against the defined quality, and for the overall ICT costs. As the costs of the ICT departments vary with the number of services provided, they are determined by the demands of BM. However, BM does not bear any responsibilities regarding these costs.

As the management of the organisations studied claims that only between 10% and 20% of the costs of operational ICT is manageable, by far the most costs are determined by decisions that are made before implementation. Therefore, cost responsibilities for operational ICT should not start at the moment of implementation, but already during the identification, justification and realisation of new ICT services.

The case studies show that the responsibilities for the alignment of operational ICT are not assigned. BM, who uses ICT to reach its business objectives, is responsible for creating value from operational ICT. In terms of the process model of Soh and Markus discussed in chapter 1, BM is responsible for efficient utilisation of ICT (the *ICT use process*). The case studies show that BM manages the ICT use implicitly. This may indicate that the BM departments studied bear no responsibility for the efficient use of operational ICT. On the other hand, it may also indicate that BM lacks the required understanding of the ICT costs to carry out the necessary cost-benefit analyses for efficiency evaluations.
Together the FM, AM and TM departments provide the ICT assets that BM can utilise to create impact. The ICT departments have insight in the costs incurred to provide the assets but cannot control the efficient utilisation of it. So its means to align the operational ICT is limited to providing as much services to BM as possible within its financial resources. As the ICT departments can bear no responsibility for the alignment of operational ICT, the overall alignment of costs and benefits of operational ICT is not managed, as the related responsibilities are not assigned.

Furthermore, we found that service level management and budgeting are the two management tools applied. Although ICT departments are searching for additional tools, from all available management tools described in chapter 2 only the balanced scorecard is considered. The results of the case studies suggest that it is hard for the management of ICT departments to translate universal management principles and tools into an ICT management environment.

Summarising, we identify as the key problem of the alignment of operational ICT that the responsibilities for aligning it are not assigned integrally. No department or manager is responsible for both costs and benefits. The main cause we identify for this is that the organisations studied have limited knowledge on how to manage the costs and benefits of operational ICT. Furthermore, at present they use management information that only includes information that is required to deal with current responsibilities.

To solve this key problem, we need to design guidelines for assigning responsibilities for the alignment of operational ICT, for managing costs and benefits of operational ICT and for determining the required management information.
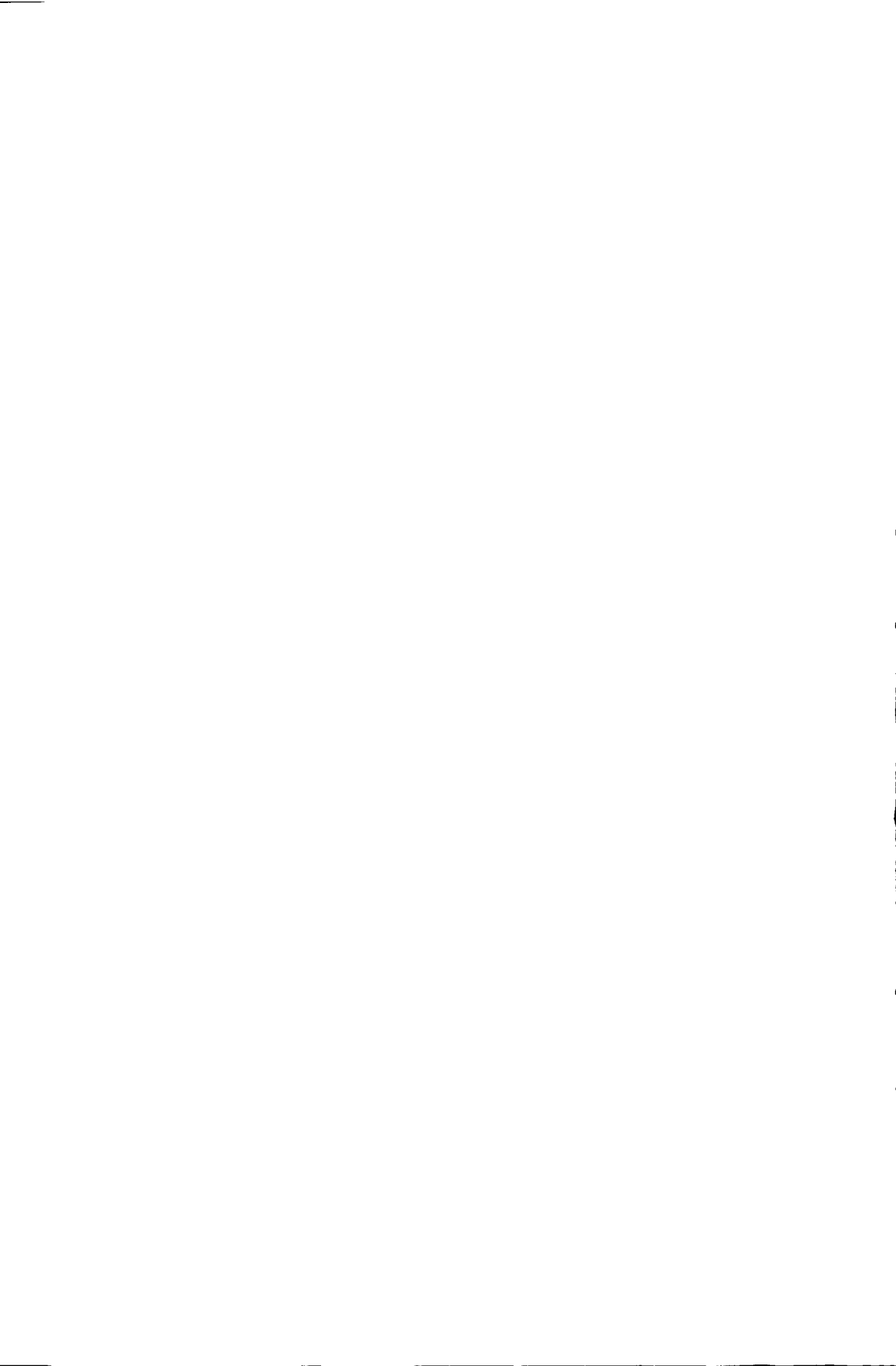
5 A method to align operational ICT

5.1 Introduction

In this chapter, a method is presented for the alignment of operational ICT, i.e. realising the optimal balance between benefits and burdens of operational ICT to support the organisation's business processes optimally. The method is designed to support organisations in aligning their operational ICT and to solve the key problem that the responsibilities for this alignment are not assigned integrally. The design of a new method is justified by the establishment that the currently available methods only concentrate on specific subjects of the management of costs and benefits, like cost price calculation, cost allocation, benefit management or the measurement or management of non-financial aspects. There is no integral approach available providing a general framework of how to align operational ICT (chapter 4). The method designed is based on the literature discussed in chapter 2, the case study results presented and analysed in chapters 3 and 4 and on additional literature discussed in this chapter.

First, the process of designing the method is discussed; the case studies are re-analysed and additional literature is presented. Second, the principles and outline of the method are discussed. Third, the way the method works is discussed in more detail by presenting four steps to implement the principles of the method. After revisiting the usability of the method, we discuss a number of management tools as a means to support the alignment of operational ICT.

5.2 Towards the design of a method

In this paragraph the main problems identified in the case studies are analysed in more detail. Furthermore, additional literature on the allocation of responsibilities is discussed. These findings will provide the basis on which the principles and outline of the method described in the remainder of this chapter are defined.

5.2.1 Findings from the three case studies

The analyses of the case studies as described in chapter four reveal that there is a discrepancy in the responsibilities regarding management of operational ICT. The business unit

management and ultimately the corporate management are responsible for the overall costs and revenues of the organisation. To handle this responsibility, management teams demand management reports that contain mainly financial information providing insight in the overall costs and revenues. In the financial reports, costs are categorised under a number of cost categories, including ICT. The revenues of a financial institution are linked to the organisation's products and services. As ICT is just one of the production means to realise these products and services, revenues of ICT are not measured separately. The business unit management and corporate management have little insight in the relation between costs and revenues of operational ICT. At this management level, the organisations studied manage just the overall costs of ICT and often focus more on expenditures. After all, expenditures can be traced easily as the financial department administers each payment, for example for new hardware of software or for external personnel.

The alignment of ICT to the business processes is delegated to lower management levels. Since they are closer to the actual operations of these business processes, they are assumed to have more insight in the contribution of ICT. The business management departments are responsible for the performance of their activities, in which they can make use of several resources including ICT. The competencies to define the requirements for ICT are delegated to representatives of the end users, being the customers of the ICT department. The three case studies revealed that the representatives can vary from a single department representing all end-user departments to a committee of managers or representatives of the departments involved. It is the responsibility of the representative to improve the requested quality with respect to the business processes supported. As in all three cases the representatives are part of the commercial department utilising the provided ICT, they have the required insight in the contribution of ICT to the business processes and thus in the creation of benefits through ICT.

In all three cases the representatives bear no cost responsibility for operational ICT. Their decisions regarding operational ICT are based on the expected business benefits only and focus on the quality aspect of operational ICT alone. In all three cases the ICT departments have to operate within a budget, limiting the personnel capacity available to realise customer requests. Within the capacity available, business representatives try to realise as much quality improvements as possible.

The ICT departments studied are all managed as a cost centre. Their performance is measured in terms of their costs and their contribution to the business, being the provision of operational ICT supporting the business processes. In terms of the ICT value creation process of Soh and Markus (1995) discussed in chapter 1, this corresponds to the provision of ICT assets. Whether the required ICT impact is realised with the assets available also depends on whether these are used properly and thus on the skills and working method of the end users. As we concluded from the case studies, this is a responsibility of business management as these aspects are beyond the influence of the ICT department.

Summarising, the corporate management and the business unit management delegate tasks for the alignment of operational ICT to the lower management. The customers of the ICT department are responsible for defining the required ICT quality and realising benefits through utilisation of ICT supporting their business processes. The performance of departments utilising ICT is evaluated based on financial indicators like costs and revenues. As in the cases B and C the costs of operational ICT are allocated to these departments, this should indicate that they bear cost responsibility for operational ICT. However, the costs are allocated in such a way that the business management cannot influence them. So, they bear no

cost responsibility for operational ICT. These costs are managed at a higher management level. As organisations currently do not possess the proper management information and insights to influence these costs, they can only control these costs by controlling the budgets of their ICT departments. So, the management of ICT departments is made responsible for these costs. But ICT management is not able to control the utilisation and thus the benefits gained from operational ICT. As a result of this, the alignment of operational ICT is not managed at all, as the responsibilities for both costs and benefits are not assigned to a single management function. We could not provide a solution solely on the basis of the literature discussed in chapter 2, and studied additional literature on the delegation of tasks and responsibilities. The result of that study is discussed in the next paragraph.

5.2.2   Additional literature

In 't Veld (1988) states that as higher management cannot carry out all tasks itself, it delegates tasks to lower management. The process of delegating tasks consists of three steps. First, certain tasks are handed over to lower management. Second, handing over the task can only be fulfilled if lower management also receives the required authorities. By accepting the task and related authorities, lower management accepts the responsibility to carry out the task correctly and to use the competencies correctly. According to In 't Veld (1988) the delegation of tasks consists of three elements that have to be realised in this order:
1. Transfer of task
2. Transfer of authorities
3. Transfer of responsibilities arising from accepting these tasks and authorities

Responsibilities themselves cannot be delegated; higher management will always be responsible for the activities carried out under its supervision (In 't Veld, 1988). To handle this responsibility, higher management requires reporting mechanisms to get informed on the tasks performed by lower management. These can be supplied by responsibility accounting; a system of accounting that describes the concepts and techniques that underlie reporting on the performance of individual managers (Louderback and Hirsch, 1982). Characteristically responsibility centres are identified throughout the organisation and the plans and actions of each centre are reflected by the assignment of the revenues and costs to the centre that has the pertinent responsibility (Horngren, 1984).

Each centre reports only on those figures its performance is evaluated on. Horngren (1984) identifies three types of responsibility centres. Cost centres report only on costs, profit centres report on costs and revenues and investment centres report on costs, revenues and investments. The behaviour of managers is often heavily influenced by how their performance is measured (Horngren, 1984).

Through responsibility management the accountability is directed to the person who has most information and the greatest potential day-to-day influence on the revenue or cost in question (Horngren, 1984). A controllable cost is defined as any cost that is subject to the influence of a given manager of a given responsibility centre (Horngren, 1984).
According to Cooper and Kaplan (1999), responsibility centres become the focal point of cost planning, cost control, and product costing, thus enabling managers to monitor and control the efficiency of responsibility centres. Costs and revenues are assigned to the persons or group of persons having the competency to make decisions and thus are responsible for them (Blox, 1992).

5.2.3   Conclusion

For the alignment of operational ICT, responsibilities have to be assigned properly. To align operational ICT, a single responsibility centre must control both quality and cost. If everyone is accountable, then in real terms, nobody is accountable for anything (Thorp, 1998). So, responsibilities for quality and cost have to be assigned integrally. The case studies showed that the responsibilities for the quality of operational ICT are not linked with the responsibilities for the related costs. As behaviour of managers is determined by how their performance is measured (Horngren, 1984), costs and benefits are not managed if they are not an indicator to assess the performance of a manager or a department. The financial reports as observed in the case studies contain only those costs that are the responsibility of the department concerned. If ICT costs are represented in the financial reports, they are considered to be a performance indicator only if business management can control these costs. As concluded from the case studies, costs of operational ICT are not allocated to the business management in a controllable way. So in the case studies, the costs of operational ICT are not an indicator of the performance of the business management.

To align operational ICT, both benefits and costs have to be controlled by the same responsibility centre. To realise this, the performance of a responsibility centre must be assessed on the basis of both benefits and cost. Cost responsibility has to be assigned to those who can influence the costs. As most costs of operational ICT are fixed, they are determined by the configuration of the ICT considered expressed in terms of *quality*. Cost and quality responsibilities have to be united into a single responsibility centre. It is stated that the principles of responsibility accounting can contribute to solving the problem of assigning responsibilities for the alignment of operational ICT.

For these aspects, the analyses of the case studies in chapter 4 reveal two main problems. First, in all three organisations studied, it appears that the responsibilities regarding the management of operational ICT are not assigned properly. Related to this is an information problem, as the management responsible has no understanding of how to manage the benefits and costs of operational ICT. However, it is unclear whether this is a cause or a result of the non-assignment of responsibilities. To be able to align the operational ICT responsibly, an organisation needs to have the proper management information. So, both problems have to be solved to enable organisations to assign responsibilities for the alignment of operational ICT.

To solve these problems, the method for the alignment of operational ICT described in the subsequent section of this chapter provides:
- guidelines for the assignment of responsibilities for the alignment of operational ICT and for solving the related information problem, and
- guidelines and practical tools to support ICT and business management in the alignment of operational ICT.

5.3   Principles and outline of the method

The design of the method concentrates on the main problems identified in the case studies and is based on both case study experiences and possible solutions obtained from literature. The method is designed to help organisations to solve these main problems by increasing the management's understanding of the alignment of operational ICT.

That is, the management of the organisation:
- knows the costs of operational ICT,
- knows the benefits of operational ICT,
- can relate benefits of operational ICT tot costs, and
- can define actions based on this information to improve the alignment of operational ICT.

The method supports organisations by describing how the main problems identified should be solved and is thus prescriptive. The principles and outline of the method are discussed in this paragraph. To design a method, one must define what a method is and what requirements it must meet first.

5.3.1 Definition of a method

A method is defined as a set of directions and rules that are or should be applied to solve problems in practice (Bemelmans and De Boer, 1989). Based on this definition, two main types of methods can be distinguished, being descriptive and prescriptive methods. Descriptive methods describe the directions and rules that are actually applied in practice to provide the reader with a better understanding of the organisation observed. Prescriptive methods provide a set of directive guidelines that have to be followed ideally to solve the problem observed (Davis and Olson, 1987). This type of method is characterised by the definition of a number of steps that have to be carried out to reach a defined goal. The extent to which one is forced to follow a predefined route and to utilise certain methods or techniques differs per method (Davis and Olson, 1987).

A method is a means that can be applied to solve a problem. The method itself does not solve the problem, whereas application of a method does not necessarily lead to an improved situation. After all, the results are actually realised by the person applying the method according to his or her personal interpretation, which may be different from the opinion of the method's originator. Therefore, one must know the originator's personal experiences and beliefs and his view on the problem and on how to solve it. Therefore, Wijers *et al.* (1989) developed a framework to compare methods for software development. This framework identifies five characteristics to describe and compare methods, being the way of thinking, modelling, working, controlling and supporting. The framework considers the software development process as a problem-solving process. Sol (1988) defined four types of problems. Systological problems focus on the organisational aspect of the problem (Welke, 1977). Infological problems concentrate on the data structures and the required processing, whereas datalogical processes focus on the actual data processing and storage (Langefors and Sundgren, 1975). Finally, technological problems focus on the technical means to be specified (Sol, 1988). As these types of problems can be identified in each problem-solving environment, the framework of Wijers *et al.* (1989) can be applied for other problem-solving methods as well. Therefore, this framework is adopted to describe the method presented in this thesis to solve the problem of aligning operational ICT.

Way of thinking

The way of thinking reflects the ideas of the person(s) who designed the method; their personal beliefs, and their view on the problem and on how to solve it. It should explain to the reader why the problem is important and why the method should help the reader to solve it. In fact, the way of thinking should provide an answer to all assumptions made in the design of the method. Many choices during the design of the method will be based on these assumptions. By defining the assumptions, the designer provides the reader with insight in

why certain choices are made. So, the way of thinking provides an answer to the 'why' question.

The way of thinking defines the assumptions of the method with respect to (Wijers *et al.*, 1989):
- the subject of the method (for example an information system),
- the function it performs with regard to its environment,
- what constitutes its environment, and
- the major characteristics of the component parts of the subject and its environment.

Way of modelling

The way of modelling defines the modelling *concepts* to be used and their *interrelationships* as well as their *external notations* and the *invariant consistency rules*. Wijers *et al.* (1989) identify four categories of modelling languages, being free models, structured models, mathematical models and dynamic models. *Free models* are only restricted in their structure by the model builder's imagination; some examples are verbal or pictorial models. *Structured models* are constrained by the types of concepts used and the priorities valid for these interrelated concepts. They are generally presented in diagrams, tables, matrices or structured text and specifically used for clarification, illustration and definition of overall logical structures. *Mathematical models* are defined by applying languages based on mathematical constructs, and are particularly used for deducing specific system characteristics. Finally *dynamic models*, like simulation models and prototypes, offer experimentation facilities and can be used to analyse the dynamic behaviour of certain system properties.

Way of working

The way of working defines how the desired result, for example the realisation of an information system, has to be achieved (Wijers *et al.*, 1989). The way of working describes the tasks that have to be performed, the decomposition of tasks into subtasks and decisions, the possible order of tasks and decisions and the informal guidelines and suggestions on how to perform tasks and how to make decisions. The way of working of a method is often expressed in a 'step-by-step-plan' that takes the user by the hand and leads him through the process step by step.

Way of controlling

The way of controlling defines how the application of the method can be controlled (Wijers *et al.*, 1989). The management wants to be sure that the desired result is realised in time and within budget. So the way of controlling includes *planning* and *evaluation* of plans. To enable planning and control activities, the process has to be divided into phases with checkpoints and baselines.

Way of supporting

The way of supporting defines how the application of the method can be supported or automated with tools (Wijers *et al.*, 1989). Software development processes can, for example, be supported by computer-aided software engineering (CASE) tools. These tools provide functionality to model the design of the system according to the modelling techniques of the method applied. Other tools that can be defined for software development are report and screen generators and 4th generation software tools.

Conclusion

If one wants to design and describe a method that can be applied by organisations to improve the alignment of operational ICT, simply describing the directions and rules is not enough. The description of a method must at least identify the way of thinking, modelling, working, controlling and supporting. These five aspects will be used to describe the method in more detail in the subsequent paragraphs.

5.3.2 Way of thinking

To solve the problems regarding the alignment of operational ICT, a proper responsibility structure and information model must be implemented. Only when responsibilities are assigned properly and each stakeholder has the proper management information, one can align the costs and benefits of operational ICT. Therefore, the method presented in this chapter identifies two parts. The first part, referred to as responsibility accounting for operational ICT, provides the guidelines for the assignment of responsibilities and for solving the information problem, thus creating the prerequisites for the alignment of operational ICT. Only when this prerequisite is met, the actual alignment of operational ICT can take place. To support the management in this, the second part of the method presents guidelines and practical tools, which are referred to as management tools for the alignment of operational ICT.

The basic point of the first part of the method is that the application of the principles of responsibility accounting as described in the previous paragraph should solve the systological problem. Following these principles, the responsibilities for costs and benefits of ICT means are assigned to responsibility centres integrally. According to Thorp (1998) a business sponsor must be identified with active, continuous ownership of the investment program. Therefore, we claim that the responsibility for the alignment of operational ICT must be assigned to business management or at least as close to the business processes as possible. The responsibility for the alignment of operational ICT must be assigned to the person or department that has the greatest potential day-to-day influence over the revenue and cost of the ICT service. Moreover, ownership must be an active, continuous involvement in management of the service making the owner a stakeholder in the alignment process (Thorp, 1998). This involvement must be treated in a positive way. Too often the accountability structure is applied as a framework for blame (Thorp, 1998). To create the required active attitude towards accountability to prevent this, Thorp (1998) defined eight key conditions:
- Clear mandate and scope
- Sufficient authority and latitude to act
- Requisite competence
- Commensurate resources
- Clear lines of accountability
- Understanding of rights and obligations
- Relevant performance measures
- Acceptance for accountability

To bear the responsibilities assigned, one must have the proper management information at one's disposal. To solve the infological problem, one must measure the things that count in the management process (Thorp, 1998). These are the costs, benefits and impact of the ICT, and the business management should possess sufficient information on these for each ICT service. The cost information is supplied by the costs of the ICT service; the information on its benefits by its quality, and the ICT impact by the quality of the ICT service, its proper

utilisation and thus the skills and attitude of the employees. This information should provide business management with enough information on each ICT service to evaluate its costs and benefits and to determine its impact.

The second part of the method is based on the principle that the ICT service should be the primary steering variable for the alignment of operational ICT. That is, the planning and control of (ICT) costs should start with the ICT services provided by one department to another department. After all, the case studies showed that the costs of operational ICT vary with the number of ICT services provided to business management, whereas the costs of each ICT service are mostly fixed. Planning of costs, revenues and non-financial aspects should start from the services the department receives and the services that the department itself provides to other departments.

Summarising, the way of thinking on which the method is based, is characterised by:
- A proper responsibility structure and information model are prerequisites for the alignment of operational ICT.
- Responsibilities are assigned according to the principles of responsibility accounting.
- Responsibilities must be assigned as close to the business processes as possible.
- Quality and costs of operational ICT must be managed integrally.
- The costs and quality of an ICT service provide the management information needed.
- The ICT service is the primary steering variable for the alignment of operational ICT.

5.3.3   Way of modelling

As the alignment problem is classified as both a systological and an infological problem, both aspects have to be modelled. For this, an *organisation model* and an *information model* are defined (see figure 5.1).

The Organisation Model describes how responsibilities for ICT services are or should be assigned within the organisation. The ICT services provided by the ICT departments are identified. As several departments play a role in delivering an ICT service to business management, services can be divided into sub-services. The relations between these various services are modelled in the *service provision model*. The *responsibility centre model* defines the responsibility centres identified and their interrelationships. Both models have to be linked to determine which responsibility centre is responsible for which ICT services.
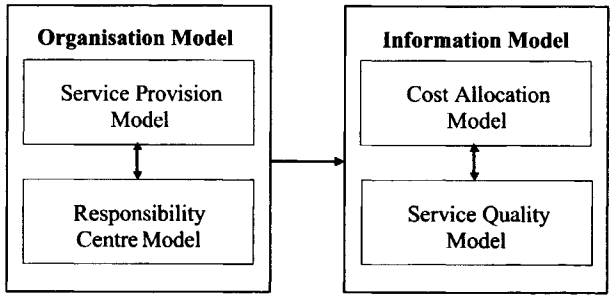
Figure 5.1 Way of modelling of the alignment method for operational ICT

The Information Model describes the management information system. The *cost allocation model* describes how the costs of an ICT service have to be determined and allocated. The *service reporting model* defines the quality aspects relevant to each of the ICT services and how to measure, collect and represent the information on these aspects. These two models have to be linked too, as the alignment of operational ICT requires linking of financial and non-financial data.

The Information Model has to be derived from the Organisation Model, as the responsibility structure determines what management information is required for accounting purposes.

Summarising, the way of modelling is characterised by two models that can each be subdivided into two sub-models:
- The Organisation Model
  - The Service Provision Model
  - The Responsibility Centre Model
- The Information Model
  - The Cost Allocation Model
  - The Service Quality Model

5.3.4   Way of working

The way of working is characterised by a once-only and a continuous component. The once-only component, represented by the responsibility accounting part of the method, provides a number of steps to realise the proper responsibility structure and information model. Only when this is realised, the cost and benefits of the operational ICT can actually be assigned. This is a continuous management activity of planning and controlling for which several already existing methods and techniques can be applied. Therefore, the management tools part of the method does not provide a number of steps, but a set of existing planning and control techniques that should be applied for the alignment of operational ICT.

The way of working of the responsibility accounting for the operational ICT part of the method is characterised by four steps. In the first step, the ICT services provided by the ICT departments have to be identified. In the second step, the responsibility centres utilising these services have to be identified and in the third step, the responsibility for the alignment of an ICT service has to be assigned to a single responsibility centre. In the fourth step, the required management information on quality and costs must be determined for the alignment of operational ICT. These steps are described in more detail in paragraph 5.4.

The way of working of the management tools part of the method is characterised by the claim that the alignment of costs and benefits of operational ICT should be a continuous management activity. Therefore, the alignment of operational ICT should be part of the regular planning and control cycle of each organisation. The steps that have to be taken in this cycle are not part of this study. But to support organisations, this part of the method presents a number of existing management tools that should be applied for the alignment of operational ICT. This set of tools is described in more detail in paragraph 5.5.

Summarising, the way of working of the method identifies two different activities. The first is a once-only activity to realise the proper responsibility structure and information model by following a four-step approach. The second activity is a continuous activity of planning and controlling the alignment of operational ICT. As this should be part of the regular

management processes of the organisation, no specific steps are identified and just a set of management tools is discussed to be used for the alignment of operational ICT.

5.3.5 Way of controlling

It is assumed that one can control the realisation of the proper allocation of responsibilities and that the related management information system can be controlled by using common project management devices for the implementation of the first part of the method. After the implementation, the alignment of operational ICT is a continuous management process of planning and control and so the second, continuous part of the method should be controlled though general management control principles. Therefore, no further attention is paid to the control aspects of the method at this moment.

5.3.6 Way of supporting

No specific tools to support the application of the method are designed here. For the implementation of the responsibility accounting principles and the management information system, one can apply the existing methods and techniques for information system development and project management. For the alignment of operational ICT after this implementation, several existing management tools are available for planning and controlling financial and non-financial aspects at various organisational levels. A selection of these tools is discussed in paragraph 5.6.

5.4   Responsibility accounting for operational ICT

This paragraph describes in more detail the steps to apply responsibility accounting for operational ICT, as defined by the way of working in the previous paragraph. In the first step, the operational ICT services as primary steering variables provided or consumed by departments within the organisation are identified. In the second step, the centres responsible for these services are identified in the organisation. Then, in the third step, the responsibilities for the operational ICT services are assigned to one of the responsibility centres. The fourth step entails the definition of the management information required for aligning the costs and benefits of the operational ICT service identified.

5.4.1   Step 1: Definition of ICT services

In step 1, the ICT services provided or purchased by the departments of the organisation have to be defined. The result of this step is a list of ICT services for which costs and benefits have to be determined so that both the supplying and consuming department can plan and control them. The identified ICT Services have to be classified into customer services, underpinning services and internal services and modelled according to the Service Provision model defined in the way of modelling.

An ICT service is defined as a logical entity of products of the ICT department as perceived by the customer (Van Bon, 1999). The case study observations indicated that organisations experience a service to consist not only of a product but also of the processes to enable and support utilisation of the product. The product, being the configuration of ICT components is created in a system development project on request of business management. After implementation, ICT management enable business management to utilise the ICT product through maintenance and support processes. In this thesis an ICT service is defined as a logical entity of *products* and *processes* of the ICT department as perceived by the customer.

An example of an ICT service to illustrate this definition is the provision by a technical management (TM) department of a Tandem system to run payment applications that are managed by a functional management (FM) department. The set of products of this service consists of all hardware and software components being part of the Tandem system. The set of processes represents all activities performed by the staff of the TM department to enable the FM department to utilise the system to run the applications. This set of activities includes for example technical support and operational control tasks or ICT management processes like incident and change management. Another example of an ICT service is the utilisation of an application supplying the dealers at the dealing room with actual information on quotations of, for example, shares, bonds and currencies.

An ICT service is characterised by its *quality* and *cost*. Quality is defined as the set of properties and characteristics of a product or service that is of interest to meet explicit and implicit requirements (ISO-8402, 1986). Conform the extended ISO model, the quality of an ICT service can be expressed in terms of its functionality, reliability, usability, efficiency[14], maintainability and portability. The costs of the ICT service mark the financial sacrifices the ICT department makes to provide the ICT service.

All resources like hardware, software and personnel have to be attributed to one of the ICT service defined. As resources can be deployed for several services, some resources cannot be attributed directly to a single ICT service provided to customers. To solve this problem, three different types of services are defined, being:
- Customer services
- Underpinning services
- Internal services

Customer services are those ICT services that are provided directly to customers of the ICT management department concerned. Examples of customer services are the provision to FM of an operational mainframe environment by TM or FM, enabling BM to use an application.
Underpinning services are ICT services that are necessary to provide other services. This type of service is often not explicitly visible as a separate service to the customer. Examples of underpinning services are for example the network facilities managed by the FM department of organisation A. These facilities are not provided as a separate service, but enable the provision of customer services. In general, all hardware or software shared by several applications can be identified as underpinning services. If another supplier provides the underpinning services, this can influence the service levels provided to the customer, as the ICT department has limited control over the third party besides the contracts it enters into.
Internal services are ICT services supporting the ICT department to perform its own processes and activities. These services are often not visible to the customer, but are indispensable for the ICT department to perform its job effectively and efficiently. Examples of internal services are helpdesk tools or tools to monitor and manage networks and systems.

5.4.2 Step 2: Identification of responsibility centres

In step 2 all departments utilising ICT services provided by other departments have to be identified, as they are all potential responsibility centres. The result of this step is a list of departments and the ICT services they utilise, represented in the Responsibility Centre model

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[14] Conform the definition of the ISO quality requirements as discussed in chapter 2, the efficiency is expressed in terms of time behaviour and resource utilisation. This is different from the definition of efficiency applied in most economic literature, in which the efficiency is defined as the relation between activities and costs.

defined in the way of modelling. The management of each department in this model bears responsibility for the costs and benefits of the ICT services utilised.

A responsibility centre is represented by a management function accountable for a given task. As stated by In 't Veld (1988), responsibilities arise from the acceptance of competencies that are necessary to perform the tasks delegated. With respect to management of operational ICT, tasks are delegated to the departments involved in activities for ICT management. The management of each of these departments is responsible for the performance of the delegated tasks and can be identified as the responsibility centre.

To provide a generic description of the method, we use the ICT management framework of Looijen as applied to describe the case studies (see chapter 3). So the responsibility centres identified in this description of the method cover the ICT management functions identified in the case studies, being:
- Business Management (BM);
- Functional Management (FM);
- Application Management (AM);
- Technical Management (TM);

Each of these management functions provides services to one or more other management functions and is the responsibility centre for the services it provides (see figure 5.2). A TM department for example, provides ICT services to the AM and FM departments and operates as a supplier of the services. The customers utilising these ICT services, the AM and FM departments, are assigned as responsibility centres as they have a direct influence on the benefits of these services as they deploy these services to provide or produce their own ICT services. These departments also have a direct influence on the costs of these ICT services as they define the quality requirements. Both the AM and FM departments are suppliers too, as they provide ICT services to the FM and BM departments, respectively.
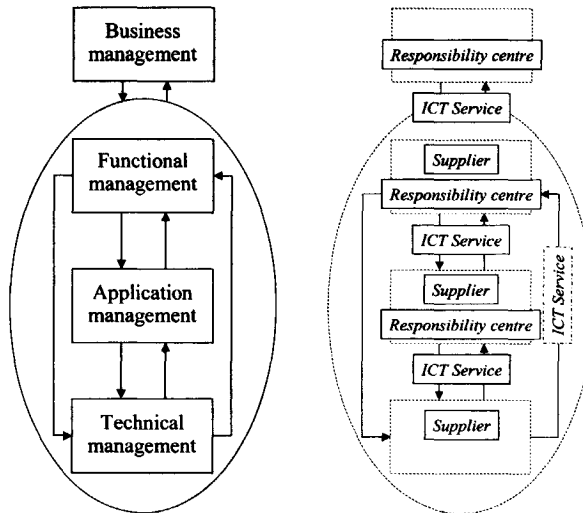
Figure 5.2 Responsibility centres for operational ICT

Eventually, the BM departments act as responsibility centres for ICT services provided to them by the ICT departments. After all, the BM departments have the most the information and the greatest potential day-to-day influence on the ICT benefits as they utilise these services to support their business processes. Likewise, the BM departments have the most influence on the costs of these ICT services as they define the quality requirements for each ICT service. Depending on the size and structure of the organisation, the number of departments involved and thus the number of responsibility centres can change.

The case studies indicate that business units and corporate management can be identified as stakeholders too, as they approve all budgets, including ICT budgets, and bear overall responsibility for costs and revenues. However, due to their high-level view they have too little insight in the relation between the benefits and cost of ICT to manage the alignment of operational ICT. As this task is delegated to lower management, they are not identified as responsibility centre in the alignment of operational ICT. This does not mean that the business unit and corporate management bear no responsibility. After all, responsibilities themselves cannot be delegated (In 't Veld, 1988).

5.4.3   Step 3: Assigning ICT services to responsibility centres

In step 3, for each ICT service identified (step 1) a single owner is selected from the list of responsibility centres (step 2), so that a single manager is primarily responsible for the costs and benefits. The results of this step are represented in the Organisation model defined in the way of modelling, linking the Service Provision model and the Responsibility Centre model.

Through responsibility management the accountability is directed to the person who has most information and the greatest potential day-to-day influence on the revenue or cost in question (Horngren, 1984). So the responsibility for an ICT service is preferably assigned to the department that is expected to have the most information and the greatest potential day-to-day influence on the costs and benefits of that service. It is stated that the responsibility for an ICT service should be assigned to the management function requesting that service. That management function is expected to have the most knowledge on the relation between the ICT service and the business processes it supports and thus on the possible ICT impact and its contribution to business performance. The responsibility for a single ICT service cannot be assigned to more than one responsibility centre. If several departments are accountable, then, in real terms, nobody is accountable (Thorp, 1998).
Furthermore, as the costs of an ICT service are mainly fixed, the costs of that service are determined by the quality requirements to be met. So, the department requesting the ICT service has the most influence on the dimension of these fixed costs.

Each ICT service is assigned to a single responsibility centre called the *owner*. The owner is responsible for defining the desired quality of the ICT service. At the same time, the owner bears the responsibility for the costs arising from this request and for the proper utilisation of the provided service.

To identify what responsibility centre should be owner of a certain ICT service, one can ask on whose request or for whose benefit the ICT service is provided. For internal services, this can be answered easily as the service is provided for the benefit of the ICT management department itself. Underpinning services are a responsibility of the department providing the customer services enabled by these services. The responsibility for customer services utilised by a single customer can be assigned to that particular responsibility centre. It may be difficult

to assign the responsibility of an ICT service to a single owner when several customers make use of the same service.

Considering the shared utilisation of a single ICT service by several potential responsibility centres, there are three alternatives to solve this problem:
a. Ownership is assigned to a central, co-ordinating department;
b. Ownership is assigned to the largest customer;
c. Ownership is assigned to the ICT department providing the service.

The first option can be selected if all customers are part of the same department or business unit. For example in case A we observed that one of the AS/400 systems provided by the TM department is owned by a single FM department whereas it is deployed for several applications managed by separate FM departments. Another example is taken from case B, where the AM department is responsible for the AS/400 systems shared by applications that are managed by several FM departments. The second option is to assign ownership to the largest customer, representing all other customers. The FM department of organisation A, for example, has signed a single service level agreement for each ICT service with a single BM department. This owner represents all other departments utilising this service. The last option is to assign ownership to the ICT department providing the service. An example of this option is found in case B where the FM department manages a number of ICT services that are used by several BM departments.

If ownership of shared services is assigned to a single responsibility centre representing all customers, it is necessary to form a consultative body that can discuss the needs of the individual customers and decide what changes should be made to the ICT service. For the TM department of organisation A the extra costs arising from this consultation and tuning was reason to decide that each Tandem system should be provided to a single customer. The TM department believes that the less efficient use of the hardware will costs less than the additional communication, negotiation and decision making.
To determine what responsibility centre can be assigned ownership of an ICT service, one must determine who has the greatest potential day-to-day influence on the costs and benefits. Who decides on the quality requirements defined for the ICT service and who can influence the business processes to change the utilisation of the service? We claim that by answering these questions one can identify the proper responsibility centre.

5.4.4 Step 4: Defining management information

In step 4 the required management information is defined to support the management of the organisation in the alignment of the operational ICT services. Responsibility centres are assumed to have most information and most day-to-day influence on the ICT service. As another ICT management department provides the ICT service, the reporting facilities must report back to the responsibility centre on the performance of the service and give insight in possible improvements. This management information has both a financial and a non-financial component. The financial information concerns the costs of the ICT service and the way these costs are allocated to the consuming departments. The non-financial component is represented by the quality of the ICT service concerned. The most important quality aspects have to be defined and management information on these aspects must be measured and reported.
The results of this activity are presented in a Cost Allocation model and a Service Quality model.

Service costing

The costs of an ICT service are defined as all financial sacrifices an organisation makes to provide the service. The ICT cost models discussed in chapter 2 and the case studies described in chapter 3 illustrate that ICT costs can be categorised in many different ways. The cost classification defined for the conceptual model is based on both literature and case studies, and consists of the categories *hardware, software, personnel,* and *other costs.*

The hardware costs cover all costs arising from the hardware deployed for a service. Hardware costs comprise depreciation costs for purchases made in the past and costs arising from contracts with suppliers for renting, leasing, maintaining and supporting hardware provided by the supplier. Costs of software can be classified similarly in depreciation costs and costs arising from contracts for maintenance, support and licences. The costs of personnel are split in costs for internal and external personnel and cover all personnel-related costs like salaries, fees and training. The other costs include all other costs of the organisational unit considered, like costs for accommodation, office equipment and all allocated costs.

To determine the costs of an ICT service, one should first allocate costs directly where possible. If resources can be attributed directly to a single service, the associated costs can be allocated directly too. If the identified customer services, underpinning services and internal services are defined correctly as described above, all hardware and software are deployed specifically for a single ICT service. So, the costs arising from these resources can be allocated directly too. Personnel costs and other costs cannot be attributed to a single ICT service, as generally several services are supported and time is spent on *"non-productive"* activities like meetings and training. As all these costs do arise from the provision of ICT services, they need to be allocated to these services. After all, if no services have to be provided, no personnel is required and no accommodation and office equipment. The main cost driver of these costs is claimed to be the time required for providing a certain ICT service. If more time is required, more personnel is needed and so more accommodation. So, all personnel and other costs are accumulated and a tariff per hour is calculated based on the total number of *productive* hours. Costs can then be allocated based on the number of hours actually spent on a particular service or on the budgeted capacity available. For the ICT department the personnel costs and other costs are fixed for the budgeted period. As discussed in paragraph 2.4.4 it is better to allocate fixed costs based on the budgeted capacity available. After all, the personnel capacity of a department is based on the (budgeted) expected workload. If less hours are consumed, the tariff per hour will increase as the fixed costs remain the same. In this way, the costs allocated to a service are made dependent of the consumption of other services.

When the service costs are calculated for all services, the costs of internal services and underpinning services are allocated to the customer services requiring these services. As the case studies showed that far most costs of an ICT service are fixed, allocation based on the principle of budgeted capacity available is preferred. That is, the allocation keys to distribute the costs of internal and underpinning services are based on the capacity budgeted for the supported customer services. The costs of a shared platform can, for example, be allocated based on the budgeted capacity that will be consumed by a service.

Allocation based on the actual use will not only hinder the budgeting of the service costs, as it becomes dependent on the consumption of other services. It will also lead to higher costs for measuring and processing the required data. On the other hand, by more frequent measurement one can control the correctness of the estimations and increase the precision. The definition of allocation keys will therefor entail a cost/benefit evaluation of the benefits of more detailed allocations against the extra cost for measurement.

As only direct costs have a direct relation with the services provided, the allocation of indirect costs is always arbitrary. Furthermore, direct costs can be managed directly, whereas indirect costs cannot. The allocation strategy does not affect the manageability of these costs, as indirect costs will not become direct by a more complex and detailed allocation. Therefore, we claim that indirect allocations must be kept simple as they are allocated for cost accounting purposes, not for cost control. The owner of the internal service or the underpinning service is responsible for the service costs.

Service quality

The quality of an ICT service is defined as the set of properties and characteristics of a product or service that is of interest to meet explicit and implicit requirements (ISO-8402, 1986). Van den Brink (1998) found that for information systems within a banking environment, the quality attributes continuity, integrity and maintainability are considered most important. With respect to the information provided by these information systems, the quality attributes correctness, availability, timeliness, and completeness are marked as most important. The results of the case studies as discussed in chapter 4 are in line with these findings. In chapter 4 it is concluded that for the operational ICT, the attributes availability, performance and output quality are applied most. For the information provided and processed by the operational ICT, the quality attributes completeness and correctness are applied most as well.

The case study results confirm that the functionality of the ICT service is an important quality attribute. In many publications it is recorded as a separate item next to quality. The functionality of an ICT service is defined as the capability to provide functions which meet stated and implied needs when used under specific conditions (Van Zeist *et al.*, 1996). The functions provided include for example the processing activities performed or the information supplied. The functionality of an ICT service enables the customer to perform his activities and to achieve his objectives. The Extended ISO model presented in chapter 2 identifies six attributes of functionality, being suitability, accuracy, interoperability, security, traceability and compliance. The customer, formulating the functional specifications, must assess these specifications on each of these attributes with respect to its objectives and processes. According to the extended ISO model, functionality is an attribute of product quality. Therefore, it is not identified as a separate item in this thesis.

According to Van den Brink (1998), quality requirements can be defined from the perspective of both the customer and the supplier. Considering the definition of a generic set of quality attributes for ICT services we claim that this set has to be defined from customer perspective. Based on the literature on product quality discussed in chapter 2, the quality of ICT services is expressed in the quality attributes *functionality, availability, performance, output quality, completeness, correctness* and *timeliness*. These quality requirements have to be identified for each ICT service. The customer must describe each of the quality requirements qualitatively and quantitatively to express his demands to the supplier. Based on these requirements, the supplier must be able to provide the requested ICT service.

When the principles of responsibility accounting are applied following the method presented in this chapter, the costs and benefits of operational ICT can actually be managed. To support these alignment activities, one can adopt several means from literature. These tools are discussed in the next paragraph.

5.5 Management tools for aligning operational ICT

Paragraph 5.4 described how responsibilities have to be assigned and what information is necessary to align costs and benefits of operational ICT. For the responsibility centres identified, the alignment of operational ICT may still be a complex activity in practice. To support organisations in this, we present four management tools in this paragraph. We claim that the ICT service should be the focal point of planning and control, the service level management process is presented first to formalise and manage the quality requirements for each ICT service. Second, budgeting should be applied to plan both financial and non-financial aspects of ICT services and departments. Third, the ICT balanced scorecard provides a tool that the management of the responsibility centres can use to identify and manage their financial and non-financial key performance indicators. Finally, the Goal/Question/Metric method is presented to responsibility centres to manage internal improvement projects.

5.5.1 Service level agreement

A service level agreement (SLA) is a formalisation of service levels in a written document or contract agreed between the customer and the supplier (CCTA, 1995). According to CCTA (1995), SLAs will typically cover the *service hours, service availability, user support levels, responsiveness, restrictions, functionality,* and *contingency,* whereas it may also include the *security* and *accounting policy.* Besides legal aspects like the identification of parties and the duration of the agreement, the SLA includes a number of organisational aspects, like contact persons, phone numbers and opening hours of for example the help desk. Furthermore, the ICT service that is subject of the agreement is described based on its functionality, quality and cost. As stated in paragraph 5.4.4, the quality of the ICT service is expressed in the quality attributes functionality, availability, performance, output quality, completeness, correctness and timeliness. The level of user support in terms of response times on incident calls and change requests is an important aspect of the service level as well (CCTA, 1995).

The principles of service level agreements, which formalise agreed-upon service levels between supplier and customer, are simple. However, in practice a complex network structure can occur when different ICT activities are provided by different suppliers that in their turn make use of suppliers as well. The customer can then lose sight of all contracts and their mutual dependencies. To solve this, one should adopt the principle of *end-to-end service provision.* End-to-end service provision is defined as providing all aspects of the service chain from a single point (Mersel and Alofs, 2000; Bellini *et al.,* 2002). So, the supplier takes care of all activities required to provide the requested service, whether or not he performs these activities himself. By applying the concept of the end-to-end service provision, the complex network structure of SLAs can be transformed into a simple service provision chain (see figure 5.3).

The activities of managing the service level agreements and of ensuring that the agreed service levels are met, are defined as service level management (Looijen, 1998). Service level management (SLM) is the process of negotiating, defining, contracting, monitoring and reviewing the service levels (CCTA, 1995). SLM also includes periodic meetings between customer and supplier to discuss realised service levels and demands for changes or new services. It can contribute to the alignment of operational ICT, as it requires interaction between customer and supplier on the costs and quality of an ICT service and a formalisation and quantification of the agreed cost and quality in SLAs.
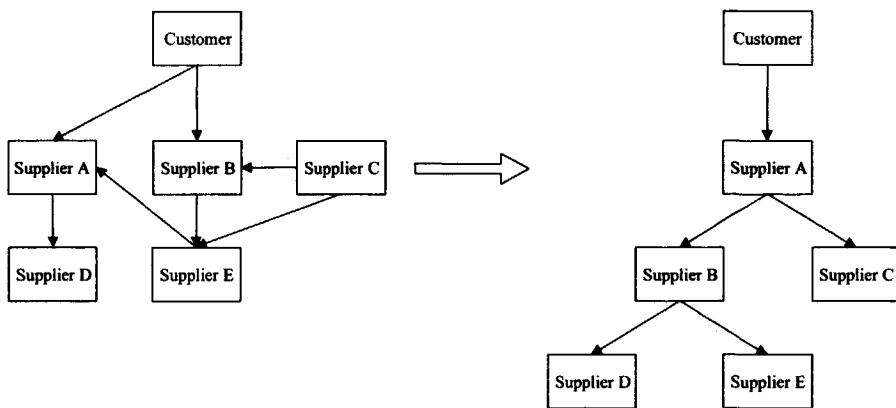
Figure 5.3 Networks of service level agreements

5.5.2 Budgeting

The ICT service is the key element in the budgeting process. Based on business plans and expectations, the impact on the required quality of the ICT service is determined. The costs of the ICT service are budgeted in two steps. First, the costs of providing the ICT service according to its current specifications are budgeted. These costs include depreciation costs of hardware and software, recurring costs for licenses and for maintenance and support contracts and the staff hours necessary to deliver the service. Most of these costs, like depreciation costs and expenses for external parties, can be estimated exactly as they are mostly fixed. The required staff hours is more difficult to estimate as this depends on many factors, like the quality of the application and the utilisation. Muniafu (2001) developed a model to estimate the human capacity required for ICT service management. His research showed that such a model could be built and provides useful data. But it also showed that the estimations from the model differ significantly from those of responsible management, although the model was based mainly on the experiences of the management (Muniafu, 2001). A positive effect of these findings is that the management now reconsiders its way of planning and budgeting.

Second, the additional costs are budgeted based on the expected substitutions of existing hardware and software and on the expectations of the customer for additional capacity, new functionality or higher quality. These costs include depreciation costs of new hardware and software, additional costs for licenses and for maintenance and support, and the staff hours required to realise the expected changes.

If the costs for each service are budgeted, each ICT management department can determine the number of staff required for providing the requested services. Based on this, each department can budget its other costs, like for example the number of staff for management and the secretariat and the personnel-related costs like training, office equipment and accommodation.

If costs are not allocated directly, but based on a predefined amount or a price per unit, the 'revenues' from cost allocation are budgeted too. Tariffs are calculated based on the budgeted costs of staff, underpinning services and internal services, and the expected number of sales or budgeted capacity available. The owners to whom these costs are passed on have to be informed, so they can incorporate these costs into their own budgets. Costs and revenues are

controlled for both ICT departments and ICT services by periodically evaluating actual figures with budgets.

5.5.3 Balanced Scorecard

Kaplan and Norton (1996) developed the Balanced Scorecard (BSC) to provide managers with tools to measure and manage the drivers of future performance. A BSC can be designed at each organisational level and for each organisational unit. Several ICT organisations use BSCs to support management. Van Grembergen and Van Bruggen (1997) observed that in practice these IT BSCs are operational instead of strategic management systems, as long-term targets are missing. Furthermore, they contain insufficient cause-and-effect relationships and insufficient performance drivers.

As they also detected a need for generic IT BSC, Van Grembergen and Van Bruggen (1997) developed the BSC for IT management presented in figure 5.4. Based on measures extracted from traditional IT management literature they translated the four perspectives for IT management purposes: *Corporate Contribution, User Orientation, Operational Excellence* and *Future Orientation*.

The definition of the four perspectives is based on Kaplan and Norton (1996):
- Corporate Contribution: How does management, being the main shareholder, view the ICT department?
- User Orientation: How do the customers (and users) view the ICT department?

User Orientation How do the users view the IT department?	Corporate Contribution How does management view the IT department?
Mission: To be the preferred supplier of information systems and to exploit business opportunities maximally through IT. *Objectives:* – Preferred supplier of applications – Preferred supplier of operations – Partnership with the users – User-satisfaction	*Mission:* To obtain a reasonable business contribution of investments in IT *Objectives:* – Control of IT expenses – Sell IT products and services to third parties – Business value of new IT projects – Business value of the IT function
Operational Excellence How effective and efficient are the IT processes?	**Future orientation** Is the IT department positioned to meet future challenges?
Mission: Efficiently deliver IT products and services *Objectives:* – Efficient software development – Efficient operations – Acquisition of PC's and PC-software – Problem management – Training users – Management of IT personnel – Use of communication software	*Mission:* Develop opportunities to answer future challenges *Objectives:* – Permanent training and education of IT personnel – Expertise of IT personnel – Age of application portfolio – Research into emerging information technologies

Figure 5.4 The IT Balanced Scorecard (Van Grembergen and Van Bruggen, 1997)

- Operational Excellence: How can the internal operations be improved to improve the service to the customers?
- Future Orientation: What should the ICT department do to remain successful in the future?

For each perspective, measures are identified categorised by the related objectives. The missions defined in figure 5.4 for each perspective indicate that Van Grembergen and Van Bruggen applied a different mission for the IT department. After all, at the beginning of this paragraph it was concluded that it is the responsibility of the ICT management department to provide ICT services to the business management. Whether these services contribute to the business or not depends on the quality of the *IT use process* and the *Competitive process*. This is a responsibility of business management. This is the main difference between the IT BSC of Van Grembergen and Van Bruggen and the balanced scorecard for ICT management departments presented here.

For each perspective, we propose a number of general performance indicators supporting the ICT department in monitoring the overall performance:

Financial perspective:	– Budget performance on costs – Budget performance on revenues / allocated costs – Budget performance on profitability
Customer perspective:	– Customer / user satisfaction – Percentage of service levels met
Internal process perspective:	– Satisfaction of staff – Number of incidents solved – Mean solving time of incidents – Number of changes realised – Mean time to implement changes
Learning & growth perspective:	– Percentage of budget spent on research and emerging technologies – Percentage of hours spent on training and education of staff

Extra indicators can be added to each perspective based on the specific goals formulated by the ICT department concerned. For example, if the ICT department also wants to sell services to external customers, the revenues from external customers can be added as indicator in the financial perspective. Possible indicators to improve the controllability of the ICT costs may be the proportion of fixed and variable costs, of indirect and direct costs or of internal and external personnel.

If the business management is not forced to buy the ICT service from the ICT department, the indicator *market share* can be added to monitor the realisation of the goal "being preferred supplier". Customer satisfaction can for example be influenced by more frequent contact or by better training of users. In that case, indicators can be added to the customer perspective like the frequency of customer meetings for service level management or steering committees, or the number of hours of training per user.

Likewise, improvement objectives for internal processes can be monitored by extending that perspective with indicators providing insight in, for example, the efficiency of the department expressed in the percentage of hours spent on productive activities. Another example is the

aim of the FM department of organisation A to work more proactively instead of reactively. Examples of indicators to measure this can be the percentage of hours spent on proactive management activities or the proportion of time spent on projects or going-concern activities. If the transfer of new services from development to operational stage has to be improved, the number of hours of ICT management staff participating in development projects can be a driver to be measured. The effects may result in fewer incidents after the implementation of a new service.

Finally, the achievement of goals formulated for the learning and growth perspective can for example be monitored by indicators like the number of hours of training of staff, the seniority of the staff, the average age of applications or operational ICT. If the activities concern a specific new technology, the goals and indicators can be defined more specifically.

As can be concluded from this discussion, a lot of indicators can be defined for each perspective. Luime (1996) and Weijers (1998) demonstrate that even more performance indicators for ICT management processes can be identified. However, it is recommended to define a limited number of indicators per perspective (Van Grembergen and Van Bruggen; 1997; Kaplan and Norton, 1996). More indicators will require more measurement resulting in more data to process and represent, leading to higher cost. The design of the BSC must include a trade-off between the cost of measurement and data processing and a limited set of indicators providing steering information. As the BSC is a strategic management tool, only goals requiring a long-term investment to be realised should be added. For short-term improvements a more temporary approach to measuring and managing the realisation of improvements must be adopted. For this purpose, we claim that the Goal/Question/Metric method provides a useful tool.

5.5.4   Goal/Question/Metric Method

The application of the GQM paradigm consists of the four phases illustrated in figure 5.5 (Van Solingen and Berghout, 1999). In the *Planning phase*, the improvement project is defined, characterised, and planned, resulting in a project plan. The measurement program required to monitor the realisation of the intended improvement is defined and documented in the *Definition phase*, including the definition of goals, questions and metrics. During the *Data collection phase*, the required data is actually collected through measurement. Finally, the collected data is processed in the *Interpretation phase*, by transforming the collected data into
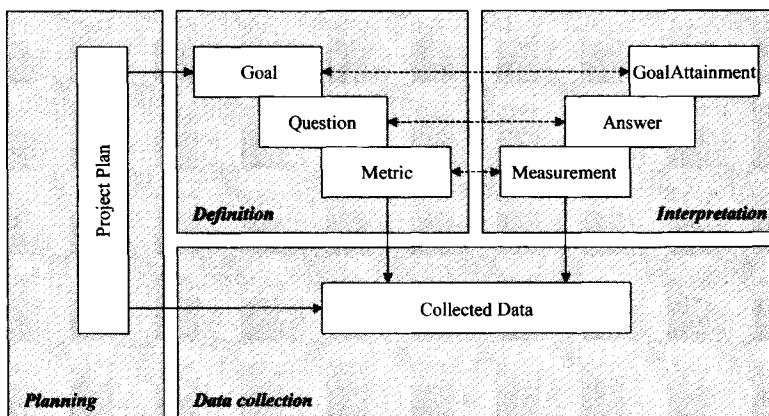
Figure 5.5 The four phases of the GQM method (Van Solingen and Berghout, 1999)

measurement results, providing *answers* to the defined questions enabling the evaluation of the *goal attainment*.

We claim that the GQM method can be applied to realise improvements in the alignment of operational ICT. These improvements should concentrate on improving the balance between quality and costs of an ICT service. Higher quality or lower costs require an initial investment. Higher quality may also lead to higher recurring costs, whereas lower costs may require lower quality requirements. So, decisions on these improvements must be based on a cost/benefit analysis.

5.6   Revisiting the method

The method presented in the previous paragraphs is designed to support organisations in solving the problem of aligning costs and benefits of operational ICT by making sure that the management of the organisation:
- knows the costs of operational ICT,
- knows the benefits of operational ICT,
- can relate benefits of operational ICT tot costs, and
- can define actions based on this information to improve the alignment of operational ICT.

Four steps are presented in the way of working to realise these improvements. First, the ICT services to be aligned are identified. Second, the departments (called owners) that have to align these ICT services are to be identified. Third, the responsibilities for each ICT service are assigned to owners. And fourth, the financial and non-financial management information for the alignment of the operational ICT is defined.

However, a method itself does not solve a problem and the application of a method does not necessarily lead to a solved problem. To solve an organisation's problems, the method has to be applied in practice. In other words, the organisation must identify ICT services and responsibility centres as described in the previous paragraph, and the responsibilities for ICT services have to be assigned to responsibility centres. But above all, the assigned responsibilities must be effectuated in practice. Assigning responsibilities to managers or department is not enough. Management must feel responsible itself and base its actions and decisions on these responsibilities. In other words, the responsibility and accounting structure must be integrated in the organisation's accounting system so that the responsibilities of the management as owner of the ICT service are included in their performance evaluation. The observations from the case studies show that the performance of most managers is evaluated based on the profit-and-loss accounts (P&L) of their departments. So, if the management is to be made responsible for costs of operational ICT, these costs must at least appear in their P&L. However, this might make the management concerned to resist their new responsibilities. After all, the responsibility accounting structure is new for these managers as well and they have to learn to deal with these new principles and responsibilities. This demands extensive information from all the managers concerned and assistance during the introduction and implementation of the method. Moreover, the impact of the method is not expected to be visible directly after implementation but will slowly emerge in the learning period after implementation. To retain this impact, the principles of the method must be pointed out to the responsible management continuously and the responsibility structure has to be supervised.

Revisiting the method presented in this chapter gives rise to the question whether application of the method actually solves the alignment problems identified in practice. Moreover, considering the literature on management accounting presented in chapter 2 and paragraph 5.2.2, the principles of the method may not be completely new. Why have organisations not put these principles in practice already and why should this method succeed?

The case studies gave us a number of clues why organisations have failed to implement principles similar to those of the method presented in this chapter. First, the organisations studied did not assign the responsibilities properly and sometimes departments even compete to gain more control over certain ICT components. Second, the organisations studied sought for complex solutions whereas we claim that a simple solution fits better. Third, a company-wide approach and a central function to control the alignment activities that might be a solution to these problems is missing in the organisations studied.

Allocation of responsibilities
Although the method presented in this chapter appears to be very self-evident, the case studies show that this allocation of responsibilities is not applied correctly by the organisations studied. Business management (BM) departments feel responsible for realising the financial and business goals they receive from higher management and through which their performance is evaluated. As costs of ICT are not allocated to the BM departments, or at least not in a way they can influence them, the ICT costs are not considered in the evaluation of their performance. So BM departments do not feel responsible for ICT costs nor for the relation between costs and benefits. Moreover, the ICT departments are usually held responsible for poor quality or high costs of ICT services, whereas these are often a result of decisions made by the BM department. For example, changes in the requirements during the development stage of a new application or requiring a very short time to market may impact the quality of the ICT service. Likewise, if the quality requirements are high this will affect the hardware and software solution and thus the costs of that service. The BM department requesting the ICT service should not only consider these consequences, but also and bear the consequences of its decisions. The case studies showed that this cost responsibility for ICT is usually put on the ICT departments. This is supported by the fact that often ICT costs are not allocated or at least not in such a way that BM can influence them. On the other hand, ICT departments want to demonstrate their business value by expanding their activities from supporting the operational ICT to supporting the business processes and by expressing their contribution in business terms. In this, they are willing to accept more responsibilities and more and more the ICT departments want to provide end-to-end services covering functional, application and technical management of the organisations business processes. For example, the technical management department studied in the first case study is working on tools to support applications that use several different types of hardware, although the functional management department manages the application itself. Likewise, the ICT department of the third case organisation wants to be responsible for the correct processing of business transactions and for increasing the automatic throughput. Markus and Keil (1994) suggest that this trend is stimulated or even started by corporate management. Based on the results of the case studies, this strategy can be questioned.

Too complex solutions
When considering the implementation of cost or benefit management for ICT, organisations are likely to adopt an all-or-nothing approach. That is, organisations do not want to learn through a step-by-step approach but want the most sophisticated and complete solution right away. The case studies showed that if cost allocation is considered, organisations want to

design a very sophisticated and complex calculation without considering the purposes of the allocation. Literally, when, at the end of the case study, we recommended organisation C to use a quite simple cost allocation strategy, one of the employees questioned this strategy and asked why they should not apply a more sophisticated and 'academic' calculation. This calculation should be based on actual usage. However, as most costs of the shared hardware platform are fixed, the costs allocated to a department depend not only on the actual usage but on two other variables as well. First, the costs allocated fluctuate with the usage of the application by the department. Second, the tariff fluctuates with the total usage of the hardware platform. As discussed in paragraph 2.3, this does not result in a cost allocation strategy that supports cost management. Moreover, as the number of cost components is large and the existing financial and asset administrations are not designed for this purpose, the allocation of all ICT costs to ICT services may be very time consuming even when a simple approach is adopted. Therefore, it might be difficult to get higher or corporate management of organisations warmed up for it. This should be solved by paying much attention to explaining both the necessities and difficulties to corporate management and by adopting an incremental approach by starting with a simple structure that can lead to results relatively quickly. Starting from a single ICT department instead of a company-wide implementation may be an option for such an incremental approach.

Furthermore, the case studies showed that cost allocation is often considered from the perspective of the department allocating costs to its customers. In that case the ICT department sees cost allocation as a means to justify its costs and to realise a zero budget performance, not as a mean to support cost management. The controllability of the allocated ICT costs by the department receiving these costs is not an objective of the ICT department introducing the cost allocation system.

No company-wide approach

The case studies indicated that when cost/benefit management is implemented within an organisation, not all ICT management and end user departments are involved and the overall co-ordination to realise a uniform approach for all departments is missing. The main reason that could be identified in the case studies is that the alignment of operational ICT is not co-ordinated from corporate level. Individual ICT departments receive orders from the corporate board or start cost management projects on their own. This may be caused by the fact that a company-wide implementation of a method for the management of costs and benefits may be very time consuming and thus can only be realised through an expensive and lengthy project.

Summarising, the method presented in this chapter is not as self-evident and trivial as it appears after considering the literature presented in chapter two. The case studies showed that organisations have difficulties with the application of a number of the management and co-ordination principles in practice. All in all we conclude that in ICT practice, a correct definition and allocation of tasks, responsibilities and authorities is not as trivial as it appears. Moreover, management of costs and benefits of operational ICT is frequently assigned to the ICT department.

We claim that this method will succeed to solve the problem of aligning operational ICT. First, it provides a step-by-step approach for supporting organisations in implementing the proper responsibility structure for the alignment of operational ICT. Second, the method entails an organisation-wide approach in which each department playing a role in both management and utilisation of ICT has to participate. And third, the method has the emphasis that responsibilities have to be put in practice and controlled after implementation.

5.7 Summary

A method for the alignment of operational ICT is presented in this chapter. The main conclusions from the case studies indicate that the alignment problem could be defined as two related problems. First, there is a discrepancy between responsibilities and authorities regarding operational ICT. Second, the management does not have the proper information to plan and control the costs and benefits of operational ICT, nor do they have the proper tools for this purpose.

The method described in this chapter is designed to solve these problems by providing:
- guidelines for the assignment of responsibilities for the alignment of operational ICT and for solving the related information problem;
- guidelines and practical tools to support ICT and business management in the alignment of operational ICT.

The method is designed to help organisations to align the costs and benefits of their operational ICT, by making sure that the management of the organisation:
- knows the costs of its operational ICT;
- knows the benefits of its operational ICT;
- can relate benefits of its operational ICT to costs, and
- can define actions based on this information to improve the alignment of its operational ICT.

The method consists of two parts. First, the proper responsibility structure and information model are implemented by a responsibility accounting approach for operational ICT. The way of working of the responsibility accounting approach is detailed in four steps, to identify and link services and responsibility centres and to determine the relevant management information. Now, the organisation knows the costs and benefits of its operational ICT and can relate them as they concern the same object: an ICT service. The management of the organisation can use this increased understanding to improve the alignment of its operational ICT; it can define actions to increase benefits or reduce costs.

The second part of the method provides a set of tools to support management in the alignment of operational ICT, after implementation of the principles of responsibility accounting. This set of means includes methods like service level management, budgeting, the balanced scorecard and the GQM method. Now, the management of the organisation can use these means to integrate the alignment of operational ICT in its regular planning and control processes and so monitor and improve this alignment continuously.

6 Validation

6.1 Introduction

The method presented in the preceding chapter is validated in this chapter. The design of the method described in chapter 5 is based on the findings from the descriptive case studies and theories and on methods provided by literature. It is designed to support organisations in solving the problem of aligning costs and benefits of operational ICT. The method itself does not solve the problem. The success of the method depends on its application by the organisation. The application of the presented method contributes to solving the alignment problem by increasing the organisation's understanding of which areas are more, and which areas are less valuable in operational ICT.

The results of this increased understanding are that the management of the organisation:
- knows the costs of operational ICT;
- knows the benefits of operational ICT;
- can relate benefits of operational ICT to costs;
- can define actions based on this information to improve the alignment of the costs and benefits of operational ICT.

To validate this claim, we have to apply the method in practice to consider whether the claimed improvements are obtained. As already discussed in paragraph 1.6, the validation will be carried out through case-study research. In this chapter the research approach used for the validation is discussed first. Second, two validation case studies are presented and analysed. Finally conclusions are drawn from both validations.

6.2 Approach for validation

As the proof of the pudding is in the eating, we will now apply the method in practice to see whether it brings about the desired results. Kloeten has studied the success of three types of case studies (Kloeten and Berghout; 1996; Kloeten, 1994):
- Action research: where the implementation and application of the method is monitored and analysed;

- Retrospective action research: where the implementation and application of two different methods is monitored, and the difference between the two methods is analysed;
- Retrospective case study: where an already implemented method is monitored and analysed.

The first type of research entails the implementation of the method to be validated and provides a lot of information on the success of that implementation. However, this approach is very time consuming and has a serious risk of failure, for example when key stakeholders switch occupation during the case study (Berghout, 1997). The second approach compares two different situations. The main disadvantage of this approach is that when they apply the second method, the decision makers will still have knowledge of the first method and will sometimes be reluctant to withdraw earlier statements (Berghout, 1997). A variant on this approach is to monitor and analyse two different methods in two different environments. This requires two comparable environments. As it is unknown what set of characteristics should be equal for these environments, it is not possible to apply this approach. The third type of research studies an already implemented method. This makes it easy to evaluate the effectiveness of the application of the method, but it involves a risk: that important stakeholders are no longer present to evaluate the implementation (Berghout, 1997).

In this research, the method will be validated through both action research and a retrospective case study. The retrospective action research approach is not suitable, as the research area is still insufficiently understood to define the relevant variables to select two comparable environments. First, in the action research type of validation, the method is implemented in practice and both the implementation and the following application are monitored and analysed. Second, an already implemented method resembling the method to be validated is monitored and analysed. In this validation, the method to be validated is applied as reference model. Both types of case studies are discussed in this paragraph based on literature.

6.2.1   Action research

Action research is defined as a type of case-study research in which the researcher participates in the organisation studied to achieve a certain result based on continuous feedback of theoretical findings and evaluations (Van Waes, 1991). Action research is characterised by the fact that the researcher participates actively in the system under study and clearly influences the observed situation. Other characteristics of action research are that:
- it investigates processes in organisations;
- the research is aimed at finding guidelines and understanding motives;
- the results are based on consensus among experts rather than on objective measurement;
- the value of the research is derived from the carefulness of the research process rather than the objectivity of the results (Van Waes, 1991).

The entities studied by action research tend to study are not variables, which can be measured to a high degree of accuracy, but roles or functions, and the relationships between them. It typically discovers structures and relationships (Van Waes, 1991).

Literature shows that action research is particularly appropriate for the following types of problems (after Benbasat et al., 1987; Straub, 1989; Yin, 1984):
- Sticky, multi-variable problems, where little a priori knowledge exists about what the variables of interest are, how they are related and how they can be measured

- Practice-based problems, where the experience of the actors is important and the context of the action critical.

The main disadvantages of action research are bad reproducibility and questionable scientific value (Van Waes, 1991). First, the line of reasoning followed by the researchers is not always clear. This leads to problems in tracing it and in checking its validity, resulting in difficulties to reproduce the research result. Second, in literature, doubt is expressed on the scientific value of this kind of research. Many authors feel that this kind of research does not fit in with that generally accepted by the scientific community. Van Waes (1991) feels that both disadvantages rest on a misunderstanding of the nature of action research and the type of information it generates.

Although several researchers question the scientific value of action research (Van Waes, 1991), it has shown promise as a tool for investigations in the ICT and related fields (Buitendijk, 1991; Achterberg *et al.*, 1990; Earl, 1989). Susman and Evered (1978) and Susman (1983) defended the scientific validity of action research by considering research from the philosophical point of view known as pragmatism. Pragmatism states that we owe all our knowledge to our experience, to our ability to deal with a world which is never completely certain or understandable. Furthermore, there are other philosophies like hermeneutics, existentialism or ethnomethodology that argue that all knowledge can only be obtained in such ways - even the so-called 'objective' knowledge of science (Van Waes, 1991).

6.2.2   Retrospective case studies

Berghout (1997) identified the retrospective case study as an adequate method for studying the evaluation of ICT investment proposals. In retrospective case studies, the method for the alignment of operational ICT applied by an organisation is studied by reconstructing one or more management and decision-making processes. According to Kloeten (1994), the disadvantage of this type of research is that it contains the risk that important stakeholders are no longer present. When one wants to study the reasons why a certain alignment method was implemented by a stakeholder, the possible absence of that stakeholder is a serious risk. But when one evaluates the experiences with the method and its strengths and weaknesses, this risk is significantly smaller. After all, the management of operational ICT is a continuous process of evaluating costs and benefits and of improving their alignment. For evaluation, one can evaluate the most recent actions, thus minimising the chance that the stakeholders have disappeared.

In a retrospective case-study we monitored an already implemented method by reconstructing the application of the method for a number of selected situations. The reconstruction of this application of the method is based on interviews with the management responsible and on the available documentation on decision-making processes. Therefore, the retrospective case studies are very similar to the explorative case studies carried out in an earlier stage of this research and discussed in chapter 3. However, by this series of retrospective case studies we do not only reconstruct the alignment method, but we also compare the reconstructed method with a reference method and analyse the differences between both methods. As the retrospective case studies are carried out to validate the method presented in chapter 5, we used the method as a reference model.

6.2.3 Objective of the validation case studies

The objective of the validation case studies is to check the applicability of the method presented in chapter 5. As the method consists of two separate parts, where the first part is a prerequisite for the actual alignment, we will focus on this part of the method: the responsibility accounting part.

It is claimed that the applicability of that part of the method is demonstrated if it is possible to implement responsibility accounting for operational ICT, as discussed in paragraph 5.4, and if the implementation increases the organisation's understanding of the alignment of operational ICT.

We claim that the organisation's increased understanding of the alignment of operational ICT is demonstrated if, after implementation, the management of the organisation:
- has more insight in the costs of its operational ICT;
- has more insight in the benefits of its operational ICT;
- can relate the benefits of its operational ICT more easily to the costs;
- can define actions based on this information to improve the alignment of operational ICT.

At the same time we verify the applicability of the method by trying to implement responsibility accounting for operational ICT as described in chapter 5. We claim that implementation of the principles of responsibility accounting for operational ICT is demonstrated, if:
- a set of customer services, underpinning services and internal services can be defined covering all ICT components of the organisation,
- a single owner can be identified for each ICT service, and
- management information can be defined for each service in terms of costs and quality.

6.2.4 Selection of case-study organisations

As the method is validated in two different types of case studies, being action research and retrospective case studies, we carried out two different selection procedures. First, for the action research type of validation, case organisations had to be found that were willing to change their accounting structure, management information system and related financial administration. As for most organisations, their financial and management accounting systems are far too important for their management control to change them, it was very difficult to get any organisation to participate in this case research. When we presented the case study report of case C, the management of organisation C offered us the opportunity to implement (part of) the method under construction. Therefore, we used organisation C for the action research type of validation in case D.

Second, a number of organisations are considered for the retrospective case studies. In these studies, we validate the method by using it as a reference model when monitoring and analysing an already implemented method in practice. For these retrospective case studies, we selected organisations that apply a method for the alignment of operational ICT resembling the principles of the method presented in chapter 5, being:
- costs are allocated to the end user organisation;
- a single owner is identified for each ICT service provided;
- the total costs of each ICT service are allocated to the owner;
- costs of shared ICT resources are allocated based on the principle of available capacity;
- the owner of a service is responsible for the alignment of costs and benefits.

A study of Van Maanen (2000) on the cost allocation strategies of 10 Dutch financial organisations indicated that 7 out of 10 ICT departments studied have a cost allocation method that does not provide the management information requested by business management. These allocation methods concentrate on administering and budgeting the (internal) costs of the ICT departments (Van Maanen, 2000). Two out of three organisations with satisfying management information on ICT cost implemented a cost allocation method that is comparable to the method described in chapter 5. As one of the organisations already participated in this validation, organisation D, the other organisation was asked to act as case E. Although the third organisation could have provided us with the opportunity of studying an organisation satisfied with the application of a different method, it was reorganising at that time and hence not willing to participate at that time.

6.3 Case D[15]: an action research case study

In this paragraph the responsibility accounting part of the method is validated through an action research case study. First, the outline of this case study is presented, and the context and content of case study D are discussed. Second, the implementation of the method is discussed according to the four defined steps and the experiences during implementation are evaluated. Furthermore, we evaluate the experiences with the application of the method to align the benefits and burdens of operational ICT. This paragraph ends by summarising the findings of this case study and by drawing some conclusions.

6.3.1   Outline of the case study

This case study is carried out in two stages. First, in accordance with the principles of action research described in paragraph 6.2.1, the researcher designed the cost allocation strategy on request of the ICT management and business management departments involved. The design of this strategy included the definition of services and the identification and assignment of owners. To design and implement this strategy, we applied the method presented in chapter 5 following the four steps to implement responsibility accounting for ICT described in paragraph 5.4. As project leader, we were able to influence the activities directly and thus the implementation of the method, which corresponds to the principles of an action research type of case study. Furthermore, this experience provided us with a lot of information and knowledge on the applicability of the method in practice.

Second, the experiences with the method during and after the implementation were evaluated more than six month after the project was ended. This evaluation was carried out through a number of structured interviews with the management of the departments involved. The interviews are carried out following the same procedure as the first series of case studies (see paragraph 3.2). First, the employees to interview were selected in consultation with the organisation. Second, each interview followed a fixed structure and by submitting an interview report to each interviewee, the results of each interview were checked. Third, the end results were represented in a case study report that had to be approved by all interviewees.

The main objective of the interviews was to make an inventory of the positive and negative experiences with the implementation of the method. Furthermore, we tried to determine

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[15] In order to improve the readability of the case studies discussed in this chapter, personifications are sometimes applied for the organisational units and ICT management functions identified. For example, if the observation is described that *"department X determines..."* it is actually meant that *"the management responsible for department X determines..."*

whether the application of the method had improved the alignment of operational ICT. The success of the method should lead to an increased understanding of the costs and benefits of operational ICT and their mutual relation, resulting in the definition of actions to improve the alignment of operational ICT.

6.3.2 Context and content

Case study D is conducted in the same organisation as case study C[16]: a Dutch multinational providing a variety of financial products like payment and savings accounts, loans and mortgages. Business unit C1 (figure 6.1) operates in the field of investment banking. This case study focused on the dealing room and the back office of C1. The dealing room is a 'virtual' organisational unit managed by the floor manager, where dealers from different departments of C1 operate in the money market (short term), capital market (long term) and foreign exchange. The activities in the dealing room are part of the front-office processes of C1, while the transactions closed by these dealers are processed in the back office of C1. The ICT environment of the dealing room includes workstations, local-area networks and applications for online market information and to process and administer transactions. Besides the ICT environment for the dealing room, the ICT environment of C1 includes several applications for processing transactions for the back-office departments of C1. The back-office department of C1 manages and supports its own PC environment and related office equipment. As several departments of C1 were involved in this case study, no particular business management department BM3 could be discerned. Therefore, the business management activities are indicated as C1.

Business unit C2 is responsible for management of central computing environments like IBM mainframes and AS/400, midrange and NT systems, and for the development and for the maintenance of application software. ICTM3 is an ICT management department of C2 that is responsible for functional, application and technical management of the ICT environment of the local dealing room and related (back office) processes and departments of C1. ICTM3 manages more than 60 services. Besides a local-area network and around 600 desktops, the services consist of a variety of PC and Unix based applications including around 150 midrange systems.

As case study D started shortly after case C had finished, the context of case D is equal to that of case C as described in paragraph 3.7.1. The most important difference in context is that case study D also includes the back office department of C1. Furthermore, after the descriptive case study had finished, corporate management of organisation C arranged that the central ICT division C2 would operate as cost centre and would allocate all costs to its customers. Till then, costs were allocated to the divisions, based on allocation keys predefined by the central planning and control division. Now C2 was ordered to allocate costs at departmental level instead of divisional level, to base the allocation on actual use and to specify the costs allocated to its customers. To realise this, the financial department of C2 started to develop a cost management system (CMS) to determine what costs to allocate to the various departments and to send this data directly to the corporate financial information system.

All departments of C2, including ICTM3, were asked to define their products and rates so that costs could be allocated through this automated cost management system. For this, the

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[16] Context and content of organisation C are presented in more detail in paragraph 3.7.

Case D
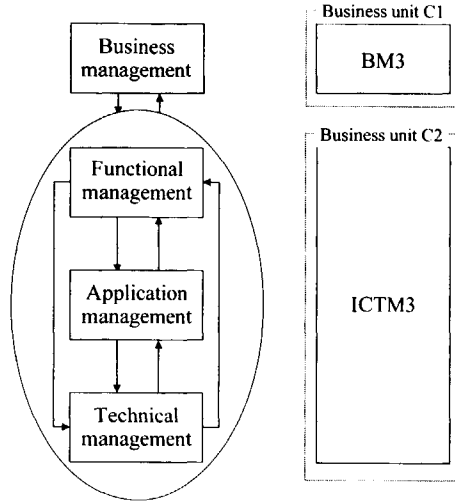
Figure 6.1 Context of Case D in relation to Looijen's model

method discussed in chapter 5 was applied. Parallel to this cost allocation part, another project was carried out by ICTM3 to define and implement service level agreements for each service.

6.3.3   Implementing responsibility accounting for operational ICT

In this paragraph, the application of the method according to the four steps as identified in paragraph 5.4 is described. These steps are defining ICT services, identifying responsibility centres, assigning ownership and defining management information. The results of each of these steps are described here.

Step 1: Definition of ICT Services

In this first step, the ICT services provided or purchased by the departments participating in this case study are identified according to the description of this step of the method in paragraph 5.4.1. More than sixty services provided by ICTM3 were identified and classified into the three types of ICT services. Some coherent, minor products are clustered into a single service. The definition of these services is based on what the customer experiences as separate functionality and what can be defined as a separate entity technically. Now, all ICT services are identified that are subject to the alignment of operational ICT and therefore costs and benefits have to be determined.

As the organisation focuses on the ICT services in their planning and control cycle, by identifying these ICT services they could identify the objects of which they have to determine the costs and benefits so that they can be related to each other.

Furthermore, all ICT services identified were classified into customer, underpinning and internal services and modelled into the Service Provision model presented in figure 6.2. Far most services (52) were classified as *Customer service*, six as *Underpinning service* and four as *Internal service*. Also six customer services were identified that were not operational anymore. The main reason to maintain these services was that they are still subject to depreciation costs. In a number of cases these costs could be attributed to the substituting,

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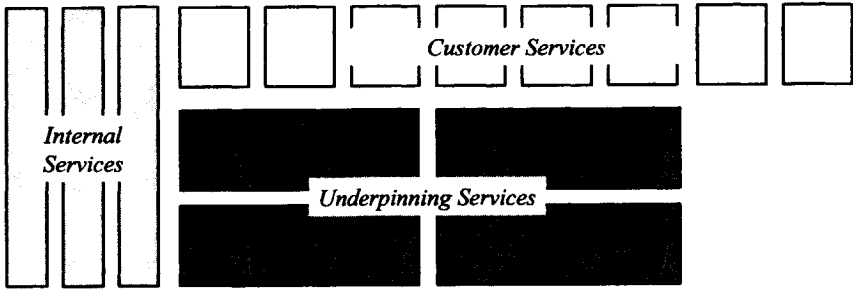
Figure 6.2 Service Provision Model for Case D

new service. This would cloud the cost calculations of the new service and future cost estimations. Moreover, we claim that separate allocation makes the customer more aware of the fact that each ICT service also involves long-term costs that will continue when the service is not operational anymore.

Step 2: Identification of responsibility centres
In the second step, all departments utilising one or more of the ICT services identified in the preceding step are identified as defined in step 2 of the method presented in paragraph 5.4.2. In this case study, each business management department (BM3) utilising an ICT service provided by ICTM3 was identified as potential responsibility centre. The result of this step is a list of departments and the ICT services they utilise, represented in the Responsibility Centre model as defined in the way of modelling. The management of each department in this model is responsible for the costs and benefits of the ICT services utilised by their department.

Each department using services provided by ICTM3 was contacted by the researcher to identify the importance of that service for its activities to determine what department should be owner. The importance of the service was evaluated based on an estimation of to what extent the service contributes to the performance of the department and of its use in relation to that by other departments. The ICT department ICTM3 can be the responsibility centre for the ICT services provided to it by external suppliers and for the internal and underpinning services it needs to provide its own services. For each service supplied by ICTM3, a responsibility centre will be assigned in the next step, which is in its turn supplier of the service to the end users within the various business management (BM3) departments (see figure 6.3).

This is illustrated by an example: assigning the responsibilities for a fictitious service MarketInfo that provides online price information about the financial markets. For that service, hardware and system software is maintained and supported by an external supplier. The ICT department that uses this service to supply its own services is the owner of that service and thus operates as responsibility centre (a). The ICT department deploys the hardware and software, for example, to run the application software MarketInfo. If this application supports the business processes of one or more business management departments, one of these business management departments is assigned ownership of that service (b). It then acts as responsibility centre for that service. In case several departments make use of that service, the owner acts as supplier of that service for all end user departments (c). If the application MarketInfo is deployed to support the ICT management
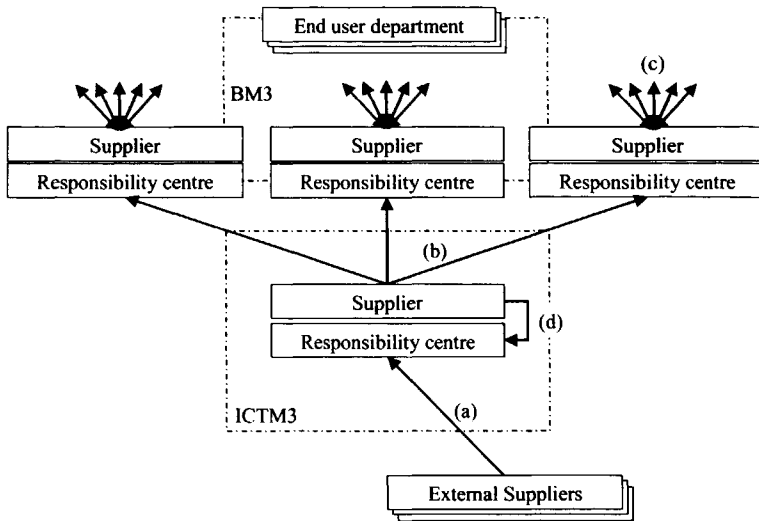
Figure 6.3 Responsibility Centre Model for Case D

processes of the ICT department, the ICT department is not only supplier but also owner of the service MarketInfo (d).

Step 3: Assigning ICT services to responsibility centres

In step three, each ICT service is assigned to a responsibility centre according to the description of step 3 in paragraph 5.4.3. Now, a single department and so a single functionary is made primarily responsible for the costs and benefits of that ICT service. The results of this step are represented in the Organisation model as defined in the way of modelling, linking the Service Provision model and the Responsibility Centre model. Now the organisation knows which functionaries are responsible for the alignment of the costs and benefits of operational ICT.

Each ICT service is assigned to a single responsibility centre, called the owner of that service. If a service is utilised by several departments, the owner acts as a representative for them all. The owner defines the quality requirements for the service and is the single function to submit change requests for that service.

For each customer service supplied by ICTM3, a department is identified as responsibility centre called the owner. If several departments make use of the same ICT service, ownership is assigned to the department that is expected to have most information and day-to-day influence on the benefits of that service. Usually this is the department that uses the service most or whose business processes benefit most from the service. This choice, option b. in paragraph 5.4.3, enabled us to assign many owners for services of ICTM3. Far most customer services of ICTM3 are utilised in the dealing room, where dealers from different departments of C1 operate. For these services it was not possible to identify a largest or most-benefiting department. In this case ownership was assigned to a central co-ordinating department (option c.), namely the floor manager of the dealing room.

Ownership of all internal services is assigned to ICTM3 itself. Initially, ownership of the underpinning services was assigned to ICTM3 as well. However, most underpinning services

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are in fact infrastructure facilities for the dealing room, like workplaces, notebooks, file servers and a local-area network. And as the dealing room facilities are managed by a central co-ordinator, ownership of five out of six underpinning services is assigned to the floor manager as well. ICTM3 remained owner of just one underpinning service.

Step 4: Defining management information

In the concluding fourth step, the management information is defined, so the owners need to align the costs and benefits of operational ICT services as described in step 4 (paragraph 5.4.4). Responsibility centres are assumed to have most information and most day-to-day influence on the ICT service. As another ICT management department provides the ICT service, reporting facilities are required to inform the responsibility centre on the performance of the service and give insight in possible improvements. The required management information contains both financial or cost information and non-financial or qualitative information. The financial information concerns the costs of the ICT service and the way these costs are allocated to the consuming departments. The non-financial information is represented by the quality of the ICT service concerned. The most important quality aspects have to be defined and management information on these aspects must be measured and reported. As a result of this step, the costs of each ICT service are determined based on product costing and activity-based costing principles. Second, as the ICT service is an entity that business management can relate to an impact on their business processes, the benefits of the ICT service can be evaluated. As costs and benefits are related to the same ICT service, they can be connected to each other and evaluated. Furthermore, on the basis of the available financial and qualitative management information, the owner is able to improve the relation between costs and benefits of the operational ICT service and thus to realise better alignment.

Service costing

To provide the owner with cost information, we determined the costs of each ICT service according to the principles of service costing described in paragraph 5.4.4. Figure 6.4 presents the Service Costing Model developed in this step. The ICT costs represent the personnel and other costs of ICTM3 and the depreciation costs of the hardware and software of the services provided. All *depreciation costs* are allocated directly to one of the more than sixty identified customer, underpinning or internal services, represented in figure 6.4 by the direct allocation of ICT costs. For this, all ICT means registered in the asset management database are categorised into the services defined. In this way not only the costs of each service are determined; the completeness of the services identified is checked as well. In this case, the check revealed the existence of non-operational customer services discussed at step 1.

The *personnel costs* and *other costs* are allocated through an hourly rate. As the numbers of hours spent on each service are administered by the time registration system, the allocation of costs per hour is considered as direct after all. For large services, the number of hours spent by ICTM3 are allocated proportionally per month. Over time, budget and realisation are compared to see that the allocated costs are in line with the actual time spent. For smaller services the actual number of hours is allocated.

As all other services benefit from the internal services, their costs are summarised and allocated indirectly to the underpinning and customer services. The keys for this indirect allocation are based on the support capacity reserved for each service, measured through the number of incident calls and change requests. The underpinning service owned by ICTM3 - a shared platform of Unix servers - are allocated to the services running on that platform, based on the computing and storage capacity reserved for each service. The keys are set annually based on measurements of the preceding period and future expectations. The underpinning
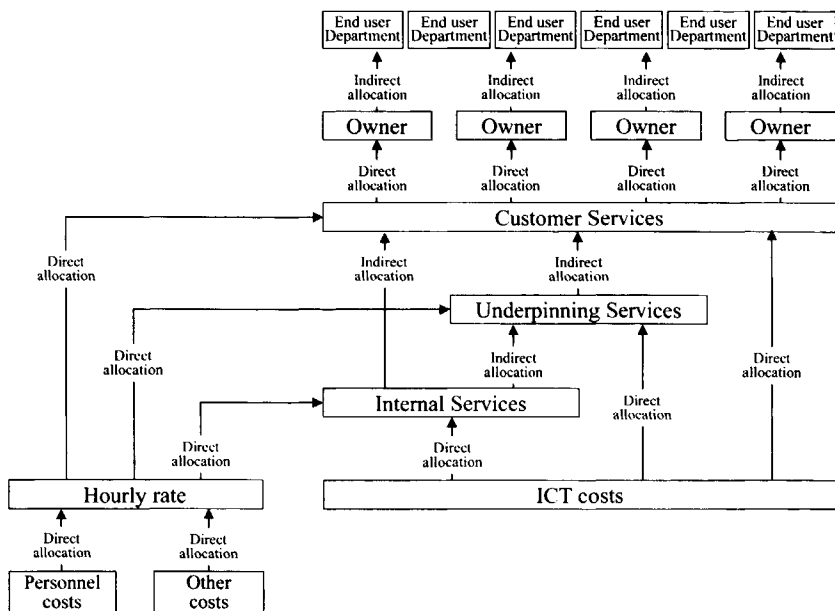
Figure 6.4 Service Costing Model for Case D

services owned by C2 - the infrastructure facilities for the dealing room - are treating as customer services in this Service Costing Model.

The costs of each customer service are allocated directly to the owner. If several departments utilise the service, the owner re-allocates part or all service costs to these departments. The keys applied for this re-allocation are expressed in a percentage and based on the number of users of each service registered for each department. For a number of services the percentage is based on the number of users and a predefined weighing factor, as departments may utilise the service differently and therefore benefit more or less from it. These weighing factors are defined in discussion with the end user departments. The keys for the re-allocation are set annually based on the budgeted number of users. Although the cost management system (CMS) developed by the financial department of C2 was originally developed to allocate costs by C2 only, additional modules were developed for CMS on request of BM3 to support this reallocation process.

To identify the costs of an ICT service in the financial administration, we defined each service as a separate cost place in the books. As this cost place is defined as the child of the cost place of the department it is owned by, the costs of the corresponding ICT service are directly allocated to the owner. In this way, ICT costs cannot only be identified for each department, but for their individual ICT services as well.

Both ICTM3 and BM3 have access to the cost information through the CMS developed by the financial department of C2. This cost information represents for each cost place the costs allocated by C2. These costs included not only the costs allocated for the ICT services provided by ICTM3, but also the costs allocated for network services, mainframe use and

development hours. To discern these various types of costs, the CMS identified a number of categories, being:
- Exploitation costs
- Hardware and Software Depreciation costs
- Hardware and Software License costs
- ICTM3 costs
- Support costs
- Development costs
- Network costs

The category *Exploitation costs* represents the mainframe costs allocated by the mainframe department of C2. These costs are allocated based on the number of CPU seconds and megabytes storage capacity used. For a limited number of processes, the costs are allocated per application, but by far, most costs are allocated per user and debited to the entry of the department the user belongs to. The data for this allocation is collected from the login files of the mainframe environments, providing the amount of CPU seconds used per user. The *Hardware and Software Depreciation costs* cover all depreciation costs of hardware and software owned. The data for this allocation is collected from the asset management administration of the central purchasing department of C2. The depreciation costs arising from the ICT services of ICTM3 are presented in this category. Other depreciation costs presented in this category are related to hardware and software that is not part of any of the services of C2 and that is purchased by BM3 according to the asset management data. Costs of workplaces and office automation are also part of this category. However, these costs do not present the actual depreciation costs, as a rate was applied for each workplace and printer registered in the asset management database. This rate was based on the total costs for depreciation and licenses of all hardware and software related to workplaces and the costs of the central department for support of workplaces and office automation.
Likewise, the *Hardware and Software Licenses costs* represent all costs for licenses as well as maintenance and support contracts for hardware and software owned, including the costs related to the services managed by ICTM3. The costs of underpinning and internal services owned by ICTM3, like network management tools and the help desk tool, are allocated to the customer services as *ICTM3 costs*. Personnel costs are allocated based on the numbers of hours spent and an hourly rate. Hours spent on support of operational ICT are represented as *Support costs;* hours for development activities as *Development costs*. The financial department of C2 defined an hourly rate that applies to all departments of C2. The number of hours for support and development can be discerned as they are allocated as different entities.
Finally, the category *Network costs* represents all allocated costs for network usage. The allocation strategy for these costs had yet to be determined. At the time this evaluation was done, the costs in this category had still not been allocated.

C2 was not able to allocate all costs to products or services. Due to an inaccurate invoice administration, in particular costs of software licenses and support contracts for hardware and software could not be traced. These costs are still allocated lump sum to all customers according to a predefined allocation key.

Service quality
The responsibility centres that are owner of an ICT service supplied by ICTM3 need information to manage the alignment of costs and benefits of these services. Management information on the service quality and costs should provide enough information to the business management to enable them to determine the ICT impact and thus indirectly the

Quality Aspect:	Item in SLA:	Expressed in:
Functionality:	Service description & Service chain	*Description of components building the service, including interfaces with other systems*
	Organisation	*Identification of all parties involved*
	Changes	*Fulfilment times of change requests*
	Service Capacity	*Number of concurrent users and locations, transactions per month, service requests and change requests per month*
	Service Level Reporting	*Frequency and content of reporting by ICTM3*
	Service Evaluation	*Frequency, content and members of evaluating meetings*
	Security Classification	*Classification on confidentiality, integrity and availability*
	Security Governance	*Security procedures defined for the service*
	Cost Management	*Cost forecast and allocation procedure*
Availability:	Service Windows	*Support hours during week*
	Service Availability	*Response and fulfilment times for service quests*
	Business continuity	*Procedures for backup and recovery and for back-out*
Performance:	Performance	*Performance times of night-runs*
Output quality:	Not identified	
Completeness:	Not identified	
Correctness:	Not identified	
Timeliness:	Not identified	

Figure 6.5 Service Quality Model of Case D

benefits. For each service, ICTM3 has signed a service level agreement (SLA) with the owner to formalise the agreed service levels. The definition of the SLAs was beyond the scope of this action research type of case study. However, the contents of the SLAs are presented here to complete the description of the management information available in this situation (see figure 6.5). The main contents of these agreements cover a number of items, which can be grouped under the quality aspects *functionality, availability* and *performance*. The quality aspects related to *completeness, correctness* and *timeliness* are not identified. The main reason for this is that all services of ICTM3 are related to dealing-room transactions and require therefore the highest possible levels of completeness, correctness and timeliness. Management information on the service quality is provided by ICTM3 in a service level report, submitted bimonthly.

6.3.4 Experiences during implementation

The preceding paragraph described the implementation of the principles for responsibility accounting for ICT as described in paragraph 5.4. The experiences gained during this implementation of the method are evaluated and discussed in this paragraph.

The experiences gained during the implementation are separated into four items, being:
• Resistance against the cost responsibility aspect of ownership;
• Allocation of depreciation costs to ICT services was very time consuming;
• Not all costs related to the services of ICTM3 are incorporated;
• Not all costs allocated to BM3 are within the scope of the project.

Resistance against cost responsibility

First, there appeared to be great resistance within business management against the allocation of all costs of an ICT service to a single owner. When ownership was presented as being necessary if one wants to define the required service levels and to decide on changes, the initial list of owners was completed easily and within little time. But when it became clear that all costs related to an ICT service would be allocated to its owner, many 'new' owners did not want to be owner anymore. Obviously, business management wants the authority arising from ownership but not the accompanying (cost) responsibility. This may be caused by the fact that the cost allocation directly affects the profit-and-loss accounts by which their performance is evaluated.

Some owners claimed that the mainframe allocation was more convenient to them, as they are charged based on the actual usage. More transactions directly leads to more allocated costs. As ICTM3 charges for the budgeted capacity available, more use is free until the reserved capacity is not sufficient anymore. Additional capacity leads to an incremental increase in costs. Moreover, as the owner is the only one who makes decisions about the service, it needs to authorise this investment in additional capacity. As a result of this, the owner must budget for all investments in the service, as the owner has most insight in the growth of its business. For the mainframe environment, the required capacity is budgeted by the ICT department. Several owners did not only consider this extra work annoying, they also believed that they were paying twice for the additional capacity. They pay for the initial purchase from their investment budget, and their cost budget is charged with the depreciation costs arising from this purchase through the cost allocation to their cost centre. It appeared that even in a financial organisation, many managers do not know the difference between expenditures and costs. Furthermore, because financially, business unit C1 is managed strongly and the performance of managers is evaluated based on financial results and costs, any additional costs can cost the managers their bonus.

During the implementation, in line with the principles of action research, we took corrective action to remove his resistance by clarifying the principles of the re-allocation of the ICT service costs. Most resistance disappeared when we explained that due to this re-allocation, the financial indicators determining the performance of each department are influenced only by those costs the department is actually responsible for. Furthermore, to prevent that the re-allocation itself would require a lot of manual labour and thus extra costs, we automated it as well.

Initial cost allocation was very time consuming

Second, the allocation of ICT costs to ICT services was very time consuming, as the items had to be considered one by one and attributed to a service. The configuration management database was not detailed enough, whereas the asset management database only contained information about the cost place the initial purchase was made from. As untill recently this information was not used and mistakes had no consequences at all, this information was not administered accurately. Many components were registered with incorrect cost places. Furthermore, over time different purchases for a certain service could have been made by several departments, depending on who needed the purchase at the time and still had investment budget. So, components for the same ICT service could be registered under different cost headings. Considering the depreciation period of 60 months for all hardware, including mice, it is likely that in a dynamic organisation, departments were renamed, merged or even disappeared.

As a result of this, the initial allocation of depreciation costs to ICT services required processing a download from the asset management database of more than 700.000 rows of data. Due to the dynamic environment of ICTM3 and its rapid growth in the last two years, the number of people with the required knowledge for the allocation was very limited. In this case, the first allocation was based on what the head of the ICTM3 department remembered. In a second round, the responsible teams had to consider the costs of each service in more detail to improve the accuracy of the allocation.

After the initial allocation, the administration could easily be kept accurate if new purchases were correctly registered on the corresponding service.

Not all service costs incorporated

Third, not all costs related to the services provided by ICTM3 were incorporated in the Service Costing Model. For example, the costs of contracts for maintenance, support and licenses (MSL) of hardware and software were not part of this model. The central financial department of C2 administered these costs for all departments of C2. However, this administration did not provide the information required to allocate these costs to services. And for several reasons, mainly the short time and little capacity available, the financial department was not willing to change that on short term. Therefore, the MSL costs were allocated lump sum to the business units that requested the initial purchase. As for around 30% of the MSL costs a department of C2 ordered the initial purchase, these costs were spread over all services proportionally. This same principle was applied to allocate the depreciation costs of all hardware and software registered on a central cost place of C2 that could not be allocated to any service of C2. Finally, the central financial department of C2 defined an hourly rate to allocate personnel costs and other costs which is equal for all departments of C2. As a result of this, the costs of services of ICTM3 include among others overhead costs for the mainframe and other costs that have no relation with these services at all. The hourly rate for ICTM3 should cover costs of ICTM3 for personnel, accommodation, office equipment, workplaces, furniture, management and overhead. Now, the hourly rate also included costs for mainframe usage and services for internal usage for C2 that are not utilised by ICTM3.

Not all ICT costs within scope project

Fourth, not all costs allocated to BM3 are related to services provided by ICTM3. So, not all costs are allocated according to the Service Costing Model presented in figure 6.4. Mainframe costs, for example, are allocated based on the amount of CPU seconds and storage capacity used. Just few of these costs were related to an application that might be identified as an ICT service. By far most costs are allocated per user. This made it very hard for BM3 to trace all costs allocated by C2 and to determine for what these costs were incurred and whether they were allocated correctly. So, applying the method to business management was more difficult.

6.3.5 Experiences after implementation

After implementation, when responsibilities are assigned according to the principles of responsibility accounting for ICT, the alignment of costs and benefits of operational ICT actually begins and actions can be defined to improve the alignment. Experiences of the organisation with the application of the method, after implementation, to align the operational ICT are evaluated and discussed in this paragraph. The experiences discussed below are evaluated one year after the implementation of the method had finished. At that time, the implementation of the cost management system of C2 was a year and a half ago. The

evaluation was carried out through a series of structured interviews following the same procedure as those for the descriptive case studies discussed in chapter 3.

One year after the implementation of the method, the entire organisation C had gone through a major reorganisation. The new organisation structure entailed new responsibility and accounting structures, resulting in new departments, business units and divisions. The ICT department ICTM3, for example, has been split into a support and a development function. The support function is now part of a central service department, whereas all ICT development functions are concentrated within another division. Furthermore, parts of the dealing-room and back-office activities of business unit C1 were moved to another country. The related support activities of ICTM3 are expected to follow this move.

With this reorganisation, the organisation's ICT cost management changed as well. The most important change is that the allocation strategy has returned to the old situation, i.e. the total ICT costs are allocated at divisional level based on predefined allocation keys. The link between the cost management system (CMS) of the central ICT business unit C2 and the corporate cost administration has been removed, although it is still running and represents the same ICT cost information based on actual data. For several departments, this removed link is the reason why they do not use CMS anymore. Other departments, like ICTM3, still believe in the principles underlying CMS and believe that the link will eventually be re-established. They now use CMS to manage the cost of the services they own, although the actual costs allocated are not in line with these figures. Furthermore, as the new accounting structure for the new organisational structure was unclear for a long period of time, no budgeting process was carried out the previous year. If budgets had been defined, they would have been based on accounting structures different from current practice and therefore be useless for cost management purposes, as actual costs cannot be compared to budgets.

The experiences after implementation, described in this paragraph, consider the period of one year that the CMS was fully operational and linked to the corporate cost administration. The experiences gained in that period are summarised and presented under seven points of interest. First, the implementation of the method has *changed the behaviour of business management* regarding ICT costs. Second, the *increased cost awareness* is one of the aspects of this change, leading to a number of *cost reductions* realised after implementation that will be discussed third. Fourth, the *management information* available is considered and the experiences with the *rates* applied by the organisation are defined (fifth). Finally, we conclude that the introduction of cost allocation entails a *learning period* for the organisation.

Changed behaviour of business management
Allocating costs of ICT services following the method presented in this thesis did change the behaviour of business management. As costs are allocated based on actual usage to business management at a lower organisational level, these costs influence their financial result and thus their performance. Management is now confronted with the consequences of its own decisions as it receives the costs arising from these decisions through allocation. Introduction of ownership creates a link between this decision and its consequences at the point where most knowledge should be available about the consequences of that decision. Organisation C did not only realise these cause-and-effect relationships for operational ICT services, but for incorporated projects as well. Ongoing costs arising from projects, having a limited lifetime, are transferred to the ongoing costs of the services they build or change. In this way, projects are linked to the services they affect or result in.

Increased cost awareness

Until recently, business management did not worry about the ICT costs allocated at all. Now that costs are allocated, business management is more interested in what service they receive and how much it costs. This shows up as many requests for information on the cost allocation strategy and cost breakdowns. Based on this cost insight, business management has changed its decision-making behaviour and bases its decisions more on actual figures than on a hunch. Resistance against allocation of all service costs to the owner has disappeared and owners feel comfortable with the way they can influence these ICT costs.

Time registration has been improved and has become a management instrument. Business management uses this information to manage the costs of projects more strictly and particularly the hours spent on projects. The number of hours for ICT services provided by ICTM3 are budgeted and controlled more accurately now. Budgeted hours for support of ICT services are close to actual figures, relatively large differences only occur for smaller services. For changes that are not planned and thus not budgeted, the owner can provide additional budget.

Although there is an increased cost awareness at ICTM3, this has a limited effect. As all costs of customer services are now allocated directly to the owner, they are more or less out of sight of ICTM3. Moreover, the authorisation of CMS even makes it impossible for ICTM3 to retrieve cost information of services and cost places not owned by ICTM3. As a result of that, ICTM3 does not feel responsible for these costs and cost management of ICTM3 concentrates on the services it owns and on how to allocate these costs to the customer services.

Realised cost reductions

This case study revealed a number of decisions that were made based on the improved cost information obtained by the implementation of the method, to reduce the ICT costs allocated. First, business management can now influence the costs of ICT services by changing the service levels of the ICT services they own. Support hours of services are brought back from 16 to 12 hours a day, whereas the maximum downtime is changed from ten minutes to a few hours. This led to significantly lower personnel costs. Second, the functionality of one service has been reduced significantly, whereas two other services are even completely removed. The removal of these two services led to a cost reduction of 3.2 million Euros on personnel costs. All the human resources used for these services were re-deployed for other activities, and if this was not possible, the number of external personnel of ICTM3 was reduced. All hardware and software resources, amounting to annual depreciation costs of around 1.6 million Euros, were used for other services as well. As both services concerned self-made applications, no MSL costs were related to the application software.

Third, several departments of BM3 reconsidered the number of users defined for the various ICT services. A number of users had already left the organisation, whereas for other users, the necessity of the service for their work was questioned. As a result of this, the number of users registered for several applications was decreased, leading to lower costs for software licenses. Due to limited insight in MSL costs, we could not establish the exact dimension of this cost reduction.

Fourth, ICTM3 will replace the server platform identified as underpinning service by a new platform based on technology which is expected to lead to significantly lower costs.

Fifth, the improved understanding of ICT costs was used when deciding whether to outsource the support of a new service or to ask ICTM3 for support. As ICTM3 was now able to calculate and explain their support costs, it turned out that the external supplier was twice as expensive in the end.

All these cost reduction activities resulted in hypothetical savings of more than 5%. However, the overall costs of ICTM3 did not drop, as the released resources were reemployed for new ICT services. Moreover, the overall costs of the ICT services supplied by ICTM3 increased as the allocation of ICT costs was improved. A lot of costs that were still registered for project codes were now transferred to the services of ICTM3. From the perspective of the ICTM3 department this entails an increase in costs, but at organisational level this has no effect on the overall costs. All in all, the overall costs of ICTM3 did not change. But as the benefits of the ICT services were increased, we conclude that the alignment of costs and benefits was improved.

Changed relation with customer

As a result of allocating costs to business management, ICTM3 finds itself more and more in a customer-supplier relationship. According to the management of ICTM3, this creates a distance hampering a close co-operation and partnership in bridging the gap between business and technology. Many costs related to the services provided are beyond the scope of ICTM3, like underpinning services as the corporate network, telephone and licenses of information providers whose financial data is presented and processed by services of ICTM3. ICTM3 wants to be main contractor of the services it provides, and takes over the contacts of these underpinning services.

Now, ICTM3 operates as a service provider, providing services at the request of customers only. ICTM3 cannot carry out any activity that the business has not requested, that is, it cannot invest in knowledge on new technologies and new opportunities of ICT to be prepared for future requests from the business. So ICTM3 operates reactively. To reduce the time to market of new technology and services, ICTM3 wants to operate more proactively. This requires that it can invest independently in (knowledge of) new technology. Furthermore, ICTM3 wants to be more independent when it comes to defining and purchasing hardware and software solutions for the ICT services it supports. Now, customers usually come to ICTM3 with a complete service solution, including the required hardware. Therefore, it is difficult for ICTM3 to realise a degree of standardisation as they now support many different types of platforms, leading to higher support costs. The customer should concentrate more on defining the required quality, including functionality, and leave the identification of the most optimal technical solution to ICTM3. A higher degree of standardisation makes the infrastructure of the services more generic and reduces the asset specificity. This will improve the controllability of the costs of operational ICT. Gaining ownership of the customer services might be a way for ICTM3 to realise such standardisation.

Management information systems

Using the right tools is essential when one wants to automate all activities to collect, process and represent the cost information. As the current information systems did not line up exactly with the allocation strategy of ICTM3, the customers of ICTM3 had a hard time acquiring the required management information. Furthermore, all changes in the services have to be administered properly. This required not only an accurate purchasing procedure but all purchases had to be checked after administration in the asset management database, as the asset management database is still not accurate enough.

Finally, the internal cost allocation structure of BM3 clouded the ICT allocation strategy. Therefore, for the management of BM3 it was often very difficult to link the costs on their financial reports to the ICT costs allocated as reported by CMS. The various systems providing processing cost management data can be integrated to a much greater extent to improve efficiency and provide a better overview of costs.

Rates

Some rates defined by C2 do not represent the actual costs of the services. Costs of work places, for example, were allocated through a rate per workplace and printer. This rate included the costs of related software and support by the central network and office automation department. The rate was defined by summarising all costs related to these hardware and software items and dividing this sum by the total number of workplaces and printers, respectively. The monthly cost allocation was based on this rate and the number of workplaces and printers of each department was extracted from the asset database.

This allocation strategy did not take into account that the central department did not support all workplaces. ICTM3, for example, manages its own workplaces and that of the dealing room, and at that time the back-office department of BM3 had its own support group as well. Furthermore, the rates neglected price differences in different types of hardware. On average, this just leads to minor differences for most departments. However, the workplaces in the dealing room are significantly more expensive than those deployed by the average office department. Although on average the hardware of a dealing-room workplace is already four or five times more expensive, the same rate per workplace is allocated.

Furthermore, the hourly rate defined by the central financial department of C2 appears to be much too high for ICTM3. The costs allocated by ICTM3 were much higher than those actually incurred, resulting in a surplus on their profit-and-loss account. Now, the hourly rate of ICTM3 has been reduced with about 13%. ICTM3 itself believes that eventually it can even be reduced with another 18%. These reductions do not directly lead to lower overall ICT costs, but in an improved relation between the costs and the activities for which they are incurred so that costs can be managed better.

ICTM3 is considering introducing further improvements in their allocation strategy and the rate defined. The current cost allocation strategy, which is based on actual costs and the principles of capacity available, appears to be suitable for customer specific services. As almost all customer services of ICTM3 are to some extent customer specific, this allocation strategy should be suitable for all the ICT services provided by ICTM3. The owner can then re-allocate these costs to the end-user departments. In combination with business management it improves the user information to increase the accuracy of the re-allocation of customer services based on numbers of users per department.

However, ICTM3 is also considering cost allocation based on a price per transaction, as for many services the primary functionality is processing business transactions. If the boundaries of the capacity available are met, more transactions will lead to higher costs for the service. Furthermore, some management levels of BM3 want to know the costs per transaction. As they calculate with average revenues per transaction, it helps them to determine the average profit per transaction. However, as by far most costs of the supporting ICT services are fixed, the costs per transaction depend on the volume. The ICT costs per transaction will fall if the number of transactions rises. Moreover, if it is decided to turn off or replace a service, the price per transaction will increase retroactively as a result of ongoing depreciation costs for hardware and software. This is very undesirable for planning and control purposes. If the number of transactions and the number of users are very large, like in the mainframe environment, the average number of transactions can be more predictable. Then, the ICT department has a limited risk that the allocation will not compensate for all costs. However, as the costs allocated are sensitive to fluctuations in the number of transactions, the customer is not sure about the costs that will be allocated. As there is a relation between the number of transactions processed and the costs allocated, this may influence the customer's behaviour. In

that way, the cost allocation based on a price per transaction may be, for example, a means to make a dealer aware of the fact that each transaction closed leads to costs at the back office too. For a dealer, more or less transactions does not matter; only profitability matters, but for the back-office processing all these transactions, fluctuations in the volume do make a difference. Although many activities are automated by ICT services, processing transactions by the back office still requires a substantial number of personnel. More transactions require more personnel, so part of these costs is variable. Now, the allocation strategy serves a specific goal: to limit the number of dealer transactions to some extent. Then the back office is responsible for the price per transaction and for the decision to charge its services through a price per transaction.

Fixed price, actual costs, a fee per user or a price per transaction are then choices not to be made for the allocation between the ICT department and system owner, but between system owner and the end users of that service. The fact that the actual re-allocation is facilitated by ICTM3 as this department has the required information on users and transactions does not make ICTM3 owner, nor does it change the responsibilities of the system owner.

Learning period
The period after implementation of the method presented in this thesis can be characterised as a period of learning. The organisation had to learn to deal with the new situation, the new responsibility accounting structure, and to use the increased understanding of the costs and quality of the ICT services. Experiences gained during this learning process can lead to improvements in the application of the method and to changes in the four models designed, being the Service Provision Model, Responsibility Centres Model and the Service Quality and Costing Models. For example, ICTM3 is working on detailing the Service Costing Model further by splitting the costs of its internal service of service support processes into costs for the help desk and for tactical processes. Furthermore, several activities are identified to improve the accuracy of rates and to improve the accounting structure.

One year is experienced as being too short a period to be able to witness the complete impact of the method, as people have to learn to deal with the new opportunities to manage ICT costs. Managers of organisation C focus mostly on profits, not on costs. It requires a lot of energy and time to change this. Management has to be aware that every business activity of the organisation does not only lead to profits, but to costs as well. They have to learn to deal with their new responsibilities and with the new opportunities to align costs and benefits. This is expected to take at least one planning and control cycle in which budgets are planned according to the new accounting structure and controlled during the budget period. As in most organisations the budget period covers one year, the learning period is expected to take at least one year. Due to the reorganisation, organisation C did not reach that point.

6.3.6 Conclusions
From this case study we learned that the implementation of the method requires a lot of effort. The definition of the ICT services and the identification of owners, but most of all the identification of the costs of each ICT service and adaptation of the financial systems were very time consuming. It took the ICT department about 9 months to implement the principles of the method and another 6 months for one of the commercial departments to receive the allocated ICT costs. The implementation time could be much shorter if the commercial department, like other departments, had participated in the first stage and if all ICT departments had applied the same allocation strategy. It is expected that the time required to implement the method will be shorter when more experience in implementing the method has

been gained, more resources are available and the required information is available more easily. We believe that the implementation will still be time consuming and will take considerable time as the knowledge of the organisation's personnel is required, for example, to define services and to allocate costs to these services. Because during the trial, apart from participating in the implementation the personnel also had to carry out their daily operational activities, we believe that the time required for implementation can be shortened limitedly.

From this case study we conclude that it was possible to define a set of customer, underpinning and internal services covering all ICT components of the organisation involved in this case study. The results of that are illustrated in the service provision model presented in figure 6.2. Furthermore, we conclude that it was possible to identify a single owner for each ICT service. The first list of owners was established very easily, but when it was clear that the owner would have to account for all costs of the ICT service, there was some resistance. Apparently, business management wanted to be owner of an ICT service if this only involved having control over the ICT service, but not if it included bearing all related costs as well. Explaining the re-allocation strategy and providing automated tools to realise this could remove most objections.

We also conclude that it was possible to define management information for each ICT service in terms of its costs and quality. The initial calculation of the cost price of each ICT service was very time consuming as the existing asset and financial administrations were not accurate and did not contain the required data. Using the experience of the personnel, we could determine the cost price of each ICT service based on the data available. During this initial allocation of ICT means to the services, we improved the reliability and completeness of the available data by making an inventory of all ICT means in the computer rooms. Finally, the quality of the ICT services could be expressed in measurable performance indicators representing the quality of the ICT service in terms of the functionality, availability and performance (see figure 6.4).
Overall, we conclude that this case study demonstrates that it is possible to implement the method presented in chapter 5.

After implementation, a learning period begins in which the management of the organisation and the owners identified have to learn to deal with the new responsibility accounting structure and to use the increased understanding of the costs and quality of the ICT services. We expect that this period of learning takes at least one planning and control cycle, or, in other words, one budget period.

Based on the experiences of the organisation after the implementation of the method, we conclude that the management has an increased understanding of the costs of operational ICT and its contribution to the business processes and thus of the benefits. As costs and benefits are known for each ICT service, the management can relate costs and benefits and weigh them against each other. We also conclude that the organisation used this information to improve the alignment of operational ICT, as after implementation, several activities were initiated, resulting in significant cost reductions. These actions were defined based on the increased understanding of costs and benefits obtained through the implementation of the method. The case study showed that organisation C used the increased understanding to initiate significant cost reductions by removing non-paying ICT services and by improving the cost/benefit relation of other ICT services by decreasing their quality level. All in all, these activities did not change the cost level of organisation C. But as the released resources

were reemployed for new ICT services, the overall benefits increased and so the alignment of costs and benefits had improved.

Overall, we conclude that this case study demonstrates that the implementation of the method has increased the organisation's understanding of the alignment of operational ICT. Management of the organisation knows the costs and benefits of the operational ICT and can relate these costs and benefits through the ICT services that they concern. Moreover, the organisation has shown that based on this information, it can define actions to improve the alignment of operational ICT.

Furthermore, the applicability of the method is demonstrated as this case study showed that:
- a set of customer services, underpinning services and internal ICT services could be defined;
- for each ICT service a single owner could be identified, and that
- for each ICT service, management information could be identified in terms of costs and quality.

6.4   Case E: a retrospective case study

In this paragraph the responsibility accounting part of the method is validated by using it as a reference model to analyse an existing situation. First, the outline of this case study is presented, and the context and content of case study E are discussed. Second, the processes for the alignment of operational ICT observed in organisation E are discussed. Furthermore, we evaluate the experiences with the method to align the benefits and burdens of operational ICT. This paragraph ends by summarising the findings of this case study and by drawing some conclusions.

6.4.1   Outline of the case study

In this case study, the method for the alignment of operational ICT applied by organisation E is studied and described. Applying the method presented in chapter 5 as reference model, we evaluated the observed method. Differences and similarities between the method of organisation E and the reference method are analysed and discussed with the organisation.

The case study is carried out though a number of structured interviews with management and controllers of the business management department BM5 and the ICT management business unit E2. The objective of the case study is to identify the characteristics of the method applied by the organisation for the alignment of operational ICT and the organisation's experiences with the application of this method. To enable comparison of this case study with the other case study organisations discussed in chapter 3, information was gathered on the context and content as well.

The interviews are carried out according to the procedure of the first series of case studies (see paragraph 3.2). That is, the set of interviewees was selected in discussion with the organisation, the interviews followed a fixed structure and each interview was recorded. By asking each interviewee to validate the interview report, the results of each interview were checked. The overall observations and conclusions were presented in a case study report that had to be validated by the case organisation.

In the following paragraphs, the context and content of the case study are discussed. Further, the observed method applied by the organisation for the alignment of operational ICT is described and the organisation's experiences with that method are discussed. Finally, the method observed is compared with the method presented in chapter 5, differences are discussed and a number of conclusions are drawn.

6.4.2 Context and content

Case E is conducted in the Dutch division of a British financial multinational. The Dutch division consists of around 6500 employees and provides a variety of financial products for the Benelux and Germany, including insurances, loans and payments. A couple of years ago, this division merged with two other Dutch insurance companies. The process of integration is still running. In this case study, two business units are involved that are part of the Dutch organisation.

Business unit E1 (figure 6.6) provides a series of life and damage insurance products. As most products are sold indirectly via independent agents, both insured persons and agents can be identified as the business unit's customers. Business management department BM5 is part of the marketing and sales department of E1. With more than 40 employees it is responsible for advising and supporting the independent agents selling the insurance products of E1. A business architect and an information manager, both in a staff department, are responsible for designing the business processes and for defining the information systems supporting these processes, respectively. Department BM5 is also responsible for the functional management of all ICT applications for the marketing and sales department. These functional management activities are concentrated in the functional management department FM5 of BM5. Some of the applications managed are utilised by other departments or business units of E1 too.

Currently, the marketing and sales department is going through a major change process as a new distribution policy is being implemented. This has major implications for the ICT applications of the marketing and sales department as well.

Case E
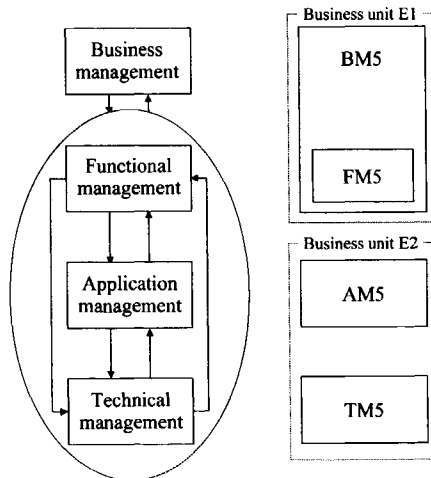
Figure 6.6 Context of case E in relation to Looijen's model

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Business unit E2 takes care of technical and application management of the Dutch division and consists of three computer centres, as each of the merged organisations had one of their own. When the case study was conducted, E2 was transforming these three centres into a single computer centre. Technical management department TM5 takes care of technical management of around 100 Unix and Windows NT systems and 2 mainframe systems. The local hardware, including networks and PCs, is spread over all 14 buildings of the Dutch division throughout the Netherlands. Application management department AM5 takes care of application development and management for business unit E1. Together the application management departments manage more than 800 applications, including 8 applications for BM5. An account manager manages the contacts between E2 and the business management departments, like BM5.

Years ago, the management of the Dutch division decided that each department should only buy ICT services from the central ICT business unit E2. According to the division management, concentrating ICT activities leads to a more professional organisation and minimises the risk of local optimisation. Corporate management had concluded on the basis of past experiences that when departments were free to select an ICT supplier by themselves, the contracts and systems were more expensive, leading to higher costs. Now, no ICT activities can be deployed without a formal assignment for the ICT business unit E2. According to division management, business management should concentrate on business activities and leave ICT to E2. E2 has a lot of knowledge on the business processes to fill the gap between ICT and business, as most ICT personnel has a business background and there is a low turnover of personnel of 2%. To structure contact between business and ICT, account managers and information managers are identified for ICT and business respectively.

The information on the costs and turnover over the year 2000 is derived from the financial reports. As the financial administrations of the merged organisations were not merged, these figures concern the situation before the merge. The overall costs of the Dutch organisation were around €274 million in 2000, of which around €94.5 million concerns ICT costs.

6.4.3 Process

This paragraph describes the method for the alignment of operational ICT as applied by the management of organisation E. To describe the observations structurally and to enable a comparison with case D and the reference method of chapter 5 we describe the situation by discussing the ICT services defined and the allocation of responsibilities.

The central ICT business unit E2 supports 800 applications. Each of these applications is defined as a separate ICT service, including all resources like hardware, system and application software required to utilise the application to support the organisation's business processes. Although the distinction between customer services, underpinning services and internal services is not made explicitly, the ICT services identified include all three types. In other words, the ICT services defined by E2 include business applications, infrastructure facilities like PCs and networks and applications to support ICT management activities.

Corporate management of the Dutch organisation has decided that business management is overall responsible for ICT, as ICT is only deployed to support their business processes. So, each business management department is potentially identified as responsibility centre for ICT services. In this case study, each department of the marketing and sales department, including the departments BM5 and FM5, can potentially be assigned the role of responsibility centre. The central ICT business unit E2 is identified as possible responsibility centre for services provided by external parties, for infrastructure services and for services supporting its ICT management activities.

For each customer ICT service, ownership is assigned to a single business management department. In case an ICT service is utilised by several departments, one of the departments is appointed as owner and acts as a representative for all other business management departments. The marketing and sales department is assigned ownership of eight ICT services. For six of these services, ownership is explicitly assigned to FM5. The ownership of the remaining two services is not clear, but it is supposed to be assigned to the information manager or the controller of the marketing and sales department. Ownership of all infrastructure services like networks and PCs is assigned to the technical management department TM5.

For each ICT service, service levels are agreed between the owner and the central ICT business unit E2. Each business management department has a single service level agreement (SLA) with E2 covering all customer services owned as well as the infrastructure services utilised. Each SLA describes the services provided by E2 and defines the service levels according to a number of quality aspects, like availability and performance. The availability is expressed in terms of the number of incidents and the average time to solve them, whereas the performance is expressed in the average number of seconds required by the ICT service to process a defined transaction. The owner periodically receives reports on the quality of the services realised based on the quality aspects mentioned in the SLA. The controllers of the business management department and business unit E2 take care of the financial part of the SLA, in which the rates are defined. The rates applied by E2 are under discussion, but both the business management and E2 believe that this stimulates both parties to pay attention to the rates and the costs of ICT.

All costs of ICT services are allocated monthly to the owners based on the CPU utilisation, storage capacity, printing pages and hours spent by ICT personnel. In this way, E2 aims at a zero result by allocating all its costs to its customers. Costs are allocated directly to each ICT service as much as possible, like for dedicated hardware and software. Indirect costs are attributed to several ICT services according to the principles of activity-based costing. Costs of personnel are allocated through hourly rates. Hours spent on the exploitation of operational ICT are attributed to the ICT service concerned, and hours for maintenance and projects are allocated per order. The costs of each service are allocated in equal monthly terms based on the estimated costs. At the end of the year, actual and budgeted usage is compared and differences are settled.

The owner incorporates the allocated ICT costs in the cost price of its own products or services, for example bookings. If other departments make use of the ICT service too, the owner is responsible for re-allocating these ICT costs to the departments concerned. Allocated costs are booked in the general ledger to the cost centre of the owner. Currently, ICT costs are re-allocated manually, but organisation E is working on an automated system. As ICT services are not identified as separate cost centres in the general ledger, the costs of each ICT service are administered separately. So, the costs of each ICT service have to be looked up in this separate administration.

The ICT management department TM5 has developed an automated system for their cost control. The managers of the departments of TM5 are responsible for entering the correct data into the system. So, the reliability of the figures depends highly on the their accuracy and honesty. But higher management has cost information on the overall performance of TM5 to check the sum of the data entered. Each department has certain targets to be met and has defined their own management information to control these targets and to deliver more

detailed reports to the customer. Furthermore, several reports can be extracted from the time registration system. For more qualitative reporting, management letters are used.

6.4.4   Experiences with the method

The basic principles of the method, like a single owner for each ICT service and the cost allocation strategy, were implemented in organisation E many years ago. The exact time is unknown, but the managers involved in this case study claim that it is more than 10 years ago. The structure of account management, information management and business architect was adopted about three years ago. For the business units that joined the organisation as a result of the merge, both principles are new. As many principles of the method were implemented several years ago, not all choices regarding the design of the alignment method by corporate management or business unit management could be evaluated.

The experiences of organisation E with the method to align costs and benefits of operational ICT are evaluated through a number of structured interviews with the management of the departments co-operating in this case study. These experiences are discussed in this paragraph and categorised into four items, being the utilisation of the management information available, the cost reduction activities identified, the relation between business management and ICT management and the management of the benefits of operational ICT.
The management of the departments studied in principle has at its disposal management information on the costs and quality of the ICT services utilised. However, not all owners use the management information available to the same degree for the alignment of operational ICT. The case study revealed two main reasons for this.

First, the performance of several departments is not evaluated based on the costs and benefits of operational ICT, but on their overall costs. Budgets of departments like BM5 are defined in total and not specified per ICT service. As a result of this, these departments are not interested in the costs of operational ICT at all, although the information is available. Higher management assumes that if the overall costs are too high, business management is able to identify ways to reduce costs, including costs of operational ICT. However, the case study shows that when they allocate costs to the business management, higher management cannot assume that they automatically take on the accompanying responsibilities as well. These responsibilities must be part of the overall accounting structure of the business as well. The realisation of this is complicated, as each business unit is managed differently. Some departments receive directions from the management that are high level and concern the overall objectives only, whereas other departments receive directions for a very detailed level and concern even the planning of the activities per team. Political games are being played and responsibilities are evaded if possible. Reorganisations and changes in management make it difficult to make progress and to improve the application of the method and the roles identified. When the case study was conducted, the focus was on realising the projects defined and not on reducing costs of day-to-day operations.

Second, the case study shows that the alignment method is not implemented completely in all its aspects for the entire organisation. Ownership is not assigned explicitly enough for all ICT services, so for these services, no one is responsible at all. This gap is illustrated by the fact that SLAs have not been made for all ICT services. Furthermore, not the costs of all relevant ICT services have been re-allocated from owners to other departments. In particular where applications with an infrastructure character utilised by several business units are concerned, it must be considered whether ownership is assigned correctly.

Based on the available cost information, the marketing and sales department has defined a number of activities to reduce the costs of operational ICT. Most cost-reduction activities concentrate on reducing the number of applications and interfaces. A smaller number of applications do not directly result in lower ICT costs, as all functionality is taken over by other applications. Therefore this activity does not lead to significantly lower cost for the operational ICT, but to lower personnel costs for the business management departments as a result of more uniform processes and fewer administrative actions. On the other hand, fewer interfaces as a result of fewer applications do lead to lower ICT costs, as interfaces require a lot of maintenance.

As business management defines the needs for ICT services, the central ICT business unit E2 acts reactively by only responding to the request from business management. E2 cannot act proactively, as it has no budget to fund activities that have no business sponsor yet. Particularly with new technology offering new opportunities, this can be a problem, as E2 can only take action at the request of a customer. Now, the first customer is charged for all costs, including the initial investments. At the same time, the time to market can be shortened significantly if E2 can act proactively and be prepared for new demands from its customers. The central ICT business unit E2 has a budget for infrastructure investments alone and even for these investments it is difficult to provide economic justification. The importance of these investments is recognised by the management, but supplying a sound justification is still difficult. The most important reason is that when it comes to ICT, it is hard to identify a direct relation between costs and revenues. Establishing such a relation is even more difficult when it comes to investing in knowledge of new technologies to anticipate on possible future customer demands.

Organisation E has not succeeded in solving the problem of determining the benefits of its operational ICT. The contribution of an application to the effectiveness of the sales activities is very difficult to quantify, as it is very hard to determine what extra revenues are a result of the utilisation of that application. There are more factors influencing customer behaviour that may lead to increased revenues. The benefits of, for example, a customer relation management application can be measured indirectly by measuring the customer satisfaction before and after the implementation. But more satisfied customers are just one factor that may lead to higher revenues, next to market growth, the economic situation and the behaviour of the competition. A way to solve this problem might be considering the contribution of ICT to the administrations supporting the business processes of business unit E1. Most ICT costs of E1 are related to the administrations supported by ICT. As the business processes of E1 are very information intensive, it has several administrations to support the execution of these processes. Each administration involves costs for collecting, processing and storing data. The choice of which parts of these administrations to automate and which not, directly determines the dimension of the ICT costs. To manage the costs and benefits of operational ICT, E1 should evaluate carefully which administrations are essential for its business processes and which should be automated.

6.4.5 Conclusions

Organisation E has several years of experience with the cost allocation strategy and single ownership for each service. Nevertheless, the method is not implemented throughout the entire organisation consequently. For example, ownership is not assigned explicitly for all ICT services, and responsibilities are not incorporated in the overall accounting structure. As a result of this, the maturity of the alignment of operational ICT varies throughout the organisation.

If ownership is assigned explicitly to an owner and management information on the costs and quality of the ICT service are available, the discussions on ICT have moved to the contribution of ICT to business performance. However, organisation E has not solved the problem of linking costs of operational ICT to revenues. Furthermore, the central ICT business unit E2 is faced with the problem of justifying investments in ICT infrastructure components and with the fact that it cannot operate proactively towards its customers.

Based on the results of this case study, we conclude that it is possible to define a set of customer services, underpinning services and internal services covering all ICT components of the organisation. Furthermore, it is possible to identify a single owner for each ICT service and to define management information representing the costs and benefits of each ICT service. Ultimately, the management can define actions for cost reduction based on this management information. Therefore, we conclude that it is possible to implement the method presented in chapter 5.

Furthermore, we conclude that in principle the management has insight in the costs and quality of the operational ICT so that they can relate these to each other. But, this increased understanding does not enable the management to link the costs and benefits of an ICT service. The obtained understanding of the costs and quality of an ICT service does enable the management to define actions to reduce costs, and thus to improve the alignment of operational ICT. In some cases these actions do not result in lower costs for the ICT departments, but in lower costs for the business management departments.
Moreover, as not all owners pay attention to the alignment of operational ICT, we conclude from this case study that the application of the method requires an active approach. The definition of ICT services, the assignment of owners and the definition of management information alone are not sufficient to start the process of aligning operational ICT. The owners must carry out their assigned responsibilities, and periodically be reminded of them. Part of their performance evaluation must be based on their alignment of operational ICT. If not, the owners will not take their responsibilities and the costs and benefits of operational ICT will not be managed or aligned. The case study showed that some owners did pay attention to the alignment of operational ICT, but this is more dictated by their personal convictions than by actions of higher management.

All in all, we conclude that implementing the method for the alignment of operational ICT does not necessarily lead to the intended impact. The implemented method requires continuous attention and it must be incorporated in the organisation's management processes. Otherwise, there is a serious risk that owners will not use the available management information to align the costs and quality of the ICT services.

6.5   Conclusions

The validation of part of the method as presented in chapter 5 is discussed in this chapter. The application of the responsibility accounting part of the method was studied in practice in two case studies. In case D, responsibility accounting for operational ICT was implemented in an action research type of case study. In case E, another organisation was studied that already had implemented its own responsibility structure for the alignment of operational ICT that resembles the most important characteristics of the method designed in this thesis. In both case studies, the experiences with the application of the method and its impact on the alignment of operational ICT were evaluated through a number of structured interviews with the management responsible. The objective of the validation case studies is to check the

applicability of the method presented in chapter 5. It is claimed that the applicability of the method is demonstrated if it is possible to implement responsibility accounting for operational ICT, as discussed in paragraph 5.4, and if the implementation increases the organisation's understanding of the alignment of operational ICT.

Both case studies indicated that it is possible to implement the principles of responsibility accounting for operational ICT. But case D showed that the implementation is very time consuming. Among others, the period required for implementation depends on the availability of key personnel and the reliability and completeness of the financial and asset data available. Furthermore, resistance against the allocation of costs to the owners as these costs affect the profit-and-loss account on which their performance is evaluated, might delay the implementation of the project as well.

After implementation, a learning period starts in which the organisation has to learn to align the operational ICT according to the method implemented (case D). Benefits of the application of the method gradually appear during the learning period. The management of the organisation and the owners identified also have to learn how to deal with the new responsibility accounting structure and to use the increased understanding in the costs and quality of the ICT services. We expect that this period of learning takes at least one planning and control cycle, or in other words, one budget period.

Both cases indicate that the application of the method potentially leads to an increased understanding of the alignment of operational ICT. Case D showed that the introduction of the method led to significant cost reductions, whereas in case E the application of the method enabled the management to evaluate costs and quality of operational ICT. Based on these evaluations the management of organisation E defined actions to reduce costs and thus to improve the alignment of operational ICT. In some cases these actions do not result in lower costs for the ICT departments, but in lower costs for the business management departments.

Furthermore, from case E we conclude that as a result of the application of the method, the discussions on ICT have moved to the contribution of ICT to business performance. However, the method did not enable the organisation to link the costs of operational ICT to benefits.

However, these benefits of the implementation and application of the method do not automatically lead to a better process of aligning operational ICT. We conclude from case E that the application of the method requires an active approach. The definition of ICT services, the assignment of owners and the definition of management information alone are not sufficient to start the process of aligning operational ICT. The assigned responsibilities must be put in practice and the owners must be reminded of their responsibilities. This can only be realised by including the alignment of operational ICT in the organisation's management process, according to which the performance of managers is evaluated. If not, the owners will not take their responsibilities and the costs and quality of operational ICT will not be managed or aligned. Case E showed that if the alignment is not incorporated in the evaluation of the owner's performance, only a few owners will pay attention to the alignment of operational ICT depending on their personal conviction of its importance. Owners that are not convinced of its importance will not make use of the available management information to align the costs and quality of the ICT services.

Summarising we conclude that the applicability of the method presented in chapter 5 is demonstrated in this chapter, as we demonstrated that the method can be implemented and that it could increase the organisation's understanding of the alignment of operational ICT. This increased understanding can result in significant cost reductions and improved decisions

on the costs and quality of operational ICT. However, we also conclude that the application of the method does not necessarily lead to the intended impact: improved alignment of operational ICT. The application of the method requires continuous attention and it must be incorporated in the organisation's management processes.

Finally, we conclude that the method influences the alignment of the costs and quality of operational ICT and that it does not enable an organisation to link costs and benefits. However, considering the relation between business results and investments in ICT discussed in chapter 1, business results are realised through many factors, of which ICT is just one (Thorp, 1998; Hoogeveen, 1997). Therefore, we conclude that the problem of linking these factors, and so ICT, to business performance should be solved from a business management perspective, not from an ICT management perspective as in this research.

7 Summary

7.1 Introduction

"Operations is what happens while everyone else is making plans." This statement of an ICT manager of a Dutch financial institute that is based on a John Lennon song lyric reflects the starting point of the research presented in this thesis. Most effort on the improvement of business performance through the implementation of information and communication technology (ICT) is spent on finding and evaluating opportunities for new investments. In the past decades, a lot of attention has been paid to judging and justifying investment proposals on economic grounds. When a new ICT application is developed and implemented, hardly any attention is paid to its costs and benefits. This despite the fact that benefits are only realised by its business application (Thorp, 1998), whereas a large part of the costs of ICT are incurred after implementation (Hinton and Kaye, 1996). All activities that are carried out before the implementation of an ICT application can in fact be considered as planning activities, as they do not influence the business performance.

The objective of the research discussed in this thesis was to design a method for the alignment of operational ICT. The alignment of operational ICT is in this thesis defined as realising the optimal balance between the costs and benefits of operational ICT. The relevance of such a method is discussed in chapter 1. A literature overview including the method and techniques used for managing costs and benefits is presented in chapter 2. In chapter 3 three explorative case studies are discussed studying the management of costs and benefits of operational ICT in practice. The observations of these case studies are elaborated on and analysed in chapter 4. Based on the literature study and the case studies, a method for the alignment of costs and benefits of operational ICT is designed. This method is and presented in chapter 5. The applicability and usefulness of the method is tested in practice in two concluding case studies. This summary discusses the most important results of the research. At the same time it gives a short description of the designed method as well as the experiences with the application of the method. The research approach is evaluated and suggestions are given for further research.

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7.2 Research question

The research presented in this thesis has been carried out at the Information Systems department of the Faculty of Information, Technology and Systems of the Delft University of Technology. The research has been carried out within the research theme *economic aspects of ICT management* of the chair *Information Strategy and Management of Information Systems*. Although this field of research gained increasing attention in the past decade, not much attention was paid to the evaluation of benefits and burdens of operational ICT. This regardless of the fact that large part of the ICT costs of organisations is caused by operational ICT (Hinton and Kaye, 1996) and that benefits of ICT are realised only in the operational stage (Thorp, 1998). Literature on the benefits and burdens of operational ICT concentrates on them separately. So literature does not consider a simultaneous evaluation of the benefits and burdens of operational ICT.

The research problem addressed in this thesis is the problem of the alignment of operational ICT. The alignment of operational ICT is defined as optimising the value of operational ICT to meet the organisation's requirements for ICT. These requirements can differ per organisation. Furthermore, organisations are expected to search for a balance that satisfies their particular needs, not a general optimal one.

The following research question underlies to the research presented in this thesis:
> *How should we align the benefits and burdens of operational ICT?*

In association with this research question, we had to answer the following sub-questions:
- What benefits and burdens of operational ICT have to be identified?
- To what extent can benefits and burdens of operational ICT be influenced?
- What methods are available to support the alignment of operational ICT?

7.3 Three case studies

As no previous research on the management of costs and benefits of operational ICT had been reported, three descriptive case studies have been carried out. The case studies have been carried out at three major financial organisations in the Netherlands. In each case study several departments were involved so that in each study all roles in ICT management came up: technical management, application management and functional management.

The objective of the case studies was to study the management of benefits and burdens of operational ICT in practice. The knowledge gained in these case studies can be used to formulate an answer to the sub questions defined in the preceding paragraph. The following paragraphs provide a brief summary of the answers to these questions.

7.3.1 What benefits and burdens have to be identified?

The costs and quality of operational ICT have to be identified for the alignment of the benefits and burdens of operational ICT.

The benefits and burdens of operational ICT have to be expressed in terms of the costs and quality. The costs of an ICT service can be specified on two axes. The first axis represents the type of ICT resource these costs are incurred, like human resources, hardware and software. The second one represents the type of cost, like depreciation costs, personnel costs or costs of

licences or maintenance and support contracts. The precise definition of these categories depends on what costs the organisation wants to control.

For the quality of an ICT service, at least the following attributes have to be identified: *functionality, availability, performance, output quality, completeness, correctness* and *timeliness*.

In practice, theoretical economic models to assign revenues to operational ICT are not applied, as they are too complex and costly. Therefore we conclude that in practice assigning the revenues of an organisation to operational ICT is arbitrary. ICT is just one of the means of an organisation that influences the performance of the organisation next to other external and internal factors. Therefore, we claim that this will not contribute to the alignment of the benefits and burdens of operational ICT. Organisations should manage their revenues from the perspective that improved business performance and revenues are the result of a combination of several means.

7.3.2   To what extent can benefits and burdens be influenced?

For the organisation, the costs of operational ICT are mostly fixed, as the dimension of these costs has no direct relation with the volume of the products or services provided by the organisation. The conclusion that most costs of operational ICT are fixed does not mean that these costs cannot be influenced. The descriptive case studies revealed several opportunities to reduce costs. These opportunities range from a more efficient utilisation, concentrating and standardising of ICT means to reducing the quality requirements or replacing the ICT service with a cheaper one. The dimension of the savings that can be realised depends among others on the extent to which contracts can be terminated and production means can be sold or re-employed for other services.

The management of the case organisations indicate that around 10% to 15% of these costs can be influenced.[17] This percentage can be higher or lower, depending on the quality and age of a service. Poor-quality ICT services provide more opportunities for cost reductions, whereas for older services several opportunities for cost reductions have already been utilised. None of the case organisations measures, monitors or evaluates the progress and results of the cost reduction activities. Therefore, an answer to to what extent the costs of operational ICT can be influenced cannot be given, other than that the management of the organisations studied believes that between 10% to 15% of these costs can be influenced.

Remarkably, most cost reductions do not visibly result in less costs in practice, as the freed resources are usually directly reused to increase the service levels or to provide new services. Obviously, when budgets are formalised, the management of the case organisations do not focus on reducing costs but on increasing their service provision within the fixed budget.

Concerning quality improvements, the organisations studied paid most attention to improving the efficiency of the ICT organisation and increasing the quality of the ICT services provided. Like with the cost reduction activities of the ICT departments, these activities for quality improvements are not quantified, measured, monitored or evaluated. Therefore, the extent to which the quality can be influenced cannot be determined either.

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[17] The estimation that 10% to 15% of the costs can be subject to cost reduction strategies does not mean that the ICT costs can be reduced with 10% to 15%. Furthermore, each cost-reduction action requires an initial investment and can lead to additional continuous costs as well, for example, when activities are automated.

7.3.3 What methods are available for the alignment of operational ICT?

The case studies revealed that the organisations studied apply several methods to support the alignment of the benefits and burdens of operational ICT. The methods observed in practice concentrate mainly on the management of costs and revenues.

Budgeting is applied by all organisations studied to plan and control the costs and revenues at all organisational levels, from departmental level to business unit level to corporate level. All organisations apply a form of *activity-based costing* to attribute costs to products or services for cost price calculations or cost allocation. Cost allocation is usually applied to allocate all costs to the commercial departments so that the total costs can easily be compared to the revenues.

Service level agreements are applied to formalise and quantify financial and non-financial arrangements on provided services between business units and in some cases between departments too. Furthermore, the organisations examined are studying the usability of the Balanced Scorecard (BSC) for planning and control purposes, but it is only used to a limited extent. Two case organisations have defined a BSC at corporate level, and one organisation has defined an ICT-BSC as well and the ICT department of another case organisation was working on the development of an ICT-BSC when the case study was carried out.

Overall, we conclude that the methods observed in practice are related to just a specific part of the alignment of operational ICT. An integral method considering costs, revenues as well as non-financial aspects of operational ICT is missing.

7.3.4 Conclusions on the research question

The case studies provided insight in the alignment of operational ICT in practice. The alignment of operational ICT should concentrate on the costs and the quality of operational ICT. The costs of operational ICT are mainly fixed, but they can be influenced in several ways. Service level agreements, budgeting, the Balanced Scorecard and the Goal/Question/Metric method are means to support the management of organisations in the alignment of operational ICT. However, organisations are still confronted with problems regarding the alignment of operational ICT. They appear to be unable to solve the problems observed using the current means, as an integral method is missing.

Before designing a new method for the alignment of operational ICT, one should question the benefits of such a method. As for the organisation most of the costs and benefits of operational ICT are fixed, it might not be worthwhile to pay attention to the alignment of operational ICT. They might rather want to concentrate on the other stages of the life cycle of an ICT service. We claim that it is important for organisations to pay significant attention to the alignment of operational ICT, for three reasons.

First of all, if organisations want to know the dimension of their costs and for what these costs are incurred, they need to consider the costs of operational ICT. After all, these costs make up the largest part of the ICT costs of an organisation. Moreover, although most costs of operational ICT are fixed, these costs can be influenced. Due to the dimension of the costs of operational ICT, a reduction of one or two percent runs into millions of Euros rapidly.
Second, benefits of an ICT service are realised only by its utilisation and thus when the ICT service is operational. So, proper utilisation of an ICT service is a very important contributing factor. Benefits do not just happen and benefit realisation is a continuous process, for which reason the benefits of operational ICT deserve continuous attention. The case studies showed

that sometimes ICT services are still operational even when they are hardly or not used. If the benefits of that service are not identified or managed, a proper cost/benefit evaluation will never be made.

Third, the fact that most costs and benefits of operational ICT are fixed indicates that they are the result of decision made in previous stages of the life cycle. So, obviously by far the largest part of the costs and benefits of operational ICT can be influenced only in the stages preceding the operational stage. The understanding of the dimension, composition and origins of these costs and benefits obtained in the operational stage can be used to improve the activities and decision-making in the preceding stages of the life cycle.

Therefore, we conclude that it is worthwhile for each organisation to pay attention to the operational stage of their ICT.

7.4   A method for the alignment of operational ICT

Because the current methods identified do not provide a solution for the problems organisations are confronted with in practice, we designed a new method for the alignment of operational ICT. Such a method should provide a general framework for the alignment of operational ICT and show how to utilise and combine existing methods. The method presented in this thesis is designed to provide this solution.

7.4.1   Short description of the method

The method presented in this thesis concentrates particularly on solving the main problem concerning the management of benefits and burdens of operational ICT as observed in the descriptive case studies. These problems are the integral assignment of responsibilities for the alignment of operational ICT and the realisation of the related management information.

The method is designed to help organisations to solve these problems by increasing the understanding of the management of the organisation in the alignment of operational ICT. In other words, the management of the organisation will:
- know the costs of the operational ICT;
- know the benefits of the operational ICT;
- relate the benefits of operational ICT to costs;
- define actions based on this information to improve the alignment of the costs and benefits of operational ICT.

The method consists of two parts. Part one indicates how organisations should assign responsibilities and authorities. Part two describes a number of techniques to support the management further in the alignment of operational ICT.

Part 1: Assigning responsibilities and authorities

Part one of the method concerns the integral assignment of responsibilities and authorities regarding the operational ICT. This is realised through a step-by-step approach, consisting of four steps:
- The definition of ICT services
- The identification of responsibility centres
- The assignment of ownership
- The definition of management information

In step 1 all ICT services are defined that are provided by or consumed by departments of the organisation. The result of this step is a list of ICT services for which costs and benefits have to be identified, so that both supplier and owner can plan and control them. The identified ICT services can be categorised into three types of ICT services, being customer services, internal services and underpinning services. Customer services are services that are provided to the consuming department directly. Internal services are services that the ICT department provides to support its own internal activities. Underpinning services are services that are supplied by other suppliers that the ICT department needs to be able to provide its customer services.

In step 2 all departments consuming ICT services from other departments or from external suppliers are identified as possible owners. The owner of an ICT service bears all costs related to the utilisation of that service and is for that service the only contact for the supplier.

In step 3 all ICT services identified in the first step are assigned to a single responsible department: the owner. The responsibility for a certain ICT service is assigned to the department with most knowledge and information on that service and that has in potential the highest day-to-day influence on its costs and benefits. Often this means that the responsibility for the costs and benefits of an ICT service are assigned to the consuming department.

In the final step, step 4, the required management information is defined to support the owner in the alignment of operational ICT. This management information focuses on the ICT services identified and concerns both a financial and a non-financial part.
The financial management information represents the costs of the ICT service. To calculate the costs of an ICT service, all ICT costs are allocated to an ICT service directly or indirectly. To identify the quality of an ICT service, a restricted set of quality attributes is defined based on the literature study and the experiences from the case studies. This set contains the following characteristics that should at least be identified when defining the quality of an ICT service: *functionality, availability, performance, output quality, completeness, correctness* and *timeliness*.

Part 2: Management tools for the alignment of operational ICT
Only when the responsibilities and authorities are assigned properly, the management of the organisation can start managing the costs and benefits and so the alignment of operational ICT. A number of management tools to support this continuous management activity are discussed in this second part of the method.

Service level agreements can be signed between supplier and owner to formalise agreed-upon levels of quality and costs of an ICT service. Budgeting is a well-known technique to plan costs and revenues. To budget the total costs of operational ICT, one must start budgeting the costs of individual ICT services.
The various financial and non-financial aspects of an ICT service or an ICT department can be presented together through the application of the balanced scorecard. Finally, the the Goal/Question/Metric method is a useful mean to support incremental improvements.

7.4.2 Conclusions on the method designed

The applicability of the method presented in this thesis is validated in practice and discussed in chapter 6. This validation demonstrated that the method can indeed be implemented in practice.

However, during implementation we were confronted with the following problems:
- managers showed resistance against changed responsibilities and cost allocation;
- there was a decreased cooperation as there was a larger distance between departments as a result of a more formal relation between customers and suppliers;
- the implementation was very time consuming;
- the realised improvements were limited as the method did not entail all ICT functions.

Furthermore, the validation demonstrated that the application of the method has the potential to improve the alignment of operational ICT. The new responsibility structure realised through the application of the designed method changes the behaviour of management towards the alignment of operational ICT. By assigning a single owner to each ICT service and by bringing the cost allocation strategy in line with this, responsibilities become clearer and the insight of the management in the costs of operational ICT increases. By signing SLAs, the owner can relate the costs to the ICT services provided and their quality. The validation showed that management can use this insight to realise a number of significant cost reductions. From this perspective, the goals of the method as defined in the beginning of chapter 5 are met.

However, the method itself does not solve the problems and will not result in a better alignment of costs and benefits of operational ICT by itself. It still is the responsibility of the management to use the obtained insight and responsibilities to define actions to improve the balance between costs and benefits. The success of every method, including this one, depends on how it is employed and lived up to.

Moreover, to realise the intended benefits, the management has to get through a learning period after implementation of the method. It has to learn to deal with the new responsibilities and has to find out how they can use the new insights to manage the costs and benefits of operational ICT. And even after that learning period the method requires continuous attention preferably by incorporating the method in the organisation's general management processes. Only then the application of the method transfers the discussion on the benefits and burdens of ICT from ICT management to business management.

Finally, the method does not solve the problem of business management to link ICT costs to business results. As the business results are effected by several factors, of which ICT is just one, we claim that this problem should be solved from a business management perspective.

7.5 Revisiting the research approach

The research discussed in this thesis is based on literature and two types of case studies, being descriptive and validating case studies. All three types of research are discussed and evaluated in this paragraph.

First, the **literature study** contributed significantly to the research by providing a diversity of methods and techniques that might be of use for managing the benefits and burdens of operational ICT. However, the study did not bring up any specific publications on the problem of the alignment of operational ICT. Many publications were identified that deal with ICT benefits and (the allocation of) ICT costs, often focusing on the difficulties of measuring these costs and benefits. No publications were found on research on the cause of these difficulties. Therefore, the literature study concentrated on related research areas like management accounting and quality management. As literature on these two areas is extensive, the researcher was faced with two problems: how to locate all relevant literature

and how to study all this literature within the time available. The literature discussed in chapter 2 is not intended to be complete, but it contains all literature the reader requires to understand the rest of this thesis.

Second, the three **descriptive case studies** provided a lot of information on the activities that financial institutions apply in practice for the alignment of their operational ICT. As no previous research on the alignment of operational ICT was known, we chose to use case studies such that they give a wide perspective on the subject. Many aspects and departments that were expected to play a role in the alignment of operational ICT were considered. So, each case study took a lot of time, both for the researcher and the case organisation. As the time made available by the co-operating organisations was limited, the depth of the case studies had to be limited. However, the information gathered was sufficient to identify the most important problems faced by the organisations studied. As these problems were not identified in the literature studied, it was proven that only the adopted strategy achieved this purpose.

Third, two **validating case studies** were conducted to validate the method designed. First, the method was implemented in an action-research type of case study. The implementation of the method in practice through action research and the possibility to make small corrections based on the experienced gained was a good way to obtain a lot of insight in the application of the method. Second, the method was applied as a reference model to evaluate an existing situation observed in practice. This comparison did not bring up as much information on the application of the method in practice, as this case consisted mainly of theoretical discussions with managers of the organisation involved.

Both series of cases provided a lot of information on the method designed, both where its implementation and application are concerned. Although this research gives rise to the claim that the method designed for the alignment of operational ICT is generic and can be implemented at any organisation more validating case studies are required to demonstrate this.

7.6   Recommendations for further research

Based on the research presented in this research a number of recommendations for further research are formulated. Above all, the fact that it concerns a first study in this field of research requires that further research has to be done to validate the observations, conclusions and recommendations. This requires similar research at other (financial) institutes. To extend the obtained understanding, further research is also necessary in which a limited number of aspects in this research area are studied more closely.

Furthermore, during the research several areas of attention were identified that require additional research to further increase the understanding of the alignment of operational ICT. Three of these areas are discussed as suggestions for further research.

Firstly, it is necessary to study in practice what prevents organisations from implementing the available principles for the alignment of operational ICT. The research discussed here shows that many principles have been commonly known for quite some time, but are hardly or not found in practice. Besides, it was difficult to find organisations that were willing to implement the method designed for validation. This resistance must be inventoried and studied to obtain a better notion of the problems organisations are confronted with regarding the alignment of operational ICT. If this **resistance against implementing** a method for the alignment of

operational ICT is not removed, the method presented here will get any or no practical value and will remain a theoretical solution.

Secondly, concerning benchmarking, the practice needs **norm figures** for example for the dimension of the ICT costs and the relation between fixed and variable costs. But also norm figures are desired that indicate the extent to which the costs and the quality of ICT services can be influenced and the effect of certain cost reduction activities. This understanding should help organisations to decide what activities to define to improve the alignment of operational ICT.

Thirdly, this research showed that the utilisation of means like service level agreements, balanced scorecards and the Goal/Question/Metric method are at a tender stage. Though service level agreements are frequently used, their success and contribution to the alignment of operational ICT is questioned frequently. The use of a few Balanced Scorecards was encountered for ICT management, whereas none of the organisations studied adopted a quality management method like the Goal/Question/Metric method. Further research has to be done to determine if, when and how such means can contribute to the alignment of operational ICT in particular.

Case study questionnaire

The interviews carried out during the case studies are based on the following standard questionnaire. This questionnaire is divided into a number of items covering the various topics that are of interest for the collection and interpretation of the research data. These items concern information about the person interviewed, the context and content of the case study and the processes for the management of benefits and burdens. The questionnaire ends with a number of concluding questions to evaluate the interview.

Questions about the person interviewed
The following questions are formulated to get an idea of the position within the organisation of the person interviewed. His or her tasks, responsibilities and authorities and his or her position regarding the management of benefits and burdens of operational ICT are identified.

1. What is your position within the organisation?
   (answer indication: business manager, network manager, controller, etceteras)

2. What tasks, responsibilities and authorities do you have in the management of ICT?
   (intention: to get an idea of the role and position of the person interviewed)

3. What is the dimension of your department?
   (answer indication: the number of staff, the dimension of the costs, etceteras)

4. How long have you held this position?
   (answer indication: the number of years)

5. How long have you been working within the field of ICT management?
   (answer indication: the number of years)

6. How many ICT components are under the management responsibility of your department?
   (answer indication: the number of ICT components)

7. What tasks, responsibilities and authorities does your department have regarding the management of benefits and burdens of ICT?
   (answer indication: responsible for, accountable for, informed about, etceteras)

8.   What products and services does your department provide and to whom?
(answer indication: management of workplaces, applications, etceteras)

9.   What is the dimension of the customers?
(answer indication: number of employees, turnover, etceteras)

Questions on the context and content

The following questions concern the organisation in which the case study has been carried out and are important to characterise and compare the organisations studied. The questions are formulated to answer questions on the context and content of the case study.

1.   What is the dimension of the overall organisation?
(answer indication: the number of staff, the dimension of the budget, etceteras)

2.   What is the dimension of the overall ICT organisation?
(answer indication: the number of staff, the dimension of the budget, etceteras)

3.   What is de dimension of the department or business unit studied?
(answer indication: the number of staff, the dimension of the budget, etceteras)

4.   To what types of customers does the department provide products and services?
(answer indication: business departments,ICT departments, etceteras)

5.   What is the complexity of the ICT environment in terms of:
   - Quantity
     (answer indication: number of ICT means like applications, platforms and workplaces)
   - Heterogeneousness
     (answer indication: number of different types and brands of ICT means)
   - Distribution
     (answer indication: the number of locations where ICT means are located)
   - Dynamics
     (answer indication: the number of changes to the ICT environment per time interval)
   - Functionality
     (answer indication: the number and diversity of the functionalities of the ICT means)
   - Coherence
     (answer indication: the number of connections and interfaces between the ICT components)
   - Ownership
     (answer indication: the number of owners of the different types of ICT means)
   - Usage
     (answer indication: the degree of diversity of the demands and prerequisites of the customers)

Questions on benefits

The following questions are formulated to gather information about the degree in which the organisation knows the benefits of operational ICT and what management processes it has defined to manage these benefits.

1. What do you define as the benefits of operational ICT?
   (answer indication: effectiveness benefits, efficiency benefits, innovation, etceteras)

2. What different types of benefits of operational ICT do you discern?
   (answer indication: effectiveness benefits, efficiency benefits, innovation, etceteras)

3. What different types of measures do you use to express these benefits?
   (answer indication: financial figures, quality characteristics, etceteras)

4. Can you give any indication of the dimension of these benefits for your organisation?
   (answer indication: dimension of cost reductions or decreased time-to-market, etceteras)

5. To what extent can the benefits of operational ICT be expressed in financial figures?
   (answer indication: percentage)

6. What determines the dimension of these benefits of operational ICT?
   (answer indication: quality of ICT means, business processes, etceteras)

7. Who is responsible for the management of the benefits of operational ICT?
   (answer indication: business management, ICT management, etceteras)

8. What benefits of operational ICT can you identify for your department specifically?
   (answer indication: effectiveness benefits, efficiency benefits, innovation, etceteras)

9. To what extent can these benefits be influenced and by whom?
   (answer indication: percentage + business management, ICT management, etceteras)

10. What benefits can be influenced by you or your department?
    (answer indication: effectiveness benefits, efficiency benefits, innovation, etceteras)

11. What is your role in the realisation and management of the benefits of operational ICT?
    (answer indication: responsible for, accountable for, informed about, etceteras)

12. To what extent does the customer satisfaction play a role in your goals and decisions?
    (answer indication: examples of decision making processes, etceteras)

13. On what perspectives of the balanced scorecard do you have defined goals for the benefits of operational ICT?
    - Customer perspective
      (answer indication: customer satisfaction, market share, etceteras)
    - Financial perspective
      (answer indication: turnover, margin, profit, etceteras)
    - Internal processes perspective
      (answer indication: improved performance, increased score on performance indicators, changes in culture, etceteras)
    - Innovation perspective
      (answer indication: new technologies, training and education, etceteras)

14. How do you control whether these goals are reached?
    (answer indication: measures and management processes)

Questions on burdens

The following questions are formulated to gather information about the degree in which the organisation knows the burdens of operational ICT and what management processes it has defined to manage these burdens. This category of questions includes some general questions on burdens and a number of questions specifically on costs and cost allocation.

General questions

The subsequent questions are formulated to get any insight in what general burdens of operational ICT the organisation identifies and how it tries to manage them.

1. What do you define as the burdens of operational ICT within your organisation?
   (answer indication: costs, non-financial consequences, etceteras)

2. What different types of burdens of operational ICT do you discern?
   (answer indication: costs, non-financial consequences, etceteras)

3. Who administers the burdens of operational ICT?
   (answer indication: responsible department, e.g. business management, ICT management, etceteras)

4. What non-financial burdens of operational ICT can you identify?
   (answer indication: inefficiencies, less employee satisfaction, etceteras)

5. In what terms do you express the burdens of operational ICT?
   (answer indication: examples of financial and non-financial terms, etceteras)

6. Can you give any indication on the dimension of these burdens?
   (answer indication: dimension of financial and non-financial terms, etceteras)

7. What determines the dimension of these burdens?
   (intention: to get an idea of the aspects influencing the burdens)

8. To what extent can the burdens of operational ICT be influenced and by whom?
   (answer indication: percentage + business management, ICT management, etceteras)

9. What management processes have been defined to manage the burdens of operational ICT?
   (answer indication: description of management processes)

10. Who is responsible for the management of the burdens of operational ICT?
    (answer indication: the responsible department, e.g. business management, ICT management, etceteras)

11. What goals have been defined regarding the burdens of operational ICT?
    (answer indication: examples of goals defined)

12. How do you control whether these goals are reached?
    (answer indication: measures and management processes)

Costs

The subsequent questions are formulated to get some insight into the extent the organisation knows the costs of operational ICT and what management processes it has defined to manage these burdens.

1. What costs of operational ICT do you define within your organisation?
   (answer indication: maintenance costs, license costs, hardware costs, etceteras)

2. Who administers the costs and expenditures of operational ICT?
   (answer indication: responsible department, e.g. business management, ICT management, etceteras)

3. Does your accounting make a distinction between costs and expenditures?
   (intention: to get some insight into the accounting principles regarding costs and expenditures)

4. How do you deal with the difference between costs and expenditures?
   (answer indication: examples of differences in procedures)

5. What types of cost have been defined?
   (answer indication: software costs, hardware costs, personal costs, etceteras)

6. Do you use any method to budget the costs of operational ICT?
   (answer indication: description of the budgeting process applied)

7. How frequent do you budget these costs?
   (answer indication: number of budget reviews per year)

8. Who approves these budgets?
   (answer indication: responsible management, e.g. business management, ICT management, etceteras)

9. How do you deal with the exceeding of budgets?
   (answer indication: not accepted at all, certain limited exceeding permitted, etceteras)

10. Do you use techniques like direct costing?
    (answer indication: description of processes for direct costing, etceteras)

11. Can you indicate how much your organisation spends on costs for:
    (answer indication: costs in millions of Euros)
    - Staff
    - Hardware
    - Software
    - Maintenance fees
    - Licences
    - Other

12. Can you indicate what the ratio in your organisation is between:
    (answer indication: costs in millions of Euros)
    - ICT costs and other costs
    - Fixed costs and variable costs
    - Development costs and exploitation costs
    - Direct and indirect costs

13. Over what time of period become fixed costs variable?
    (answer indication: number of weeks, months or years)

14. Did you ever cooperate in a total-cost-of-ownership (TCO) research?
(intention: to get some insight into the experiences with TCO research)

15. Has your organisation been subject to a benchmark research?
(intention: to get some insight into the experiences with benchmark research)

16. What other means do you use for cost management?
(answer indication: examples and descriptions of management processes for cost management)

17. How successful or satisfying are these means?
(answer indication: satisfying or not-satisfying and the reasons why)

18. To what extent can you influence the costs of operational ICT?
(answer indication: percentage)

19. Can you indicate how much time and cost you spend on cost management?
(answer indication: number of hours or functions, costs in millions of Euros, etceteras)

20. What goals have been defined for the costs of operational ICT?
(answer indication: examples of goals defined)

21. How do you control whether these goals are reached?
(answer indication: measures and management processes)

Cost allocation

The subsequent questions are formulated to get some insight into the extent the organisation knows the costs of operational ICT and what management processes it has defined to manage these burdens.

1. Do you allocate costs for operational ICT to other departments? (Which?)
   - What method for cost allocation do you use?
     (answer indication: full costing, direct costing, hybrid system)
   - What costs for which products or services do you allocate to other departments?
     (answer indication: all costs, costs of hardware, software, personal, etceteras)
   - How do you determine the rates for cost allocation?
     (answer indication: description of the processes to determine rates)
   - Do you determine the cost price of products and services periodically?
     (answer indication: number of times per year)
   - What method and what units do you use for cost price calculations?
     (answer indication: full costing, direct costing, hybrid system)
   - In what way does your customer benefit from efficiency advantages?
     (intention: to get some insight into how the customer benefits from efficiency advantages)
   - To what extent can your customer influence the allocated costs?
     (answer indication: percentage)
   - Can you indicate how this cost allocation has changed the behaviour of your customer regarding ICT costs?
     (answer indication: examples of changes in behaviour and decision making)

2. Do other departments allocate costs for operational ICT to your department? (Which?)
   - What method for cost allocation do they apply?
     (*answer indication: full costing, direct costing, hybrid system*)
   - What costs for which products or services do they allocate?
     (*answer indication: all costs, costs of hardware, software, personal, etceteras*)
   - How do they determine the rates for cost allocation?
     (*answer indication: description of the processes to determine rates*)
   - What method and what units do they apply for cost price calculations?
     (*answer indication: full costing, direct costing, hybrid system*)
   - To what extent can you influence the costs allocated to you?
     (*answer indication: percentage*)
   - Can you indicate how this cost allocation has changed your behaviour regarding ICT costs?
     (*answer indication: examples of changes in behaviour and decision making*)

3. In what way are you involved in the cost allocation system?
   - Do you (co-)decide on the method for cost allocation used?
   - Do you (co-)decide on rates and how they are defined?

4. Can you indicate how much time and cost you spend on the allocation of costs of operational ICT?
   (*answer indication: number of hours or functions, costs in millions of Euros, etceteras*)

Questions on benefits and burdens

The following questions are formulated to gather information about the degree in which the organisation knows and evaluates the benefits and burdens of operational ICT and what management processes it has defined to manage them.

1. How does the ratio between benefits and burdens of operational ICT play a role in your management activities?
   (*answer indication: description of management processes*)

2. How do you evaluate the ratio between benefits and burdens of operational ICT?
   (*answer indication: description of management processes*)

3. Can you indicate what benefits and burdens you manage in your department?
   (*answer indication: examples of benefits and burdens of operational ICT*)

4. Can you indicate what other aspects you manage in your department?
   (*answer indication: examples of other aspects*)

5. Do you feel that you have enough information to perform your job? If not, what information do you miss?
   (*intention: to get some insight into the management information that is required to perform a certain job*)

6. What problems regarding ICT have you been confronted with over the last three years?
   (*intention: to get some insight into the ICT problems management is confronted with over the last three years*)

7. What problems regarding ICT are you confronted with now?
   (intention: to get some insight into the ICT problems management is confronted with now)

8. What problems regarding ICT do you foresee in the near future?
   (intention: to get some insight into the ICT problems management foresees in the near future)

9. Can you indicate what items you have to report to higher management?
   (answer indication: performance indicators, costs, benefits, etceteras)

10. Can you indicate on what items the performance of your department is evaluated?
    (answer indication: performance indicators, costs, benefits, etceteras)

11. Can you indicate how often the ratio between the benefits and burdens of operational ICT are on the agenda of your department?
    (answer indication: number of times per week, month or year)

12. Do you discuss with your customer the ratio between the benefits and burdens of the products or services provided?
    (answer indication: description of management processes)

13. Do you advise your customer on the requested products or services with respect to the benefits and burdens?
    (answer indication: description of management processes)

14. How often do you report to your customer and in what terms?
    (answer indication: number of times per week, month or year and the report items)

15. Do you have closed service level agreements (SLA) with your customers on the services provided? If so, what benefits and burdens are recorded in these SLAs?
    (answer indication: examples of service level agreements)

16. Do you have a periodic customer satisfaction investigation?
    (answer indication: description of the procedures for customer satisfaction investigations)

17. To what extent are your customers satisfied with the benefit/burden ratio of the ICT services provided?
    (intention: to get some insight into the satisfaction of customers with the value of operational ICT)

18. How can your customer influence the benefit/burden ratio of the ICT services provided?
    (intention: to get some insight into how customers can influence the value of operational ICT)

19. What is the diversity in the complexity of the services requested by the various customers?
    (answer indication: in terms of functionality, quality, time, costs, etceteras)

20. What goals have you defined for the ratio between benefits and burdens of operational ICT?
    (answer indication: examples of goals defined)

21. How do you control whether these goals are reached?
    (answer indication: measures and management processes)

Questions on the interview

The following concluding questions are formulated to identify items that may have been missed during the interview and to evaluate the interview itself.

1.   What is your opinion of how your organisation pays attention to the management of benefits and burdens of operational ICT?

2.   What do you feel could be improved?

3.   What is your opinion of this interview?

4.   Did it meet your expectations?

5.   Are there any subjects of interest for this research that have not been discussed?

List of acronyms

A1	Business unit 1 of case-organisation A (entailing BM1, FM1/AM1)
A2	Business unit 2 of case-organisation A (entailing TM1)
ABC	Activity-based costing
AM	Application Management
AM1	The department performing the application management activities of organisation A
AM2	The department performing the application management activities of organisation B
AM5	The department performing the application management activities of organisation E
B1	Business unit 1 of case-organisation B (entailing BM2, FM2 and AM2)
B2	Business unit 2 of case-organisation B (entailing TM2)
BM	Business Management
BM1	The department performing the business management activities of organisation A
BM2	The department performing the business management activities of organisation B
BM3	The department performing the business management activities of organisation C
BM5	The department performing the business management activities of organisation E

BSC	Balanced Scorecard
C1	Business unit 1 of case-organisation C (entailing BM3, FM3 and AM3)
C2	Business unit 2 of case-organisation C (entailing TM3)
CIW	Cost model for ICT Workplaces
CMM	Capability Maturity Model
CMS	Cost Management System
CNO	Cost of Network Ownership model
CPU	Central Processing Unit
CVP	Cost-Volume-Profit
E1	Business unit 1 of organisation E
E2	Business unit 2 of organisation E
EFQM	European Foundation for Quality Management
EUC	End user Computing Cost of Ownership model
FM	Functional Management
FM1	The department performing the functional management activities of organisation A
FM2	The department performing the functional management activities of organisation B
FM5	The department performing the functional management activities of organisation E
GQM	Goal/Question/Metric method
ICT	Information and Communication Technology
ICTM3	The department performing the ICT management activities (functional, application and technical management) of organisation C
INK	Dutch Quality Institute ("Instituut Nederlandse Kwaliteit")
ITIL	Information Technology Infrastructure Library
NCO	Network Cost of Ownership model
P&L	Profit-and-Loss account

RCO	Real Cost of Ownership model
SLA	Service Level Agreement
SLM	Service Level Management
TCO	Total Cost of Ownership
TM	Technical Management
TM1	The department performing the technical management activities of organisation A
TM2	The department performing the technical management activities of organisation B
TM5	The department performing the technical management activities of organisation E

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Summary in Dutch

Het in lijn brengen van operationele ICT

1. Inleiding

"De operatie is wat er gebeurt, terwijl iedereen plannen aan het maken is." Deze op een songtekst van John Lennon gebaseerde stelling van een manager van een financiële instelling in Nederland geeft het uitgangspunt van dit onderzoek weer. Veel van de aandacht voor het verbeteren van de bedrijfsprestaties door de inzet van informatie- en communicatietechnologie (ICT) is gericht op het vinden en het evalueren van nieuwe toepassingsmogelijkheden. De afgelopen decennia is veel aandacht uitgegaan naar het op bedrijfseconomische gronden beoordelen en verantwoorden van investeringsvoorstellen. Nadat een nieuwe toepassing is ontwikkeld en in gebruik is genomen, wordt er echter nauwelijks meer aandacht besteed aan de baten en lasten ervan. Dat is opmerkelijk aangezien de uiteindelijke baten van de toepassing voor het bedrijf pas worden gerealiseerd door het gebruik ervan (Thorp, 1998) en het merendeel van de ICT-kosten wordt gemaakt nà de ingebruikname (Hinton en Kaye, 1996). Alle activiteiten die daaraan vooraf gaan, zijn feitelijk te beschouwen als planningsactiviteiten en hebben geen invloed op de bedrijfsprestaties.

De doelstelling van het in dit proefschrift beschreven onderzoek was een methode te ontwerpen voor het in lijn brengen van operationele ICT. Onder "het in lijn brengen van operationele ICT" wordt in dit proefschrift verstaan: het optimaliseren van de waarde van operationele ICT. Het belang van een dergelijke methode is beschreven in hoofdstuk 1. Een overzicht van de literatuur en de daarin beschreven methoden en technieken voor het beheer van baten en lasten staat in hoofdstuk 2. Hoofdstuk 3 belicht drie beschrijvende praktijkstudies die worden gebruikt om de praktijk van het beheer van baten en lasten van operationele ICT te bestuderen. De observaties van deze praktijkstudies zijn nader uitgewerkt en geanalyseerd in hoofdstuk 4. Op basis van het literatuuronderzoek en de praktijkstudies is een methode ontworpen voor het in lijn brengen van de baten en lasten van operationele ICT. Deze methode wordt gepresenteerd in hoofdstuk 5. In twee afsluitende praktijkstudies is de toepasbaarheid en bruikbaarheid van de methode aan de praktijk getoetst.

Deze samenvatting geeft de belangrijkste resultaten van het onderzoek weer. Daarnaast is er een korte beschrijving van de ontworpen methode zelf en van de ervaringen met de toepassing

van de methode. Vervolgens belicht de tekst een evaluatie van de onderzoeksmethode en er worden enkele suggesties gegeven voor verder onderzoek.

2. Onderzoeksvraag

Het in dit proefschrift beschreven onderzoek is uitgevoerd binnen de afdeling Informatiesystemen van de Faculteit Informatie Technologie en Systemen van de Technische Universiteit Delft. Het onderzoek is uitgevoerd binnen het onderzoeksgebied *economische aspecten van beheer* van de leerstoel *Informatiestrategie en beheer van informatiesystemen*. Hoewel de belangstelling voor dit onderzoeksgebied in het afgelopen decennium sterk is toegenomen, is er nog maar weinig aandacht besteed aan de evaluatie van de baten en lasten van operationele ICT. Dit ondanks het feit dat een groot deel van de ICT-kosten van een organisatie bestaat uit de kosten van operationele ICT (Hinton en Kaye, 1996) en dat de baten van ICT pas tot uitdrukking komen in de operationele fase (Thorp, 1998). Literatuur over de baten en lasten van operationele ICT concentreert zich op de baten en lasten afzonderlijk. Daardoor spreekt deze literatuur zich niet uit over een gelijktijdige evaluatie van zowel de baten als de lasten van operationele ICT.

Het onderzoeksprobleem dat in dit proefschrift wordt behandeld is het probleem van het in lijn brengen van de operationele ICT. De hier gehanteerde definitie van "het in lijn brengen van operationele ICT" is: het optimaliseren van de waarde van operationele ICT zodat deze voldoet aan de eisen die de organisatie aan de ICT stelt. Deze eisen kunnen per organisatie verschillen. Bovendien worden organisaties verwacht te zoeken naar die balans die aan hun eisen voldoet in plaats van naar de beste.

De onderzoeksvraag die aan dit onderzoek ten grondslag ligt is:
Hoe moeten baten en lasten van operationele ICT met elkaar in lijn worden gebracht?

Op basis van deze onderzoeksvraag zijn de volgende deelvragen geformuleerd:
- Welke baten en lasten van operationele ICT moeten worden geïdentificeerd?
- In welke mate zijn baten en lasten van operationele ICT te beïnvloeden?
- Welke methoden bestaan er ter ondersteuning van het in lijn brengen van de baten en lasten van operationele ICT?

3. Beschrijvende praktijkstudies

Omdat bij aanvang van het onderzoek geen eerdere studies naar het beheer van baten en lasten van operationele ICT bekend waren, zijn eerst drie beschrijvende praktijkstudies uitgevoerd. De praktijkstudies zijn uitgevoerd bij drie financiële instellingen in Nederland. Bij elk van de praktijkstudies zijn verschillende afdelingen betrokken zodat in elke studie elke vorm van ICT-beheer, te weten technisch beheer, applicatiebeheer en functioneel beheer, aan de orde kwam.
Het doel van de praktijkstudies was een helder beeld krijgen van de praktijk van het beheer van baten en lasten van operationele ICT. Met de in deze praktijkstudies opgedane kennis kunnen de in de vorige paragraaf geformuleerde deelvragen worden beantwoord. De volgende subparagrafen geven een samenvatting van het antwoord op deze vragen.

3.1 Welke baten en lasten van operationele ICT moeten worden geïdentificeerd?

Voor het in lijn brengen van de baten en lasten van operationele ICT moeten de kosten en de kwaliteit van operationele ICT worden geïdentificeerd. De kosten van een ICT-dienst zijn te specificeren naar twee assen. De eerste as geeft aan voor welke resources de kosten worden gemaakt, bijvoorbeeld personeel, hardware of software. De tweede as geeft aan om wat voor type kosten het gaat, bijvoorbeeld afschrijvingskosten, personeelskosten of kosten voor licenties of onderhoudscontracten. De precieze definitie van deze categorieën is afhankelijk van welke kosten de organisatie wil beheersen.

De kwaliteit van een ICT-dienst wordt uitgedrukt in de volgende karakteristieken: *functionaliteit, beschikbaarheid, prestatie, kwaliteit van de uitvoer, compleetheid, correctheid* en *tijdigheid.*

In de praktijk worden theoretische economische modellen voor het toewijzen van opbrengsten aan operationele ICT niet toegepast aangezien zij daarvoor te complex en te kostbaar zijn. Daarom concluderen wij dat in de praktijk het toewijzen van de opbrengsten van een organisatie aan operationele ICT arbitrair is. ICT is slechts één van de productiemiddelen die samen met andere externe en interne factoren de opbrengsten van de organisatie beïnvloedt. Daarom leidt dit tot de stelling dat het toewijzen van opbrengsten aan operationele ICT geen bijdrage levert aan het in lijn brengen van de baten en lasten van operationele ICT. Organisaties moeten hun opbrengsten beheren vanuit het oogpunt dat verbeterde bedrijfsprestaties en opbrengsten het resultaat zijn van een combinatie van verschillende productiemiddelen.

3.2 In welke mate zijn baten en lasten van operationele ICT te beïnvloeden?

De kosten van operationele ICT zijn voor een organisatie voornamelijk vaste kosten, omdat de omvang van deze kosten geen directe relatie heeft met het volume van de producten of diensten die de organisatie levert. De conclusie dat de meeste kosten van operationele ICT vast zijn, wil echter niet zeggen dat deze kosten niet zijn te beïnvloeden. In de beschrijvende praktijkstudies zijn verschillende mogelijkheden naar voren gekomen om kosten te verlagen. Die variëren van het efficiënter inzetten, concentreren en standaardiseren van ICT-middelen tot het verlagen van de gevraagde dienstenniveaus of het vervangen van de ICT-dienst door een goedkopere. De omvang van de besparingen die kunnen worden gerealiseerd hangt mede af van de mate waarin contracten kunnen worden opgezegd, productiemiddelen kunnen worden verkocht of kunnen worden ingezet voor andere diensten.

Het management van de onderzochte organisaties geeft aan dat ongeveer 10% tot 15% van de kosten van operationele ICT te beïnvloeden is[18]. Dit percentage is hoger of lager afhankelijk van de kwaliteit en de leeftijd van een ICT-dienst. Een lagere kwaliteit biedt meer mogelijkheden voor kostenbesparingen, terwijl voor oudere diensten reeds verschillende mogelijkheden voor kostenbesparingen zijn benut. Geen van de onderzochte organisaties meet, controleert of evalueert de voortgang en resultaten van de kostenbesparingsactiviteiten. Het was dan ook niet mogelijk om objectief vast te stellen in welke mate kosten van operationele ICT te beïnvloeden zijn.

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[18] De schatting dat 10% tot 15% van de kosten te beïnvloeden is wil nog niet zeggen dat de kosten van operationele ICT met 10% tot 15% terug te dringen zijn. Bovendien vereist elke kostenbesparende activiteit eerst een investering en kan zij leiden tot extra continue kosten, bijvoorbeeld wanneer activiteiten worden geautomatiseerd.

Opmerkelijk is dat in de praktijk veel kostenbesparingen niet echt worden gerealiseerd aangezien de vrijgekomen resources zoals personeel of hardware doorgaans worden ingezet voor het realiseren van nieuwe diensten of hogere dienstenniveaus. Kennelijk richt het management van de onderzochte organisaties zich nadat budgetten zijn geformaliseerd niet op het verlagen van kosten, maar op het vergroten en verbeteren van haar dienstverlening binnen het vastgestelde budget.

Op het gebied van kwaliteitsverbetering was bij de onderzochte organisaties de aandacht vooral gericht op het verbeteren van de efficiëntie van de ICT-afdeling en het verhogen van de kwaliteit van de geleverde ICT-diensten. Net zoals bij de kostenbesparingsactiviteiten van de ICT-afdeling worden deze activiteiten voor kwaliteitsverbetering niet gekwantificeerd, gemeten, gecontroleerd of geëvalueerd. Daarom kan ook voor de kwaliteit niet worden vastgesteld in welke mate deze te beïnvloeden is.

3.3 Welke methoden bestaan er ter ondersteuning van het in lijn brengen van de baten en lasten van operationele ICT?

De praktijkstudies laten zien dat de onderzochte organisaties verschillende methoden gebruiken voor het in lijn brengen van de baten en lasten van operationele ICT. De in de praktijk waargenomen methoden concentreren zich op het managen van kosten en opbrengsten.

Alle onderzochte organisaties passen het budgetteren toe voor het plannen en bewaken van de kosten en opbrengsten op elk niveau binnen de organisatie, van afdelingsniveau en bedrijfsonderdelen tot aan de totale organisatie. Alle organisaties passen een vorm van activity-based costing toe om kosten toe te wijzen aan producten of diensten voor het berekenen van kostprijzen of het doorbelasten van kosten. Het doorbelasten van kosten gebruiken zij doorgaans om alle kosten toe te wijzen aan de commerciële afdelingen zodat de totale kosten eenvoudig kunnen worden vergeleken met de opbrengsten.

Dienstenniveau-overeenkomsten gebruikt men om financiële en niet-financiële afspraken over geleverde diensten tussen bedrijfsonderdelen onderling en in een aantal gevallen ook tussen afdelingen onderling te kwantificeren en te formaliseren.
Daarnaast bestuderen de onderzochte organisaties de bruikbaarheid van de Balanced Scorecard (BSC) voor de planning en beheersing van bedrijfsactiviteiten. Twee van de onderzochte organisaties hebben een BSC gedefinieerd op bedrijfsniveau. Één organisatie heeft ook een ICT-BSC gedefinieerd en de ICT-afdeling van een andere organisatie werkte ten tijde van de praktijkstudie aan de ontwikkeling van een ICT-BSC.

Over het geheel genomen concluderen wij dat de in de praktijk waargenomen methoden elk slechts betrekking hebben op een specifiek onderdeel van het in lijn brengen van operationele ICT. Een integrale methode die zowel kosten, opbrengsten als niet-financiële aspecten van operationele ICT in ogenschouw neemt, ontbreekt.

3.4 Conclusies naar aanleiding van de onderzoeksvraag

De praktijkstudies hebben inzicht gegeven in het in lijn brengen van de operationele ICT in de praktijk. Het in lijn brengen moet zich concentreren op de kosten en de kwaliteit van operationele ICT. De kosten van operationele ICT zijn voornamelijk vaste kosten, maar ze zijn wel op verschillende wijzen te beïnvloeden. Dienstenniveau-overeenkomsten, budgetteren, de Balanced Scorecard en de Goal/Question/Metric-methode zijn hulpmiddelen

die het management van organisaties kunnen ondersteunen bij het in lijn brengen van operationele ICT. In de praktijk blijken organisaties echter niet in staat om de gesignaleerde problemen op te lossen met de huidige hulpmiddelen, aangezien een integrale methode ontbreekt.

Voordat men een nieuwe methode ontwerpt voor het in lijn brengen van operationele ICT moet men kritisch kijken naar de baten van een dergelijke methode. Aangezien de kosten en baten van operationele ICT voor de organisatie voornamelijk vast zijn, kan men zich afvragen of het voor organisaties zinvol is om aandacht te besteden aan het in lijn brengen van operationele ICT. Wij stellen dat het voor organisaties wel belangrijk is om dat te doen om de volgende drie redenen.

Ten eerste, als organisaties willen weten wat de omvang van hun kosten is en waar deze kosten voor worden gemaakt, moeten zij ook de kosten van operationele ICT in beschouwing nemen. De kosten van operationele ICT vormen immers het merendeel van de ICT-kosten van de organisatie. Bovendien zijn de kosten van operationele ICT, hoewel deze voornamelijk vast zijn, te beïnvloeden. Gelet op de omvang van deze kosten, loopt een besparing van één of twee procent al snel in de miljoenen Euro's.

Ten tweede, de baten van een ICT-dienst ontstaan uitsluitend door het gebruik ervan, dat wil zeggen wanneer de ICT-dienst operationeel is. Het correct gebruik van een ICT-dienst is dan ook van groot belang (Hoogeveen, 1997). Baten ontstaan niet vanzelf en het realiseren van baten is een continu proces (Thorp, 1998). Om die reden verdienen ook de baten van operationele ICT continue aandacht van het management. De praktijkstudies lieten zien dat er operationele ICT-diensten zijn die nauwelijks of niet worden gebruikt. Als de baten van deze diensten niet worden geïdentificeerd of beheerd, vindt nooit een kosten/baten-afweging plaats.

Ten derde, de constatering dat het merendeel van de kosten en baten van operationele ICT vast is, geeft aan dat deze kosten zijn bepaald in eerdere fasen in de levenscyclus ervan. Het overgrote deel van de kosten en baten van operationele ICT is dus kennelijk te beïnvloeden in de fasen voorafgaand aan de operationele fase. De kennis over de omvang, samenstelling en oorsprong van deze kosten en baten opgedaan in de operationele fase kan worden gebruikt om de activiteiten en besluitvorming in de eerdere fasen van de levenscyclus te verbeteren.

Daarom concluderen wij dat het voor elke organisatie waardevol is om aandacht te besteden aan de operationele fase van hun ICT.

4. Een methode voor het in lijn brengen van operationele ICT

Omdat er geen methode bestaat die een oplossing biedt voor de geschetste problemen waarmee organisaties zich in de praktijk zien geconfronteerd, hebben we een nieuwe methode ontworpen voor het in lijn brengen van operationele ICT. Zo'n methode moet een algemeen raamwerk bieden voor het in lijn brengen van operationele ICT en voor de wijze waarop bestaande technieken daarbij zijn te gebruiken en ermee zijn te combineren. De in dit proefschrift beschreven methode is ontworpen om in dit raamwerk te voorzien.

4.1 Korte beschrijving van de methode

De in dit proefschrift beschreven methode richt zich met name op het oplossen van de belangrijkste problemen rond het beheer van baten en lasten van operationele ICT zoals waargenomen tijdens de beschrijvende praktijkstudies. Het betreft hier de problemen van het integraal toewijzen van de verantwoordelijkheden voor het in lijn brengen van de kosten en

baten van operationele ICT en het tot stand brengen van de bijbehorende managementinformatievoorziening.

De methode is ontworpen om het management van organisaties inzicht te geven in het in lijn brengen van operationele ICT door er voor te zorgen dat het management:
- weet wat de kosten van operationele ICT zijn,
- weet wat de baten van operationele ICT zijn,
- de baten van operationele ICT kan koppelen aan de kosten, en
- op basis van deze informatie acties kan definiëren voor het in lijn te brengen van de kosten en baten van operationele ICT.

De methode is opgedeeld in twee delen. Het eerste deel beschrijft hoe de organisatie de verantwoordelijkheden en bevoegdheden moet toewijzen. Het tweede deel beschrijft een aantal technieken die ondersteuning kunnen bieden aan het management bij het in lijn brengen van de operationele ICT.

Deel 1: Het toewijzen van verantwoordelijkheden en bevoegdheden

Het eerste deel van de methode is gericht op het integraal beleggen van de verantwoordelijkheden en bevoegdheden ten aanzien van de operationele ICT. Dit gebeurt aan de hand van een stappenplan, bestaande uit vier stappen:
1. Het definiëren van de ICT-diensten.
2. Het identificeren van mogelijke eigenaren.
3. Het toewijzen van eigenaarschap.
4. Het definiëren van de managementinformatie.

In de eerste stap worden alle ICT-diensten gedefinieerd die worden geleverd of afgenomen door de afdelingen van de organisatie. Het resultaat is een lijst van ICT-diensten waarvoor de kosten en baten moeten worden vastgesteld, zodat zowel de leverancier als de afnemer deze kunnen plannen en bewaken. De gedefinieerde ICT-diensten zijn onder te verdelen in drie typen diensten, te weten klantgerichte diensten, interne diensten en onderliggende diensten. De klantgerichte diensten zijn de diensten die direct aan de afnemende afdeling worden geleverd. Interne diensten zijn diensten die de ICT-afdeling levert ter ondersteuning van de eigen interne activiteiten. Onderliggende diensten zijn diensten geleverd door andere partijen die de (ICT) afdeling nodig heeft om de door haar geleverde klantgerichte diensten te kunnen leveren.

In de tweede stap worden alle afdelingen die diensten afnemen van andere afdelingen of van externe partijen geïdentificeerd als mogelijke eigenaren. Het management van de afdeling die als eigenaar van een ICT-dienst optreedt, draagt alle kosten die samenhangen met het gebruik van deze ICT-dienst. Dit management is voor die dienst de enige contactinstantie naar de afdeling die deze dienst levert.

In de derde stap worden alle ICT-diensten uit de eerste stap toegewezen aan één enkele verantwoordelijke afdeling: de eigenaar. De verantwoordelijkheid voor een bepaalde ICT-dienst wordt toegewezen aan die afdeling die de meeste kennis en informatie over de dienst heeft en die in potentie de grootste dagelijkse invloed heeft op de kosten en baten ervan. Veelal betekent dit dat de afnemende afdeling verantwoordelijk wordt voor de kosten en baten van een ICT-dienst.

In de vierde stap wordt de benodigde managementinformatie gedefinieerd die de eigenaar moet ondersteunen bij het in lijn brengen van de operationele ICT. Deze managementinformatie is gericht op de geïdentificeerde ICT-diensten en bevat zowel een financiële als een niet-financiële kant.

De financiële managementinformatie geeft de kosten van de ICT-dienst weer. Voor het vaststellen van de kosten van een ICT-dienst moeten alle ICT-kosten worden toegewezen aan ICT-diensten, direct danwel indirect. Voor het vastleggen van de kwaliteit van de ICT-dienst is op basis van literatuurstudie en de ervaringen uit de praktijkstudies een beperkte set karakteristieken gedefinieerd. Deze set bevat de volgende karakteristieken die in ieder geval moeten worden meegenomen bij het bepalen van de kwaliteit van een ICT-dienst: *functionaliteit, beschikbaarheid, performance, kwaliteit van de uitvoer, compleetheid, correctheid* en *tijdigheid*.

Deel 2: Management-tools voor het in lijn brengen van operationele ICT

Pas nadat de verantwoordelijkheden en bevoegdheden op de juiste wijze zijn toegewezen, kan het management van de organisatie van start gaan met het beheer van de baten en lasten en dus met het in lijn brengen van de operationele ICT. In het tweede deel van de methode wordt een aantal management-tools gepresenteerd ter ondersteuning van deze continue managementactiviteit.

Zo kan men door dienstenniveau-overeenkomsten af te sluiten tussen leverancier en eigenaar de gemaakte afspraken over de kwaliteit en kosten van een ICT-dienst formaliseren. Budgetteren is een bekende techniek voor het plannen van kosten en opbrengsten. Het budgetteren van de totale kosten van operationele ICT begint met het budgetteren van de kosten van de individuele ICT-diensten.

De verschillende financiële en niet-financiële aspecten van een ICT-dienst of een ICT-afdeling kan men gezamenlijk in kaart brengen door gebruik te maken van de Balanced Scorecard. Tenslotte is Goal/Question/Metric-methode een goed hulpmiddel bij het aanbrengen van stapsgewijze verbeteringen.

4.2 Conclusies ten aanzien van de methode

De toepasbaarheid van de in dit proefschrift gepresenteerde methode is in de praktijk getoetst. Deze toetsing toonde aan dat het mogelijk is de methode in de praktijk toe te passen. Daarbij werden wij echter geconfronteerd met de volgende problemen:

- managers vertoonden weerstand tegen verantwoordelijkheden en kostendoorbelasting;
- er was sprake van een verminderde samenwerking door een grotere afstand tussen afdelingen als gevolg van een meer formele relatie tussen klanten en leveranciers;
- de implementatie was erg tijdrovend;
- de gerealiseerde verbeteringen waren beperkt aangezien niet alle ICT-afdelingen betrokken waren bij de implementatie.

Voorts bleek uit de toetsing dat de methode in potentie een positieve bijdrage levert aan het in lijn brengen van operationele ICT. Het gedrag van het management ten aanzien van het in lijn brengen van operationele ICT verandert als gevolg van de nieuwe structuur van verantwoordelijkheden die door het toepassen van de ontworpen methode is gerealiseerd. Door per dienst slechts één eigenaar aan te wijzen en de wijze van kostendoorbelasting daarop af te stemmen maakt men de verantwoordelijkheden helderder en neemt het inzicht van het management in de kosten van operationele ICT toe. Door het afsluiten van SLA's is de eigenaar tevens in staat om kosten te relateren aan de geleverde ICT-diensten en de kwaliteit

daarvan. De toetsing liet zien dat het management het verkregen inzicht kan gebruiken om een aantal significante kostenbesparingen te realiseren. Met het oog daarop kan worden gesteld dat de doelstellingen van de methode zoals gedefinieerd in hoofdstuk 5 zijn gerealiseerd.

Echter, de methode zelf lost de problemen niet op en zorgt niet voor een betere afstemming van kosten en baten van operationele ICT. Het is nog steeds aan het verantwoordelijk management om de verkregen inzichten en verantwoordelijkheden te gebruiken om acties te definiëren voor het verbeteren van de balans tussen baten en lasten. Het succes van elke methode, dus ook van deze, wordt bepaald door hoe hij wordt toegepast en nageleefd.
Om deze balans te realiseren is bovendien een leerperiode nodig na implementatie van de methode. Het management zal moeten leren omgaan met de nieuwe verantwoordelijkheden en ondervinden hoe het, met de nieuwe inzichten, de kosten en baten van operationele ICT kan beheren. Ook na deze leerperiode vereist de methode continue aandacht, bij voorkeur door de methode op te nemen in de algemene managementprocessen van de organisatie. Alleen dan zal de toepassing van de methode er toe leiden dat de discussies over de baten en lasten van operationele ICT zich verschuiven van ICT-management naar het bedrijfsmanagement.

5. Methode van onderzoek

Het in dit proefschrift beschreven onderzoek is gebaseerd op een literatuurstudie en twee verschillende typen praktijkstudies, te weten beschrijvende en toetsende praktijkstudies. Alledrie de typen onderzoek worden in deze paragraaf kort geëvalueerd.

Ten eerste, de **literatuurstudie** leverde een bijdrage aan het onderzoek door het verschaffen van een veelheid aan methoden en technieken die mogelijk van nut zouden kunnen zijn voor het beheer van baten en lasten van operationele ICT. De studie leverde echter geen specifieke publicaties op over het probleem van het in lijn brengen van operationele ICT. Veel gevonden publicaties handelen over ICT-baten en (het doorbelasten van) ICT-kosten, veelal gericht op de problematiek van het meten van kosten en baten. Er werden geen publicaties gevonden over onderzoek naar de oorzaak van deze problematiek. Daarom richtte de literatuurstudie zich op aanverwante onderzoeksgebieden, zoals managementaccounting en kwaliteitsmanagement. Aangezien de literatuur op deze twee gebieden erg omvangrijk is, zagen wij ons geconfronteerd met twee problemen: hoe vast te stellen welke literatuur relevant is en hoe al deze literatuur te bestuderen binnen de beschikbare tijd. Het resultaat van de literatuurstudie is beschreven in hoofdstuk 2.

Ten tweede leverden de drie **beschrijvende praktijkstudies** informatie op over de activiteiten die financiële instellingen in de praktijk toepassen voor het in lijn brengen van hun operationele ICT. Aangezien er, voor zover bekend, nog niet eerder onderzoek is gedaan naar het in lijn brengen van operationele ICT, zijn de praktijkstudies opgezet met een zeer breed perspectief op het onderwerp. Vele aspecten en afdelingen die mogelijkerwijs een rol zouden kunnen spelen bij het in lijn brengen van operationele ICT zijn meegenomen. Elke praktijkstudie nam daardoor veel tijd in beslag van zowel de onderzoeker als de onderzochte organisatie. Omdat de tijd die de onderzochte organisaties ter beschikking stelden beperkt was, betekende dit dat de diepgang van elke praktijkstudie beperkt was. De verzamelde informatie was echter voldoende om de belangrijkste problemen te identificeren waar de onderzochte organisaties mee worden geconfronteerd. Omdat deze problemen niet uit de literatuurstudie naar voren waren gekomen, wordt geconcludeerd dat de gehanteerde aanpak voor het gestelde doel toereikend was.

Ten derde werden twee **toetsende praktijkstudies** uitgevoerd om de ontworpen methode te toetsen. De methode is eerst geïmplementeerd in een praktijkstudie volgens het principe van action research. Het door action research in praktijk kunnen brengen van de methode en direct kunnen bijsturen op basis van de opgedane ervaringen bleek een geschikte manier te zijn om veel inzicht te krijgen in de toepassing van de methode. Vervolgens is de methode gebruikt als referentiemodel om een bestaande situatie zoals geobserveerd in de praktijk, te evalueren. Deze vergelijking leverde weinig informatie op over de toepassing van de methode in de praktijk, aangezien deze praktijkstudie vooral bestond uit theoretische discussies met het management van de betrokken organisatie.

De beschrijvende en toetsende praktijkstudies leverden veel informatie op over zowel de implementatie als de toepassing van de ontworpen methode. Hoewel dit onderzoek aanleiding geeft te stellen dat de ontworpen methode voor het in lijn brengen van operationele ICT generiek is en kan worden toegepast in elke organisatie, zijn meer validerende praktijkstudies nodig om dit aan te tonen.

6. Aanbevelingen voor vervolgonderzoek

Op basis van het in dit proefschrift beschreven onderzoek volgt hierna een aantal aanbevelingen voor nader onderzoek. Allereerst geeft het feit dat het hier slechts een eerste onderzoek op dit gebied betreft aan, dat er nader onderzoek zou kunnen worden gedaan om de observaties, conclusies en bevindingen te valideren. Dit vereist meer soortgelijk onderzoek bij andere (financiële) instellingen. Daarnaast is dit onderzoek gestart vanuit een breed perspectief. Om het verkregen inzicht verder uit te bouwen is verder onderzoek noodzakelijk dat dieper ingaat op een beperkter aantal aspecten uit het onderzoeksgebied.

Gedurende het onderzoek zijn voorts verschillende aandachtsgebieden geïdentificeerd die aanvullend onderzoek vereisen om de kennis van en het inzicht in het in lijn brengen van de operationele ICT verder te vergroten. Drie daarvan worden hier voorgesteld als mogelijk interessant voor vervolgonderzoeken.

Ten eerste moet nader onderzoek in de praktijk uitwijzen wat organisaties ervan weerhoudt om de beschikbare principes voor het beheer van kosten en baten te implementeren. Uit het hier gepresenteerde onderzoek blijkt dat veel principes reeds algemeen bekend zijn, maar niet of nauwelijks in de praktijk worden aangetroffen. Daarnaast bleek het moeilijk om organisaties te vinden die bij wijze van toetsing de ontwikkelde methode wilden implementeren. Deze weerstanden vragen een nadere inventarisatie en onderzoek om zo een beter begrip te krijgen van de problematiek waarmee de organisaties worden geconfronteerd rond het in lijn brengen van operationele ICT. Wanneer deze **weerstanden tegen het implementeren** van een methode voor het in lijn brengen van operationele ICT niet worden weggenomen, krijgt de hier gepresenteerde methode nauwelijks of geen praktische waarde.

Ten tweede is er, met het oog op het kunnen vergelijken van organisaties vanuit de praktijk, behoefte aan **kengetallen.** Bijvoorbeeld kengetallen voor de omvang van de ICT-kosten van een organisatie, voor de verhouding tussen vaste en variabele kosten, voor de mate waarin de kosten en voor de kwaliteit van ICT-diensten kan worden beïnvloed of voor het effect van bepaalde kostenbesparende activiteiten. Deze inzichten moeten organisaties helpen bij het bepalen van welke activiteiten zij moeten ontplooien voor het in lijn brengen van hun operationele ICT.

Ten derde liet dit onderzoek zien dat het **gebruik van hulpmiddelen** als dienstenniveau-overeenkomsten, Balanced Scorecards en de Goal/Question/Metric-methode zich nog in een pril stadium bevindt. Organisaties gebruiken weliswaar veelvuldig dienstenniveau-overeenkomsten, maar het succes ervan en de bijdrage ervan aan het in lijn brengen van operationele ICT trekken zij regelmatig in twijfel. Slechts enkele Balanced Scorecards zijn aangetroffen voor ICT-management, terwijl geen van de onderzochte organisaties een kwaliteitsmanagementmethode als de Goal/Question/Metric-methode gebruikt. Meer onderzoek zal moeten worden gedaan naar of, wanneer en hoe dergelijke hulpmiddelen een bijdrage kunnen leveren aan het beheer van ICT en aan het in lijn brengen van operationele ICT in het bijzonder.

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Rick Klompé
Delft, April 2003

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About the author

Rick was born in Delft as Roderick Harald Klompé on June 20th, 1971. From 1983 until 1989 he attended the "Christelijke Scholengemeenschap Voorburg 't Loo" in Voorburg. In 1989 he started his study of Technical Informatics at the Faculty of Technical Mathematics and Informatics of the Delft University of Technology. In 1995 he graduated on a series of experiments on the evaluation of IT investments. He presented the conclusions of his Master's thesis *"The influence of evaluating supporting methods on evaluation processes"* at the Second European Conference on IT Investment Evaluation at Henley's Management College (UK) in July 1995.

In September 1995 Rick started working at InterProm (taken over by Inter Access in 1998), a small firm of consultants on the management of operational ICT. He executed several assignments for a number of mainly financial organisations on the (re-)design and implementation of ICT management processes like incident management, change management and cost management. Being a member of InterProm's Research and Development department he spent a significant part of his time on research and product development. These activities concentrated on the development of ICT management models and methods to support the consultants and project managers 'in the field'. He contributed to the development of methods like the Standard Integrated Management Approach (SIMA) and the Integrated Incremental Implementation Method (3-IM). His main area of interest was the development of an economic perspective on ICT management. In the summer of 1997 these activities were combined with research on information economics at the Delft University of Technology, resulting in the PhD research presented in this thesis.

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Rick is author of more than 15 publications in conference proceedings and scientific and professional journals. He has co-authored several books on ICT management. He is editor in chief of the correspondence course *IT Cost & Value* of the International Management Forum (IMF) and wrote three out of eight lessons for this course. He is also author of the lesson *"ICT Costs"* of IMFs correspondence course *Strategic Alignment Business-ICT*.

The Alignment of Operational ICT

Many organisations evaluate the value of information and communication technology (ICT) at the point of decision making. After decision making and implementation the value of the then operational ICT is not considered anymore. What problems restrain organisations to do this? What methods and models exist to support them? And can a method be developed to help organisations to manage the value of operational ICT and to align it with corporate strategies? This research tries to provide an answer to all these questions resulting in a method for the alignment of operational ICT.

Rick Klompé (1971) studied Technical Informatics at the Faculty Of Technical Mathematics and Informatics of the Delft University of Technology. From 1995 till 2001 he worked as consultant in the field of ICT management. Now, Rick has the position of senior auditor at KPN Audit.

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