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Quality Management for IT Services

Perspectives on Business and Process Performance



CLAUS-PETER PRAEG & DIETER SPATH

Quality Management for IT Services:

Perspectives on Business and Process Performance

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Claus-Peter Praeg, Fraunhofer Institute for Industrial Engineering (IAO), Germany

The chapter of Spath, Bauer and Praeg outlines the topic of IT service quality management and describes fundamental concepts, models and definitions for IT service quality management. A lifecycle model for IT services is presented and also a model for classifying quality management methods into the phases of the IT lifecycle. The last part of the chapter illustrates the various effects of IT service quality management on company performance.

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The chapter written by Dressler, Ege, Heck, Klein and Walter shows how processes can be consistently and collaboratively modeled using ITIL as a basis. It also points out the problem regarding the fact that processes depicted in ITIL are essentially described in a text-based way and that implementable process models are not shown explicitly. It answers the question as to how textual processes can be represented in ITIL based on the guidelines of modeling. To do this, a metamodel describing ITIL process models is shown, explained and presented by way of a pilot example.

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The chapter by Gerke, Petruch and Tamm focuses on the challenge to improve business process support with the aid of IT services. As part of their contribution, the authors describe a concept which enables the continuous improvement of business processes. The model is based on a combination of ITIL reference processes, a 7-step improvement process and process mining.

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The contribution submitted by Cortina, Picard, Valdés and Renault demonstrates the relevance of process assessment in improving IT service quality. Based on an evaluation of the initial situation, a concept is presented which allows process assessment to be carried out and an improvement project to be commenced founded on this knowledge.

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Chapter 11
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Anette Weisbecker, Fraunhofer-Institut für Arbeitswirtschaft und Organisation, Germany

In the future, the use of divided IT resources will be strongly influenced by cloud computing. In her contribution, Weisbecker points out how cloud services can be organized with the aid of service engineering and how the quality of cloud services can be managed by enterprises through implementing certain concepts.

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Luis Kalb Roses explains the importance of taking the expectations of customers and service providers into account with regard to IT service quality management. To do this, the author uses the SERVPERF method, which identifies expectations regarding service performance from the point of view of both the customer and the provider. Based on an empirical study, Luis Kalb Roses demonstrates the importance of aligning IT staff with staff from the customer company as far as quality management is concerned.

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The final chapter by Praeg introduces a framework called "value engineering for IT services", which is used to enable value-orientated IT service management in enterprises. In the process, he integrates concepts from IT business alignment, business process management, strategic IT management and IT service portfolio management. He also outlines interrelationships between consistent value orientation and quality improvement in IT service management.

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Preface

In the field of IT, the markets, business activities, needs and requirements of internal and external service providers and customers are changing in ever-shortening cycles. This forces companies to increase their organizational flexibility not only as far as their structure is concerned but also with regard to established business processes. This is partly achieved by reducing the added value ratio and partly by integrating partners more and more into processes associated with the delivery of products and services. To do this however, companies have to develop the necessary competencies to manage the various partners and procedures, as well as establish processes to ensure high quality services.

Customer expectations and demands regarding high-quality products and services have also risen. As far as the customer is concerned, studies show that the performance and quality of IT services are much more important than the prices of the services themselves. More in-depth market studies prove that poor services result in damages for companies amounting to several billion Euros.

IT services are especially becoming a more and more important module in commercial value adding. Many business processes would be unable to function without the corresponding IT services. Supplementary technological innovations such as service-orientated architectures, web services and cloud computing will make future IT structures very different to those of today. They will no longer be made up of monolithic systems and applications but rather of separate modular service components.

These developments and the experience we have gained from numerous consulting and research projects prompted us to deal with the subject of IT service quality management in more detail. Up until now, the topic has hardly been researched.

The aim of the book is to reduce this knowledge gap and to encourage people to spend more time researching the numerous facets of this fascinating subject in the future. To present the relevant aspects of IT service quality management in a structured way, we have divided the book into 6 sections with a total of 16 chapters.

The first section of the book introduces the subject of quality management for IT services and presents general concepts and a review of the current state of research.

In the first chapter, the contribution submitted by Spath, Bauer and Praeg outlines the topic of IT service quality management and describes fundamental concepts, models and definitions both for IT service and quality management. A lifecycle model for IT services is presented and also a model for classifying quality management methods into the phases of the IT lifecycle. The last part of the article illustrates the various effects of IT service quality management on company performance.

The contribution written by Barrutia und Gilsanz describes the current state of electronic services in the form of a literature review. Ideas for future research work in the field of e-service quality management are presented based on current research results.

The chapter from Bruhn presents a concept regarding the general quality assurance of generic service processes. The author goes on to describe various instruments for quality planning, quality controlling, quality inspection and quality assurance for service processes. Bruhn then describes 10 steps to be taken in order achieve high quality service management.

In the second section of the book, strategic management concepts and models for IT service quality management are presented.

In order for IT service quality management to be successful, all aspects of company management need to be taken into consideration. Therefore, in their contribution, Köhler and Vauth describe the IBM Component Business Model™, which enables all areas to be recognized which are relevant to successful IT service management in order to provide high quality IT services.

The chapter submitted by Looso, Goeken and Johannsen shows how various governance frameworks can be utilized for and integrated into IT management in order to master growing IT management demands. To do this, various IT governance frameworks are examined with regard to different criteria. A metamodel is then developed from the information gained, which describes how the different concepts interact with one another.

The contribution from Wild describes a model for IT service quality management which examines various areas of quality management and identifies existing gaps in quality. The model also enables a quality requirement to be achieved by defining demands and ascertaining specific quality requirements. Wild‘s quality model is derived from a combination of various IT service management concepts such as ITIL, CoBIT and ISO 20000.

The third section of the book concentrates on process-based concepts and models relevant to IT service quality management.

The chapter written by Dressler, Ege, Heck, Klein and Walter shows how processes can be consistently and collaboratively modeled using ITIL as a basis. It also points out the problem regarding the fact that processes depicted in ITIL are essentially described in a text-based way and that implementable process models are not shown explicitly. It answers the question as to how textual processes can be represented in ITIL based on the guidelines of modeling. To do this, a metamodel describing ITIL process models is shown, explained and presented by way of a pilot example.

The chapter by Gerke, Petruch and Tamm focuses on the challenge to improve business process support with the aid of IT services. As part of their contribution, the authors describe a concept which enables the continuous improvement of business processes. The model is based on a combination of ITIL reference processes, a 7-step improvement process and process mining.

The contribution submitted by Cortina, Picard, Valdes and Renault demonstrates the relevance of process assessment in improving IT service quality. Based on an evaluation of the initial situation, a concept is presented which allows process assessment to be carried out and an improvement project to be commenced founded on this knowledge.

The fourth section of the book addresses infrastructural components which play a role in IT service quality management.

In his chapter, Boris Otto highlights the importance of quality management with regard to corporate data assets. The author then presents and describes a reference model for Corporate Data Quality Management (CDQM).

In the future, the use of divided IT resources will be strongly influenced by cloud computing. In her contribution, Weisbecker points out how cloud services can be organized with the aid of service engineering and how the quality of cloud services can be managed by enterprises through implementing certain concepts.

The fifth section of the book focuses on the application of practical solutions and case studies.

The chapter contributed by Herzwurm and Pietsch describes a case study which shows how the quality of ITIL processes, especially IT service support, can be improved in complex environments. The case study describes the concept of qualitative process improvement based on an example from the telecommunications industry.

Founded on practical experience gained in the field of application management, the contribution from Kociemba shows which concepts and techniques can be utilized to monitor, measure, record and analyze operational IT data and to achieve the corresponding service quality.

IT service quality management not only has to be capable of fulfilling strategic, process-related and technical requirements but also general economic conditions. Therefore, the sixth section of the book focuses on combining not only economic aspects but also soft factors in the context of IT service quality.

The contribution from Wulf and Zarnekow deals with the economic aspects of service quality management with regard to Internet-based IT services. They describe different dimensions of economic factors as well as the corresponding quality factors.

Luis Kalb Roses explains the importance of taking the expectations of customers and service providers into account with regard to IT service quality management. To do this, the author uses the SERVPERF method, which identifies expectations regarding service performance from the point of view of both the customer and the provider. Based on an empirical study, Luis Kalb Roses demonstrates the importance of aligning IT staff with staff from the customer company as far as quality management is concerned.

The final chapter by Praeg introduces a framework called “value engineering for IT services“, which is used to enable value-orientated IT service management in enterprises. In the process, he integrates concepts from IT business alignment, business process management, strategic IT management and IT service portfolio management. He also outlines interrelationships between consistent value orientation and quality improvement in IT service management.

The aim of the book is to give both scientists and practical experts an insight into the many different facets of IT service quality management.

Dieter Spath
Claus-P. Praeg
Editors

Acknowledgment

We would like to express our sincere thanks to all the authors for their contributions, without whose support the publication of this book would have been impossible. Thanks also go to the numerous reviewers whose valuable comments helped to further improve the quality of the contents of the book. We would also like to thank the staff of the IGI Global for their support during the entire publishing process. Without their willingness to publish this book, we would never have been able to realize our project in this way.

Dieter Spath
Claus-P. Praeg
Editors

Section 1

Quality Management:
General Concepts and Review for IT Service Quality Management

Chapter 1
IT Service Quality Management: Assumptions, Frameworks and Effects on Business Performance

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ABSTRACT

IT service management is a focal point of interest for practitioners, managers and researchers. In this chapter, the authors outline the field of IT service quality management - a topic that has not been adequately discussed in research literature to date. The authors introduce a framework for IT service quality management and show how the framework can be applied to different phases of an IT service lifecycle. Furthermore, they illustrate possible effects of IT service quality on business performance. For this reason, they define indicators, which are effective measures of business performance, and the relations between indicators and IT service quality. Due to the increased use of modular IT services and the high pressure on IT effectiveness and IT efficiency, IT service quality management has the potential to become a highly relevant topic for IT service providers and IT departments within enterprises.

INTRODUCTION

The quality of IT services is an interesting issue in the field of IT service management. However, until now it has not intensively discussed either in science or in practice. Based on the response of one of our previous publications (see (Praeg & Spath, 2008) we would like to illustrate different aspects of IT service quality management. Analyzing and understanding the effectiveness of IT services will become more and more important in the near future (Jiang *et al.*, 2000; Roses *et al.*, 2009). Due to the increase in the intensity of information in businesses and the rising need for the distribution and use of information and IT services in different situations under changing conditions, systematic IT service management within enterprises is essential for business suc-

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cess. In consequence, the management of external service providers and internal IT departments is a crucial factor for successful IT service management in enterprises.

Our experience gained in information-intensive branches has also shown that the internal operation of an IT data processing center is not a critical factor for success but rather the ability to manage IT in business processes effectively. This also includes the ability to identify the IT requirements of changing business needs systematically, to translate these needs into technical service requirements and to communicate them to internal or external IT service providers. As a result, the management of IT service quality will become a high priority theme for companies over the next few years. Hence, there is a need for enterprises to redefine their processes regarding IT service management and to implement effective processes for managing IT service quality.

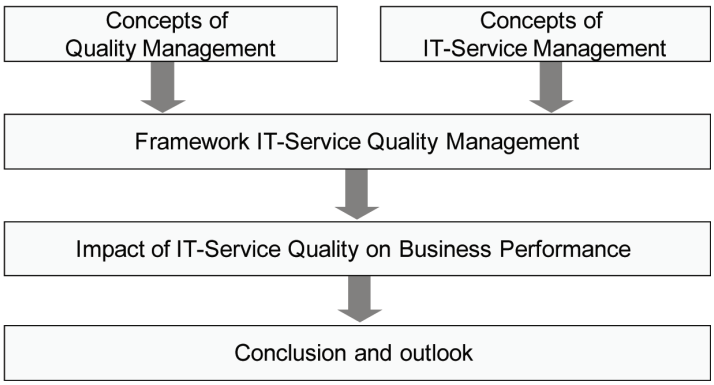
Accordingly, this topic is also of great interest to scientific research. However, our literature review of IT service quality management has shown that only a few publications focus on this topic (Praeg & Spath, 2008). Other publications analyze the effect of IT-based services on service quality (Zhu *et al.*, 2002), the use of IT in improving customer services (Dabholkar, 1996; Ray *et al.*, 2005) as well as concepts for measuring the quality of information systems (Kettinger *et al.*, 1995; Watson *et al.*, 1998). For this reason, our goal is to close this gap and provide a sound basis for future scientific discussions and research work.

The aim of this chapter is to outline the possible effects of IT service quality on the business performance of companies. The results of this chapter help IT service providers and internal IT departments to identify indicators relevant to service quality.

In order to achieve these aims, we outline the topics of quality, quality management and selected standards as well as concepts for managing service quality. Using this as a basis, we present a brief overview of selected IT service management concepts and derive requirements for a framework for IT service quality management. The next section introduces such a framework and describes the various framework modules. The final part of the chapter addresses the possible effect of IT service quality management on company business performance.

Following Glass et al. (2004), the solution described in this chapter is a conceptual analysis and an instrumental development based on a design science approach (Glass et al., 2004; Hevner et al., 2004). In IT research, design science creates and evaluates IT artifacts with the intention of solving organizational challenges. In this context, the organizational problem is the analysis of possible effects of IT service quality on business

Figure 1. Structure of the chapter



performance. IT artifacts are generally defined as constructs (vocabulary and symbols), models (abstractions and representations), methods (algorithms and practices), and instantiations (implemented and prototype systems) (Hevner et al., 2004).

FROM QUALITY MANAGEMENT TO IT QUALITY MANAGEMENT

This part introduces aspects of quality and quality management and illustrates selected quality management concepts. Quality management covers a broad spectrum of definitions and perspectives. As illustrated in Figure 2, the structure of this section starts with a general definition of quality, quality management and introduces selected approaches for service quality. We derive requirements for IT service quality management based on the different concepts.

The international standard ISO 8402 defines "quality" as being the total characteristic of a product or service concerning its suitability to fulfill predefined requirements (ISO 8402). Based on the definition, there are two perspectives for interpreting the term "quality":

Figure 2. From quality management to IT service quality management



Firstly, quality can be perceived as being the "degree to which a set of inherent characteristics fulfils requirements" (ISO 9000). This approach focuses on hard facts and objective criteria of products or services (product-based view). Secondly, quality can be interpreted from a customer's point of view. In this case, quality is perceived by the customer conception (user-based). Contrary to the product-based view, this approach focuses on the subjective perception of a service product by the customer. The customer evaluates the quality of a product or service individually with regard to his/her personal values. Hence, the challenge for companies is to fulfill a great number of heterogeneous customer demands (Bruhn, 2004).

Quality Management and Total Quality Management

In general, quality management systems consist of structures, processes, procedures, responsibilities and resources (Dilg, 1995). The aim of quality management is to combine all these components both effectively and efficiently. Furthermore, quality management is the coordinated management task in order to govern an enterprise in terms of quality. Quality management is defined by quality policies, targets, processes, controlling and continuous quality improvement within a company. In order to achieve these goals, quality management has to cover human resources within the enterprise and consider business processes and the technological infrastructure accordingly (Praeg & Spath, 2008).

Total quality management (TQM) is the foundation of an integrated quality management concept within a company. However, TQM is more than just a quality management concept. Due to the high significance of quality, especially in service-oriented companies, TQM has to be part of corporate culture and strategy. It has an influence on all management activities and leadership concepts established and implemented in enterprises. For this reason, the conceptual basis

of the TQM approach is that the management as well as staff is responsible for the maintenance and improvement of the quality of products and services.

Transformed in the context of service providers, the TQM concept can be focused on three areas (Bruhn, 2004; Wonigeit, 1994):

- Total: The integration of all persons involved in service development and operation
- Quality: The consequent concentration on the quality demands of internal and external customers with regard to all activities and processes in the service company
- Management: The responsibility of the management for the systematic identification of quality culture and goals as well as for continuous quality improvement.

The ISO 9000 Standard for Quality Management

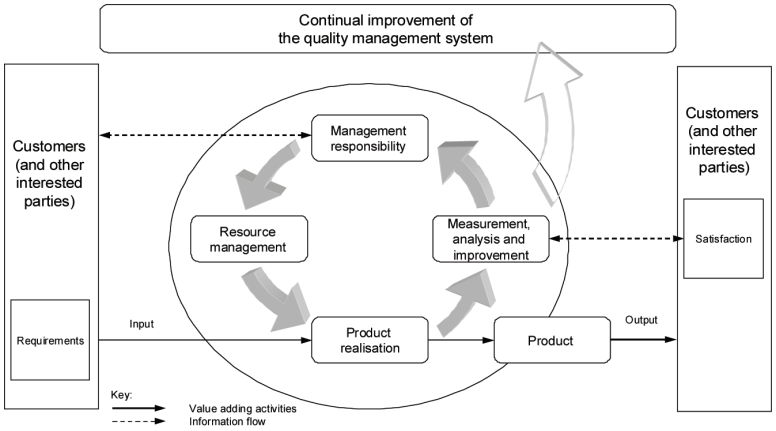
The international standards ISO 9000ff. define which requirements an enterprise has to fulfill in order to conform to a defined level of quality management. The most important standards are ISO 9000 (which describes the fundamentals of quality management systems and specifies the terminology of quality management), 9001 (specifies requirements for quality management) and 9004 (provides guidelines that consider both the effectiveness and efficiency of quality management systems) (ISO 9000). The ISO 9000 standards understand quality management as a leadership task for the continuous improvement of organizational processes in order to meet customer requirements and expectations with the result of generating customer satisfaction.

The above-mentioned norms promote the adoption of a process towards high quality standards during the development, implementation and thus improvement of the effectiveness of a quality management system (ISO 9001). According to the ISO 9001 "… this process orientation emphasizes the importance of:

- understanding and meeting requirements
- the need to consider processes in terms of added value
- obtaining results of process performance and effectiveness and
- continual improvement of process based on objective measurements"

The standard ISO 9004 suggests the implementation of quality management principles in order to direct enterprises towards improved

Figure 3. ISO 9000 process-based quality management model (source: Praeg & Spath 2008)



performance. According to ISO 9004, these principles are customer focus, leadership, involvement of people, the process approach, system approach to management, continual improvement, factual approach to decision making, mutually-beneficial supplier relationship (ISO 9004).

The ISO 9000 standards are essentially oriented towards conventional production companies. They focus on distributed production processes and procedures, which are typical for this sector. However, service enterprises have also recognized the advantages of a quality management system based on the ISO 9000 standards. With regard to the immaterial character of services, there is a need to create new quality management concepts that focus on these circumstances.

Service Quality

Service quality management can be seen as the integration of all areas of management which enable the internal and external analysis, planning, organization, operation and controlling of all quality-relevant aspects in service management by a service company (Bruhn, 2004).

Service quality represents a pre-defined performance level of service. With regard to the management of service quality, several principles have been identified which have to be considered in this context. They include customer orientation, consequence, competitor separation, consistence, congruence, coordination, communication, completeness, continuity and cost-benefit orientation.

Service quality is defined as "the capability of a service provider to provide primary, intangible and customer-oriented service on a predefined performance level corresponding with the customer expectations" (Bruhn, 2004). Therefore, three characteristics of services need to be considered in the management of service quality: the intangibility of services, the uno-actu principle (concurrent provision and consumption of services) and the integration of external factors (Haller, 2002).

Service Quality Models

During the last few years, numerous models have been developed for service quality (Seth *et al.*, 2005). A review of nineteen service quality models by Seth (2005) shows that there are two general principles for service quality models and service quality measurement. Firstly, quality is measured according to a multiple item scale. Secondly, quality is measured by the relative perceptual distance between customer expectations and evaluations of service experience (Seth et al., 2005; Zhu *et al.*, 2002).

Some authors have researched for indicators that are suitable for defining service quality. In these models, quality is the level of fulfillment and achievement of these indicators. Other models define service quality by the existence of pre-defined GAPs, with the level of quality being defined by the size of the defined GAPs. With regard to all service quality models, it is common sense to consider the customer and customer perception. Due to the size restrictions of this article, we focus especially on the service quality models described by Grönroos (1984) and the GAP model by Parasuraman et.al (Parasuraman *et al.*, 1985).

The model by Grönroos defines quality perceived by the customer as being the difference between customer expectations and their experiences of the service (Grönroos, 1984). For an enterprise, this means that it has to match the service expected and the service perceived in order to ensure customer satisfaction. High service quality is achieved if the level of quality perceived is higher than the level expected. Grönroos identified three components of service quality: technical quality, functional quality and image. In the model, technical quality is the quality received by the customer as a result of interaction with the service provider as well as the individual evaluation of the service quality perceived (Seth et al., 2005). Functional quality focuses on how the customer receives the technical outcome and

emphasizes subjective perception. In addition to these two dimensions, the image of an enterprise also influences a customer's perception of service quality because company image may enhance or weaken the perception of technical and functional quality (Bruhn, 2004).

In the GAP model of Parasuraman et al. (1985) the author argues that service quality is the result of differences between expectations and the actual performance of the service (Parasuraman et al., 1985). In the model, the authors describe how customers evaluate service quality. The basis of the model is formed by the interaction between consumers and service providers and possible gaps in this relationship. The authors identified five possible gaps (Seth et al., 2005):

- GAP 1: Differences between consumer expectations and the management's perceptions of those consumer expectations.
- GAP 2: Differences between the management's perception of consumer expectations and service quality specifications.
- GAP 3: Differences between service quality specifications and the service actually delivered.
- GAP 4: Differences between service delivery and communication with consumers about service delivery.
- GAP 5: Difference between consumer expectations and the service perceived. This gap depends on the direction and size of the four above-mentioned gaps, associated with the delivery of service quality on the side of the provider.

Performance expectations and performance level are defined from the point of view of the customer. Service quality has a strong focus on the customer demands and the customer's perception of quality.

As a result of their exploratory research, Parasuraman et al. originally identified ten quality dimensions that are relevant to the evaluation of the service quality perceived by the customer. Based on this results, they refined the SERVQUAL model for measuring customer perception of service quality (Parasuraman et al., 1988; Seth et al., 2005). The SERVQUAL approach covers five dimensions used to measure service quality: reliability, responsiveness, tangibles, assurance and empathy.

With this concept, a high quality of services and products is the result of the commitment of staff to high quality standards (Kamiske & Umbreit, 2001). Hence, quality cannot only be defined and efficiently managed within an enterprise – it also has to be exemplified through the performance of all parties and employees involved. In order to support this effort, the quality management has to ensure that existing processes and infrastructures allow the engineering of products and services within pre-defined quality levels. Therefore, the responsible management of quality also takes into account the use of different concepts and methods for achieving quality goals within a company (Praeg & Spath, 2008).

Findings and Requirements in the Context of IT Service Quality Management

As mentioned beforehand, up until now there are no specific concepts and models described in scientific literature regarding an integrated IT system for service quality management. However, the previously described concepts and models provide a basis for several requirements for an IT service quality management framework, enabling us to identify the following requirements:

- R1: Quality is a management task. The framework has to consider different levels of quality management - from a strategic level right up to operational processes and infrastructures.
- R2: The framework needs to consider customer perceptions and demands.

- R3: The framework should provide quality processes that continuously improve IT service quality.
- R4: The framework has to consider multiple stakeholders of an enterprise, the external demands of customers and suppliers as well as taking internal structures and organizational processes into account.
- R5: The framework needs to consider the capabilities and demands of employees.

These are requirements from the perspective of service quality. In combination with requirements from the IT service management, they form the basis for developing a framework for IT service quality management.

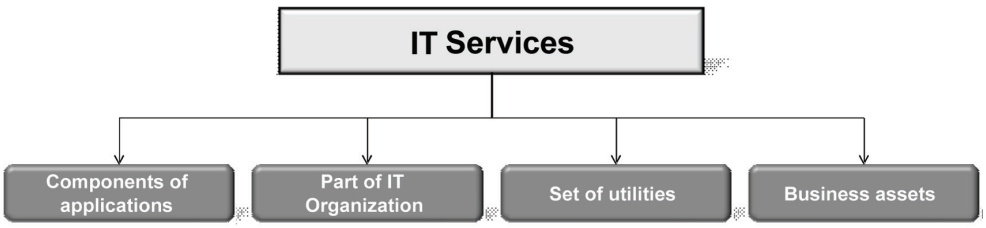
CONCEPTS OF IT SERVICE MANAGEMENT

IT service management is an intensively discussed topic in science and managerial practice. In order to develop a framework for IT service quality management we need to analyze existing concepts and models for IT service management. However, before discussing selected public and non-public IT service management concepts, we outline briefly the different understanding of IT services that exists in literature and managerial practice (see Figure 4).

A first perspective focuses on IT services as components of IT applications. They are embedded in IT systems and IT infrastructure and are the outcome of an IT application. A second perspective addresses IT services as a part of IT enterprises with their own set of capabilities and resources. IT services are viewed as a set of services that support organizational processes in order to deliver and operate the IT infrastructure within an organization. IT services have a support function to ensure that all customers of an IT unit can use the services, applications and infrastructure in a defined way. This perspective focuses on IT services in a customer context. From a third perspective, IT services are a set of utilities used by business processes. In this context, IT services are seen as independent products provided by an internal or external IT provider that are used in business processes and functions. A fourth perspective addresses IT services as a category of business assets that provides a stream of business benefits for their owners (OGC, 2007a, 2007b).

The perspectives of IT services show that it is essential to understand the meaning of a term in a given context. In our article, we focus on the third perspective and view IT services as independent products that can be traded on a market and which support or enable business processes. Summarized, IT services can be defined as "a service provided to one or more customers by an IT service provider. An IT service is based on the use of information technology and supports customer business processes. An IT service is made from a combination of people, processes and technology and should be defined in a Service Level Agreement" (OGC, 2007b)

Figure 4. Views on IT services



Beside the different views of IT services, numerous concepts have been developed for managing IT services. These concepts can be divided into public domain and non public domain concepts. Public domain concepts are founded on an intra-organizational perspective and integrate best practice from different enterprises. Non-public concepts are developed by service providers and provide methodologies, processes and procedures from a single enterprise.

IT Infrastructure Library (ITIL)

The ITIL framework is a source of best practices in IT service management. ITIL is used worldwide by companies to establish and improve capabilities in service management (OGC, 2006).

ITIL was developed at the end of the 1980's by the British Office of Government Commerce (formerly Central Computer and Telecommunication Agency (CCTA)). ITIL is the de-facto standard for IT service management and is the most widely adopted approach for IT service management (Sallé, 2004). The ITIL framework is a collection of best practice processes for IT service management.

The structure of the third version of ITIL is based on a service lifecycle model. The different phases are service strategies, service design, service transition, service operation and continual service improvement (OGC, 2006).

The service strategy defines targets and guidelines for the management of IT services. The phases service design, service transition and service operation represent the implementation, operation and alteration of IT service management within an enterprise. Continual service improvement supports the internal implementation of improvement programs and projects. Overall, the third version of ITIL covers 26 reference processes for IT service management as well as different tasks from financial management, service portfolio management and demand management which are handled as processes (Buchsein *et al.*, 2007).

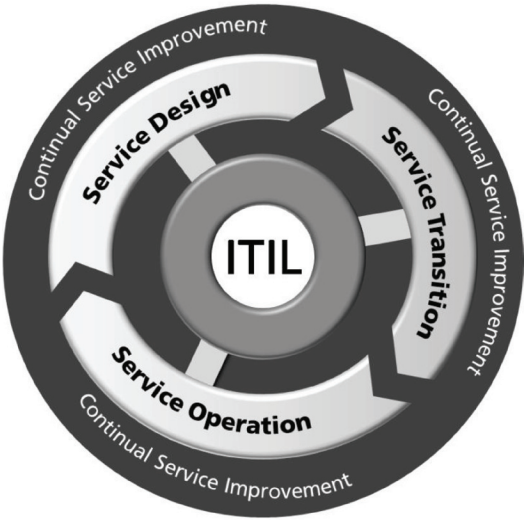
One important issue of the ITIL Version 3 is a glossary of standard terms and definitions. It emphasizes the integration between business and IT aspects. Furthermore, ITIL Version 3 also aims at supporting the implementation of value-added networks between IT service providers and service recipients.

ISO/IEC 20000

The ISO 20000 provides a formal und universal standard for enterprises seeking to audit and certify their service management capabilities. Therefore, the ISO standard provides minimum requirements that companies have to fulfill in order to provide services of a defined quality. The standard is divided into two parts. The first part is named "service management: specification" and covers the formal aspects. Defined guidelines are documented and have to be fulfilled and maintained by enterprises in order to achieve the audit.

The second part of the standard "service management: code of practice" complements the requirements of best practices and provides guidelines and recommendations for IT service

Figure 5. General structure of the ITIL V3 framework (source: (OGC, 2007b)



processes. These processes are based on the ITIL framework.

The ISO 20000 demands a strategic planning process for IT service management. The process must integrate short, medium and long-term planning. The aim is to align IT service management and IT strategy. Furthermore, the standard requires a defined process owner and a management control process for all IT service management processes. This must be proved for all IT service management processes implemented (Buchsein et al., 2007).

While ISO 20000 is a standard to be achieved and maintained, ITIL offers the necessary body of knowledge in order to achieve the standard.

Control Objectives for Information and Related Technology (COBIT)

CobiT has been developed by the Information Systems Audit and Control Association (ISACA) and is promoted by the IT Governance Institute. Designed as an IT governance aid for the management in order to identify and manage the risks and benefits associated with IT, CobiT creates the link between the business objectives of an entity and the specific IT and IT management tasks via statements about control objectives (Sallé, 2004).

The CobiT framework covers a lifecycle concept that is oriented towards the use of IT within an enterprise and is closely connected to IT governance. The CobiT framework identifies four domains grouped in a lifecycle. The four dimensions cover 34 IT processes which are necessary for successful IT management (Buchsein et al., 2007). It also defines 318 detailed control objectives and audit guidelines for assessing the 34 IT processes (Sallé, 2004).

The domains are planning & organization, acquisition & implementation, delivery & support and monitoring. Planning & organization covers strategy as well as tactics and identifies ways on using IT to support the achievement of the business objectives most effectively. Acquisition & implementation focuses on the identification, development or acquirement of suitable IT solutions. The delivery & support domain is concerned with the actual delivery of services required. The monitoring domain focuses on the assessment of quality and compliance with control requirements over time (Sallé, 2004).

The advantage of ITIL is the process model and process description as well as the recommendations for implementation. COBIT provides useful indicators for managing IT and measuring performance. The IT service processes from both concepts (ITIL and COBIT) are so well aligned that there is a good chance of integrating the two concepts (Buchsein et al., 2007).

Non-Public Domain IT Service Management Models

The HP IT service management reference model is a high-level IT process map that provides a coherent representation of IT processes and a common language for defining IT process requirements and solutions. The model is structured around five groups: business IT alignment, service design and management, service delivery assurance, service development and deployment and service operations (Sallé, 2004).

The Microsoft operations framework provides technical guidance to support enterprises in achieving critical system reliability, availability, supportability and manageability of IT solutions based on Microsoft products and technology. The process model is a functional model performed by operational teams in order to manage and maintain IT services. It is organized around four quadrants and twenty management functions. The quadrants are changing, operating, supporting and optimizing (Sallé, 2004).

The IBM system management solutions lifecycle framework provides a high-level consulting road map. The four-phase process is similar to the ITIL processes. The IBM approach considers the phases of process assessment, process improvement definition, analysis & design and

pilot deployment. There are also extensions to provide an integrated and comprehensive solution (Sallé, 2004).

There are additional concepts in the context of IT service management that cannot all be described in this article. Further important models in the field of IT service management include Capability Maturity Model Integration (CMMI), Projects in Controlled Environments (PRINCE2), Project Management Body of Knowledge (PMBOK), eSourcing Capability Model for Service Providers (eSCM-SP) and Telecom Operations Map (eTOM) (OGC, 2007b).

Findings and Requirements in the Context of IT Service Quality Management

The descriptions of the different IT service management concepts have shown that most focus on internal structures, processes and infrastructure management within enterprises. They provide organizational processes for managing the design, transition and operation of IT services.

External factors, such as customer demands, are considered indirectly, i.e. by defining the User Help Desk as single point of contact between customers and IT organization. The proactive management of customer demands and market developments is not explicitly addressed. The implicit assumption of most IT service management concepts is that the implementation of management processes will lead to good results and an acceptable level of quality.

Furthermore, IT service concepts emphasize technical and organizational processes with the intention of achieving quality as a result of their implementation. However, some concepts, e.g. the CoBIT and ITIL frameworks, integrate procedures for quality management and a continuous improvement cycle for process maturity and performance.

The analysis of IT service management frameworks leads to a number of framework requirements. An IT service quality management framework should:

- R6: Provide an inherent set of processes and key performance indicators to manage IT enterprises
- R7: Define points of contact with internal and external customers
- R8: Provide procedures and processes to manage organizational and technical changes due to changing market conditions.
- R9: Consider different management levels (from strategy to execution)
- R10: Provide processes to manage technical infrastructures
- R11: Regard the IT service lifecycle both from an internal and customer perspective.

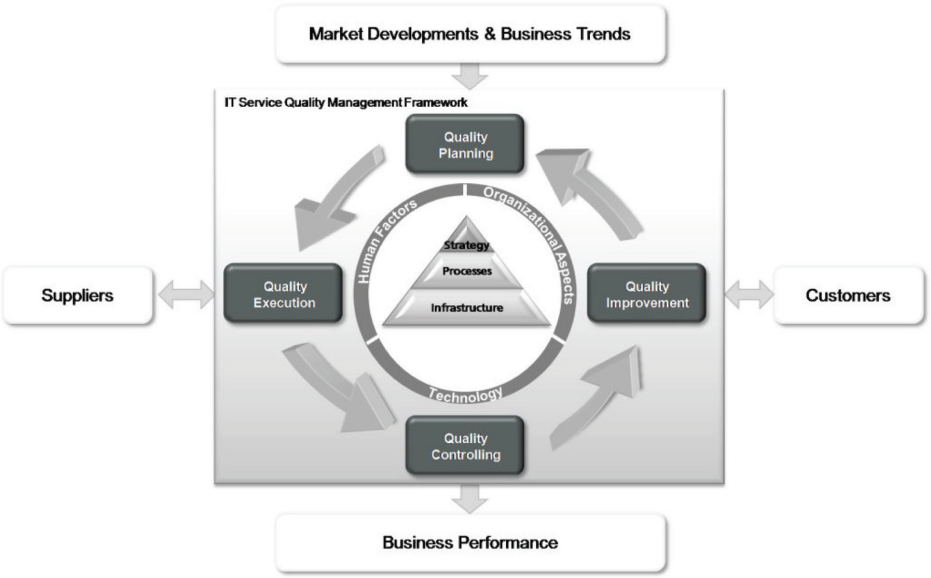
These requirements form the basis for developing a framework for IT service quality management. The structure and processes of the proposed framework are described in the following section.

FRAMEWORK FOR IT SERVICE QUALITY MANAGEMENT

As a result of the previously described concepts and models, a framework for managing IT service quality has to consider different dimensions and views with regard to quality and to perspectives on management and managing processes.

In our framework, IT service quality management needs to consider external developments (i.e. market development, changes in customer demands etc.) as well as internal aspects and processes within an enterprise. Additionally, the framework has to integrate different management processes, e.g. quality and IT service management processes as well as different levels of management (i.e. strategic, process and infrastructure level). The framework also has to consider different management perspectives, which have an important influence on the quality of IT services.

Figure 6. Framework for IT service quality management



From the external perspective, market developments and business trends have a direct influence on the competitive environment of enterprises and an indirect influence on the requirements of IT service quality. With regard to changed market situations or business trends, companies need to adjust their processes and corresponding IT support. Market developments and business trends also influence the lifecycle of IT services. In fast changing markets, the lifecycle of services may be shorter due to rapidly changing requirements compared to lifecycles in markets that are more stable.

A further important external perspective regarding IT service quality management is customer demands and requirements. As seen before, the customer's expectations and requirements of services is one of the most important factors in defining and managing IT service quality. Research from (Roses et al., 2009) shows the importance of managing perceptions of IT service quality. The performance and quality of IT service providers depend on the perception of the customer.

Not only the customer perspective but also the supplier perspective of IT service management needs to be considered in a quality framework. With regard to the reduction of own value added chains, the management of different suppliers becomes an important factor in the context of IT service management. IT service providers have to build up competences that enable the identification and evaluation of potential suppliers as well as implement processes supporting cooperation management with different suppliers.

The internal perspective of the framework addresses additional areas of IT service quality management. On the one hand, the framework considers different levels of management. On a strategic level, IT targets and suitable strategies for achieving the defined targets need to be determined. The strategic level also covers management processes regarding strategic IT business alignment (Chan, 1996; Henderson & Venkatraman, 1993). Together with market developments and customer requirements, the strategic level defines the framework for identifying and evaluating suitable quality factors.

The strategic level forms the basis for the design or adaption of suitable processes within the enterprise. The process level has to be aligned

with the strategic level to enable the defined goals to be achieved. The process level also focuses on the implementation of suitable processes and procedures in order to provide IT services with a predefined level of quality. Here, processes from the previously described IT service management concepts can be implemented (or be customized) within an enterprise. Appropriate quality and key performance indicators are required for efficient management (Buchsein et al., 2007). The third level considers the IT infrastructure necessary to provide IT services of a defined quality. There are also concepts for managing an appropriate IT infrastructure in the IT service management frameworks described in the previous sections.

Beside these management levels, there are other areas of interest that should be considered in the field of IT service quality management. One aspect is organization. Here, a framework should provide concepts as to how an IT department should be integrated into the overall enterprise. This area should also describe suitable processes and procedures within the company in order to provide services with a defined level of quality. In addition to the structure and processes, this area should also cover instruments and concepts for financial and value management within the company.

Furthermore, a generic framework for IT service management needs to consider human factors because they are a key success area in this field. This is highly relevant as human factors are often considered inadequately in cases where IT projects have failed.

An additional area should focus on technology. This area includes all aspects of technology management, including trend watching, evaluation and implementation in the enterprise.

Beside the management aspect, the framework also covers a quality management process. The process is made up of four steps: plan, execute, control, and improve.

In the planning phase, quality targets need to be derived from overall business and IT targets as well as from customer expectations and the market situation. The defined quality targets must be detailed and operationalized. During the operation phase, the IT service management processes have to be measured according to performance and quality. The control phase analyses the performance and quality measures if they reach the targets. Furthermore, analyses of possible gaps are necessary for the subsequent phase. During the improve phase, the reasons for the existence of the gaps have to analyzed and proper measures taken to improve the IT services according to the defined quality levels.

IT Service Lifecycle Management

In addition to the quality process, a methodology is required to identify, evaluate and implement suitable quality instruments in order to improve IT service quality. IT service lifecycle concepts can support this task.

With regard to lifecycle concepts, different perspectives need to be taken into consideration. A first view addresses the lifecycle from an internal perspective. An appropriate example is ITIL Version 3, which addresses an IT service lifecycle with the phases of strategy, design, transition, operation and continual service improvement. This lifecycle describes phases of IT service management from an intra-organizational view.

An important requirement in service quality management is to meet customer demands. Therefore, IT service quality management has to provide a lifecycle concept that addresses an external perspective. For this reason, we use the IT service lifecycle model from Praeg & Schnabel (2006). This lifecycle model differentiates between five phases of IT service viewed from a customer's perspective.

- Phase 1 addresses the phase of requirement engineering, which considers all stakeholder and customer needs in order to define requirements for IT services.

- Phase 2 focuses on sourcing and procurement in which potential service providers are identified and evaluated.
- Phase 3 deals with design, testing and orchestration as well as proving a detailed description of the IT service parameters. Here, performance indicators are identified and measurement procedures documented.
- Phase 4 addresses operation, maintenance and support, covering all relevant concepts in order to deliver high quality service.
- Phase 5 focuses on the replacement of IT services and also covers the management of changes and risks due to the replacement.

A further challenge in IT service quality management is to select suitable quality instruments and tools for the different phases of the lifecycle. The concept from Praeg & Spath (2008) describes mapping quality methodologies and instruments to the different lifecycle phases.

The mapping process between the various phases of the IT service lifecycle and the quality management methods is described in two steps. The first step deals with mapping between quality factors, derived from the methods mentioned in the previous chapter and the different lifecycle phases. This is because each phase sets different focuses on quality management. Based on this, the second step in the mapping process focuses on the association between quality management methods and the different lifecycle phases.

Each quality management method concentrates on the support and fulfillment of one or more quality factors. Therefore, for each lifecycle phase, different quality management methods can be used to support the quality factors (Praeg & Spath, 2008). Figure 8 shows an example of the result of the mapping process.

This section concentrates on describing the IT service management framework. It has been demonstrated that a framework for the quality management of IT services has to consider different management and process areas. Seen from this point of view, IT service quality management has to be integrated into the overall strategic and operational management within an enterprise. This aspect leads us to the final part of this article. In IT service quality management, it is also important to consider the possible effects of IT service quality on business performance. The following section gives an overview of possible effects.

Figure 7. IT service lifecycle model (source: Praeg & Spath, 2008)

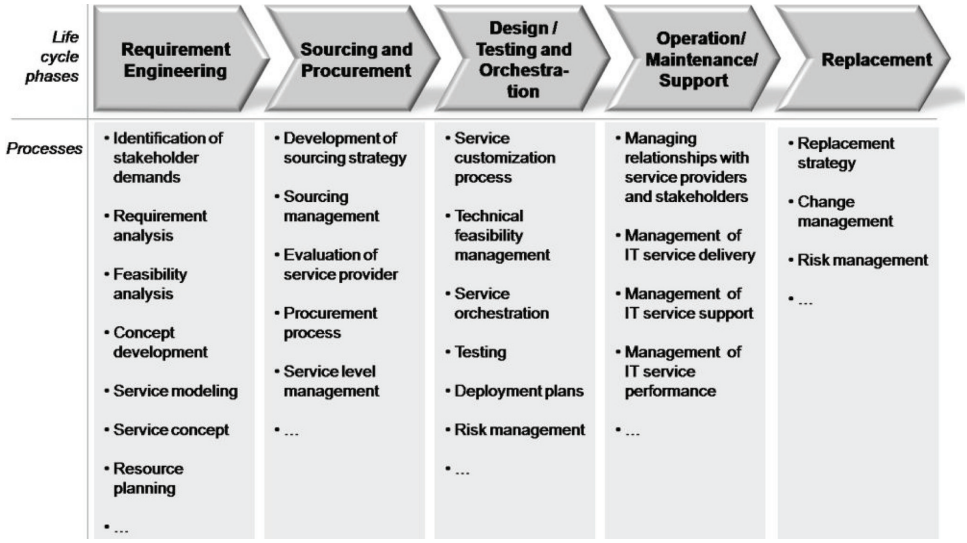
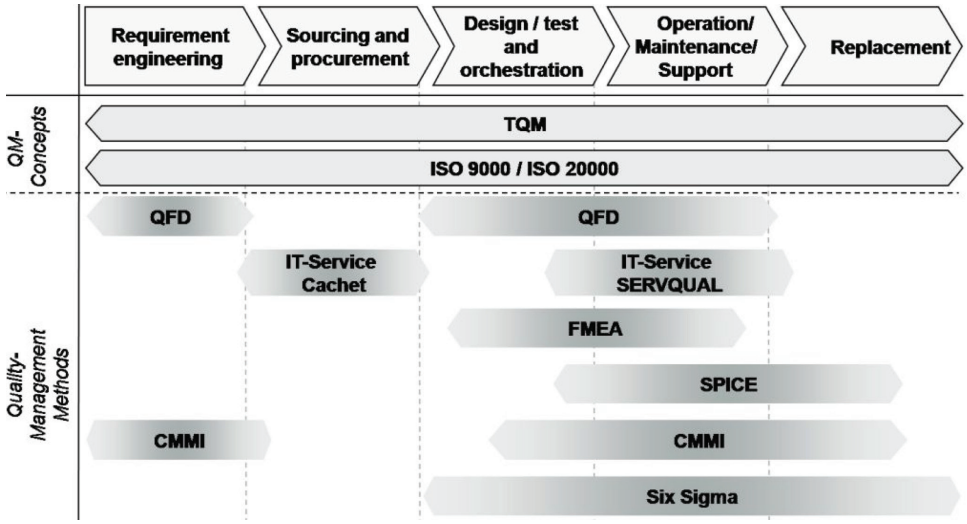


Figure 8. Example of mapping quality methodologies to lifecycle phases (source: Praeg & Spath, 2008)



EFFECTS ON BUSINESS PERFORMANCE

The aim of this section is to show the possible effects of quality management on business performance. To illustrate this, it is necessary to define the term performance as well as suitable performance indicators.

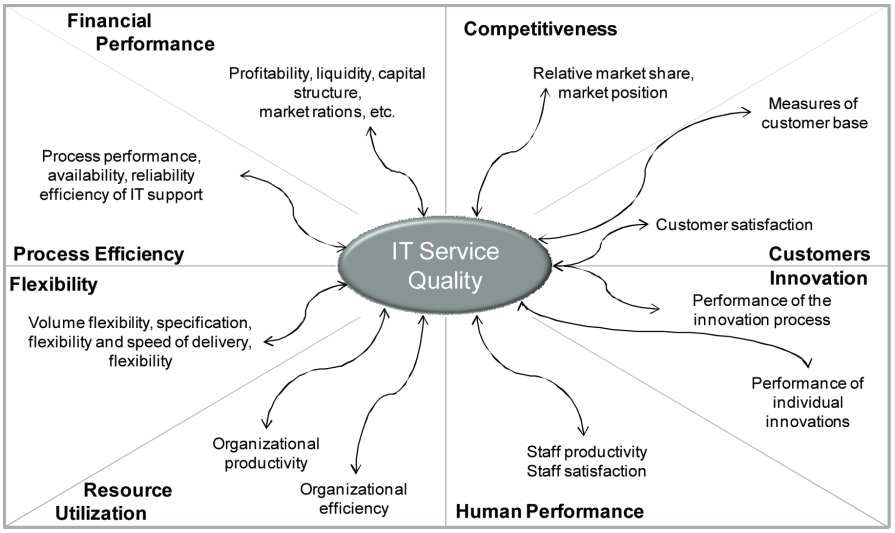
There is no single agreed definition of the term "business performance management" in scientific literature. In our article, we define business performance management as a combination of systems, processes, metrics and methodologies for monitoring and managing a company's business performance (Rayner, 2002). In the context of performance management, it is essential to define performance dimensions and company targets with regard to strategic goals. Performance targets not only require definition but also operationalization by determining suitable performance measures. A meta-analysis from Nair (2006) shows that diverse studies use different concepts to measure business performance.

In order to demonstrate the possible effect of IT service quality on business performance, it is necessary to show the effects on different aspects of performance. Therefore, we prefer a multi-dimensional construct to define business performance.

Research results from Marchand, et.al (2002) show that financial performance measures alone are not an adequate indicator. Management studies suggest that multiple measures of business performance should be used, giving the different perceptions of stakeholders, employees, customers and managers (Marchand et al., 2002). In various studies (Chan, 1996; Kettinger & Lee, 1994; Kettinger & Lee, 1997, 2005), several indicators are analyzed which provide reliable and valid measures of business performance. As a result, the studies show that market share growth, financial performance, level of innovation and the ability to achieve a superior company reputation are all factors that contribute towards business performance (Marchand et al., 2002).

A frequently used concept for operationalizing business performance in the context of service management is the model from Fitzgerald et.al. (1993). The concept groups business performance indicators from an enabler and perspectives of results. For each perspective, different performance dimensions with several performance measures are identified.

Figure 9. Effect model



However, in our experience and due to the framework of the IT service quality management described in the previous section, there is a need for additional performance perspectives. With regard to the balanced scorecard concept (Kaplan & Norton, 1996), it is also necessary to consider internal processes and customer perspectives (Gleich, 2001). In the context of services, staff performance also needs to be taken into account. Our experience shows that human performance is an important aspect in the management of business performance that is often disregarded in favor of traditional organizational and financial factors. As a result, in this article we can summarize that business performance is seen from a multi-dimensional perspective. Therefore, we define eight dimensions to describe business performance: business process efficiency, competitiveness, the customer, financial performance, flexibility, human performance, innovation and resource utilization. Based on this perspective, Figure 9 illustrates potential effects of IT service quality on business performance.

To illustrate the possible effects of quality on business performance, each performance dimension is defined by several performance indicators (see Table 1). In addition to this, different time horizons also have to be considered because effects may change over time.

With regard to financial performance, studies (Nair, 2006) show an overall positive correlation between quality and performance. However, in the short-term it is assumed that financial performance will decrease due to a higher investment requirement needed to set up the service quality management. Therefore, the overall profitability and capital structure may decrease leading to a weaker financial performance.

Table 1. Indicators of business performance (source: modified from (Fitzgerald et al., 1993)

Performance Dimension	Indicators
Competitiveness	Relative market share and position Sales growth, customer satisfaction
Financial Performance	Profitability, liquidity, capital structure market rations, etc.
Flexibility	Volume flexibility, specification and flexibility of speed of delivery
Resource Utilization	Productivity, efficiency, etc.
Innovation	Performance of the innovation process, Performance of individual innovations, etc.

The second dimension addresses the effect of IT service quality on organizational competitiveness. From a customer point of view, several studies indicate that the quality of service is an important factor when it comes to choosing a service provider (Praeg & Schnabel, 2006).

Another important development in IT service management is that IT providers not only offer a single service but also service packages in which different services are combined into unique and customized "services" (Zarnekow & Brenner, 2004). Here, quality is an important factor that creates sustainable competitive advantages because, from a customer point of view, these service bundles are unique and there are no benchmarks for comparing different service offers. Thus, service quality of is an important factor influencing the choice of service provider and resulting in a competitive quality advantage. Based in this assumption, it can be concluded that the quality of IT services has a positive influence in business performance.

However, competitiveness is not only defined by quality. In some market situations, a high level of quality may lead to competitive disadvantages. Especially in markets with a high cost pressure and standard services, high quality may result in service providers charging higher prices, therefore creating a competitive disadvantage. It can be summarized that IT service quality has a positive influence on competitiveness in cases where quality is an important differentiation aspect for customers. However, in markets with standard services and a high cost and price pressure, it may lead to competitive disadvantages.

With regard to the customer, a suitable indicator is customer satisfaction. It is assumed that there is a positive correlation between IT service quality management and customer satisfaction. However, as illustrated in the previous section, customer satisfaction depends on multiple factors. Research results from (Roses et al., 2009) show that there is a need to manage customer perceptions from the point of view of IT service quality.

It can be summarized that IT service quality may influence customer satisfaction and have an influence on business performance.

For the indicator "innovation", the influence of IT service quality management cannot be clearly described. On the one hand, service quality should lead to increased service availability, resulting in an increased time budget for employees to develop ways to improve services and foster innovation. On the other hand, quality management supports a continuous improvement process, which should result in an increased number of innovations. It is assumed that employees use the increase time budget to consider innovations in processes, procedures and structures. It can be summarized that there are only indirect effects of quality management on innovations. Many other factors also require analysis in order to make an adequate hypothesis regarding the possible influence on business performance.

The aspect of human performance addresses almost the same situation as mentioned in the financial section. In the short term, it is assumed that the business performance of staff will decrease due to additional efforts brought about by IT service quality management. One reason for this hypothesis is that an employee needs time to adapt to the change and to handle new situations. During this time, the individual performance of an employee decreases. However, studies from Brynjolfsson (1993) and Brynjolfsson & Hitt (1996; Erik Brynjolfsson & Hitt, 1998; E. Brynjolfsson & Hitt, 2000; Erik Brynjolfsson & Hitt, 2003) found that productivity increases in the long term as a result of IT investments. Therefore, seen from the long-term perspective, IT service quality should positively support staff work performance.

Resource utilization is a further indicator of business performance. This indicator focuses on organizational efficiency and productivity. We assume that quality management has a positive effect on organizational efficiency and productivity. Based on the construct of the framework, quality management has to ensure that the targets defined

on the strategic level are achievable. It should also provide procedures to support the achievement of the targets, with the consequence that quality management supports the effectiveness of an enterprise. Additionally, due to a continuous improvement process and suitable quality processes within a company, quality management also helps to improve existing processes and structures, further improving organizational efficiency and productivity. It can therefore be summarized that IT service quality management has a positive influence on resource utilization.

The performance indicator "flexibility" addresses the ability of companies to adjust their structures and processes to changing market situations or customer demands. Furthermore, flexibility can be operationalized. It can be categorized into flexibility with regard to volume, specification and speed of delivery. In this area, IT service quality management has varying effects on business performance. In the case of volume flexibility, the IT service quality framework addresses processes that focus on the continuous measurement of customer demands. Thus, changes in volume requirements need to be identified at an early stage in order to plan and realize the necessary organizational and technical changes as fast as possible. We can therefore assume that IT service quality has a positive influence on business performance.

With IT service quality management, structures and processes within enterprises need to be flexible in order to adapt to any changing specifications in customer demands. Therefore, we can assume that there is a positive relationship between specification flexibility and quality management.

The third aspect of flexibility is speed of delivery. The IT service quality management framework and IT service management concepts provide processes supporting fast service delivery. Due to a continuous improvement process, quality management helps to improve the performance of these processes. We can therefore assume that IT service quality management has a positive influence business performance.

A further indicator of business performance is process efficiency. In order to analyze the effect of quality on process efficiency, the factors affecting process efficiency first need to be defined. In general, efficiency is the relationship between input and output factors. Consequently, quality supports the reduction of input factors and helps to increase output by decreasing the number of these input factors. There are many ways of realizing such effects, by example through business reengineering or by improving IT business alignment on a process level. Service quality focuses on the improvement of IT service processes as well as on business processes. In the case of IT services, quality management advances process efficiency constantly through the implementation of a continuous improvement process.

A further important aspect regarding process efficiency is IT business alignment. The targets of IT business alignment are to align strategic business with IT strategies as well to align business processes and IT services on an operational level. In this context, quality management aims to support the alignment processes by measuring the achievement of the business and quality targets as well as by deriving suitable measures in order to improve existing alignment levels and process maturity. As a result, we can assume that IT service quality management has a positive influence on process efficiency and business performance.

OUTLOOK AND FURTHER RESEARCH

The aim of the chapter was to develop a framework for IT service quality management. To achieve this, we illustrated concepts of quality and IT service management and described a framework for IT service quality management. In this regard, we emphasized that IT service quality management not only focuses on IT service providers but also

on any enterprise using IT services in their day-to-day business. Based on this situation, we also highlighted the differentiation between internal and external perspectives concerning IT service quality management.

With regard to requirements derived from the different concepts of quality management and IT service management, from the quality perspective we can summarize that the requirements R1 to R5 are fully taken into consideration in our framework. As previously explained, the framework views IT service quality as being a management task, considers different levels of management, addresses stakeholder demands, taking especially customers and employees into account, and provides a continuous improvement process. In case of the requirements R6 to R11, it can be concluded that the framework covers most of the requirements. With regard to Requirement 6 (inherent set of processes and key performance indicators), the framework needs to be extended in more detail.

Relating to the effect of IT service quality management on business performance, we illustrated possible relationships between indicators of business performance and IT service quality management. The theoretical analysis showed that there is a high probability that IT service quality management will have positive effects on business performance. Nevertheless, the theoretical consideration needs to be analyzed by carrying out empirical research. Here, root-cause analysis (Campbell *et al.*, 2005) may be helpful in investigating the influences of the different indicators on overall business performance.

However, the framework has been developed based on theoretical models and on our experience gained from practical projects in the field of IT service management. Consequently, there is a need to discuss the framework and its modules scientifically in more detail. There is also a necessity to test the hypothesis empirically with regard to the effects of IT service quality on business performance. There are many more research questions to be answered in this area, focusing for example on the practical existence and strength of influence of service quality on business performance. New metrics suitable for describing IT service quality also require consideration.

Due to changed values in society and increasingly important ecological aspects regarding business management, new or additional metrics for defining and measuring business performance also need to be considered. The rising importance of sustainability and ecology may influence discussions about future business performance concepts. The relationships between sustainability, ecology, quality and business performance may also be interesting for further research.

Our intention is to trigger discussions as well as motivate researchers to individually adapt the initial model of the framework and start considering new ways of managing the quality, sustainably and performance of IT services as well as business performance.

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KEY TERMS AND DEFINITIONS

Business Performance Management: Business performance management is a combination of systems, processes, metrics and methodologies for monitoring and managing a company's business performance

ITIL: The IT Infrastructure Library is a de facto standard for IT service management

IT Service Management: IT services as independent products that can be traded on a market and which support or enable business processes. IT service management covers all processes to plan, design, bulid, implement, operate and maintain IT services.

Quality Management: The international standard ISO 8402 defines "quality" as being the total characteristic of a product or service concerning its suitability to fulfill predefined requirements (ISO 8402). quality management is the coordinated management task in order to govern an enterprise in terms of quality. Quality management is defined by quality policies, targets, processes, controlling and continuous quality improvement within a company

Service Quality: Service quality represents a pre-defined performance level of service. To define service quality there are several principles which have to be considered: customer orientation, consequence, competitor separation, consistence, congruence, coordination, communication, completeness, continuity and cost-benefit orientation.

Chapter 2
e-Service Quality: Literature Review and Future Avenues of Research

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ABSTRACT

The development of new orientations and focuses for the conceptualisation and measurement of electronic service quality (henceforth, e-SQ) is demonstrably necessary. This chapter is mainly addressed to highlight research avenues for improving our understanding of e-SQ management, based on a critical review of previous literature. The orientation of this study aims to reduce the efforts of researchers who desire to enter this field. To do this, we offer a research agenda and synthesise the main previous studies, including the dimensions employed within a set of selected works. We start by expounding the reasons that justify the carrying out of a project of investigation to measure e-SQ. We move on to describe the current e-SQ research gaps (research opportunities). And we conclude with a section devoted to the setting out of our conclusions and indicating possible routes for future investigation.

OVERVIEW

This chapter has a dual purpose: (1) to describe and systematise the state of the art of literature examining the quality of electronic service or e-Quality, and (2) to indicate possible routes for future investigation.

Large growth potential is forecast for the provision of products and services via electronic channels (mainly, the Internet) (e.g. Evanschitzky et al. 2004). There is also ample evidence that service quality delivery has a positive impact on desired attitudinal, behavioural, and financial outcomes (Parasuraman et al. 2005, Fassnacht & Koese 2006). So, appropriate conceptualisation and measurement are crucial for the effective management of *electronic service quality* (henceforth, *e-SQ*) and a major issue on the market research agenda (e.g. Parasuraman & Zinkhan 2002, Fassnacht & Koese 2006).

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Although e-SQ is an emergent research field (e.g. Sweeney & Lapp 2004), considerable research effort has already been devoted to it and substantial advances have been made (Francis 2007). According to Fassnacht and Koese (2006), this is not surprising given the managerial importance and theoretical appeal of the subject. But they also affirm that clear definitions, solid conceptual work, and empirical studies in multiple settings have been scarce, suggesting that we are still in the early stages within this field of research. Consistently and somewhat more flatly, Park and Gretzel (2007), affirm that "the development of Website evaluation methods has been all but systematic and conclusive" (pp.46).

Data collection was carried out in different stages between September 2003 and May 2009. Computer databases (e.g. Google scholar) were the main tools used to identify relevant research in the area. Then the electronic and physical bibliographical resources from universities in two different countries were used to obtain the papers. Both sources proved to be complementary. To cross check, the business and management journals included in the Social Citation Reports were also specifically searched. Consequently, we hope to have included in the review the highest-quality literature on the subject.

The identified papers were then evaluated with respect to their suitability for inclusion in the study. As the domain of our research is e-Quality or the customer's overall judgment of an e-entity's excellence (Santos 2003, pp. 235), papers had to be categorised between (1) e-SQ and (2) other related constructs such as *Website satisfaction* (e.g. Szymanski & Hise 2000, Evanschitzky et al. 2004), *Website success* (Liu & Arnett 2000), *satisfactory online experiences* (Novak et al. 2000), *online service value* (Heinonen 2007) and *customer Website loyalty* (e.g. Cho et al. 2002, Gummerus et al. 2004). 37 papers were selected for the first group.

To present this chapter, we commence by expounding, in detail, in a first section, the managerial and theoretical reasons that justify the carrying out of a research project to conceptualise and measure e-SQ. Then, in the second section, we explain the situation in which e-SQ investigations currently stand by focusing on research gaps. In the third section, we offer an overview of the main scales utilised in e-SQ measurement. We offer two tables (Tables 1 and Table 2) presenting a synthesis of the methods, constructs, dimensions and results of a body of selected e-SQ investigations. We end with a section devoted to the setting out of our conclusions and indicating possible routes for future investigation (summarised in Table 4).

RELEVANCE OF E-QUALITY

The development of new orientations and focuses for the conceptualisation and measurement of e-SQ is demonstrably necessary. The aim of this section is to offer a summary of the disposable evidence (Barrutia and Gilsanz, 2009).

Firstly, Parasuraman and Zinkhan (2002) maintain that electronic services contribute two key advantages: information efficiency and transaction efficiency. It is not surprising, therefore, that online customers should be attracted by cyberspace in their search for these two qualities. Consequently, large growth potential is forecast for the provision of products and services via electronic channels (mainly, the Internet) (e.g. Evanschitzky et al. 2004).

On the other hand, E-SQ is a basic requirement for the good performance of electronic channels. But, whereas in the first stages of electronic retail commerce low prices and a mere presence on the Web could be sufficient for commercial success, today, due to the intense competitiveness, they are simply necessary conditions for survival, but are not sufficient in themselves (e.g. Luedi 1997, Jun et al. 2004, Lee & Lin 2005). E-SQ surpasses these variables in importance in terms of predicting the success or failure of Internet-based operations (Parasuraman & Zinkhan 2002, Zeithaml et al.

Table 1. A selection of e-Quality studies

Study	Key dimensions	Approach
Bauer, Falk & Hammerschmidt (2006)	**Resulting factors:** Overall service quality, Perceived value, Customer satisfaction, Relationship duration, Repurchase intention **Predictor factors:** Functionality/Design (7 items), Enjoyment (4 items), Process (4 items), Reliability (6 items), Responsiveness (4 items).	**Objective of the study:** Measurement of the Electronic Retailing Service Quality. **Method:** Scale developed from literature review and semi-structured qualitative interviews with online users: graduate-level students or university staff. The quantitative data were collected by means of a structured questionnaire distributed by a German market research institute to randomly selected members of its online panel. They only considered respondents that completed a product purchase. 384 fully usable questionnaires. Exploratory and confirmatory factor analysis, structural equation modelling, multiple regression analysis.
Collier & Bienstock (2006)	**Resulting factors:** Satisfaction and Behavioural intentions. **Predictor factors:** 3 second-order dimensions and 11 first-order dimensions: *Process quality:* Ease of use (5 items), Privacy (4 items), Design (5 items), Information accuracy (6 items), Functionality (5 items). O*utcome quality:* Order condition (3 items), Timeliness (3 items), Order accuracy (3 items). *Recovery:* Interactive fairness (10 items), Outcome fairness (4 items), Procedural fairness (6 items).	**Objective of the study:** Measurement of the Electronic Retailing Service Quality. **Method:** Analysis of both academic and practitioner literature. Refined survey was administered to college students who had completed an online transaction with an e-retailer. 334 usable questionnaires (recovery dimension questions are applicable to 189 respondents). Analysis by means of structural equation modelling.
Fassnacht & Koese (2006)	**Resulting factor:** Overall service quality, Overall service satisfaction. **Predictor factors:** 3 second-order dimensions and 9 first-order dimensions: *Environment quality:* Graphic quality (3 items), Clarity of layout (3 items). *Delivery quality:* Attractiveness of selection (2 items), Information quality (3 items), Ease of use (4 items), Technical quality (3 items). *Outcome quality:* Reliability (2 items), Functional benefit (2 items), Emotional benefit (2 items).	**Objective of the study:** Development and empirically testing of their conceptualisation of the e-service quality, drawing on Rust and Oliver's (1994) framework as a theoretical reference. **Method:** To elaborate the relevant dimensions and subdimensions, they draw on the findings from the existing literature and the results of a qualitative study involving explorative interviews. Their sample consists of registered customers of three different electronic services (paying customers in two of them): a service for the creation and maintenance of personal homepages, a sports coverage service, and an online shop. A separate online questionnaire was developed for each of the three areas of investigation. 349, 345, and 305 usable responses were obtained for the homepage service, the sports coverage service, and the online shop, respectively. Confirmatory factor analysis, Multigroup CFA, structural equation modelling. The model is tested successfully with a large aggregated sample from the three different electronic services.
Parasuraman, Zeithaml & Malhotra (2005)	E-S-QUAL scale: **Resulting factors:** Perceived value, Loyalty intentions. **Predictor factors:** Efficiency (8 items), Fulfilment (7 items), System availability (4 items), Privacy (3 items). E-RecS-QUAL scale: **Resulting factors:** Perceived value, Loyalty intentions. **Predictor factors:** Responsiveness (5 items), Compensation (3 items), Contact (3 items).	**Objective of the study:** From a differentiation between core service and recovery service, they conceptualise and test the Electronic core service quality scale (E-S-QUAL) and the Electronic recovery service quality scale (E-RecS-QUAL) to measure the Electronic Retailing Service Quality. **Method:** After conducting Confirmatory factor analysis and validity tests on the final scales, they administered them via online surveys to representative samples of customers of Amazon (n=653) and Wal-Mart (n=205). Analysis by means of structural equation modelling.

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Table 1. continued

Study	Key dimensions	Approach
Wolfinbarger & Gilly (2003)	**Resulting factors:** Customer perceptions of quality, Electronic Satisfaction, Electronic customer Loyalty, Attitudes toward the Web site. **Predictor eTail Quality factors:** Website design (5 items), Fulfilment/Reliability (3 items), Privacy/Security (3 items), Customer service (3 items).	**Objective of the study:** Creation and validation of the Electronic Retailing Service Quality scale (eTailQ), from the. comQ scale developed in Wolfinbarger & Gilly (2002). **Method:** They review both Marketing and Information Systems literature that explore the online consumer experience, and use a multi-method measurement development process in three steps: (1) Focus groups; (2) structured conceptualisation; and (3) exploratory and Confirmatory factor analysis of online survey data. Online survey using the Harris Poll online panel restricted to participants who purchased products. 1013 respondents. Cluster analysis, Exploratory and Confirmatory factor analysis, and structural equation modelling.

Study	Key research findings
Bauer, Falk & Hammerschmidt (2006)	-The authors capture all stages of the electronic service delivery process (Four phases: Information; Agreement; Fulfilment; After-sales) in order to develop a transaction process-based scale for measuring service quality (eTransQual). -e-TransQual scale integrates both utilitarian (extrinsic) and hedonic (intrinsic) e-service quality elements. -*Responsiveness* dimension does not emerge as a distinct scale, which is only relevant when users run into problems. -Measurement of marketing relevance: All dimensions (especially reliability) show a significant positive impact on perceived value and customer satisfaction. -Measurement of economic relevance: *Enjoyment* dimension is a dominant factor influencing both relationship duration and repurchase intention as major drivers of customer lifetime value.
Collier & Bienstock (2006)	-A conceptual framework of e-service quality that combines Process, Outcome, and Recovery dimensions is developed and empirically tested. -Empirical support is found for the three-dimensional approach to conceptualising e-service quality. e-Service quality must not only encompass Web site interactivity or process quality but also outcome quality and recovery quality. So, e-service quality is more than just customer interaction with the Web site. -Outcome quality dimension exclusively refers to reliability element. -Empirical support is found for the use of formative indicators instead of reflective indicators to conceptualise e-service quality. -Satisfaction plays a mediator role between Outcome quality and Behavioural intentions, as well as between Recovery and Behavioural intentions.
Fassnacht & Koese (2006)	-Conceptualisation and testing of a hierarchical model for electronic services that includes Environment, Delivery, and Outcome dimensions. -The authors define electronic services, emphasising the pure self-service character of the concept, i.e. the focus is on the interaction between customer and the Web site. They focus on the core offering. So, customer-employee interactions are not included. -Development of a reliable and valid scale that is applicable to a broad range of electronic service offerings rather than one specific area. -A transaction process-based framework to electronic service encounters incorporating both utilitarian and hedonic e-service quality elements is applied. -Comprehensive view of the outcome dimension of quality of electronic services is provided. This view includes emotional and functional benefits in addition to reliability element.
Parasuraman, Zeithaml & Malhotra (2005)	-The E-S-QUAL is a reliable and valid scale applicable to e-retailing. -For the E-RecS-QUAL scale there is insufficient evidence; it needs to be improved by future research. -The recovery service scale is only applicable to customers whose Web site encounters are non-routine.
Wolfinbarger & Gilly (2003)	-Development of a reliable and valid scale applicable to a broad spectrum of e-retailing experiences. -eTail Quality is defined as a higher order factor. -There is a weak relation between customer service dimension and Web site quality.

Source: Barrutia and Gilsanz (2009)

Table 2. e-Quality, dimensions and items used

Dimensions	Items	Investigators
Web site Design **Fulfilment/Reliability** **Privacy/Security** **Customer Service**	-The Web site provides in-depth information. -The site doesn't waste my time. -It is quick and easy to complete a transaction at this Web site. -The level of personalisation at this site is about right, not too much or too little. -This Web site has good selection. -The product that came was represented accurately by the Web site. -You get what you ordered from this site. -The product is delivered within the timeline promised by the company. -I feel like my privacy is protected at this site. -I feel safe in my transactions with this Web site. -The Web site has adequate security features. -The company is willing and ready to respond to customer needs. -When you have a problem, the Web site shows a sincere interest in solving it. -Inquiries are answered promptly.	Wolfinbarger and Gilly (2003)
Quality of Service Delivered by Website: **Efficiency** **Fulfilment** **System Availability** **Privacy** ***Quality of Recovery Service:*** **Responsiveness** **Compensation** **Contact**	-This site makes it easy to find what I need. -It makes it easy to get anywhere on the site. -It enables me to complete a transaction quickly. -Information at this site is well organised. -It loads its pages fast. -This site is simple to use. -This site enables me to get on to it quickly. -This site is well organised. -It delivers orders when promised. -This site makes items available for delivery within a suitable time frame. -It quickly delivers what I order. -It sends out the items ordered. -It has in stock the items the company claims to have. -It is truthful about its offerings. -It makes accurate promises about delivery of products. -This site is always available for business. -This site launches and runs right away. -This site does not crash. -Pages at this site do not freeze after I enter my order information. -It protects information about my Web-shopping behaviour. -It does not share my personal information with other sites. -This site protects information about my credit card. -It provides me with convenient options for returning items. -This site handles product returns well. -This site offers a meaningful guarantee. -It tells me what to do if my transaction is not processed. -It takes care of problems promptly. -This site compensates me for problems it creates. -It compensates me when what I ordered doesn't arrive on time. -It picks up items I want to return from my home or business. -This site provides a telephone number to reach the company. -This site has customer service representatives available online. -It offers the ability to speak to a live person if there is a problem.	Parasuraman, Zeithaml and Malhotra (2005)

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2002a). Web presence may be imitated, and price comparisons are easily accomplished. Moreover, customers become more and more demanding, and they are less tolerant of poor service performance. Thus, better quality is a primary source of competitive advantage for providers of electronic services (Fassnacht & Koese 2006). As Reichheld

Table 2. continued

Dimensions	Items	Investigators
Functionality/Design **Enjoyment** **Process** **Reliability** **Responsiveness**	1. Efficiency of navigation. 2. Accessibility of relevant content. 3. Clarity of the Web site. 4. Relevance of information. 5. Timeliness of information. 6. Visual appeal. 7. Professional Web site design. 8. Personalisation of information and offerings. 9. Fun of using the Web site. 10. Excitement when shopping online. 11. Entertainment provided by the Web site. 12. Availability of the Web site. 13. Stability of data transmission. 14. Efficiency of online order processing. 15. Waiting time. 16. Timeliness of order delivery. 17. Accuracy of order delivery. 18. Product availability. 19. Breadth and depth of product range. 20. Encoding of personal information. 21. Confidentiality. 22. Availability of alternative communication channels. 23. Return policy. 24. Availability of service personnel. 25. Promptness of reactions to requests.	Bauer, Falk and Hammer-schmidt (2006
Source: Own preparation based upon Parasuraman, Zeithaml and Malhotra (2005)		

and Schefter (2000) hold, price does not seem to govern the Web.

Furthermore, E-SQ contributes to achieving the main business goals. A higher level of e-SQ contributes to achieving the main business goals (Zeithaml et al. 2000, 2002a), in terms of better (e.g. Keating et al. 2003) and more efficient (e.g. Rust & Lemon 2001) relations with customers, more power to attract potential customers (e.g. Cai & Jun 2003, Yang et al. 2004), greater competitiveness (e.g. Poulymenakou & Tsironis 2003, Tan et al. 2003) and greater company benefits in the long term (e.g. Santos 2003). E-SQ is, therefore, recognised as one of the principal determinants of success for organisations.

Nevertheless, there is evidence to indicate that organisations seem to be offering low quality e-SQ (e.g. Picolli et al. 2004). Among the fundamental reasons that explain why, in practice, lower electronic service quality is delivered we find: 1) a confused definition of customer expectations of e-SQ (e.g. Parasuraman & Zinkhan 2002, Long & McMellon 2004), owing to lack of experience; 2) insufficient comparison of online services provision by organisations (e.g. Zeithaml et al. 2001); 3) the presence of organisational deficiencies (aspects of information, design, communication) (Zeithaml et al. 2000).

But, appropriate conceptualisation and measurement are crucial for the effective management of service quality. It is needed because it will help to control and improve the performance of online companies (Yang et al. 2003) and, in addition, to establish priorities in the development of e-SQ, when organisational resources are limited and the market is intensely competitive (Jun & Cai 2001, Santos 2003, Yang et al. 2003).

Through an understanding of the main dimensions that online clients use in order to assess service quality, online providers might identify the suitable actions to be taken so as to control and increase performance or results within these

dimensions and, likewise, avoid service failures or faults (e.g. Zeithaml et al. 2002a, Jun et al. 2004).

Nevertheless, traditional service quality scales are not appropriate for measuring e-SQ. There are significant differences between traditional service and Internet service experiences. The first and most obvious of these is the non-existence or only occasional existence of interactions between customers and employees in Internet service experiences. The arrival of customer-Website interactions detracts from the importance of personal aspects in service encounters. Zeithaml et al. (2000) suggest that personal service is not a critical element in e-SQ, except when problems occur or in situations where customers have to adopt complex decisions.

So, the limitations of traditional service scales for measuring e-SQ are obvious. Thus, in the opinion of Van Riel et al. (2001), since the dimensions of traditional service scales (as, for instance, the SERVQUAL scale) were developed from, and for, interpersonal encounters, the descriptions of content and the scale items should be reformulated before they can be conveniently used in an electronic service context. A wide section of customers, for example, do not necessarily expect to come across much empathy in an online setting, except when they have queries or problems.

THE CONSTRUCTION OF E-SQ SCALES: DIMENSIONS AND ITEMS UTILISED

After a process of systematic review of e-SQ papers (see Barrutia and Gilsanz, 2009 for more details) some representative papers of extant research in the e-SQ area were selected. A summary of these papers can be found in Table 1.

There is no agreement as to the exact nature or number of dimensions of service quality to be included in the evaluation customers make of electronic services. And because of a lack of clear definitions, comparison of existing research findings is at times not easy. Furthermore, some sources of error remain in the e-SQ literature. Sometimes nomenclature varies even when the underlying concept is very similar and sometimes the same nomenclature hides different concepts. For instance, accessibility has different meanings in different studies. In some instances it refers to usability concerns such as ease in finding the Website and downloading speed (e.g. Van Riel et al. 2004), whereas in other instances it refers to accessibility of service representatives (e.g. Jun et al. 2001). Gummerus et al. (2004), meanwhile, discussed the quality dimension of responsiveness in terms of the response to customer feedback, whereas in the work of Loiacono et al. (2007) this dimension refers to the loading time of Websites.

We will now overview the main dimensions employed by customers when assessing Web pages in general and Website service quality in particular, as identified in academic investigations. These dimensions are classified in accordance with the five relevant criteria identified by Zeithaml et al. (2002a). Other proposed dimensions are then incorporated.

The availability of information and contents mainly refers to the obtaining of information directly from the page, to the depth or quantity of the information, to its quality, and its credibility (e.g. Zellweger 1997, Wolfinbarger & Gilly 2001, Janda et al. 2002, Tan et al. 2003, Ho & Lee 2007). Information is considered to be an important element in e-SQ evaluation, since it is presumed that customers wish to access complete information that will enable them to check out product availability and make comparisons of prices, characteristics and qualities (Trocchia & Janda 2003), so as to improve the decision-making process regarding a product, service or purchase (Novak et al. 2000). Similarly, product information, in terms of richness and quality, is identified as an element of electronic satisfaction by Szymanski and Hise (2000).

Information credibility is about the trust exhibited by customers vis-à-vis information provided

on Web pages (Trocchia and Janda, 2003). Yang and Jun (2002) define the credibility dimension in terms of whether the Web page gives details, on the one hand, of the business record or history of the online services supplier and, on the other, concerning discounts and diverse rewards (for repeated purchases, for instance, or to loyal customers…).

Ease of use, which is often also termed Usability, include search functions, download speed, global design, and page organisation (e.g. Jarvenpaa & Todd 1997, Novak et al. 2000, Collier & Bienstock 2006, Loiacono et al. 2007). The suggestion is that customer assessment of Web pages will probably be influenced by: 1) the ease of use of the pages and by 2) the effectiveness of Web pages in helping customers to get what they want (Zeithaml et al., 2002b). This concept was first developed by Davis, Bagozzi and Warshaw (1989) in reference to the adoption of new technologies within the work environment, but it is also applicable in an online context. The studies carried out by Adams, Nelson and Todd (1992), Hendrickson, Massey and Cronan (1993), Keil, Beranek and Konsinsky (1995), Segars and Grover (1993) and Subramanian (1994) come to similar conclusions.

The main aspects that affect usability include search functions, download speed, global design, and page organisation (Jarvenpaa and Todd, 1997; Montoya-Weiss, Voss and Grewal, 2000; Novak, Hoffman and Yung, 2000). Jun et al. (2004) basically associate ease of use with the proportion of well-organised online catalogues, with concise contents, and terms and conditions that are easy to understand. In this area, Reibstein (2002) is of the understanding that fundamental aspects of ease of use are funcionality, accessibility of information, convenience when making orders and surfing.

With regard to the relevance of ease of use as an antecedent for e-quality, Dabholkar (1996) maintains that it is a determinant of quality of service. In the same vein, Xue and Harker (2002) consider that usability increases efficiency in system use and that it therefore constitutes a decisive element for customer satisfaction. Gefen and Straub (2000) underline the special importance of ease of use for new users.

Privacy and/or security constitutes another criterion that has been analysed due to its impact on online customer perceptions. In principle both concepts are different. Privacy implies the protection of users' personal information (Friedman et al. 2000). Several studies reveal the unease of online customers about providing personal data (e.g. Davis et al. 2000). Security, meanwhile, concerns the protection of users from the risk of fraud and from economic losses when using their credit cards or disclosing other financial information (Montoya-Weiss et al. 2000). Nevertheless, in the literature both concepts have tended to be used jointly (e.g. Wolfinbarger & Gilly 2003, Parasuraman et al. 2005). Thus, authors such as Janda et al. (2002) and Jun et al. (2004) maintain that the security dimension of security takes in, on the one hand, customer perceptions of the degree of protection of personal information or non-financial security (e.g. disclosure of a telephone number) and, on the other, perceptions of the degree of online risk when making online or financial security transactions (e.g. disclosure of a credit card number). When Zeithaml et al. (2002b) refer to privacy it includes aspects of both financial and non-financial security, while Wolfinbarger and Gilly (2003) define the privacy/security dimension as including both aspects. Ribbink et al. (2004) likewise identify the guarantee dimension in the same sense, incorporating both security and privacy.

In general it is recognised by companies that the availability of a formal policy of Web page privacy and confidentiality is fundamental, so that there exists secure access which customers immediately recognise; that the general reputation of the service provider or supplier be furnished; and that a security certification or guarantees, plus reports charting the experiences of other customers, and so forth, be provided. Security

and privacy are both identified as determining aspects of quality of service as perceived by Yoo and Donthu (2001), Liljander et al. (2002), and Zeithaml et al. (2000).

Another criterion that has been researched because of its influence on online services evaluation, is graphic style (Hoffman and Novak, 1996; Lynch and Ariely, 2000; Montoya-Weiss et al., 2000; Novak et al., 2000), which involves features such as colour, format, size and print type, number of photographs and graphs, and animation. In the most recent investigations, several authors, amongst whom are to be found Gummerus et al. (2004), Ribbink et al. (2004) and Van Riel el al. (2001), allude to aspects already mentioned when referring to user interface. User interface captures aspects such as general page design (Wolfinbarger and Gilly, 2003; Zeithaml et al., 2000), or electronic scenario (e-scape) (Van Riel et al., 2004), including format (Srinivasan et al., 2002), surfing ease (Kaynama and Black, 2000; Zeithaml et al., 2000), ease of use (Dabholkar, 1996; Srinivasan et al., 2002; Zeithaml et al., 2000) and page aesthetic (Zeithaml et al., 2000).

Authors usually cite user interface as the element that reflects the way in which services are provided, that is, the channel via which customers enter into contact with the services provider (Van Riel et al., 2001). It must be pointed out that, for some authors, user interface as a determiner of e-SQ consists of a single dimension (Grönroos et al., 2000), while for others it comprises various sub-dimensions (Donthu, 2001; Zeithaml et al., 2000; Kaynama and Black, 2000). Others refer to a dimension of sensations (Janda et al., 2002, Trocchia and Janda, 2003) to depict the way that an Internet services provider pays attention to aesthetic aspects of online purchase experiences. Within this dimension they also look at the online consumer's skill at interacting with the product, as well as with other individuals, during the purchase experience, in reference to the interactive characteristics of an electronic retailer Web page (Janda et al., 2002, Trocchia and Janda, 2003).

Fulfilment/reliability, which in the offline quality context is considered to be the most significant dimension (Parasuraman et al. 1988), is also identified as an important factor in the online context, in association with an exact time distribution, with regard to product/service characteristics and other questions of compliance, such as price precision and promised time response (e.g. Liljander et al. 2002, Wolfinbarger & Gilly 2002, Jun et al. 2004, Bauer et al. 2006). In addition it incorporates aspects related to Website technical functioning or system availability (Zeithaml et al. 2002a, Parasuraman et al. 2005 and Rosenbaum 2005).

Fassnacht & Koese (2006) and Collier & Bienstock (2006) include reliability as a component of the outcome dimension of e-SQ. Specifically, Collier & Bienstock (2006) include three dimensions in reference to reliability as components of the higher order outcome dimension of e-SQ, whereas the aspects related to the functioning of the website are included in the dimension quality of process.

Mulvenna et al. (2000) hold that other criteria such as access, responsiveness and personalisation deserve a mention with respect to Website quality. Access/accessibility includes the ability to communicate with the provider or service representatives (Jun et al. 2004), and the variety and universality of the products offered on the Website (e.g. Janda et al. 2002, Van Iwaarden et al. 2004). Contact (Parasuraman et al. 2005) and consumer service (Wolfinbarger & Gilly 2003) are related dimensions which refer to offering clients different alternatives of contact with the supplier of the service. Responsiveness, just as in a traditional services context, is about the efficacy and efficiency with which customers receive a response to the problems they experience (e.g. Zeithaml et al. 2000, Long & McMellon 2004) or when they make enquiries or suggest improvements (Ribbink et al. 2004). Bauer et al. (2006) consider that, in general, this dimension refers to a capacity to serve clients beyond the mere

transaction and to the ability to build long-term relationships.

Then we have personalisation/customisation, which, in purely electronic environments, concerns the adaptation of service to individual customer preferences, and whether the service adapts to customers in line with previous information that the company keeps about them, without them being consulted (Liljander et al. 2002).

Another dimension that is mentioned is price knowledge (Zeithaml et al. 2000). Nevertheless, in later studies by Zeithaml et al. (2002a), as well as by Tan et al. (2003), the price knowledge dimension is not considered for the evaluation of service quality.

One emergent factor is playfulness/enjoyment. Although still not widely recognised in Web evaluation frameworks (as exceptions, see Bauer et. al. 2006 and Fassnacht & Koese 2006), playfulness and enjoyment have received increasing attention in the overall human–computer interaction literature (e.g. Lin et al. 2005). Social involvement has also emerged as a factor that signifies opportunities to share information and communicate experiences and opinions to others (Park & Gretzel 2007). It emphasises the sharing and peer communication dimension of Website interactions.

Technology integration is another factor that could be considered for Web evaluation studies because it will increase in importance as new technologies such as car navigation systems, MP3 players, Web-enabled cell phones and other forms of mobile computing become widely adopted by the travelling public (Park & Gretzel 2007).

In Table 2, the items associated with each of the dimensions identified by different researchers are specified.

E-QUALITY RESEARCH CHALLENGES

The conceptualisation and measurement of quality is a major issue on the research agenda for electronic services. But progress in our understanding of e-quality is limited. In consequence, the conceptualisation and measurement of e-SQ poses a series of gaps/challenges and offers a range of opportunities for researchers. The main aim of this section is to highlight and justify these gaps (we have found ten main gaps). We echoes a decalogue of electronic service-quality research GAPS provided recently by Barrutia and Gilsanz (2009).

1) Few E-SQ Definitions Have Been Provided. Mostly They Remain Ambiguous and There is no Consensus Regarding the Main Elements

Unfortunately, up to now, a generally accepted definition of e-SQ has not existed. As has been already noted (Fassnatcht & Koese 2006), most authors neither define the exact domain of their quality construct nor provide a clear-cut definition of electronic services. When definitions are provided, they differ on coverage from article to article and are not sufficiently explanatory with regard to what exactly they are including. The most relevant differences vis-à-vis scope are: (1) focus on the Internet vs. focus on electronic channels in general (e.g. automated teller machines, mobile phones or interactive television); (2) including solely online shopping vs. including other types of online services as well (e.g. information/content-related services); and (3) considering only the pure self-service character of the concept, i.e. customer-technology interactions vs. additionally including other related interactions (e.g. an employee's answer to a customer's e-mail, recovery service, etc).

The first formal definition of e-SQ was provided by Zeithaml et al. (2000): "the extent to which a Website facilitates efficient and effective shopping, purchasing, and delivery of products and services" (p. 11, also in Parasuraman et al. 2005, pp. 217). This definition focuses on shopping-led

Website-customer interactions. Although the definition is not sufficiently explanatory, the authors' empirical work suggests that their view includes self-service interactions and technology-mediated interactions with company employees (regarding service recovery).

Gummerus et al. (2004) offer an alternative definition: "the consumer's evaluation of process and outcome quality of the interaction with a service provider's electronic channels" (p. 177). This definition refers to electronic channels, in general, and includes a broad range of online services (not solely online shopping). Along the same lines, Fassnacht & Koese (2006), define e-SQ as "the degree to which an electronic service is able to effectively and efficiently fulfil relevant customer needs" (p. 25). But electronic services are defined as "services delivered via information and communication technology where the customer interacts solely with an appropriate user interface in order to retrieve desired benefits" (pp. 23). This definition includes all kinds of electronic channels (not solely the Internet) and the whole range of online services (not just shopping) but does not include customer-employee interaction of any kind. This view is not shared by other authors such as Bauer et al. (2006), who, along the same line of thought as Zeithaml et al. (2000), recently affirmed that "a complete definition should cover all cues and encounters that occur before, during and after the electronic service delivery" (pp. 867).

2) There is a Lack of Solid Theory-Building Research and More Theory-Supported Research is Needed

As research has often taken an exploratory approach in the development of scales, the structure and meaning of the obtained dimensions have mainly been determined ex post by results from data analysis. A theoretical framework has hardly been used. The works by Collier and Bienstock (2006) and by Fassnacht & Koese (2006) may be considered as exceptions. Collier & Bienstock (2003) derivate their conceptualisation of e-SQ from the logistic model of service quality developed by Mentzer et al. (2001), and obtained empirical evidence in Collier & Bienstock (2006). Fassnacht & Koese (2006) based their findings on Rust & Oliver's framework for traditional service quality (Rust & Oliver 1994).

Some authors mention a specific theory or concept at the outset of their model development, but this is not clearly reflected in the dimensionality of their scale (e.g Loiacono et al. 2002, Bauer et al. 2006). Parasuraman et al. (2005) use a means-end framework to situate their research, thereby delimiting it to an understanding of the content and the consequences of e-SQ quality.

We used the *Paradigm Funnel* framework (Nairn et al. 2007, pp. 258) to categorise the selected papers and to offer a structured analysis of the e-quality body of research. It categorises papers within four levels, in accordance with what constitutes the primary objective of each paper: (1) to show what was observed 'in nature' (empirical observation) (2) to test analytical methods (3) to verify or explore a theory (specific theories) and (4) to question the core metaphysical assumptions of an existing theory (core assumptions). Unfortunately, little research attention has been paid to levels 3 and 4 of the paradigm funnel.

Consequently, there should be more studies based upon a theoretical reference for developing e-SQ scales. This would make it possible to test a pre-specified model structure and thereby help in advancing the study of e-SQ from exploratory to confirmatory approaches. Moreover, more efforts orientated towards specific e-SQ theory-building are needed. An exception is Sousa & Voss' work (2006), which calls for a broader conceptualisation of service quality, recognising that customer experience is formed across all moments of contact with a firm through several channels.

3) Most Scales Do Not Fully Reflect the Consumer Perception of e-SQ

E-SQ conceptualisation and measurement is still in its first stages. Some scales and dimensions proposed for measuring e-SQ have not been empirically validated and, solely considering the empirically validated studies, some of them (1) do not examine the complete purchase experience as they do not include, for instance, aspects of customer service and fulfilment, and (2) do not consider the outcome dimensions of quality and/or (3) employee-customer interactions.

Among the empirically validated studies that have examined the complete purchase experience of customers to define Website quality are to be found the contribution by Wolfinbarger & Gilly (2003), which develops the eTailQ scale, and the work by Parasuraman et al. (2005), who develop the E-S-QUAL (applicable to all customers of a Website) and E-RecS-QUAL scales (applicable only to customers with service recovery experiences). This scale is the result of a previous research project, carried out by this team of investigation and published in three work documents (Zeithaml et al. 2000, 2001, 2002b) and an article (Zeithaml et al. 2002a).

But these scales do not consider the outcome dimensions of quality. Fassnacht & Koese (2006) highlight the necessity of considering the outcome dimension of quality (functional and emotional benefits, and reliability). According to these authors the outcome dimension takes into account that technology is a means, not an end.

4) e-SQ Research Exhibits a Single Channel Orientation and Does Not Capture the Consumer Perception of Quality in Multichannel Contexts

Most e-SQ investigations concentrate on examining the interaction between the customer and the Website, avoiding other kinds of relations that exist between the customer and the organisation and impact on e-SQ. In this connection, Sousa & Voss (2006) allege that e-SQ research exhibits a front-office orientation. In addition, they affirm that e-SQ research to date exhibits a narrow focus: a single channel orientation. E-SQ scales consider the internet to be an isolated channel and not just another of the different channels that organisations make available to their customers via an integrated multichannel approach.

Their article develops a framework for conceptualising multichannel service quality, distinguishing between virtual, physical, and integration quality. Integration quality is identified as a key new service quality component. The framework also addresses how the three components of service quality are delivered by the different parts of the service delivery system and identifies the associated challenges for providing good levels of service quality. But up to now this approach has been not empirically validated.

5) Limited Attention Has Been Paid to Information Searchers

Most e-SQ studies (e.g. Zhang & Von Dran 2001, Wolfinbarger & Gilly 2002, 2003, Parasuraman et al. 2005, Bauer et al. 2006) pay no attention to information searchers, concentrating only on purchasers. Nevertheless, investigations exist that indicate that the Internet is principally used as an information search tool rather than as a medium for executing commercial transactions (Janda et al. 2002, Yang et al. 2004). Similarly, other researches reflect customer preference for seeking product/service information within the online environment and carrying out their purchases in traditional brick-and-mortar establishments (Porter 2001, Wolfinbarger & Gilly 2001, Van Iwaarden et al. 2004).

Among the exceptions that try to obtain service quality dimensions perceived by two groups of Internet users, purchasers and information searchers, we have the works developed by Cai & Jun (2003), Yang & Jun (2002) and Cristobal et al.

2007, and some controversy remains. Yang & Jun (2002) distinguish between purchasers and non-purchasers for the assessment of e-SQ, and they conclude that the dimensions that determine online quality of service perceived by purchasers and non-purchasers differ. Conversely, Cristobal et al. 2007 do not find differences in the results of their study if the total sample is divided between buyers and information searchers, but they refer to the consequences on e-SQ (satisfaction and loyalty) more than the e-SQ measure itself.

6) The Possible Contingent Character of the Scales Has Not Been Sufficiently Considered

It is highly possible that, as critics of traditional service quality scales already argued, e-SQ dimensions, on the one hand, tend to be contingent on different industries (e.g. Carman 1990, Bolton & Drew 1994, Tan et al. 2003), and, on the other hand, to be dependent on the type of service, even within one and the same industry (e.g. Bienstock 1997, Mehta et al. 2000). But authors usually analyse a specific industry/type of service. Studies of multiple types of services, such as Fassnacht & Koese's (2006) work, which covers three different electronic services: a service for the creation and maintenance of personal homepages, a sports coverage service, and an online shop, are an exception. So, the generalisability of results across different industries/types of services is far from proven. In their work on the subject, Francis (2007), Gummerus et al. (2004) and Janda et al. (2002) consider that for the development of any e-SQ measurement it is necessary to take into account the specific type of service that is to be evaluated.

The literature also recognises the advisability of identifying different segments of Web users (Van Riel et al. 2001, Tan et al. 2003), as well as different Web use profiles (Cai & Jun 2003, Sweeney & Lapp 2004). It might be useful, therefore, to take the existence of moderating factors into account, such as the technological readiness of customers, type of service, or even the degree to which a customer desires to participate in self-service, for instance, when considering customer online service quality perceptions.

An additional difficulty for research stems from the fact that the Internet is a relatively new and unpredictable channel (Oliva 1997), on the one hand, because complete understanding of online customer behaviour does not exist (Yang et al. 2003), and, on the other, because customer expectations and perceptions of Internet services evolve over time (Broderick & Vachirapornpuk 2002). Moreover, in line with Parasuraman & Zinkhan (2002), we must consider the fact that customers use a variety of criteria when evaluating quality of service on the Web.

In their work on the subject, Gummerus, Liljander, Pura and Van Riel (2004) and Janda, Trocchia and Gwinner (2002) consider that for the development of any e-SQ measurement it is necessary to take into account the specific type of service that is to be evaluated. Indeed, it is highly possible that, as critics of traditional service quality scales already argued, e-SQ dimensions, on the one hand, tend to be contingent on different industries (e.g. Andaleeb, 2001; Bolton and Drew, 1994; Buttle, 1996; Cronin and Taylor, 1992; Tan, Xie and Li, 2003), and, on the other hand, to be dependent on the type of service, even within one and the same industry (Bienstock, 1997; Jun, Peterson and Zsidisin, 1998; Mehta, Lalwani and Han, 2000; Van Dyke, Kappelman and Prybutok, 1997). The literature also recognises the advisability of identifying different segments of Web users (Tan, Xie and Li, 2003; Van Riel, Liljander and Jurriëns, 2001), as well as different Web use profiles (Cai and Jun, 2003; Janda, Trocchia and Gwinner, 2002; Sweeney and Lapp, 2004; Tan, Xie and Li, 2003). So it is possible to assemble a variety of user types, behaviours and types of service (See Table 3).

Where service type is concerned, Grönroos, Heinonen, Isoniemi and Lindholm (2000) propose

Table 3. Web user types, web user profiles and web service types

Web user types	Criteria	Investigators
Long-term orientated customers Transactional customers Novice customers Expert customers Customers with preference for high-level self-service Customers with preference for low-level self-service Internal users External users	**Organisation-customer relationship** **User experience** **Level of customer participation** **Geographical**	Narayandas, Caravella and Deighton (2002) Nielsen (1993) Snyder (1996) Lindroos (1997)
Web use profiles	**Criteria**	**Investigators**
Online buyers Information searchers Goal-directed customers (purchasing orientation,...) Experiential customers Information searching Selection Purchase behaviour After-sales behaviour	**Purpose/functions** **Purpose/functions** **Decision-making process**	Yang, Jun and Peterson (2004); Cai and Jun (2003) Sweeney and Lapp (2004); Moe (2003); Wolfinbarger and Gilly (2001); Paden and Stell (2000); Hoffman and Novak (1996) Pedersen and Nysveen (2002)
Web service types	**Criteria**	**Investigators**
Core service Supplementary services User interface Online retailers Content-based service (i.e., a healthcare Web site)	**Service conceptualisation** **Service foundation**	Grönroos, Heinonen, Isoniemi and Lindholm (2000) Gummerus, Liljander, Pura and Van Riel (2004)
Source: Own preparation using Tan, Xie and Li (2003)		

broadening the traditional concept of service, which includes basic service, and supplementary services (facilitating services and support services), with a fourth service component, user interface. Then there are authors who recognise that it is necessary to differentiate between online retailer e-SQ and content-based services (e.g. Gummerus, Liljander, Pura and Van Riel, 2004, centre their investigation on an online healthcare Web page, where the informational element is fundamental).

7) Limited Attention Has Been Paid to Pure Services

Likewise, the most relevant investigations have centred on the physical product ambit. Accordingly, Parasuraman et al. (2005) analyse customers of Amazon and Wal Mart. This leads them to state that "an important research priority is to examine the scales in the context of pure service sites" (Parasuraman et al. 2005, pp. 229). They also state (p. 229) that some items "could be modified or eliminated (and perhaps supplemented with additional items if necessary)".

Along the same lines, Liljander et al. (2002) affirm that e-services remain a neglected area in marketing research. Among the exceptions we have the works by Gounaris & Dimitriadis (2003), who investigate the quality of business-to-consumer portals, which they characterised as pure information content services, and Gummerus et al. (2004), who focused on a health care portal.

8) A Lot of Methodological Replication Exists and There are Some Avenues That Remain Almost Unexplored

First-order structure vs. hierarchical constructs: In the main, e-SQ has been considered as a first-order structure. But service quality dimensions might also be viewed as higher-order constructs that have various sub-dimensions (Brady & Cronin 2001), indicating that there might exist several levels of abstraction that should be taken into account. Accordingly, three recent works (Collier & Bienstock 2006, Fassnacht & Koese 2006 and Loiacono et al. 2007) have developed hierarchical e-SQ models. Thus, Collier & Bienstock (2006) consider e-SQ as a three-dimensional, hierarchical construct, i.e. the sub-dimensions are treated as first-order factors and the dimensions as second-order factors of the service quality construct. The introduction of second-order factors is conceptually attractive, because it represents a first step toward a better understanding of the associations between the various sub-dimensions (first-order factors) of e-SQ.

Convenience samples or self-selected samples vs. representative samples: Samples from a service provider's actual customer base are rarely found. Most authors resort to either convenience samples (mainly students) or self-selected samples. Not even the most quoted studies in the area (e.g. Parasuraman et al. 2005 and Wolfinbarger & Gilly 2003) use samples drawn from the actual customer base of a service provider. As an exception we can highlight Fassnacht Koese's work (2006). This important limitation of extant research needs to be addressed.

Reflective vs. formative scales: The issue of whether reflective or formative measurement is more appropriate is becoming a more and more important topic in market research. Nevertheless, formative models have rarely been used in the relevant e-SQ literature. One exception is the work by Collier & Bienstock (2006). They use formative indicators inside a MIMIC model (multiple indicators and multiple causes). Fassnacht & Koese (2006) also highlight the relevance of comparing the reflective and formative approaches. They propose a hierarchical model and the question arises as to whether the model specification between the first-order and the second-order levels should be formative or reflective, but, unfortunately, they are unable to compare the two approaches to measurement model specification within their study. Future research should explicitly address this issue.

9) More Qualitative In-Depth Research in Order to Understand Why Some Dimensions are (Or are Not) Relevant is Needed

As we show below, a lack of consensus exists regarding the necessity of including some dimensions to measure e-SQ: in relation to the privacy/security construct, for instance. In the first e-SQ studies, security and privacy are both identified as determining aspects of perceived service quality (e.g. Yoo & Donthu 2001, Liljander et al. 2002, Zeithaml et al. 2000). But, on the other hand, recent studies suggest that privacy/security often carries the notion of trust in the service provider and do not include this dimension (e.g. Yang et al. 2004, Fassnatcht & Koese 2006). Discussions regarding this topic require thorough qualitative research.

Another controversial dimension is related to the emotional value (e.g. enjoyment) of electronic services. Some relevant works do not include this. For instance, Parasuraman et al. 2005 believe that this dimension may not be relevant in many contexts or to many consumers. Conversely, other authors emphasise the relevance of this dimension (e.g. Bauer et al. 2006). Qualitative in depth research could help to shed light on these disagreements. Techniques such as introspection could be used to obtain in-depth understanding of e-SQ dimensions.

Weaknesses in the delimitation of the dimensions to be included in e-SQ are most frequently due to the fact that such boundaries are drawn by starting out from customer perceptions, without considering the perceptions of other agents: sellers, managers, Website designers, etc.

10) The Consequences of e-SQ Have Not Been Fully Developed

Previous literature has concentrated on the development of e-SQ scales more than on e-quality consequences. They might include intentions (to revisit the site or to repurchase, for instance) and behaviours (such as saying positive things about the site) (Zeithaml et al. 2002a). The consequences of e-SQ scales on other constructs such as customer satisfaction, perceived value, trust and loyalty should be examined.

For managers it is critical to determine which e-SQ factors are hygiene factors, in that they only inhibit customer interactions when absent, and which factors are true catalysts for changes in consumer attitudes and behaviours (Park & Gretzel 2007, Kim & Fesenmaier 2008). Many Web evaluation efforts currently restrict themselves to ratings of features and do not link evaluations to outcome measures. What these outcome measures are is an area of research that clearly needs attention.

Table 4. Avenues of future research (white area)

	Perspective		Product/Service		Customer objectives		Purchase experience		Channel	
	Customer	Organisation	Product	Service	Information searchers	Purchasers	Complete	Not complete	Single-channel	Multi-channel
Akinci, et al. (2009)										
Barrutia, et al. (2009)										
Bauer, et al. (2006)										
Cai & Jun (2003)										
Caruana & Ewing (2006)										
Collier & Bienstock (2006)										
Cristobal, et al. (2007)										
Fassnacht & Koese (2006)										
Gummerus, et al. (2004)										
Ho y Lee (2007)										
Janda, et al. (2002)										
Jun, Yang & Kim (2004)										
Loiacono, et al. (2002)										
Long & Mc Mellon (2004)										
Parasuraman, et al. (2005)										
Ribbink, et al. (2004)										
Santos (2003)										
Source: Own preparation										

CONCLUSION AND FUTURE AVENUES OF RESEARCH

Research work to analyse e-SQ or e-Quality is still at an emergent stage, particularly within the academic field. Most e-Quality investigations that have been carried out have pursued the analysis, adaptation and relation of concepts from the literature dealing with quality of service, quality of online systems (technology and information) and relational management. Academic literature referring in depth to the quality of online systems is scanty, in spite of it being a conceptual category that is gaining more and more weight in electronic services literature (Jun and Cai, 2001; Jun, Yang and Kim, 2004; Santos, 2003; Yang, Jun and Peterson, 2004).

Acceptance of the multidimensional nature of the e-Quality concept is unanimous, but there is no consensus as to the dimensions it is composed of. A first weakness concerning the delimitation of the dimensions to include in e-SQ is due on most occasions to the fact that such boundaries are drawn by starting out from customer perceptions, without considering the perceptions of other agents: sellers, managers, Web page designers, etc. A second weakness arises because a good part of the dimensions that are examined in the evaluation of e-Quality are specifically associated with technology. To take an example, page design, privacy/security and ease of use are dimensions that are frequently present in these investigations.

Moreover, not all dimensions of service quality affect the same way perceptions of quality or customer satisfaction. The identification of the main dimensions that customers use to evaluate the service quality in each channel, electronic and personnel, and their relative importance, could be a key issue for the allocation of limited resources by managers.

On the other hand, for e-Quality conceptualisation and measurement various moderators need to be identified (e.g. degree of customer participation, technological training of customers, and so on). It must be added that most of the scales proposed for e-Quality have, in the main, been developed in the USA. The question has to be answered as to whether the scales proposed are applicable to different contexts. For instance, it is not clear to what point these concepts and the theories associated with them can be transferred from the USA to other national, normative and cultural contexts (Evanschitzky, Iyer, Hesse and Ahlert, 2004). So there are a growing number of papers that consider other contexts (e.g. Akinci et al. 2009; Caruana & Ewing, 2006).

Table 4 provides a simulated map for future lines of research. Accordingly, we have classified a whole group of works selected in accordance with their content in relation to four variables: (1) perspective adopted: the consumer or the organisation as a whole; (2) basic content of the offer: product o service; (3) consumer objectives: information search or purchase; (4) consideration of the purchase experience: incomplete or complete, and; (5) Channel: single channel or multichannel. The area in white reflects the main avenues of future investigation we have identified and that allow for research proposals from different perspectives.

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KEY TERMS AND DEFINITIONS

Availability of Information and Contents: Refers to the obtaining of information directly from the page, to the depth or quantity of the information, to its quality, and its credibility.

Ease of Use or Usability: Includes search functions, download speed, global design, and page organisation.

Electronic Service Quality (e-SQ): The extent to which a Website facilitates efficient and effective shopping, purchasing, and delivery of products and services.

Information Credibility: Refers to the trust exhibited by customers vis-à-vis information provided on Web pages

Paradigm Funnel: A tool that enables researchers to explore, classify and analyse the composition and the dynamics of change within a body of literature.

Privacy: Implies the protection of users' personal information.

Reliability: Related to the functioning of the website.

Responsiveness: Refers to the efficacy and efficiency with which customers receive a response to the problems they experience.

Security: Meanwhile, concerns the protection of users from the risk of fraud and from economic losses when using their credit cards or disclosing other financial information.

Chapter 3
Methods for Service Quality Assurance[1]

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ABSTRACT

This chapter describes how the four phases of quality management (quality planning, quality control, quality inspection and quality assurance) for service firms should be structured and what individual measures can be employed in the respective phases. Since the QM-system – particularly in the case of the services sector – has to be adapted to a firm's specific characteristics, the selection of the methods and techniques suited to the specific situation is of particular importance. For this reason, the criteria for evaluating such methods are also outlined. In addition to the classical instruments used for quality management, recently quality awards, national customer satisfaction barometers and certificates have become well established, also sharing the objective of raising quality standards for services. Finally, an overview is given of the techniques and methods used for securing and promoting quality standards which are linked to the phases of the management process – analysis, planning, implementation and audit. This results in the construction of a systematic system for the quality management of services using a ten-step procedure.

1 MANAGEMENT OF SERVICE QUALITY

Establishing a high standard of service quality has increasingly become one of the central activities of service and industrial goods firms as well as of consumer goods firms and has become a major competitive factor. A change in the marketing paradigm has taken place over the last few decades, driven by a sharpened focus in economics on the tertiary sector (services). This is reflected in the way that quality orientation is aligned to a service offering that is based on customer choices (customer orientation).

The higher standards in *service quality* expected by clients and the potential impact of

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quality deficiencies make it essential that service providers adopt quality management systems. In view of the numerous aspects of service quality, it is impossible to achieve 'total' service quality by optimizing it simply on an individual level or with regard to individual dimensions. *Quality management* therefore refers to "the use of dovetailed activities for directing and steering an organization with regard to quality" (DIN EN ISO 9000), where "directing and steering with regard to quality" basically involves the activities of all managers engaged in determining quality policy, objectives, and responsibilities as well as in implementing these via quality planning, quality control, quality assurance and quality improvement in the context of the quality management system (DIN EN ISO 8402:1992).

The Total Quality Management System, originally developed in Japan, has increasingly established itself in the United States and Europe since the end of the Second World War. Numerous quality management concepts, such as Deming's "14-point Program" (Deming, 2000), "Fitness for Use" (Crosby, 1992) or the "Six Sigma" (e.g. Hummel & Malorny, 2002) (a concept from statistics, which is synonymous with zero-mistake-tolerance), have been subsequently developed under the concept of Total Quality Management (TQM).

One of the important extensions of the TQM-concept is the Taguchi philosophy (Taguchi, 2001), which introduces the addition of a socio-political quality dimension, Process Management (Pall, 1987) and the Kaizen Concept (e.g. Imai, 2002), as a method aimed at achieving continuous and consistent improvements in all processes throughout the firm.

The need for a comprehensive quality management system for services marketing is reflected in the realization of Total Service Quality Management (TSQM). The core concept of a comprehensive quality management system for services, derived from the TQM-concept, is based on the following three building blocks:

- Total signifies that all parties (employees, suppliers, marketing intermediaries and clients) should be drawn into the TMQ process.
- Service Quality signifies consistent quality orientation in service processes in all internal and external customer relations.
- Management signifies that managerial staff has to adopt an exemplary role in representing service quality (a participative-cooperative style of management) (Lovelock, 1988).

2 STRATEGIC FOCUS OF QUALITY MANAGEMENT FOR SERVICES

A comprehensive focus on quality issues of this kind across the service firm requires that a "suitable" quality management concept is devised, developed and implemented; that is, one which is tailored to the individual requirements and resources of the specific firm. The principle objective is to define the strategic focus of the firm's quality management. There are four fundamental tasks that have to be fulfilled here (Bruhn, 2008):

1. Specification of strategic quality positioning: The firm's present and future strategic quality positioning has to be determined subject to the profile of its individual strengths and weaknesses and with respect to existing and potential market competitors.
2. Specification of the quality strategy: The quality strategy has to be defined subject to the strengths, weaknesses, opportunities, and risks present in attaining the targeted quality position.
3. Specification of quality principles: So that a firm's routine provision of services satisfies quality principles, the quality strategy has to be laid down in the form of a mission statement specifying conduct and quality requirements.

4. Specification of quality goals: Quality management (QM-) objectives are chiefly stipulated by the imperative provisions laid down in the business plan (positions of advantage) to be achieved by applying the specified instruments. A basic differentiation is made between marketing targets (for example, increasing customer satisfaction and loyalty, and image improvements) and corporate targets. Corporate targets can be further divided into economic goals (for example, productivity increases) and psychological goals (for example, creating quality consciousness in the minds of employees).

The QM-strategies derived from the service firm's QM-strategic quality positioning make up an essential part of QM-strategic planning. These strategies are principally responsible for increasing perceived service quality as seen from the customer viewpoint.

Perceived service quality from the customer's viewpoint is understood as the difference between actual performance and the customer's expectation of it (Boulding et al., 1993), since a customer's evaluation is said to be high if the service they receive satisfies their expectations at least (Parasuraman, Zeithaml, & Berry, 1985). There are two methods used in setting up QM-strategies for steering perceived service quality (Bruhn, 2008):

- Steering customer expectations
- Steering performance outcomes (classical quality management)

Expectations-based strategies are derived for *steering customer expectations*. Performance outcomes relate to classical quality management. In this context, a differentiation is made between *expectations-based strategies* and *performance-outcome-based strategies*, the latter being achieved by improvements in performance.

Expectations- and performance-based strategies are further subdivided according to their operational areas (Bruhn, 2008). These operational areas are categorized for the (overall-) market, customers and competitors.

Market-based strategies define, in particular, whether multiple markets (integrated strategy) or simply a single market (isolated strategy) should be considered with regard to expectations and their satisfaction. Customer-based strategies determine the degree of individualization that should apply to forms of address used in customer dealings – how specific these should be. Competition-based strategies specify the firm's conduct towards its competitors. Here, conflict and cooperation strategies are distinguished (Bruhn, 2008).

3 OPERATIONAL STRUCTURES OF QUALITY MANAGEMENT FOR SERVICES

Specific QM-instruments are necessary for implementing Total Quality Management and the Quality Management System operationally. Their function is to guarantee service quality during the different phases of the performance output process. Quality Circles are referred to here. *Quality management circles* are subdivided into four phases (DIN EN ISO 8402:1992; Zollondz, 2006):

- Quality planning
- Quality control
- Quality inspection
- Quality assurance

The sections below describe how the different phases of quality management should be structured for service firms and which specific quality-oriented measures must be implemented at which phase.

3.1 Instruments of Quality Planning

Quality planning, according to the ISO standard "EN ISO 9000:2000", is defined as that part of

Quality Management that specifies quality targets and the necessary completion processes as well as the associated resources required for satisfying the firm's quality goals.

In this context, quality management's first phase involves planning and further developing the quality requirements set for the different services of the firm. Here, it is a matter of setting the various quality requirements (Meffert & Bruhn, 2009) rather than determining the quality of the specific firm services. Accordingly, the precise requirements for service quality are identified from the customer's and supplier's standpoint. This is the necessary pre-condition for developing products and services that are in line with the preconceptions of the interested parties. Table 1 illustrates how quantitative and qualitative measurement procedures for recording expectations and perceptions of quality might be implemented.

Management is responsible for ensuring that comprehensive client surveys are carried out at least once a year. Each branch office should receive a detailed analysis of its results, where customer judgments based on various individual criteria as well as general estimations should be presented in a coherent form.

Of the numerous quality measurement procedures available, only those instruments that seem particularly suited to capturing the quality criteria

Table 1. Exemplary plan for measuring service quality (Source: Bruhn, 2008)

Quality instrument	Quantitative/qualitative measurement procedure (SERVQUAL, Blueprint, FRAP-Analysis)
Goal of application	Record client expectations/perceptions of quality
Scope of research	All aspects of the firm's service chain
Manager	Managerial staff of the service firm's market research division
Activities	Data evaluations based on regular customer surveys
Time period/ date	At least once per year

specific to quality planning will be introduced briefly below (Benkenstein, 1993; Haller, 1998).

Some of the procedures to be employed within the quality-planning framework that should be mentioned are:

- Sequential incident technique
- Frequency Relevance Analysis for Problems (FRAP)
- Attribute- / customer-oriented approaches
- Attribute- / employee-oriented approaches
- Employee suggestion procedure
- Quality function deployment (QFD)
- Benchmarking
- Fishbone analysis
- Event-oriented process chain (EPC)

Sequential Incident Technique

If a service provider intends to ascertain and exploit specific key experiences of their customers, the Sequential Incident Technique will provide a systematic analysis of service processes with the help of a graphic workflow diagram (Stauss & Hentschel, 1991). This so-called *'blueprint'* allows a comprehensive survey and evaluation of different contact situations from the client's perspective to be made.

Frequency Relevance Analysis for Problems (FRAP)

Blueprinting and FRAP-analysis are often employed as ancillary visually comprehensible measurement tools for recording the different components of the service process and for identifying conspicuous problems and any need for intervention.

Attribute- / Customer-Oriented Approaches

Attribute-/Customer-oriented approaches – in particular, attribute measurement procedures –

are employed to identify performance criteria applying to the customer's viewpoint as well as establish general satisfaction measurements and pinpoint internal factors determining service quality (Parasuraman, Zeithaml, & Berry, 1985, 1988). In practice, the SERVQUAL-approach is often employed for this, as it provides a procedure that is extremely practical for many industries' service firms. Companies employ this instrument within quality planning to ascertain which quality criteria are relevant to their firm or industry by means of focused group interviews with customers, expert discussions and pretests. By carrying out regular (i.e., at least once a year) customer and employee surveys the firm can then discover how the relevant interested groups assess the performance criteria, how they weight these, and where bad quality originates within the firm.

Attribute- / Employee-Oriented Approaches

Comprehensive surveys carried out on employees very often use attribute- / employee-oriented approaches. These are particularly important in developing and implementing the quality management systems used for service firms. All members of the firm's workforce should be invited by the firm's market research department to respond to surveys investigating the perceived quality of both external and in-house service performance, preferably at a maximum of twelve-month intervals. On the one hand, it is important to establish how employees assess the quality of the products and services from their personal standpoint (Haist & Fromm, 2002) and what assumptions they make about customer expectations. On the other hand, it is important to note the significance they attribute to specific quality criteria. Here, the different attitudes existing between managerial staff and employees who deal with clients are recorded as well as the differences existing between branch offices. As a rule, the service firm's management is responsible for carrying out these comprehensive employee surveys, thereby ensuring that the survey results are accepted throughout the firm.

Employee Suggestion Procedure

This procedure provides information supplementing the obligatory employee surveys and helps in identifying the problem areas in quality which have to be addressed in line with the quality requirements set within the quality planning framework.

In the interests of staff motivation, it is important to reward the improvement suggestions that employees make (with material or immaterial recognition) and, above all, to implement them. The improvement suggestions that merit reward should be published in staff newspapers whenever possible, thus inspiring colleagues to participate as well (Haist & Fromm, 2002).

Quality Function Deployment (QFD)

QFD is a multiple-stage concept: By means of a detailed analysis of the value-added chain at every step of the service process, customer requirements are reformulated as specifications for the services that have to be performed. This process delivers a service duties handbook and requires that the duties specified within it be enacted as service specifications (Sachs, 1993).

Benchmarking

Benchmarking is basically aimed at improving the firm's competitive position. Here, a strategic target is systematically searched for – a so-called benchmark or target measure. This process is carried out not only within the firm or its industrial sector but also across industries.

Within the benchmarking process the causal factors determining the success of selected benchmarks are identified and the preconditions necessary for the success of the firm being reviewed are established. Here, for example, a particularly successful competitor's customer-satisfaction

value should be set and the target value. Moreover, the factors leading to the competitor's success, once ascertained and analysed, can be adapted and applied to the reviewed company's procedure.

Fishbone Analysis

Fishbone analysis, based on a so-called Ishikawa diagram, can help to systematically and comprehensively determine and graphically illustrate the various causes of a specific quality problem from the supplier's viewpoint. Following on from this implementation stage, the service specifications then have to be transformed into service delivery specifications that are important for the service-production process (Sachs, 1993). Here, the success of in-house and external quality planning essentially depends on avoiding service interface problems and coordinating planning areas (DIN EN ISO 9000).

Event-Oriented Process Chain (EPC)

The EPC method is a business process modeling technique adopted from information management that presents service production processes as a sequence of functions. So-called events (i.e., the postal receipt of a customer enquiry) are triggers and outcomes of different functions. In EPCs links are illustrated by interconnection knots locating the so-called connection operators. These operators are the rules and conditions that direct the service processes. The EPC facilitates a systematic and comprehensive planning of customer contact points as well as the processes supporting these.

3.2 Instruments of Quality Control

The *quality control* phase follows the quality planning phase. It is defined as that part of quality management that aims to satisfy the quality requirements. This comprises all such activities that support realizing the service-quality requirements from the viewpoint of the customer and firm (Bruhn 2008). The different groups of instruments are identified as follows (Figure 1):

- Staff-related instruments
- Culture-related instruments
- Organization-related instruments

3.2.1 Staff-Related Instruments of Quality Control

Services are usually conducted between the employee of a firm – contact personnel – and the client in the context of a so-called interaction-oriented process (Schulze, 2000). Here the level of significance attributed to an interactive event, as an indicator of service quality, varies in response to the duration, intensity and integration of the external factor. In a service encounter (Bitner, Mooms, & Tetreault, 1990) the personal contact between client and contact personnel plays an important role both for problem-oriented and individual interactive services.

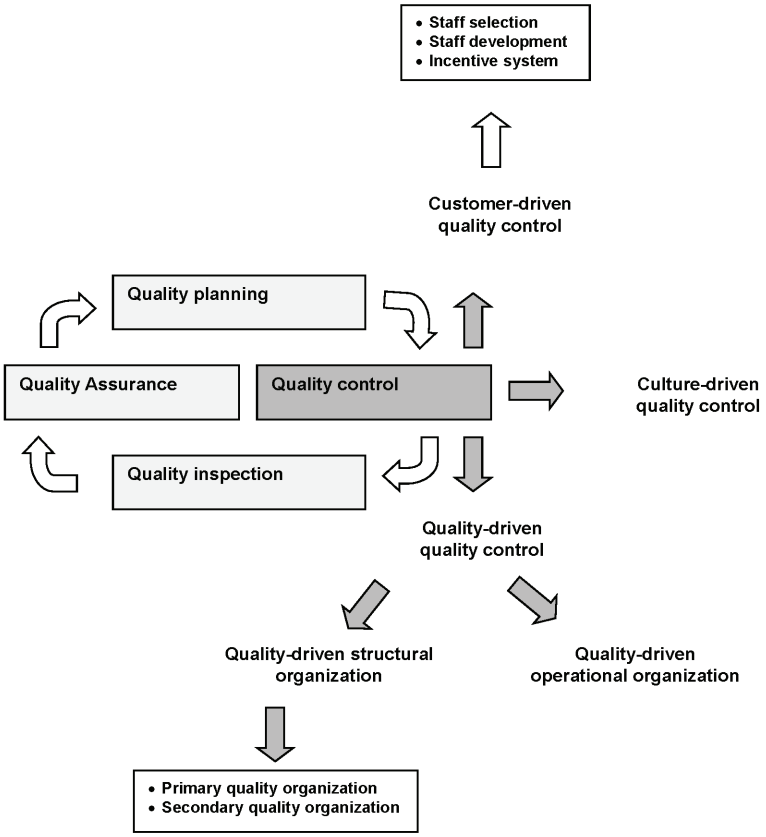
It is therefore crucial to the quality of service performance that the firm suits the professional credentials of its contact staff to the client's specific requirements in conducting the service.

Management has a duty to secure and continually upgrade the competencies and eagerness of staff to produce the high – required – service quality standards through its *personnel policy measures*. The following quality-related instruments are listed among the various instruments available for this purpose:

- Personnel selection
- Personnel development
- Staff incentives

Quality-Oriented Personnel Selection
When engaging new staff for activities that entail frequent direct customer contact (for example, cashiers, client advisors, and account managers), in addition to the technical qualifications, selection criteria that assess the social competence of the

Figure 1. Quality control instruments for service firms



applicant have to be specified (Hoffmann, 1989). Besides written aptitude tests and interviews, behavior tests (role plays, group discussions), for example, should be conducted where the applicant is confronted with "real" customer contact situations and where their communicative abilities can be observed (Hoffmann, 1989).

If job applicants are seen as having only weak customer-service mindsets, or none at all, and show no sociability or empathy during their interview, they will neither be satisfied with the envisaged job, nor be able to satisfy their customers later on as contact personnel. Specialized knowledge, the ability to deal with technical matters and such like can usually be taught or improved in training courses. However, service mindedness, communicativeness and sociability are components of personality and can only be acquired to a limited extent through training. Technical specialists and personnel managers, who are responsible for employing new staff, should pay greater attention to the service and communication skills of their applicants.

Quality-Oriented Personnel Development

Measures employed in quality-oriented personnel development – in particular, quality-orientated education and continuing education – play an important role in quality control. They facilitate the implementation of the corporate quality-management approach and achieve the objective of involving all members of staff.

In this connection, the fundamental task of personnel development is to increase the staff competency. Here, four *types of competency* are identified (Schneider & Schechter, 1991):

1. Technical or specialist competence: Technical knowledge for the respective position; for example, an insurance salesman's knowledge of the insurance market.
2. Methodological or conceptual competency: The ability to apply various methods for solving problems, to make choices and learn; for example, in dealing with specific customer problems.
3. Social competence: Capacity for team work, conscientiousness, communication skills, customer focus.
4. Psychological competence: Motivation, attitudes, industry; for example, establishing a customer-oriented corporate culture.

A quality-oriented personnel development policy that aims to implement the quality management system across the whole enterprise should extend or improve its existing personnel development program by familiarizing staff with social and psychological competencies – in addition to the on-going training of specialist and methodological competencies.

Staff surveys should also be used to find out which training areas the staff themselves identify as required for their own needs and those of their colleagues, thereby not exceeding what is necessary. Additionally, feedback meetings are useful for evaluating the content, form and length of the training in order to permanently improve the quality of training and continuing education measures.

Several training areas relating to specific targeted groups count as the central building blocks of quality-oriented training for service-firm staff. The following three modules, already employed by successful service firms, are particularly effective:

- Quality seminars: The target group comprises all employees. The seminar often serves as a discussion platform for different quality issues; such as, for example, customer and staff surveys, the optimization of internal processes or the quality of the client advisory services. The particular importance of such modules is in their capacity to build incentives and cultivate a pronounced customer-, service-oriented focus.
- Service training for contact staff: The target group is composed of all the employees who work in customer-contact situations (for example, receptionists, telephonists, account managers). By teaching discussion and questioning techniques as well as sales psychology, the training improves the participants' performance competence by extending their behavioral repertory. Contact staff strengthens their ability to listen to the wishes and needs of their customers.
- Coaching for managerial staff: The managerial staff working for branch and head offices who work closely with customer services make up this target group. This seminar building block supports the management of a service firm that has service-related responsibilities by furthering the development of their communication and motivational skills. These skills are prerequisites for improving managerial capacity and thus guarantee service quality. In order to bring about changes in the attitudes and behavior of staff, thereby improving service and customer orientation, all managerial staff should be trained in psychological managerial and communication techniques. This assistance is offered when structuring appraisal interviews.

A central aspect should be highlighted: The training contents must be appropriate and employable, irrespective of the scope and structure of the specified qualifying measures (Schildknecht, 1992): A prerequisite for producing positive learning effects and thus the fundamental basis for successfully realizing the quality management concept is the realization of customer oriented behavior within the firm, which depends, as a

rule, on the relative scope for freedom of action and decision-making that exists.

Quality-Oriented Incentives for Staff

It is necessary for corporate management to devise and apply suitable incentive measures so that employees are willing to put the knowledge they have acquired about customer orientation into practice and satisfy the approved standards (von Diemer, 1990; Rostenstiel, 2001). Types of *extrinsic motivation* are particularly important when developing and introducing quality management systems; that is to say, the use of incentives relating to employment situations or progress work during implementation as a means of rewarding commendable staff efforts. In addition to these, *intrinsic motivations* should be built into employment activities themselves for the purpose of ensuring that quality standards of customer-oriented behavior are upheld on a long-term basis. Working conditions and activities should be geared to generate enthusiasm in staff, prompting them to act on the force of their inner motivations in providing high standards of service quality.

Table 2 lists types of personal incentives that serve to motivate staff in improving their customer-oriented behavior. Incentive schemes that focus on groups include stimuli such as team bonuses and service-team recognition. Such motivators effectively promote the quality-oriented mindset of project groups and departments.

Remuneration systems that specify a modifiable salary component play a particularly important role here. In addition to classical remuneration systems that are based on turnover, the firm should consider setting up a so-called *customer-orientated remuneration scheme* for services, which is aimed at training up quality-oriented personnel and implementing quality management (Tuzovic, 2004; Bruhn, 2008). Here non-financial factors such as customer satisfaction and customer retention are used as the basis for assessing variable remuneration – with the objective of eliciting better standards of service quality from staff for customers.

In addition, it is important from an overall perspective to see that the various incentive schemes for different corporate areas and departments are harmonized. This prevents certain groups of staff from being disadvantaged in spite of identical achievements and also prevents status discrepancies from occurring between the incentive schemes.

3.2.2 Culture-Related Instruments of Quality Control

In addition to the personnel policy aspects, the working atmosphere among staff also has an important effect on quality management in firms. *Firm culture* – the system of common values and normative perceptions as well as shared thought and behavioral patterns that inform the decisions, actions and activities of members of the organiza-

Table 2. Quality-related incentives for service firms

Incentives for maintaining and increasing extrinsic motivation		Incentives for maintaining intrinsic motivation
Material incentives	**Immaterial incentives**	
• Premiums for customer- oriented advice • Reward-related salary components (customer's viewpoint) • Salary rises for customer-oriented behavior • Right to participate in seminars • Incentive travel	• Personal commendations • Publication of achievements via internal media (staff newspaper, bulletin board) • Transfer of responsibility for project performance tasks (e.g., quality groups) • Possibility of advancement	• Announcements of personal praise • Improvement of working conditions • Modifications to structure of work content

tion – should be developed further in the direction of customer and service orientation. This ideally means that all managerial staff as well as all front-office and back-office staff value good service quality and that internal and external customer orientation becomes synonymous with a "natural way of life"; that is, it is seen as a matter of course in daily work. This is the only way to establish a service culture that spans the whole corporation (Grönroos, 2000; Bruhn, 2008).

Transforming corporate culture is, however, a very lengthy and exacting process. On the one hand, some employees will react dismissively towards establishing quality management if it appears to entail changes that contradict the long-established values and norm structures they have. On the other hand, formal amendments can only be employed to a limited degree in bringing about fundamental cultural changes – in contrast to re-structuring organizations or introducing specific quality activities (Bruhn, 2008).

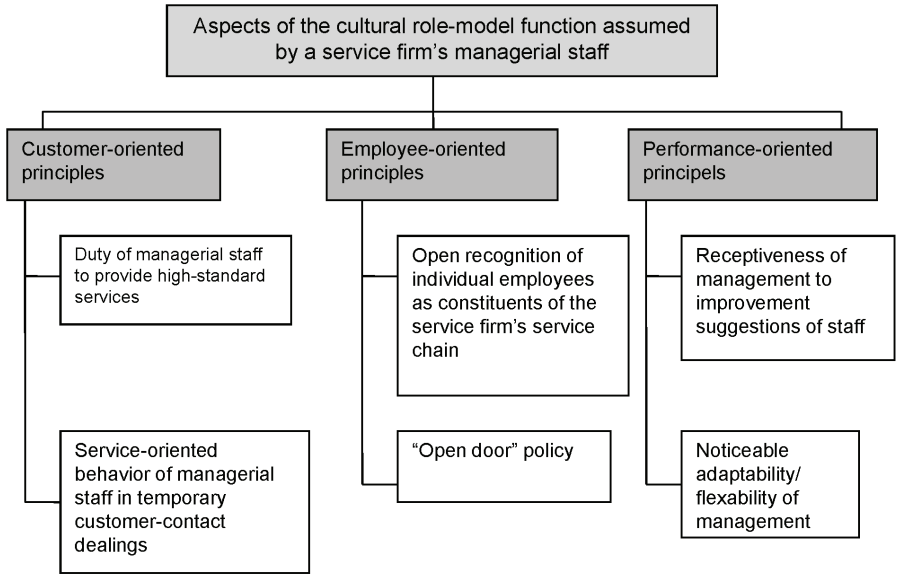
Against the backdrop of these potential corporate-cultural barriers, service firm managerial staff are requested to set an example of the quality concept to their colleagues and market partners through their decisions, actions and activities, and in this way promote an expansion of service culture. Considering the numerous approaches for corporation management and branch managers as well as the departmental heads to assume an exemplary function, the cultural aspects mentioned in Figure 2 are especially important.

In addition to the personnel- and culture-linked instruments of quality control, which aim, above all, at altering value judgments, thought processes and behavior, the way in which quality management is embedded organizationally also plays an important role.

3.2.3 Organization-Related Instruments of Quality Control

In order to satisfactorily implement specific measures of quality management, various structural and operational prerequisites have to be established (Grönroos, 2000; Schneider & Bowen, 1995). The goal is to institutionalize quality management within the service firm's organization, thereby facilitating a fast and flexible quality control.

Figure 2. Aspects of the cultural role-model function assumed by a service-firm's managerial staff



Quality-Oriented Organizational Structure

Configuring the organizational structure of quality management for service firms is a challenge, as often numerous and heterogeneous departments as well as subsidiaries and associated companies all have to be integrated within the one structure. Not only are the service and marketing departments affected, but also staff of the corporation's service chain; in other words, staff in the front and back office, as well as departmental heads and directors. It is effective to enlist not only primary (i.e., anchored in the long term) but also secondary (i.e., anchored in the short term) measures for quality organization:

- Primary quality organization: Delegates responsibility for quality management to line management or obliges every manager to ensure that quality- and customer-orientation is guaranteed and that the stipulated quality goals are achieved. Next to the decentralized operating structural units for quality management and their respective subsidiaries or branch offices, it is sensible to set up a central quality office with coordination and communication functions. Also the conceptualization and implementation of quality training programs and quality revisions should be carried out principally by the staff of this central department. In this way the firm can develop consistent quality standards and make comparisons between departments and branch offices.
- Secondary quality organization: Quality circles can be seen as a complementary or secondary method for organizing quality management. Quality circles are permanent meeting groups. They consist of five to ten staff members or several departments that are hierarchically subordinated to an operational division that meets at regular intervals (at least once per month) during or outside regular working hours on a voluntary basis for the purpose discussing select quality problems. Solutions to problems can be worked out under the supervision of a trained moderator by applying special problem-solving techniques: A trial implementation of these solutions can be carried out and subsequently monitored. Improvement suggestions must be validated by the legal and corporate regulations. Quality circles are used increasingly frequently – in addition to targeted improvements for service quality – to build up quality consciousness and responsibility in the minds of the staff: They overlap departmental areas in order identify quality-related problems and improve the quality of internal communication with the branch offices or head office. Quality circles are suitable as managerial tools since they facilitate shared experiences and promote personal development. Thus, there are specific topical areas that should be analyzed and discussed in quality circles. So that the information and suggestions produced by the quality circles is taken seriously and actually carried out, it is essential that all levels of management are convinced of their importance and that presentations are held regularly providing the board of directors with results they offer.

Quality-Oriented Operational Organization

In devising a quality-oriented process organization, two essential components involved are process-oriented structural organization and interface management (Bruhn, 2002). *Process-oriented structural organization* is principally aimed at operating processes that are tailored to customer expectations in the sense of customer-oriented process management. This means that processes should not be looked at in isolation, but rather that different departments should be linked by uniform processes. Process management and re-engineering are of greater importance here (Bruhn & Frommeyer, 2004).

In the case of *process management* it is principally a matter of selecting the so-called core processes from the numerous existing performance processes and configuring these with suitable organizational measures that have as few interfaces as possible. As a result, particularly forms of organization such as project management and team work will be applicable.

The goal of *re-engineering* is short-term in nature and deals with redesigning or eliminating weak points within processes.

Closely associated with process-oriented structural organization is *interface management*. Here it is a matter of steering the interfaces between departments – for example, between Marketing and Research & Development – towards improved service-quality. Two approaches are available here: With the first, superfluous coordination requirements have to be cut back (for example, by amalgamating departments). With the second, it is a matter of successfully reducing the need for unavoidable coordination requirements (for example, by creating cross-functional teams).

To achieve successful quality control in service firms, ultimately it is necessary to also adapt information and communication systems. In addition to the specialist-knowhow and personal qualities that customers demand of contact personnel, the performance capacity of the information and communication technologies that are employed in support of communication have become increasingly important in contributing to service quality.

3.3 Instruments of Quality Inspection

During the quality inspection phase, it is a matter of establishing 'the extent to which an operational unit satisfies the quality requirements set for it' (DIN EN ISO 9000). Here it is a question of finding out whether and to what extent the service quality requirements that are laid down in the service and service-delivery specifications have actually been implemented. Here, so-called in-house and external quality inspections are distinguished.

3.3.1 Instruments of In-House Quality Inspection

The task of in-house quality inspection is to determine to what degree customer requirements have been achieved from the firm's perspective. The following tools come into consideration for this:

- Four-eye principle / Supervisory checks
- Staff monitoring
- Staff appraisal / Staff appraisal feedback
- External quality audits / Staff surveys
- In-house quality audits

Four-Eye Principle / Supervisory Checks

First, an internal quality appraisal is carried out using the four-eye principle. This method is only applied in practice for assessing external quality if all personnel possess a sufficiently keen awareness of quality and clear understanding of what the customer requirements are. Every member of staff has to be self-critical and responsible when going through checklists in daily work and monitoring the extent to which they or their colleagues have maintained the service standards specified for advisory and transaction situations.

In order to monitor the quality of a customer advisory service from the provider's viewpoint, it is important that the firm's management periodically (i.e., at least once per month) participates in the advisory meetings that take place between customer and client. Ideally, the boss should actively participate; he or she should intervene in the interaction process between the employee and the customer whenever the opportunity presents itself or it is required.

In addition to the four-eye principle, firms increasingly employ service supervisory controls and data backup protection with computers, on the one hand as monitoring tools against misuse. On the other hand, these tools also help to ensure compliance with specified quality norms.

Staff Monitoring
In the framework of in-house quality inspection, a manager's passive vigilance as an observer at customer advisory meetings is still recommended. In the interests of constructive, productive staff criticism, it is helpful to always hold feedback meetings subsequent to employee appraisals, so that the strengths and weaknesses of the service-oriented behavior of the employee engaged in customer dealings can be openly reviewed.

Staff Performance Appraisal / Performance Appraisal Feedback
Staff appraisals or staff performance appraisal feedbacks are generally conducted once per year by managerial supervisors for the purpose of conducting a general assessment of the individual employee's performance and scheduling essential future activities. Operational quality targets and tasks are stipulated at these employee feedback meetings; their success or failure being monitored at the next meeting. The joint-agreements of superior and subordinate must be recorded.

The reasons for performance deficits in services are attributed, among other things, to faulty job descriptions and requirements profiles.

Problems such as these should be noted during the meeting and improvements introduced (Horváth & Urban, 1990). Since one can assume that there is a strong link between employee and customer satisfaction, it is sensible to analyze the problems and grievances that staff voice and consequently adjust activities and competencies where necessary. At performance appraisal meetings it is important to exchange ideas with an employee on their specific contribution in securing and improving service quality, interpreted from the customer's perspective of the quality management system. Assuming that all employees are aware of the influence that their individual performance has on external or in-house customer dealings for the whole service chain, it is their motivational drive to be customer oriented that will ultimately determine how successful a quality management system is.

External Quality Audits / Staff Surveys
This procedure is used to determine the employee's appraisal of how far the external customer requirements have been realized. Staff members assess their own performance in dealing with customers by appraising themselves from their customer's viewpoint (change of perspective): They create a picture of themselves by comparing what they see the customer as expecting of their performance with their own perception of their performance (Bruhn, 2008). Their image of themselves becomes particularly significant when compared to the external image given by the customer's quality appraisal.

In-House Quality Audits
The procedure of in-house quality audits ascertains the extent to which external customer requirements have been fulfilled. Here, the concept of the national client satisfaction barometer in a modified form can be adapted to corporate- and group-level issues (Bruhn & Murmann, 1998). *Internal service barometers* make cross-functional measurements of customer satisfaction so as to understand its determinants and effects. They are carried out regularly by a neutral institution at corporation- or group-level (Bruhn, 2004; Bruhn & Siems, 2004).

The particular advantages of an internal barometer approach are due, on the one hand, to the regular and consistent collection of client-satisfaction data that makes it comparable across the organization. On the other hand, the advantages are due to the potential uses of the data, in part as indices for satisfaction, in part as indices for quality, as a steering tool for quality management. Depending on firm size and firm or group structure, sub-indices are often additionally used at various firm levels to supplement the overall index. Examples of this kind would be all such group enterprises that possess their own legal identity,

profit center and individual service departments and specific service outlets.

3.3.2 External Quality Audit Instruments

External quality audits have the task of checking the fulfillment of the customer requirements from the customer's viewpoint. Some approaches are used for measuring customer expectations and perceptions of service quality. Among the preferred approaches used are:

- Objective customer-oriented approaches: silent shopper and specialist observation questionnaires.
- Attribute approaches: multi-attribute methods and similar approaches
- Problem-oriented approaches: FRAP, complaints analysis, and others

Objective Customer-Oriented Approaches
For several years now service firms have increasingly considered "mystery shopping methods", particularly banks and retail firms. Here, a real customer relationship is monitored, trial accounts held, and trial advisory meetings conducted (Drewes, 1999).

Using of these forms of mystery shopping, the customer agrees to temporarily allow his or her accounts to be monitored, chiefly for the purpose of identifying weak spots in standard performance from the customer's viewpoint. Here, for instance in the case of banks, account documents are monitored and customer appraisals of their experience are gathered at regular intervals so as to assess the clarity of account statements, the intelligibility of forms, entry date records or postal delivery times.

The management of dummy test accounts without informing the office carrying such accounts, but with the consent of the auditing department, is a quality control instrument that requires increased steering since it permits targeted account and business transactions in investment and credit departments to be initiated and eventually checked.

One-off checks that involve employing an actor in the guise of a customer who presents various role attributes for the purpose of monitoring banking services are known as desk tests or test advisory meetings. These deliver snapshots of the components of service requirements such as the friendliness and civility of the advisor, specialist knowledge, commitment, and effort at cross-selling. Test purchasing should be repeated at regular intervals to allow statements that are representative of perceived service quality to be made and to secure visible improvements in service over time. It is also necessary to formulate detailed questionnaires for the evaluation so as to systematize the subjective impressions of test clients after the meeting and at least partially objectivize them. Test advisory discussions are also often carried out over the telephone, which will become increasingly important in the future in view of the rising customer demand for home banking services.

Attribute-Oriented Approaches
When customer surveys are carried out, not just once, but regularly in the context of a "customer satisfaction tracking system", it is possible to gather data that can be used for making comparisons across time, departments and branch offices. This makes it possible to identify positive and negative changes in customer perceptions of service quality.

Regular, comprehensive customer surveys are of major importance to service firms for monitoring quality measures. In order to ascertain, for example, which individual quality management instruments have proved to be particularly effective, it is necessary to ask customers for their opinion of the firm's products and services during and after implementation of the quality management system.

It should be noted here however, that the quality measures that have been implemented only show results with a time lag and are more likely to furnish results in the future. Accordingly, causal

relationships can rarely be identified immediately. However, regular customer surveys will highlight positive or negative trend developments. These usually show up improvements or deteriorations in quality standards: Data comparisons of different departments or branch offices shed light on aberrations, such as subsidiaries that are suffering from implementation difficulties caused by operating problems.

Problem-Oriented Approaches

A central instrument of external quality inspection for service firms is that of systematic complaints management (Bruhn, 1982; Riemer, 1986; Stauss & Seidel, 2007). Information gathered from client's verbal and written complaints gives an indication of possible quality deficits in the provision of services on the one hand, and shows where there is potential for improving services in future. On the other hand, complaint processing that is seen as satisfactory by the client (for example, apologies, swift document search, compensation) will lead to an even greater level of customer retention if the client feels 'well cared for' by the branch, even in face of problems. Such a situation is referred to as "complaint paradoxum". In order to systematically record the various complaints that service customers make, it is necessary to institutionalize and implement various process steps for complaints management. A systematic complaints management system comprises the following part steps, at least (Stauss & Seidel, 2007):

- Complaint stimulation
- Complaint acceptance
- Complaint processing / complaint reaction
- Complaint analysis

In order to achieve an effective complaint input structure (complaint stimulation), barriers to complaints have to be broken down (Riemer, 1986). It is easy to give clients the immediate opportunity to respond negatively or positively to the services they have just received via so-called 'comment cards' or 'complaint boxes'. Immediate staff requests for customer suggestions, wishes or objections are an additional help in lowering customer inhibition thresholds.

3.4 Instruments of Quality Assurance

The scope of quality assurance extends to all "planned and systematic activities that are realized within the quality management system and that are demonstrated as required so as to present satisfactory trust that the products offered satisfy the respective quality requirements" (Zollondz, 2006).

Here, internal and external quality management objectives can be distinguished: To build up confidence among management and staff in the firm's capacity to provide quality both inside and outside the firm and thereby create motivational tools.

In particular, quality assurance serves the purpose of reinforcing a differentiated identity to customers and other user groups and also serves in some cases as a basis for issuing certifications.

There are comprehensive concepts and systems that are available in support of quality assurance that make use of numerous individual instruments:

- Quality management handbooks
- Quality statistics
- Benchmarking
- Integrated communication
- Quality audits
- Certification

Quality Management Handbooks

Quality management handbooks principally state the firm's quality policy and describe the organization's quality management system. So-called 'quality manuals' comprehensively cover the firm's corporate activities or only a section of these (DIN EN ISO 9000).

The whole process of service design and actual service performance – based on the quality targets

set – should be recorded when such a handbook is compiled. This includes the documentation of the organizational and operational structures of quality management. Service elements and quality requirements should be defined, and authorities and fields of responsibility fixed (Churchill, 1993; Sachs, 1993).

Statistics on Quality

Beyond this, quality statistics, supported by success ratings for example, provide information aimed at safeguarding service quality standards. Such statistics often reflect the results of attribute-related approaches and are made available to all levels of managerial staff.

Quality statistics provide the basis for so-called quality reports. A *quality report* is produced regularly (for example, on a quarterly basis) and gives an account of all the data related to customer satisfaction and the expense and earnings situation of a firm. Here, use is often made of different indices to represent the customer-side appraisal of specific service-provider performance dimensions (for example, reachability, friendliness, sympathy, technical competence). Often quality reports provide information on the frequency of complaints, newly gained or lost customers, and profitability associated with specific customer segments.

Benchmarking

In addition to in-house comparisons, the firm can publish corporate and branch-wide comparisons that act as 'benchmarks'. Here, relevant ratios, such as, for example, customer satisfaction indices or customer evaluations of service quality are set against other internal and external objects of comparison. In the case of failed targets, the first step is to identify the possible reasons for the mistakes using deviation analysis and so pinpoint the respective problem areas. The next step is to make the staff aware of the problem areas that impact on quality standards.

Integrated Communication

In order to guarantee that these measures have the desired effect outside the organization, quality assurance should be conducted both inside and outside the organization using internal and external tools. From the internal perspective of the firm, this demands that communication is candid and consistent regarding the firm's strengths and weaknesses in providing services. In this context, the target measures that are used within integrated communication should strongly underline the extent of service-provider's serious efforts aimed at advancing quality standards (Bruhn, 2000).

Quality Audits

Quality audits principally serve to identify weaknesses within the quality management system with the aim of inspiring various groups of staff to improve quality and monitor quality control measures. Quality reviews are either carried out externally, for instance, by an independent management consultancy firm or internally in the form of quality audits.

A quality audit entails conducting a thorough investigation to determine whether the activities influencing the service provider's quality standards and the results of these conform to the stipulated requirements. Here, checklists are used to monitor the respective criteria.

The aim of a quality audit is principally to assess the need for improvements and corrective measures. Corporate management is in charge of quality audits for services in such matters.

Certification

Firms strive to accumulate more and more certificates as a warranty of their adherence to specific norms, standards and process procedures for their external market partners. In real terms, a firm receives a specific certification once it has successfully passed a quality audit and can then

use it for promotion purposes. Certification – an official statement of the specific quality standards applying to a firm and its services – vouches first and foremost for a firms' corporate quality-management philosophy and promotes the firm's corporate identity most often as well. At the same time, certification also serves to protect customers from poor service quality: In particular, purchase risks are reduced with certified service providers.

4 A SUMMARIZED APPRAISAL OF THE QUALITY MANAGEMENT INSTRUMENTS FOR SERVICES

Overlaps exist between the methods and techniques for ensuring service quality, already described, and those employed for gauging service-quality standards. Complaints management helps identify quality shortcomings as well as safeguard service quality. Identifying problem areas is just a first step towards achieving a comprehensive quality management system. The methods and techniques used to secure service quality should be evaluated according to the following criteria (Bruhn, 2008):

Theoretical Criteria

- Quality dimension: This attribute identifies which quality dimensions (dimensions regarding potential, process and/or result) should be considered for the respective instruments.
- Quality concept: This criterion identifies which quality concept – from the five defined by Garvin (i.e., transcendent, product-based, user-based, manufacturing-based and value-based concept) underlies the respective instrument.

Criteria Related to Preparatory Work

- In-house / external initiative: This criterion expresses whether the firm is itself capable of initiating implementation of an instrument ('in-house' specification) or whether external groups are needed to occasion the introduction, such as customers for example ('external' or 'joint' specification). The more it is a case of the latter, the less easily is the company able to steer the instrument itself.
- Need to make adaptations tailored to the firm: The methodology of a large part of the procedure is kept very general. Thus, methods have to be adapted to specific branch- or corporate-level characteristics (of "essential necessity"). With some instruments this kind of adaptation is only conditionally required (of "conditional" necessity").
- Need for modification during the process: There are numerous procedures requiring that the changes in the firm's internal and external field of activities be adapted to a greater or lesser degree.

Implementation-Based Criteria

- Costs: Some of the costs estimated for implementing individual instruments vary very strongly. Factors influencing the costs include such things as the number of employees involved, the need for external specialist knowledge and the time taken to carry out the implementation.
- Organizational expenses: The organizational expenses associated with implementing the individual instruments (as well as preparation work) vary greatly. Organizational costs are associated with other appraisal criteria, such as, for instance, the need for firm-specific adaptations, necessary modifications and complexity. Further factors

influencing this criterion are – depending on the phase of application – the number of services being offered, the number of staff, the need for representativeness in the test results, and the size of the firm.
- Complexity: The methodologies of individual procedures vary in complexity.
- Continuity of use: An instrument should be used sporadically or consistently depending on its purpose.
- Frequency of use: The frequency with which an instrument is employed should depend on its purpose, and financial and organizational costs.

Result-Based Criteria

Result-based criteria are applied uniquely for assessing the service quality measuring approaches used in the quality planning and testing phases. Important criteria to be considered here are:

- Reliability: A measurement is considered reliable if the measuring tool is consistent, that is, when repeated measurements produce identical results and thus are capable of producing 'accurate value' readings.
- Validity: The validity of a measuring approach states whether or not the measuring tool actually measures the intended aspects.
- Actuality: In order to guarantee the explanatory power of planning and testing tools, the procedure should apply the most up-to-date assumptions.
- Relevance to quality: Applying measurement tools in the quality-management framework is only sensible if the tool in question is capable of compassing and monitoring quality.
- Completeness: The various instruments display different degrees of 'completeness' with regard to their observed performance and the specific criteria considered. However, it is neither compulsory nor desirable to use the most "complete" tools. Depending on the object being investigated, it is sensible to only probe those quality aspects or problem areas needing a higher degree of intervention.

All quality-management instruments should be evaluated according to these criteria in the light of the service-provider's specific corporate context. Figure 3 shows an overview of such an evaluation (Bruhn, 2008):

In addition to the instruments used in quality planning, quality control, quality inspection and quality assurance discussed in the previous chapter, in recent years quality awards, certifications and national customer (satisfaction) barometers have established themselves as ways of steering and demonstrating a service firm's quality capability.

5 IMPLEMENATATION AND SUPERVISION OF QUALITY MANAGEMENT FOR SERVICES

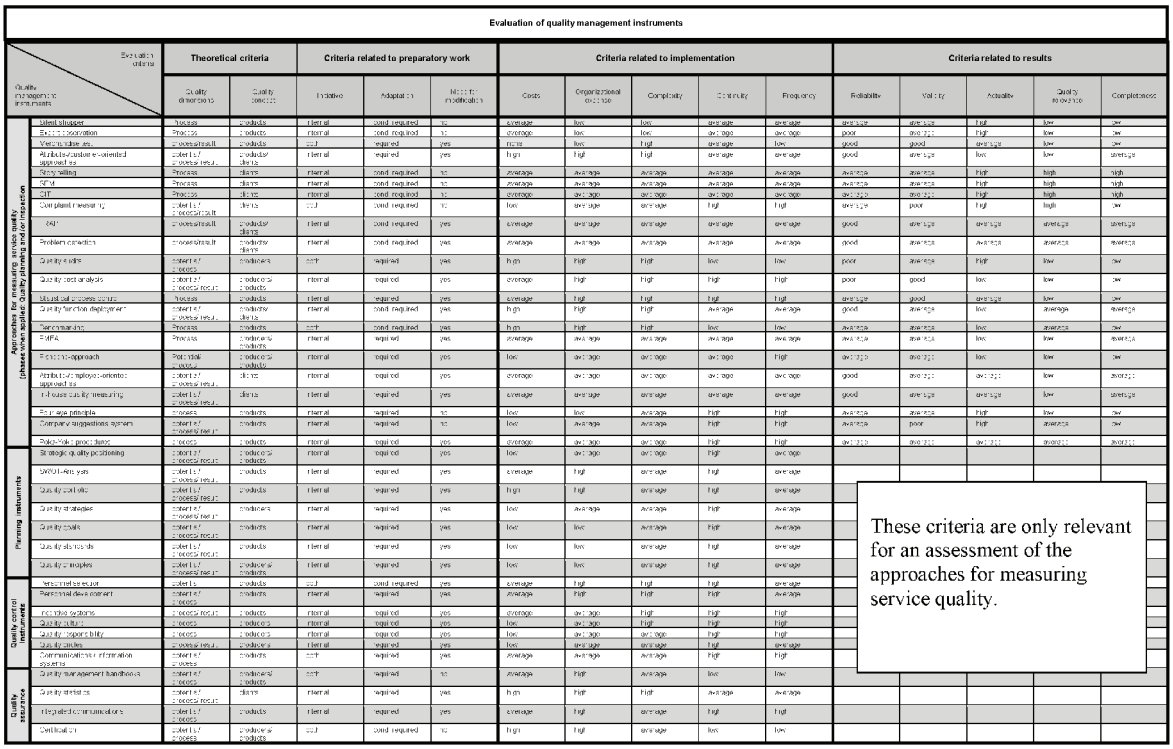
Quality Awards for Service Firms

Instruments have been developed to promote a holistic view of quality management systems, using quality awards as incentives to boost the use of these systems within firms.

Quality awards are prizes awarded by special institutions that vouch for a firm's endorsement of quality and the quality concept throughout its whole organization as well as the firm's successful implementation of these both internally and externally.

A further important goal of quality awards is their didactic purpose: Honorary distinctions like these serve to promulgate expertise on competition and its strategic deployment. This promotes an awareness and understanding of how quality improvements impact the economy and opens an

Figure 3. Evaluation of quality management instruments



Evaluation of quality management instruments

Evaluation criteria / Quality management instruments		Theoretical criteria		Criteria related to preparatory work			Criteria related to implementation					Criteria related to results				
		Quality dimensions	Quality objects	Incentive	Adaptation	Need for modification	Costs	Organizational structure	Complexity	Continuity	Frequency	Reliability	Validity	Actuality	Quality awareness	Completeness
Approaches for measuring service quality (phases when applied: quality planning and/or inspection)	Talent shopper	Process	products	internal	bond required	no	average	low	low	average	average	average	average	high	low	low
	Exact coordination	Process	products	internal	bond required	no	average	low	low	average	average	poor	average	high	low	low
	Value-added-an...	process-oriented	products/ clients	self	required	yes	none	low	high	average	low	good	good	average	low	low
	Attribute-/customer-oriented approaches	talent-/ process-/ service-/ result...	products/ clients	internal	required	yes	high	high	high	average	average	good	average	low	low	average
	Story telling	Process	clients	internal	bond required	no	average	average	average	average	average	average	average	high	high	high
	CPM	Process	clients	internal	bond required	no	average	average	average	average	average	average	average	high	high	high
	CIT	Process	clients	internal	bond required	no	average	average	average	average	average	average	average	high	high	high
	Complaint-/reward-/...	talent-/ process-/result	clients	self	bond required	no	low	average	average	high	high	average	poor	high	high	low
	QAT	process-/result	products/ clients	internal	bond required	yes	average	average	average	average	average	good	average	average	average	average
	Problem-/correction...	process-/result	industry/ clients	internal	bond required	yes	average	average	average	average	average	good	average	average	average	average
	Quality-/cycle	talent-/ process	employees	staff	required	yes	high	high	high	low	low	poor	average	high	low	low
	Quality-cost-analysis	talent-/ process-/ result	products/ products	internal	required	yes	average	high	high	high	high	poor	good	low	low	low
	Statistical process control	Process	products	internal	required	yes	average	high	high	high	high	average	good	average	low	low
	Quality-function-deployment	talent-/ process-/ service-/ result...	industry/ clients	internal	bond required	yes	high	high	high	average	average	good	average	low	average	average
	Benchmarking	Process	products	staff	bond required	yes	high	high	high	low	low	average	average	low	average	low
	FMEA	Process	products/ products	internal	required	yes	average	average	average	average	average	average	average	low	low	average
	Poka-Yoke-approach	Product risk	products/ products	internal	required	yes	low	average	average	average	high	average	average	low	low	low
	Attribute-/employee-oriented approaches	talent-/ process-/ service-/ result...	clients	internal	required	yes	average	average	average	average	average	good	average	low	average	average
	Failure-/safety-measuring	talent-/ process-/ service-/ result...	clients	internal	required	yes	average	average	average	average	average	good	average	average	low	average
	Kaizen-principle	process	products	internal	required	no	low	low	average	high	high	average	average	high	low	low
	Company-suggestions-system	talent-/ process-/ service-/ result	products	internal	required	no	low	average	average	high	high	average	poor	high	average	low
	Poka-Yoke-principle	process	products	internal	required	yes	average	average	average	high	high	average	average	average	average	average
Planning instruments	Strategic-quality-positioning	talent-/ process-/ result	products/ products	internal	required	yes	low	average	average	high	average					
	SWOT-Analysis	talent-/ process-/ result...	products	internal	required	yes	average	high	average	high	average					
	Quality-portfolio	talent-/ process-/ result	products	internal	required	yes	high	high	average	high	average					
	Quality-strategies	talent-/ process-/ result	employees	internal	required	yes	low	average	average	high	average					
	Quality-goals	talent-/ process-/ result	products	internal	required	yes	low	low	average	high	average					
	Quality-structure	talent-/ process-/ result	products	internal	required	yes	low	low	average	high	average					
	Quality-principles	talent-/ process-/ result	employees/ products	internal	required	yes	low	low	average	high	average					
Quality control instruments	Value-added-audit	talent-/ process	products	self	bond required	yes	average	high	high	high	average					
	Personnel-development	talent-/ process	employees	internal	required	yes	average	high	high	high	average					
	Process-audits	process-/ result	products	internal	required	yes	average	average	high	high	high					
	Quality-audits	process-/ result	products	internal	required	yes	low	average	high	high	high					
	Quality-support-ability	process-/ result	products	internal	required	yes	low	average	average	high	high					
	Quality-circles	process-/ result...	products	internal	required	yes	low	average	average	high	average					
	Communication-/-information-systems	talent-/ process	products	staff	required	yes	average	average	average	high	high					
	Quality-management-handbook	talent-/ process	employees/ products	staff	required	no	average	high	average	low	low					
Quality assurance	Quality-services	talent-/ process-/ result	clients	internal	required	yes	high	high	high	average	average					
	Registered-communicators	talent-/ process	products	internal	required	yes	average	high	average	high	high					
	Certification	talent-/ process	employees/ products	self	bond required	no	high	high	average	low	low					

These criteria are only relevant for an assessment of the approaches for measuring service quality.

exchange of ideas on successful quality strategies (Reimann & Hertz, 1994).

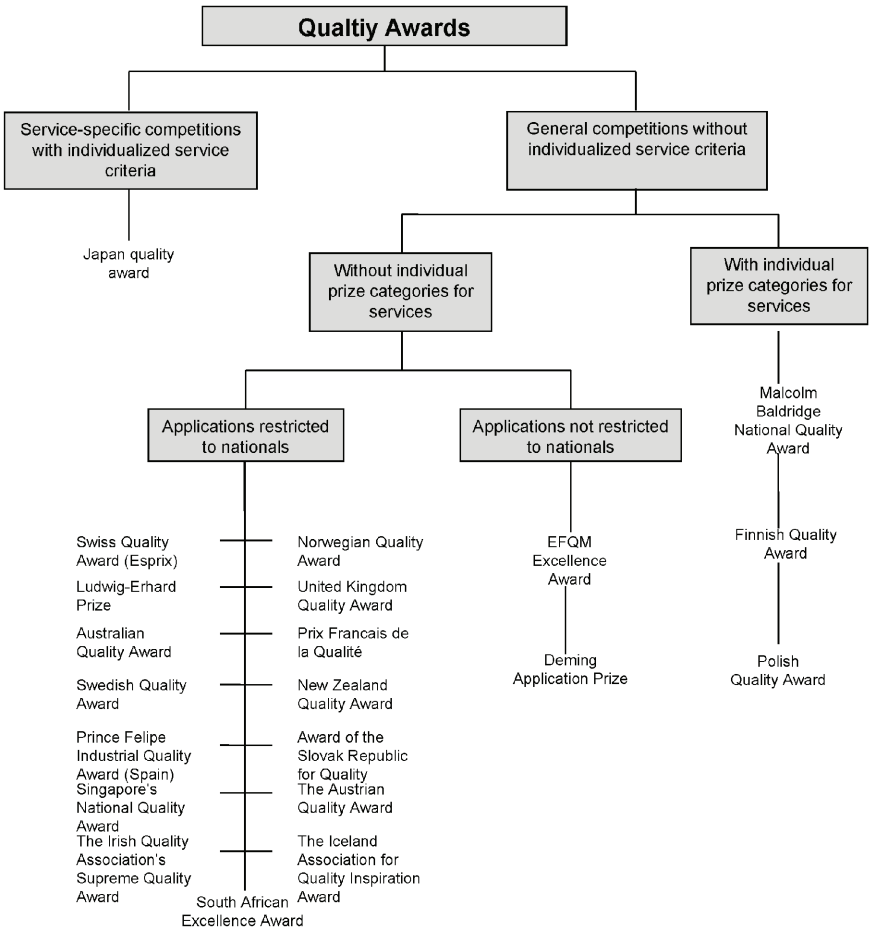
A chart categorizing the currently most well-known quality awards is given in Figure 4. Here, quality awards are classified into their respective award categories distinguishing awards that are specific to service companies from those that are open to all companies.

Service-specific awards only deal with prizes that appeal to criteria specifically relating to the service sector. Investigating and evaluating service firms as an independent category makes good sense as goods and services each have significantly different quality concepts, demanding a different QM-focus for each. "The Japan Quality Award" falls within this category. The award has been granted since 1996 and is based on the concept of the four principle elements of customer-oriented focus, employee-oriented focus, public responsibility and the provider's ability to produce a unique service (Japan Quality Award, 2009).

Prizes that are not specific to companies of the service sector feature evaluation criteria that apply equally to goods firms and other firms in general, as well as service providers: This category is then subdivided where there is a separate category awarding services, such as the "Malcolm Baldrige National Quality Award" (MBNQA) or the "Finnish Quality Award" (MBNQA, 2009). The national, annually awarded MBNQA was established in 1987 with the prize categories 'manufacturing companies', 'service companies' and 'mid-size companies'. The international importance of the MBNQA is demonstrated by the fact that other quality prizes have adopted its appraisal criteria. Moreover, it is a non-performance-related award that is endowed with an individual prize category for services.

The group of quality awards that does not have its own subcategory of service prizes is subdivided for prizes that are restricted to national applicants and those that are not. Among the prizes that are

Figure 4. Systematization of selected national and international quality awards (Source: Bruhn, 2008)



not limited to national applicants are the 'Deming Application Prize', and the 'EFQM Excellence Award' (EEA) (EFQM, 2009), which was formerly called the 'European Quality Award' (EQA) until 2006. The EEA or its precedent, the EQA, has a subcategory 'public area', associated specifically with services. This, however, applies only to public service organizations that are, for the most part, purely engaged in the non-profit activities. Examples of awards that are restricted only to nationals are the Australian, French, Swedish, Norwegian, Swiss, and British awards as well as the German Ludwig-Erhard-Prize. Although the quality prizes referred to above are marginally different, they share the following commonalities with regard to their objectives, quality concepts, and application and assessment procedures:

- The most important goals deal with improving competitive capacity, creating transparency, and communicating knowledge regarding quality.
- Quality awards are underpinned by a fully defined understanding of quality, including a catalogue checklist that leaves no room for interpretation.
- Awards are granted on the basis of a systematic assessment procedure. The guidelines for awarding the various quality prizes (for example, MBNQA, EEA)

are usually based on the firm's ability to achieve outstanding quality, comprehensive customer benefits and successful business performance.

- Finally, all quality awards share the fact that the winners are publicly announced at the end of the competition and an official award-giving ceremony takes place (for example, the President of the United States awards the winner with the MBNQA).

Quality Awards offer the participating firms a guiding hand based on the rules of participation: These rules provide a yardstick for evaluating their current situation and determining guidelines for successful quality strategies.

Here again, a number of advantages are bound up together; for example, significant quality and productivity increases, higher levels of customer and staff satisfaction, larger market shares and improvements in profitability. Participating in quality awards may, however, also have disadvantages for the firm. Table 3 lists the possible advantages and disadvantages associated with various criteria.

Apart from participating in the quality award process and the associated benefits that the prize offers in promoting a firm, the quality model can be adopted by firms that do not apply. Often a company will base its managerial bias on the self-evaluation methods specified by the quality prize criteria (Stauss & Scheuing, 1994). There are different forms of self-evaluation: questionnaires, 'pseudo-candidatures', external audits.

Self-Evaluation Using Questionnaires

The first method for self-evaluation is offered by questionnaires, which make a detailed record of the quality award assessment criteria that have been satisfied. Each individual criterion has a list of various questions or statements requiring a response from the firm on a scale of one to five. In the firm's own interest the evaluation should be as accurate as possible. The strengths and weaknesses of the firm are then educed from an evaluation of the answers. This form of self-evaluation provides an appraisal of the firm's situation that is both quick and inexpensive. Strengths and weaknesses are, however, only roughly identified here. The main benefit of this approach is in initiating a discussion process within the firm.

Self-Evaluation via 'Pseudo-Candidacy'

The self-evaluation method via 'pseudo-candidacy' initiates a process that mimics the quality-

Table 3. Advantages and disadvantages of participating in quality awards

Criteria	Possible advantages	Possible disadvantages
Target-setting process	• Opportunity to check firm's targets • Clear in-house communication and implementation of targets	• Overlooking relevant contextual changes because concentration is centered on specified objectives • Neglect of maintenance targets
Staff motivation	• High motivation levels • Increasing enthusiasm	• Staff motivation only short-term • Steep fall in motivation levels in cases of failure producing frustration
In-house managerial conflicts	• Efforts to win the prize reinforce collaboration and reduce conflicts. • Encourages socialization of new members	• New group conflicts and rivalries arise from competition. • Unrealistic socialization owing to the exceptional nature of the effort
Image	• High image gain	• Image gain only for a few winners

prize application procedure. This necessitates that a comprehensive quality management system is implemented and strictly monitored. An in-house evaluation team is set up for this purpose, and the firm is then assessed as it would be in a real procedure using the quality-prize candidacy documents. This method often results in the firm becoming more intensively involved in the quality management process and generates fewer costs and risks than would be associated with an official application.

External Audits

The third way of employing the quality-prize criteria is with external auditing. An external advisory group assesses the in-house 'candidacy documents'. A discussion of the results often provides the firm with valuable information, especially when the advisors are quality-management specialists. This form of self-appraisal offers the greatest number of methodological approaches for achieving a realistic assessment of the firm as regards a comprehensive quality management: It is, however, also associated with higher external costs.

The quality-prize criteria catalog can offer successful firms a basis for planning a comprehensive TQM-program. Here, strategic corporate planning aligns itself here to the categories that already exist within the quality prize framework (Stauss & Scheuing, 1994).

The National Customer Satisfaction Barometer as the Information Base for Quality Management Systems

National Customer Satisfaction Barometers are supra-sectoral surveys that use periodic surveys to measure customer satisfaction levels and associated issues in numerous sectors, industries and enterprises of a country or economic area (Bruhn & Murmann, 1998; Bruhn, 2008).

Customer satisfaction surveys are becoming increasingly important in association with quality management for service providers. The methods used for carrying out national surveys on the quality of services and customer satisfaction are still relatively new. The Swedish Customer Satisfaction Barometer (SCSB) started in 1989 by investigating satisfaction for Sweden's largest companies (Fornell, 1992).

In 1994 the American Customer Satisfaction Index (ACSI) was established, being closely aligned to the Swedish model. Since 1992, national customer satisfaction data have be gathered in Germany in association with the German Customer Satisfaction Barometer (Meyer & Dornach, 1995). Numerous other countries have already carried out pilot projects, such as Österreich, Italy, Norway and Switzerland. In 1999, initiated by the European Commission and organized by the European Organization for Quality (EOQ), as well as the European Foundation for Quality Management (EFQM) (EFQM, 2009), a pilot evaluation on customer satisfaction and customer loyalty as well as on the factors influencing these took place in twelve European countries in the framework of the European Performance Satisfaction Index (EPSI). This national barometer enables cross-country data comparisons to be made as well as supra-sectoral measurements. The last EPSI survey took place in 2006 with eleven countries participating, among which Germany was not represented (Bruhn, 2008).

The results of national customer barometer investigations into the sources, the levels and the effects of customer dis /satisfaction with a service provider permit conclusions to be made for various target groups, such as firms, customers or socio-political policy makers (Bruhn, 2008).

National customer barometers have many applications for service firms. In the context of strategic quality planning, barometers serve, on the one hand, to highlight the service provider's quality-related competitive position. In this way, they contribute more to intrinsic staff motivation.

On the other hand, they are a useful addition to the attribute- and problem-related approaches for capturing customer requirements, both measuring the degree to which customer requirements are met by the firms' performance as well as revealing any need for intervention owing to quality-related performance problems. Moreover, customer barometers are useful in quality assurance as they document a service firm's customer orientation with regard to its internal and public dealings.

Concept, Meaning and General Framework of Certification within Services

A certification states that a product, service, process, or quality management system or an environmental management system has met the required standards. The written document that records this is called the certificate.

The certification of services thus serves two objectives in particular: Firstly, it the serves inspection purposes associated with implementing a quality management system within a service firm and vouches for specified standards of service quality; secondly, it serves to build trust (Zollondz, 2006) by furnishing current and prospective customers with a guarantee of an assured level of service quality.

The certification process is conducted in practice by means of audits that systematically and independently investigate whether the directives set by the quality requirements have actually been realized (Zollondz, 2006).

The certification process is divided into four steps (Jahn, 1988):

1. Selection of the certifying body
2. Decision regarding the underlying inspection norms
3. Preparatory work for certification
4. Process of issuing the certification

In an initial step service firms select a *certifying agency* from a number of independent certifying institutions that are in competition with each another. The crucial criterion in selecting a certification agency is the amount of information that the certificate will provide. Certification agencies use an umbrella organization to vouch for their standing (so-called accreditation) as evidence of their competence and as a record of the quality of their audits. If certification is required, as is especially the case for customer-supplier relationships, the customer will often stipulate that the certification be carried out by an institution that they choose.

Just as with selecting the certification agency, the *certification basis*, which specifies the quality assurance standards that have to be adhered to, also has to be recorded. The DIN EN ISO 9001 standard has established itself as the audit basis for quality management certification, its institutionalization in over 80 countries in the world reflecting its worldwide acclaim (Zollondz, 2006). It belongs to a family of standards labeled ISO 9000 ff., which are comprise of the following norms:

- ISO 9000:2005 (Quality management systems: Fundamentals and vocabulary concepts)
- ISO 9001:2008 (Quality management systems: Requirements)
- ISO 9004:2009 (Quality management systems: Guidelines for performance improvements)

In order to satisfy the various requirements of the respective organizations, the ISO 9001:2008 standards offer the user a wide *scope for interpretation*. Often the standard is flexibly structured using terms such as "appropriate", "where necessary", "where applicable" (Schlüter & Dunkhorst, 2000).

When preparing a certification or quality audit, the central question to be answered is whether the fundamental preconditions for certification have been satisfied by the firm. During this phase, the quality management handbook is examined in

preparation of the actual audit. The results produced by this review and an appraisal of whether the stipulated structural and procedural elements correspond to the requirements of the underlying quality assurance standard are recorded in an audit protocol.

The *certification process* commences with a contractual agreement specifying the scope of the audit/certification (Bruhn, 2008). Once this is achieved, corporate documentation is handed over to the certification agency and the company's quality management documents are then audited with regard to the company's conformance to the stipulated standards. In the actual *certification audit*, a check is carried out on the firm's implementation of the measures specified in quality management documents by means of a checklist or audit-question list. Once this is done, the audit report is then drawn up and the certificate issued. *Monitoring audits* are carried out at regular intervals in order to validate adherence to the quality management system during the term of the certificate's validity.

A negative aspect of certification that should be mentioned is the situation where the standards often dictate framework conditions that are too rigid for the service provider and even obstruct the firm's opportunities to differentiate itself and achieve market advantages. For this reason, norms are often bound to quality assurance system standards, while their actual formulation and the method of implementing them are subject to the discretion of the firm. Although, up until now, it has been manufacturers for the most part that have sought certification, an increasing trend can be seen in the certification of service providers. This development is accelerating all the faster as the service sector, similar to the manufacturing sector, is now also beginning to consider only certified suppliers. In Germany numerous service firms now carry the DIN EN ISO 9000ff. certification.

6 TEN STEPS TO SUCCESSFUL QUALITY MANAGEMENT FOR SERVICES

For service firms to gain a comprehensive view of quality management, it is imperative that they understand the technical rationale linking the various activities of quality management. This is the only way that suitable instruments may be selected for the different phases of analysis, planning, implementation and monitoring. Certainly, there is no need for a chronological stepwise procedure with the aspects given here when it comes to actually implementing the quality management system. A pragmatic approach in implementing quality management is more satisfactory in achieving the goal. A pragmatic approach of this kind consists of the following ten steps (Bruhn, 2008):

1. Definition of service quality
2. Measurement of service quality
3. Involvement of top management
4. Internal communication regarding the quality initiative
5. Determining what the customer expectations are
6. Determining and prioritizing quality attributes
7. Internal announcement of quality goals
8. Initiating quality measures
9. Communicating quality strategies outside the firm
10. Feasibility check

Step 1: Definition of Service Quality

The firm's in-house understanding of quality is the starting point for every quality initiative in service firms. Starting off with a general definition of quality that identifies performance and expectations as distinct components of perceived service quality, it is then a matter of the defining quality-related aspects that are specific to the individual firm. One has to determine which customer expecta-

tions for which group of customers are of prime importance for the firm. On the performance side, initial facts associated with the performance and quality attributes that are important for the sector or individual firms should be collected.

Step 2: Measurement of Service Quality

The first measurement of quality to be carried out, a so-called 'zero-measurement', provides a basis for later appraisals of the quality initiative (see also, Step 10.) Here, there are a large number of methods available for the service provider to choose between in line with various criteria, and which appear particularly appropriate for his or her specific case. Ideally, qualitative procedures are applied next. These clearly highlight actual experiences customers have with services from their perspective and help to further concretize the dimensions of service quality. Verifiable values can be generated for quality using quantative methods, which help to weight individual quality attributes for instance or are often used as initial values in subsequent checks or in evaluating customer-oriented remunerations.

Step 3: Involvement of Top Management

The quality initiative has a broader base to work from when top management is tied in: Otherwise, there is often the danger that the small group of quality-management initiators will not take the views of other corporate members into consideration. The results of the quality assessment, when purposefully presented, can be used to convince top management of the need for intervention.

Step 4: Internal Communication Regarding the Quality Initiative

Since the service quality objective poses a task that applies to the entire enterprise, and since the workforce in most service firms has a more or less direct effect on service quality, securing information and bringing all business divisions, functions and staff on board is an important precondition for the success of the quality initiative. The human resources department together with the communications department fulfills an important role as in most firms it is entrusted with responsibility for internal communications issues. One of the most important tasks for top management at this phase is to communicate as directly as possible with staff and work at gaining their support for the quality initiative.

Step 5: Determining What the Customer Expectations Are

Knowledge about customers' expectations is the basis for planning quality measures. Knowing which customer groups have which expectations establishes priorities for quality management. Here, most branches should approach customer expectations in an individualized way. Customer expectations should be analysed from a nuanced perspective, not only with regard to the type of expectation investigated, but most importantly from a perspective of the customer category that the expectations derive from so that the customer requirements can be optimally enforced.

Step 6: Determining and Prioritizing Quality Attributes

Analysing customers' expectations and quality measurements are also of help in prioritizing quality attributes. In principle, quality attributes that are particularly not strongly pronounced offer key insights for quality improvements. When prioritizing quality attributes, the principle attributes to be considered are those that place the customer in the foreground and where the customer appraisal plays relatively less of a role (i.e., where the service provider was noted for its shortcomings).

Step 7: Internal Announcement of Quality Goals

The prioritized quality attributes constitute the means for maintaining real long-term goals. They convey incentives for implementing quality management in a consistent manner. In addition to determining the quality goals, success depends on communicating these goals within the firm during this phase. The firm's staff must know what the company's quality goals are, understand what they imply, and accept them. Top management's involvement is also a significant ingredient of success here.

Step 8: Initiating Quality Measures

When initiating quality measures, it is particularly important that the right people are selected for the success of quality management. This process will be hampered if, owing to sectoral egotism for example, the right contact person for the task is not brought on board to implement the quality measures. Moreover, when measures are specified, they should reflect a balanced view with regard to the quality goals.

Step 9: Communicating Quality Strategies Outside the Firm

Quality management will be all the more effective, the more powerfully the quality measures are publicized outside the firm. This means that quality measures do not have to only be 'discretely' implemented – in the hope that the customer will perceive the improvement in quality – but that the enhanced performance should also be actively advertized. This is how a kind of 'self-fulfilling prophecy' can be achieved: If the customer is already pre-focused on quality improvements, they will then actually perceive this to be the case.

Step 10: Feasibility Check

Unlike quality management for the commodities sector, where usually mainly technical and statistical procedures are applied, a service firm often bases its quality management on non-objective indicators. However, this should not simply be schrugged off as 'art for art's sake' or as a 'soft fact'. A great number of measures (for example, circles of quality, internal communication and superior quality methods) cannot be implemented gainfully without a creative input. In this connection, the financial success from having introduced quality management to services will depend on instituting continuous feasibility checks on quality management activities. Problems can be avoided if feasibility issues are considered ahead of time: This is a lesson learnt from numerous real cases where feasibility issues were only considered when it was already too late.

The chronological ten-step process should be considered when systematically setting up quality management. Thus, because service quality is the responsibility of the whole enterprise, quality management can only be successful for services when all members of the enterprise contribute the high level of service quality.

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KEY TERMS AND DEFINITIONS

Perceived Service Quality: The difference between actual performance and the customer's expectation of a service

Quality Assurance: That part of quality management that comprises all planned and systematic activities that are realized within the quality management system and that are demonstrated as required so as to present satisfactory trust that the products offered satisfy the respective quality requirements National Customer.

Quality Control: That part of quality management that specifies quality targets and the necessary completion processes as well as the associated resources required for satisfying the firm's quality goals

Quality Inspection: That part of quality management that examines the extent to which an operational unit satisfies the quality requirements set for it.

Quality Management: The use of dovetailed activities for directing and steering an organization with regard to quality

Quality Planning: That part of quality management that specifies quality targets and the necessary completion processes as well as the associated resources required for satisfying the firm's quality goals

Satisfaction Barometers: Supra-sectoral surveys that use periodic surveys to measure customer satisfaction levels and associated issues

in numerous sectors, industries and enterprises of a country or economic area

ENDNOTE

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Section 2

Management Concepts and Models for IT Service Quality Management

Chapter 4
Quality Management for IT Services:
IBM Implementation of Quality Management

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THE IBM COMPONENT BUSINESS MODEL AS ENTRY POINT TO DETERMINE HOT COMPONENTS FOR QUALITY MANAGEMENT

Establishing a solid quality management for IT services requires a 'big picture' viewpoint – it is important to analyze the complete business picture rather than focusing only on the IT services as defined in a service catalog. The entire business of an IT service provider is more complex and has many related areas which may influence the quality of the provided IT services. A new way of looking at the entire business is IBM's *Component Business Model*™ (CBM). The method decomposes all relevant areas of an IT service provider in individual business components which are mapped in a two-dimensional model.

The first dimension is the organizational level. Each business component will be mapped to one of the three levels:

- the directing level (making strategic decisions: long term)
- the controlling level (management tasks: tactical or midterm)
- the execution level (operational tasks: daily business or short term)

The second dimension is described by functional areas which groups components handling the same topic. They are called business competencies and they may vary from one IT service provider to

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another. Typically, an IT service provider would have the following business competencies:

- IT Business Strategy
- Business Resilience
- Information and Knowledge
- Competencies to develop, deploy and support new services and solutions

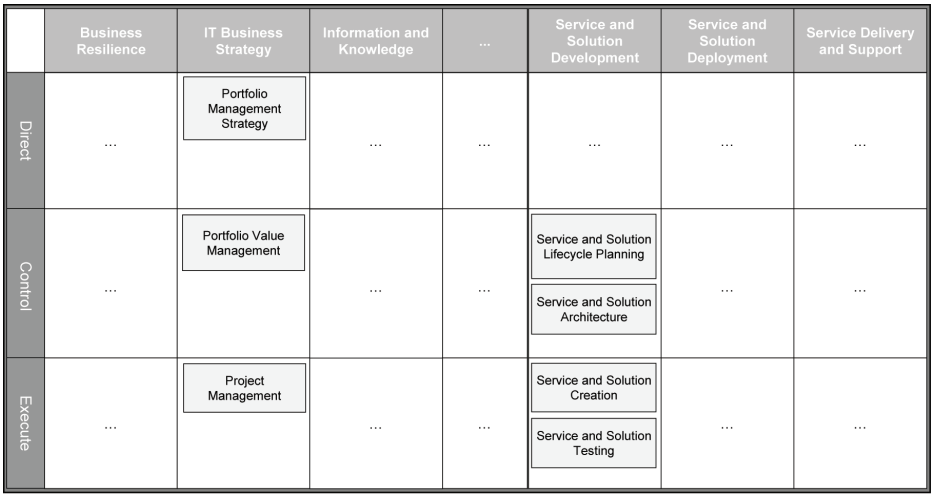
Figure 1 shows a sample CBM with the previously described business competencies and some components used later in this chapter.

The business components are defined for each IT service provider and may include something like portfolio management strategy, portfolio value management, project management, service and solution lifecycle planning, service and solution architecture or a test component. They will get a description, a list of activities which belong to this component and the relevant Key *Performance Indicators* (KPIs). The KPIs are used to measure the performance of a specific component against the market and/or to measure the progress year-over-year within the company. The business components may be enhanced by mapping processes, people (e.g. organization, roles) or even IT (e.g. systems, applications, interfaces) to the components.

After an initial 'as-is' analysis and definition of the components the IBM method gives the possibility to define specific attributes for further analysis. Typical attributes are the criticality or value for the company, the costs or the actual performance of a component. To find weak points in terms of quality management, the analysis team can add quality specific attributes like customer satisfaction, rework costs or compliance to predefined rules and processes. By defining the attributes for each component an overall "heat map" will be generated showing the hot components where changes would bring the biggest value in terms of quality management improvement.

The Component Business Model™, including the company specific evaluation criteria and hot components, is usually used by the senior management to have a one-page overview of their organization and the related issues. It will be used for defining strategic decisions and to focus on the right components regarding effort and expected value.

Figure 1. Sample outline of a component business model for an IT services provider



QUALITY MANAGEMENT IN THE CONTEXT OF PORTFOLIO MANAGEMENT AND PROJECT DELIVERY

The successful delivery of engagements is the highest priority of IBM Global Business Services (IBM GBS). IBM's goal is also to deliver projects and programs with speed, effectiveness and high quality to generate client value. Therefore, quality management at IBM is targeted at, but not limited to, planning for and executing processes and activities in such a way that projects are delivered according to pre-defined requirements and specifications. It is seen in a much broader context and therefore better described as *Delivery Excellence* (DE). Delivery Excellence has contributed positively towards IBM's business results in recent years and is intended to drive continuous and sustainable improvement in delivery capabilities. The focus is on consistent execution of best practice processes, proven methods and tools, assets and other intellectual capital by skilled and experienced people as well as appropriate and responsible handling of project and business risks throughout the project lifecycle. Lessons learnt are continuously collected and analyzed for further improvement potential. Key Performance Indicators (KPIs) and tools support the achievement of IBM goals of satisfied and referenceable clients and profitable growth. This enables IBM to offer services with confidence that they can be delivered and to launch projects with a full understanding of what defines and drives success, thus delivering value to their clients.

Delivery Excellence is implemented at all management levels (directing, controlling, executing) of the CBM map within the competency 'Business Management'. It also plays a crucial role in the competencies 'Business Resilience' and 'Information and Knowledge'.

Delivery Excellence Strategy

On the directing level several strategic objectives have been defined to put the mission of Delivery Excellence (DE) into operation, such as:

- Focus on, monitor and assess customer satisfaction and client value. Streamline and enhance the procedures for surveying client satisfaction.
- Increase efficiency and assure delivery quality by consistently applying best practices, standards, methods and tools.
- Ensure a consistent approach to manage all classes of risk.
- Monitor and measure performance by appropriate KPIs. Provide transparency and visibility into Industry portfolio risk and financial portfolio health.
- Close the gap between pricing cases and actual contract gross profit (cGP). Minimize operational costs.
- Ensure financial integrity and SOX compliance. Focus on security, privacy and data protection.
- Ensure full integration within the organization including Global Delivery Centers to leverage the full range of capabilities and experiences and to increase effectiveness and efficiency.
- Establish a DE infrastructure to support the business units and project managers in the execution of their DE responsibilities.
- Retain high skill level individuals, e.g. ensure high project management capabilities.

Delivery Excellence Control and Execution

In support of these strategic objectives and in accordance with the controlling level of the CBM map a tactical plan (*DE Management System*) has been derived. The DE Management System is a framework that defines DE processes, activities,

records, methods and tools. It also includes the criteria for success, the respective targets, how these targets should be achieved and how exceptions are to be handled. The focus is on acting proactively and anticipating problems before they occur rather than just responding to and correcting situations that are out of alignment.

Delivery Excellence Management System

One of the design principles is the seamless integration of the DE Management System into the IBM GBS business process that applies to all IBM GBS contracts. The business process is a framework that focuses on the tools and infrastructure and related business processes that help IBM GBS function as an integrated, global organization. In this sense it defines all steps that are required during the engagement lifecycle starting from opportunity identification until project closure based on IBM GBS sales and delivery methods and audit requirements. Compliance to the business process is regularly inspected and evaluated by business control reviews and business control analysis according to the business compliance strategy and planning methodology.

Another major design principle of the DE Management System is the use of mature tools such as the Book of Business into which contract-related data are loaded and maintained. The functionality of the Book of Business tool allows the project managers to easily self-assess their projects based on the so-called *Seven Keys To Success*®. The Seven Keys To Success® is a formal framework comprising of a set of questions and goals to proactively assess, monitor and manage all important aspects of a project that relate to a successful implementation such as scope, schedule, stakeholders and business benefits. It provides a methodology to identify warning signs, to implement actions on critical dimensions, and to communicate project status in a condensed, standardized and structured way in defined reporting cycles.

Projects within the IBM GBS portfolio are classified by their *business transaction type* (1 through 5, where 1 represents a simple, standard terms & conditions engagement and 5 represents a complex engagement with non-standard terms & conditions) and their *project health* (A: under control, B: currently under control, but potential problems requiring positive management attention, C: significant problems with probability for project exposures and customer dissatisfaction requiring aggressive management action, D: major problems; definite, serious financial exposure and/or customer dissatisfaction). The business transaction type and the last health rating of a project trigger the frequency of risk reviews during the delivery as well as the delegation level for risk management activities. As a sub-process of the business process the risk management process is built on the principles that independent subject matter advisors (for risk management, pricing, legal, technology, etc) provide guidance according to the business process and that risk reviews are performed based on standard tools and techniques. The risk management process focuses on mitigating the risks that are natural elements in any work undertaken, by providing global policies and procedures to proactively manage business and technical risks and instill prevention techniques in the proposal development phase. Identification of risk factors considers both internal and external factors, e.g. late changes to scope/requirements, schedule and budget variances, personnel shortfalls, first-of-a-kind solutions, organizational integration, and security. The risk manager is responsible for integrating the results of the various subject matter advisors and for creating an integrated risk management plan that classifies business and technical risks, and determines their impact and response strategy. It is the risk manager's responsibility to consult the project teams in the management of project risks and handling out-of-line situations.

The results of the Seven Keys To Success® project manager self-assessment, the risk level of a signed contract (1-4: low risk, 5-7: medium risk, 8,9: high risk) and the health rating of a project as assessed by the independent risk manager are some of the indicators to evaluate the overall health status of a project that are contained in the service portfolio. Other important indicators can be obtained from *Earned Value Analyses*. The Earned Value Analysis of a project may indicate a performance according to plan (no cost and schedule variances in the estimates to completion, cost and schedule performance indices=1) but specific circumstances lead to financial impact on a quarterly revenue stream. A simple example would be that a project payment milestone slips from the end of one quarter into the next quarter due to minor schedule delays which do not impact the overall project performance, but, as a result, quarterly revenue streams and consequently quarter cGPs are impacted. Another example is the impact of accounting rules that may influence quarterly results significantly even though the overall performance is within the target range or when risk mitigation actions may lead to recovery of a financial exposure. Apart from the project manager self-assessment and the independent risk rating these considerations lead to a set of indicators that need to be factored in to establish a mature and effective early warning system. Therefore, IBM GBS designed the *Indicative Predictive Framework (IPF)* that defines all criteria that give indication to DE Exposure in accordance with the strategy as outlined in the Business Management dimension of the CBM map. Projects that are identified based on the IPF are monitored at short intervals and prioritized for DE coaching by DE experts with the aim to identify and execute mitigation actions to bring the project back on target. In case of significant DE exposure these projects are additionally assigned to a specific Management Board to perform in depth reviews and to evaluate recovery plans from a senior management point of view. Amongst others key selection criteria are: high volume engagements, high risk rating, estimate at completion below plan/forecast at completion erodes over time, Seven Keys To Success® assessments result in alerts, quarter financial forecasts point to negative quarter cGP.

For transparency and visibility reasons, and in order to assess portfolio risk and financial portfolio health, various analyses are regularly executed and results are tracked over time using scorecards. These analyses include but are not limited to the following KPIs: negative quarter cGP, portfolio erosion, expense to revenue ratio, number of projects with health classifications of C or D, monetary value of identified DE improvement actions, monetary value of executed DE improvement actions, monetary value of identified DE exposure and monetary value of realized financial risks, results of customer satisfaction surveys, portfolio coverage in terms of executed risk reviews and DE coaching. These analyses are enhanced by continuous lessons learnt-sessions to help identify systemic issues and drive continual improvement.

As Delivery Excellence processes and activities are implemented at all management levels and across several competencies in the CBM for IBM GBS, seamless integration of business divisions and business processes is a critical success factor as well as thorough communication planning. The communication plan includes roles, responsibilities, decision structures, communication channels and communication media based on the organizational model and supporting organizational integration to eliminate redundant effort, reduce complexity, assure appropriate assignments of skilled people to specific operational tasks and thus reduce operational costs. Cross-division integration ensures consistent DE management and enables effective communication. It leverages synergies, avoids redundant efforts as well as duplicate analyses and ensures single sources for information in terms of specific DE topics.

Delivery Excellence and Project Management

At the executing level of the CBM map, project management and the professional capabilities and experiences of project managers are important drivers for project success and delivery excellence. IBM follows a consistent approach for project management and implemented an Enterprise Project Management approach with the aim to consistently apply project management disciplines to the management across the organization. IBM's *Enterprise Project Management* approach includes a project-based infrastructure that embodies core methodologies, practices, processes, tools and techniques, skilled and experienced project management professionals, and the use of project management disciplines in the day-to-day management of the business. IBM projects are delivered following the *IBM Worldwide Project Management Method (WWPMM)*. WWPMM is aligned with industry standard models and adaptable to project situations of any complexity and size to accommodate individual business considerations. WWPMM supplies a set of plans, procedures and records to easily tailor a project's Project Management System and describes how to shape, plan and manage a project by the means of three interrelated views. The methods that comprise WWPMM are based on decades of experience derived from many different types of projects across multiple industries and geographies.

The first view is knowledge based (*project management domains*) and groups project management processes into subject areas. It provides detailed guidance on how specific types of project management activities are carried out.

The second view, called *project management work patterns*, is event based and describes a series of steps a project manager should take during project execution in order to meet a particular project management goal or to respond to a particular project management situation. Work patterns are organized in work pattern groups. For each work pattern the goal is described together with the circumstances that trigger the work pattern execution. Entry and exit points, interactions with other work patterns and references to work products are also provided.

The third view is document based and provides *project management work products* as generic templates with indications of their impacts on the management of the project and best practice examples. The work products are the verifiable outcomes that are used to manage projects.

IBM's Project Management tool suite supports the use of technical methods and WWPMM in project planning and execution. The tools can be used in standalone or in integrated configurations to support a wide range of project environments.

Figure 2. Three interrelated views to shape, plan and manage a project

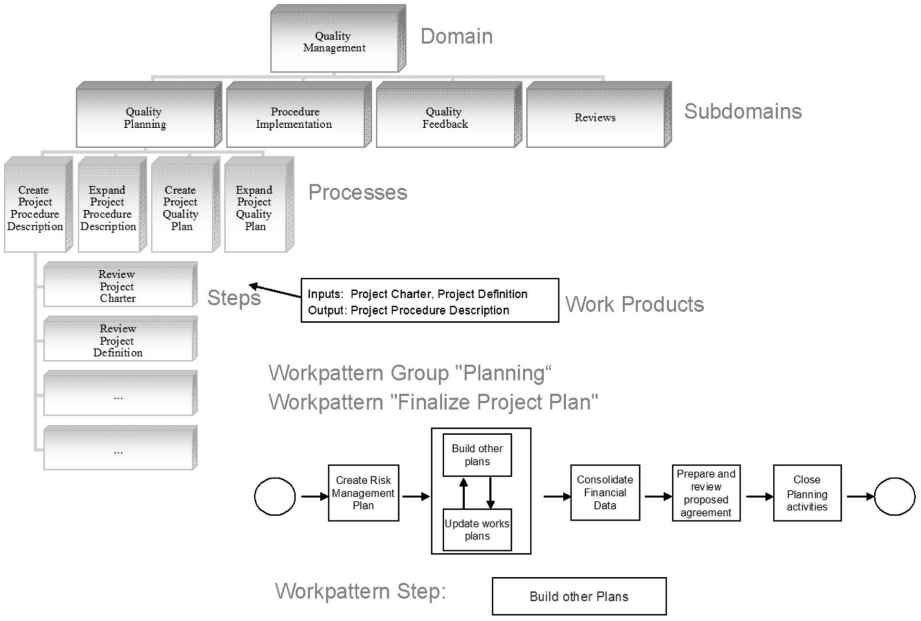


Delivery Excellence and Technical Methods

IBM's previously described project management method is fully integrated with the approach and methods used for defining, implementing, testing or managing a new service or solution. IBM uses official standards like CMMI, ITIL or Systems Engineering and enhances them based on IBM's experience and needs in the different service projects.

The *Capability Maturity Model Integration* (*CMMI*) is used to achieve delivery excellence and

Figure 3. Elements of IBM's worldwide project management method



to optimize the process for software development in the IBM services organizations. By following and adapting this international standard, some IBM organizations have already achieved CMMI level 5. For projects concentrating more on the service maintenance and management, IBM has been using the IT Infrastructure Library (ITIL) best practice approach for several years. IBM is involved in the development of ITIL publications, has certified ITIL service managers and is authorized to perform ITIL education. Systems Engineering is mainly used to look at a complete problem by considering business requirements as well as technical requirements and by performing several specific reviews along the project lifecycle.

The "Delivery Excellence and Technical Methods"- chapter focuses on Systems Engineering and two other major success factors IBM uses in its projects in addition to the previously described project management method and official external standards:

1. Establish Systems Engineering and end-2-end SME reviews.
2. Establish a solution development lifecycle method.
3. Establish early test integration and offer a test component as a service.

By following the official standards and by using the described major success factors the following typical problems can be avoided or at least reduced massively and the overall quality and customer satisfaction will improve:

- **Requirements are not detailed enough and there is no interaction with the client:** The IT team receives only high-level requirements of the target solution, creates the design almost independently and performs the development without further interaction with the client. In many cases the team has "guessed or inferred" missing or unclear information when making the transition from the textual description to their application design. If the clients are not being involved before the final integration test starts, it is likely that they will com-

plain about misinterpreted requirements and missing functionality.

- **Team concentrates on functional requirements:** The development team focuses on the functional work to be done, and does not consider the non-functional requirements and the infrastructure within which the target solution has to operate. Problems regarding the non-functional requirements will become visible very late in the development process, sometimes even after the solution is moved to the production infrastructure. Depending on the KPIs defined in the service catalog, the IT service provider will get severe problems in fixing the application in the time defined in his Service Level Agreements (SLAs) or Service Level Objectives (SLOs).
- **Work done within previous phases is not used:** The requirement and analysis team produces several documents which are not used by the design and development team. Very often the design team begins to rethink functionality and requirements without building on the preliminary work products. The main reason is often that the documentation was not delivered in a format they could use, it was not precise enough or major information had been missing. This may lead to misinterpreted requirements and problems fulfilling the project schedule due to the unplanned additional work.
- **Some documents are not updated, but used by follow-on teams:** Another common and significant mistake is that some documentation is not updated in the case of changing requirements. The team updates only the latest documents in the process (e.g. the physical data model or the JSPs) and omits to update related documentation, like the business object model or a user interface design specification. Other teams, like testing, might still use the previous documentation as their key input and have to work now with an old business object model or user interface design specification. The overall project might be at stake, because the testers find defects, based on the outdated or inconsistent input that is available.
- **Testing is underestimated and not integrated in full lifecycle:** Sometimes the testing of a new service or solution is underestimated and not fully integrated in the overall development lifecycle. Typical project plans have a sequential planning like analysis, design, development, test and deployment. The test manager and test team are planned for the test phase only, with a minor setup phase before. The available time to plan, setup and run the test is not sufficient and major defects will not be detected before the handover to the customer. The project may not get a final acceptance or the costs for warranty will exceed the planned estimates.

1. Establish Systems Engineering and end-2-end SME reviews

A key standard IBM uses in its service projects is the Systems Engineering approach. According to the International Council on Systems Engineering (INCOSE) "Systems Engineering" is defined as follows:

"Systems Engineering is an interdisciplinary approach and means to enable the realization of successful systems. It focuses on defining customer needs and required functionality early in the development cycle, documenting requirements, then proceeding with design synthesis and system validation while considering the complete problem: Operations, Cost & Schedule, Performance, Training & Support, Test, Disposal, Manufacturing.

Systems Engineering integrates all the disciplines and specialty groups into a team effort forming a structured development process that proceeds from concept to production to operation. Systems Engineering considers both the business and the technical needs of all customers with the goal of providing a quality product that meets the user needs"

[http://www.incose.org/practice/whatissystemseng.aspx]

IBM has adapted the Systems Engineering approach and establishes specific review points throughout the whole development lifecycle of a new service or solution. Depending on the solution to be developed, the number of reviews and the participants may vary (e.g. in a business requirement review the client should be involved, in a system requirement review a representative of the managed operations and the test team leader should participate). The most important recommendation is to plan and conduct these reviews seriously, to use the reviews as a facilitator for improving the overall quality and to avoid that the team sees the reviews only as unnecessary formal tasks to be done. Therefore a key task for the lead IT architect and project manager is to convince the team of the benefits such reviews bring to the overall project and to plan sufficient time and the right people for each review to ensure that it can be prepared thoroughly. The findings of the reviews should be integrated into the design and project documents before the team moves on to the next phase.

The following list describes typical reviews as described by the *Systems Engineering Capability Pattern* adapted by IBM. It starts with reviews for the requirements and design, checks the test readiness and finishes with a production readiness review:

1. *Business Requirements Review*
   a. Scope: Get a clear understanding of functional and non-functional requirements, the "as-is" processes and acceptance criteria. The outcome is a baseline for the client's business requirements.
   b. Participants: client, IT architects, project manager
2. *System Requirements Review*
   a. Scope: Review the system, component and test architecture and verify them against system requirements. Identify and review technical dependencies, risks and mitigation plans. The outcome is a system technical baseline.
   b. Participants: client, IT architects, project manager, test team leader, representative from the service delivery center (managed operations)
3. *Design Reviews* (at least 2: one preliminary, one final)
   a. Scope: Check if the system requirements fulfill the business requirements by analyzing system architecture, technical performance measures, technical dependencies and the traceability from the client requirements to the system requirements. Check the completeness of the design; verify the end-to-end test strategy and that the production infrastructure capacity supports the system requirements.
   b. Participants: (client), IT architects, project manager, test team leader, representative from the service delivery center (managed operations), lead application developers
4. *Test Readiness Review*
   a. Scope: Check if the test entrance criteria have been met for each component to be tested. Verify that the test team, the required test data and the test environments are available.
   b. Participants: client, IT architects, project manager, test team leader, representative from the service delivery center (managed operations), lead application developers

5. *Production Readiness Review*
   a. Scope: Establish the release content and check the test result and the content for the specific release. Review the deployment plans including system availability, performance and data migration.
   b. Participants: client, IT architects, project manager, test team leader, representative from the service delivery center (managed operations), lead application developers

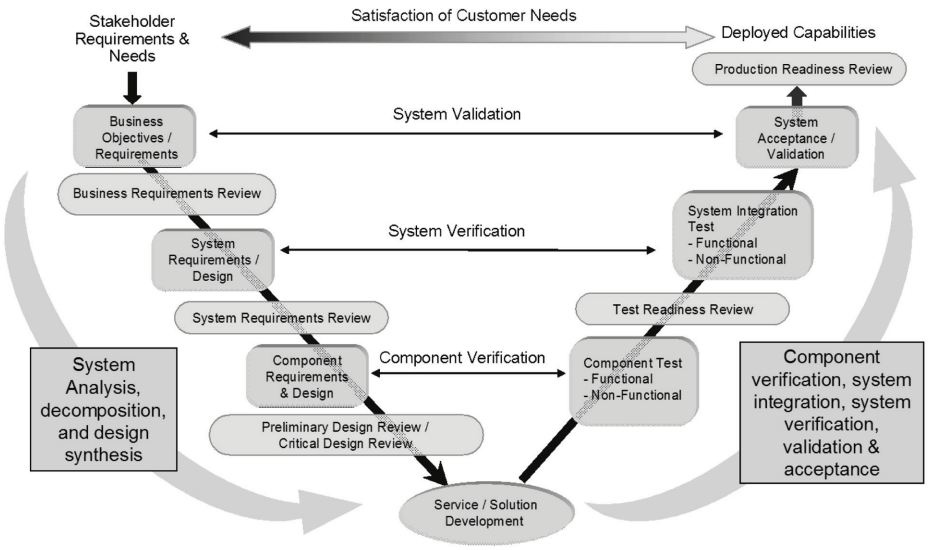
Figure 4 shows the different reviews along the full lifecycle of a service development to achieve full traceability.

In addition to the reviews defined by the Systems Engineering Capability Pattern, IBM conducts also end-to-end SME-reviews after a solution is outlined and before it will be proposed to the customer. These reviews look at technical and at delivery risks and issues of the project. They determine how viable the proposed system is, whether it meets the requirements and whether the estimates, the project and the people planned for the project seem to be realistic. The end-to-end reviews will be conducted by experienced subject matter experts (SMEs), who have access to a large knowledge database, checklists and tools to verify the estimation and the solution to be reviewed.

2. Establish a Solution Development Lifecycle Method

Most of the companies developing applications for a specific solution follow a solution development lifecycle method provided by their company, demanded by the customer or defined by an outside organization. Depending on the method and practices used by the team and the complexity of the new solution, the team has to develop numerous work products during the life-cycle of the project. A work product is an item used as input or output in any phase of the solution development lifecycle method. It might be a document, a model, a piece of source code or something similar. The work products belong to different domains, depending on the view and purpose of a work product (e.g. business, architecture, infrastructure, management, operations, organizational, etc.) and can

Figure 4. Reviews according IBM's systems engineering capability pattern



be assigned to a practice. A practice is a proven approach to solve one or several commonly recurring problem in a specific area (a practice can be something like use case driven development, requirements management or test management). Compared to a complex method, practices are smaller and can be combined to a set of practices fitting to the specific project needs. For the project team it will be easier to do a selection on practices, rather than on complex methods or by looking on low level work products only.

The method and practices should also provide information about how the different work products should look, how they depend on or interact with each other, who should develop them, who should read them and how they are integrated in the overall process of the software development.

For each project, the lead IT architect and project manager should run an adoption workshop, where they analyze the specific project requirements and decide which overall method, which practice(s) and in each practice, which work products they need for the project and where to integrate them into the overall project plan.

To establish a good quality management it is required that the team follows the selected approach and that the team members know which work product they have to produce and, even more importantly, which additional work products they have to consider.

Therefore, a good quality management should not only focus on formal milestones, but should make sure that the following elements are well-established in the project:

- The team uses a formal method and the method (or practices) is adopted across the project
- The method provides information about
  - purpose and structure of a specific work product (e.g. provides templates)
  - the writers and readers of a work product
  - the dependencies between the different work products
  - the overall process (where and when a work product is used)
  - guidelines and checklists about defining the work product
  - examples (reuse as much as possible)
- The team is skilled in writing and especially in using the work products
- All impacted work products are updated when required
- There is auditability and traceability for the work products (e.g. from requirements to design elements, from test back to requirements, etc.). Specific baselines are defined at major milestones (e.g. end of requirement phase) to establish the traceability and to avoid moving targets
- Where possible, a formal tool is used to develop most of the work products (e.g. create requirements in a requirement tool, model UML-diagrams in an architecture tool and link test artifacts to both from another tool of the same tool suite)

For a smooth transition and a good maintenance, an IT service provider should request the documents created during the project lifecycle. It will help him in understanding the solution, in finding defects and in getting an overall picture about the maturity of the solution. For future enhancements he would need only to update the existing documents instead of rebuilding them. This would improve the overall quality of his IT services management.

3. Establish Early Test Integration and Offer a Test Component as a Service

The third key success factor is the early integration testing in the overall project. IBM established the role of a test architect who is working together with several test SMEs by using a proven test method.

The test method may include the following phases:

1. Plan Test
   - Define the test plan and strategy
   - Discuss and agree on strategy, plan and requirements with client
   - Define the test coverage at a high level
   - Participate in requirement reviews
2. Specify Test
   - Define business scenarios to be used in testing
   - Define high-level test scenarios and test cases
   - Create a requirement traceability and verification matrix
   - Participate in design reviews
3. Build Test
   - Create the detailed test cases and scenarios (best by using a tool)
   - Define test data (request from client) and map them to test cases
   - Setup test scripts to load data and to run specific test cases automatically
   - Establish test environment (request from provider)
   - Prepare the test reporting
   - Perform the test readiness review
4. Run Test
   - Execute the different tests according the plan
   - Document the test results (e.g. within a tool)
   - Report errors and review percentage of test completion
   - Provide test reports
   - Perform re-testing of fixed defects and regression tests
5. Close Test
   - Provide test protocols
   - Perform final user acceptance (support client)

The first phase starts in parallel to or a little after the beginning of the analysis phase and will be performed by the test architect. A deep integration and good teamwork between test architect and solution IT architects, project manager and client helps to specify the right tests, to get sufficient test coverage and to detect defects as early as possible in the project.

The typical phases in the test method should be combined with a good tool set, templates and guidelines which the test team should reuse in each new service development. The key challenge for the IT service provider would be to establish a generic test process and environment. If this is only done for a small number of services, then typically the costs outweigh the benefits of the test infrastructure. If the service provider is responsible for a larger amount of services, if he even has to develop new solutions or if he is supporting other projects which are developing new solutions he should offer a 'test component' as a service.

Depending on the service provider, this test component may include the following:

- Support in one or all five test phases by providing test architects and test SMEs
- Conduct reviews for all different test phases
- Provide a test environment (several systems depending on the test scope: systems for development, integration, system test, performance test, user acceptance test, etc.)
- Provide a test tool suite for defining tests, reporting, test automation, etc.
- Run and manage the test tool suite
- Run the tests

In providing the test component the service provider will get involved in new services at a very early stage. This gives him the additional benefit that the test team can build up the required skill for running and maintaining the service after start of production without the need of an intensive learning curve.

Delivery Excellence Initiatives

Delivery Excellence also covers initiatives aiming at improving delivery capabilities on a broader level. The definition of DE initiatives can either be influenced by looking backwards at common DE issues and their root causes or by looking forward and refining the existing DE approach to stabilize or further improve DE KPIs. Typical examples of DE initiatives deal with methods, tools, deployment and training.

An example of a past DE initiative is the deployment of IBM's strategic Project Management Tool and key enabler in the transition to an enterprise project management environment. It provides a web-enabled, common repository that supports key project and portfolio management activities, respectively to all major stakeholders. The deployment included tool training for practitioners along with an awareness training of the strategic context, project support/help desk and progress monitoring of the usage.

Another example was the development and deployment of tools to support project managers and IT architects in capturing and consolidating actual project efforts in a structured and standardized way to construct an estimating database. This made actual effort data generally available as a sanity check for estimates of subsequent projects of similar nature. This DE initiative also shows that DE is not limited to Business Management of the CBM map, but also covers other competencies such as Information and Knowledge.

Other DE initiatives dealt with the collection and deployment of lessons learnt results from projects with the involvement of global delivery centers, training and support material for project managers and engagement owner on the prevention of typical issues generated during the sales and launch of a project.

KEY DRIVERS FOR A SUCCESSFUL QUALITY MANAGEMENT IMPLEMENTATION

The key factor for a successful quality management at IBM is the consistent and seamless implementation across all levels of the business and the organization starting with a clear strategy and followed by appropriate planning and control and focused execution. In support of IBM's goals of delivering client value and enabling profitable growth, IBM has analyzed its business according to the CBM Model and established a strong delivery excellence management system for portfolio planning and controlling purposes. IBM has developed a set of methods and tools that includes worldwide and long-lasting experiences derived from many different types of projects. The focus is on anticipating problems before they occur and thus on acting proactively. Projects are delivered by experienced and trained people; lessons learnt are continuously collected and fed back to processes and for methods and tools enhancements.

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KEY TERMS AND DEFINITIONS

CBM: The Component Business Model™, including the company specific evaluation criteria and hot components is usually used by the senior management to have a one-page overview of their organization and the related issues. It will be used for defining strategic decisions and to focus on the right components regarding effort and expected value.

Delivery Excellence (DE): Intends to minimize profit leakage and close the gap between pricing cases and actual and forecasted profit. DE focuses on both life cycle (project view) and quarter (finance view) performance.

Enterprise Project Management: Management approach that applies project management disciplines to the management of all functions of an organization. An Enterprise project management solution includes a project based infrastructure (methods, tools, processes), skilled and experienced project management professionals, and the use of project management disciplines in the day-to-day management of the business.

IBM Worldwide Project Management Method (WWPMM): Consistent project management method for use by all project management professionals at IBM. WWPMM describes how to shape and plan a project, and then manage its execution.

Indicative Predictive Framework: Set of indicators for financial life cycle and quarter performance.

Project Health: Classifies the status of a project in categories from A (under control) to D (troubled) in terms of the key aspects that relate to a successful implementation such as scope, schedule, stakeholders and business benefits.

Seven Keys to Success®: Framework to proactively assess, monitor and manage project health.

Chapter 5
Comparison and Integration of IT Governance Frameworks to Support IT Management

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ABSTRACT

Recent years have seen an unprecedented consolidation of best practice know-how in various areas of IT management. With it came a certain popularity of standards and reference models (COBIT, ITIL, CMMI, ISO/IEC 27000 family etc.) commonly classified as frameworks for IT governance. Each of these frameworks aims to support certain parts of IT management with best practice knowledge and enhances the quality of the delivered IT Services. But now we are facing a situation characterised by an abundance of these IT governance frameworks. In particular their combined or parallel usage increasingly creates redundancies and issues of complexity. To organise an efficient interaction between frameworks and to cope with their heterogeneity; e.g. in process semantics and description techniques; the application of these frameworks has become a lively issue of research. In this contribution the authors will reflect on the state of the art in comparing and integrating IT governance frameworks, analyse pros and cons of various approaches, and present their own approach based on metamodelling. The authors consider metamodelling a promising approach to close the gap between high-level comparison and detailed mapping as it allows an identification of redundancies and incoherent semantics on a framework-independent level. Promising an increasing return on investment, harmonisation is an important topic within IT departments (Siviy et al., 2007). This approach is a first step toward an integrated and harmonised handling of the meanwhile mandatory frameworks for IT management.

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INTRODUCTION

The recent past has seen the appearance of a wide variety of standards, best practice frameworks, reference models, and proprietary methods (hereafter collectively named frameworks) dedicated to the support of IT governance. The frameworks are typically aimed at improving e.g. IT alignment, compliance, service management, process quality, and security management (Johannsen & Goeken, 2007). Well-known examples of frameworks are COBIT (Control Objectives for IT and related technology), ITIL (IT Infrastructure Library), CMMI (Capability Maturity Model Integration) and the ISO/IEC 27000 family of standards for security management. With ISO/IEC 38500, a specific standard for "Corporate Governance of Information Technology" is currently being specified.

While the implementation and application of a single framework already creates significant efforts in operative business environments (or governmental institutions), the usage of multiple models usually constitutes strong concerns regarding complexity, redundancies of functions, and total costs of ownership. The current situation is characterised firstly by a steep growth of acceptance of these frameworks and secondly by increasing investments in the implementation of frameworks in operations. The reasons for applying frameworks may be based on issues of conformance (compliance to rules and regulations) or performance (gaining optimal efficiency and effectiveness that is IT alignment) or both.

Given the degree of heterogeneity of best practice groups and standardisation bodies producing frameworks, the need for analysing those with respect to the coverage of functions, redundancies of functions and activities and inconsistencies of functions becomes obvious. This holds also for analysing integration options of multiple frameworks in the same environment. In the following we will give an overview of our work regarding analysis, comparison, and integration of frameworks. The presented approach is the foundation of a management-oriented project within the field of IT governance. This ongoing project aims to support management in order to raise the challenges of the multimodel environment and increases return of IT investment.

EMERGENCE OF MULTIMODEL ENVIRONMENTS

Companies are exposed to the coexistence of several frameworks, which are used in parallel or partially to support the different tasks of an IT department. The frameworks increasingly show overlapping areas with respect to their functions and application areas although they focus on different purposes. COBIT for example is commonly used by auditors and accountants (ITGI, 2007a & 2006a) whereas IT developers often use CMMI however COBIT includes a maturity model (SEI, 2007). IT operations although it could be ITIL focused may however cover business value issues addressed also by COBIT (OGC, 2000 & 2007). The supervised and controlled combination and integration is a precondition for an effective usage and the disposal of the disadvantages of each individual framework.

The multimodel environment (Siviy et al., 2008) creates a significant challenge for companies' IT departments as (1) partial or customized frameworks and/or (2) their usage in parallel will trigger the inherit complexity of applying frameworks and the cost of covering overlapping and redundant application fields to soar and application costs to rise. Thus a satisfactory cost/benefit ratio in a multimodel environment may hard to gain.

In recognition of these developments, our approach consists of two parts analysis (I) and reduction of overall complexity (II):

- Situation analysis: We investigate why companies (1) may use only parts of frameworks and (2) why they tend to apply

a multiple of frameworks in parallel and what obstacles they have to overcome by doing so.
- Complexity reduction: We propose (1) to compare and (2) to integrate IT governance frameworks according to requirements in question.

Ad I.1 Frameworks as e.g. COBIT, ITIL or ISO 27000 all have a potentially deep impact on to a company's process architecture and process operations. The partial use of frameworks reflects the reluctance of companies to accept the costs caused by the amount of change going along with an implementation. A pragmatic approach to avoid these drawbacks is 'cherry picking" i.e. trying to select only those parts fitting to specific requirements as e.g. strategic planning, service level management or sourcing.

Ad I.2 We identified three main reasons leading to the application of multiple frameworks in parallel.

The first reason for the simultaneous use of frameworks is the growth of the field of potential application of each model. We recognize that the latest versions of several models are more holistic than their predecessors. A good example is ITIL V3 when being compared to ITIL V2. The focus of ITIL in its new version is the integration of IT into business, assuring the delivery of business value and the treatment of services as business assets. At its core, ITIL V3 covers a much broader angle than V2, and it adds service strategy and service lifecycles into the mix to better fit more mature IT organisations. Where the previous ITIL framework focused primarily on processes, V3 now revolves around services and has more emphasis placed on strategy and operations management. As a result, support and delivery processes are now divided over the lifecycles of service design, transition, and operations. From the viewpoint of an enterprise this means an overlapping between formerly separate models occurs. Consequently a more simultaneous use is to be enforced.

A second reason might be the tighter integration of business units or different departments within IT as e.g. the better integration between IT operations and system development. The integration may support units using different frameworks by aligning processes, e.g. if a system is developed with an approach supported by CMMI and will afterwards operate in an environment, dominated by ITIL. However, interdisciplinary teams acquainted to different frameworks need to speak the same "language" to work together.

The third motivation for multimodel environments is linked to the second reason. The companies' stakeholders maintain a natural preference to the model closest to their specific expertise and viewpoints. For example systems engineers typically prefer to work with CMMI whereas IT operations may stick to ITIL and the IT auditor most efficiently works with COBIT.

Ad II Considerations of reasons listed above for applying multiple frameworks or a set of partial implemented frameworks obviously lead to a suboptimal leverage of the models capabilities and potentially high redundancies in multimodel cases. This in turn may destroy the overall business cases of applying frameworks and thus discredit their usage.

Ad II.1 Frameworks for IT governance obviously are covering overlapping aspects of companies IT as e.g. process management, performance, alignment, value contribution.

Before these redundancies, which are potentially the cause for significant inefficiencies, can be eliminated, they have to be identified properly. In the following we will propose an approach to systematically compare frameworks in order to identify redundant aspects and semantics. Beside redundancies, gaps of functionality have to be identified in order to understand how the limits of the framework will result in uncovered functional areas.

Ad II.2 To improve efficiency and gain a better benefits/cost ratio as a result of applying frameworks in multimodel mode we - as second

step - will introduce an approach to integrate frameworks. Integration will create an environment where frameworks are able to be operated in parallel however without overlapping aspects and semantics, and thus by reducing complexity and avoiding efforts for coordination.

The remainder of this chapter is dedicated to the state of the art in comparing frameworks, our viewpoint on this and on our approach of modelling, mapping and integrating frameworks by taking an approach based on metamodelling.

APPROACHES TO COMPARE AND INTEGRATE IT GOVERNANCE FRAMEWORKS

For comparison and integration of IT governance frameworks we will introduce a widely feasible approach, however restricting ourselves to a limited set of frameworks. Actually we mainly focus on COBIT, ITIL, Val IT and CMMI. COBIT we are going to position as an anchor allowing us to leverage the well structured "architecture" of IT processes as part of COBITs self-contained scope.

COBIT can basically be considered holistic and representative of (nearly) all tasks and processes an IT organisation should carry out. As a sort of drawback we have to be aware of the fact that COBIT intentionally only proposes THAT certain control objectives will be met by IT processes. However it does not state HOW the means of doing so should be implemented and used. ITIL on the other hand also contains HOW processes have to be executed - not just the fact that they have to be done at all. ITIL however focuses more on "running" IT – that is, providing and managing services - than on managing and controlling it. As a third example, CMMI focuses on quality and sets up priority on systems' development. The CMMI framework is – like COBIT – well structured and coherent.

By considering this significant degree of heterogeneity of frameworks respectively available goals and documentation an approach to compare them contributes to a better understanding and more efficient usage. Comparing and integrating the frameworks, of course, may be done in different ways. In the following two paragraphs two basic approaches will be outlined on a high level and in detail, comparing framework, i.e. the multi criteria comparison and mapping of functions.

Multi Criteria Comparison

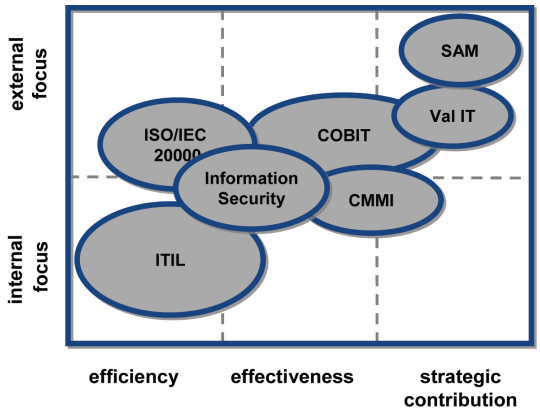
The first step to integrate frameworks is to analyse and compare them. In this chapter, different ways to compare models will be presented by using criteria and their characteristic value.

As a start we will take quite a high-level view. The matrix in Figure 1 shows an example for the classification of different frameworks within the categories *focus* (external and internal perspective) and *efficiency, effectiveness* and *strategic contribution*.

"Internal focus" means that the framework mainly addresses aspects referring to the activities and functions of the IT department itself. "External focus", in contrast, addresses the business orientation of the framework, e.g. by bridging the gap between business and IT.

While COBIT and even more so Val IT (ITGI, 2006b) strongly relate to the strategies of business

Figure 1. High-level classification of frameworks



and IT, maintaining a viewpoint to the company from an external market position, ITIL is dedicated to efficient operations of services and focuses more internally to a company's infrastructural aspects. Similar to the related ITIL, ISO/IEC 20000 is also dedicated to efficient services. Different to ITIL V2, the new ITIL version V3 moves closer to the centre of the figure. Information Security (ISO/IEC 2700v family of standards) are just in the middle and concerned with effective security i.e. the strategy and - quite naturally - have a focus on both internal and external aspects equally.

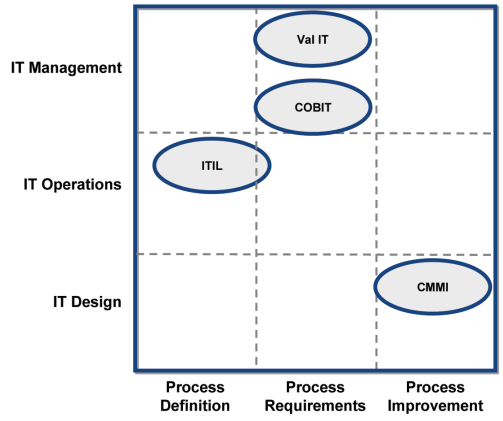
Another way to compare the frameworks is proposed by Dohle & Rühling (2006). The two dimensions are composed of the main responsibilities of the IT department and the main intended use (Figure 2):

Responsibility: The vertical axis of the matrix is composed of the area of responsibility of the IT department. Here, management IT as a whole is distinguished from development of new systems as well as the operative business: *IT management*, *IT operations* and *IT design*.

Purpose: The horizontal axis describes the main intended use of the framework.

Further, they distinguish *process definition* (the purpose of a model is to define IT processes) from *process requirement* (requirements a process has to fulfil are defined, e.g. metrics for process performance) and *process improvement* (the framework supports the improvement of processes).

Figure 2. Positioning of frameworks (Adapted from Dohle & Rühling (2006))



While the classifications above (Figure 1, Figure 2) allow a high-level illustration of IT governance framework according to their purpose, they do not provide insights into potential overlapping of functions and activities. But these classifications help to characterise the subject area of a framework in general, allowing a rough orientation. However, they are too limited to further analyse the interdependencies of the frameworks and thus to draw conclusions for a combined application.

More detailed comparisons can be made by applying lists of criteria. Walter & Krcmar (2006) compare "frameworks for service management" to "frameworks for the management of software development" by usage of a list of criteria. Criteria are subject areas such as duties of the IT operation and software development. The lists have been derived from the phases of the software life cycle, which again is mapped to the process structure of the ITIL core (Service Support and Service Delivery) and supplemented with the contents of other ITIL books and further relevant tasks of software development. Figure 3 illustrates the degree of coverage of various frameworks. Intersections are indicated by check marks.

Thus, compared to the matrices, more detailed information on the certain subject area can be obtained. Interestingly, the observation by Walter & Krcmar (2006) is not limited to software and system support but also includes models and methods of system development. However, it should be critically noted that the list of criteria does not address a range of topics which covers IT governance. Thus, business-like criteria such as value-based management of the IT and IT alignment are missing.

Hochstein & Hunziker (2003) characterise and compare frameworks by using an extended list of criteria derived from the goals and expectations of the framework usage. They distinguish between formal and pragmatic criteria. The former affect

Figure 3. Criteria-based comparison of frameworks (Freely adapted from Walter & Krcmar (2006))

Life Cycle Phases	Software Development										IT Service Management															
Process	Project Management	Quality Management	Risk Management	Partner Management	Standard Software Selection	Business Process Modelling	Requirements Management	Architecture Management	Implementation	Test Management	Business Perspective	Service Desk	Incident Management	Problem Management	Configuration Management	Change Management	Release Management	Service Level Management	Financial Management	Capacity Management	ITS Continuity Mmt	Availability Management	Security Management	ICT Infrastructure Management	Software Asset Management	Plan to Impl. Sercv. Management
COBIT	x	x	x	x	x		x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x
Val IT					x						x						x		x							
ITIL				(X)			(X)			(X)	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
ISO 20000 / BS 150001				x							x		x	x	x	x	x	x	x	x	x	x	x			x
ISO/IEC 27000													x	x									x			
CMMI	x		x	x	x		x	x	x	x				x	x	x	x									
MOF			x	x								x	x	x	x	x	x	x	x	x	x	x	x	x		
eTOM				x									x	x	x	x	x	x	x	x	x	x	x	x		
MSF	x		x				x	x	x	x							x				(X)					
RUP	x					x	x	x	x	x					x	x	x									
V Modell XT	x	x		x	x		x	(X)	x	x				x	x	x	(X)						x			

the components and the structure of the framework, the latter refer to criteria which are mainly relevant for the application in practice.

Compared to the list of applications by Walter & Krcmar (2006), the defined requirements build a more general grid, which addresses more the structural aspects rather than specific contents. Figure 4 and Figure 5 show the approach by Hochstein & Hunziker (2003). We have adjusted it to COBIT 4.1.

The criteria-based comparison by Hochstein & Hunziker (2003) offers a rather high-level evaluation grid with two sets of characteristics, i.e. formal criteria and pragmatic criteria, comprising three indicators each (yes/evidence/no and high/medium/low). As no specific model content is addressed, the criteria do not allow comparison of frameworks on a functional content-specific level. For the classification by Walter/Krcmar, these generic criteria - from our point of view - offer a good complement as the frameworks are highlighted from a different perspective.

The outlined approaches by Hochstein & Hunziker (2003) and Walter & Krcmar (2006) provide a fairly good differentiation of frameworks on a high level, however failing to compare frameworks on the level of functions and activities. In order to overcome this restriction, we will apply metamodelling as a description method and compare modelled processes stepwise in the following.

Mapping of Frameworks

The second approach of comparing and later mapping frameworks is - in contrast to the criteria-based approach outlined above - based on comparing the specification of components, i.e. functions/processes the frameworks provide.

Figure 4. Criteria used by Hochstein & Hunziker (Freely adapted from Hochstein & Hunziker (2003))

Formal Criteria		
1	Goals	There are clearly defined process goals.
2	Level of Detail	Components of the frameworks are described adequate (i.e. activities for each process).
3	End-to-End	The framework is holistic and includes all relevant tasks.
4	Consistency	The framework has a coherent structure.
5	I/O-Schema	The relations between process and activity are describes with inputs and outputs.
6	Roles/Responsibilities	Roles and responsibilities are clearly defined.
7	Tools	The frameworks include management instruments and tools for methodological support.
Pragmatic Criteria		
8	Success Factors	Success factors of processes and activities are described.
9	Ratios (Effectiveness)	Ratios to measure effectiveness are proposed.
10	Ratios (Efficiency)	Ratios to measure efficiency are proposed.
11	Implementation Guide	The framework includes hints for the implementation i.e. per maturity models.
12	Clarity/Simplicity	Clarity/Simplicity according to comprehensibility for users and business people.
13	Flexibility	The framework can be adjusted depending to the situation.
14	Enhancements	Institutions and resources for enhancements of the model are in place.
15	Pervasiveness/Utilisation	The framework has a high level of acceptance

Editing organisations respectively the owner of frameworks, such as ISACA/ITGI, OGC and itSMF have taken efforts not only to compare different frameworks, but to correlate them. In "Aligning COBIT, ITIL and ISO 17799 for Business Benefit" (ITGI, 2005), the mentioned organisations attend to the question of how well COBIT, ITIL and ISO 17799 harmonise and how

Figure 5. Criteria-based comparison of Hochstein & Hunziker (Adapted from Hochstein & Hunziker (2003))

		Public Domain		Non Public Domain	
Formal Criteria		ITIL	COBIT 4.1	IBM ITPM	HP ITSM
1	Goals	Yes	Yes	Yes	Yes
2	Level of Detail	High	High	High	High
3	End-to-End	Yes	Yes	Yes	Yes
4	Consistency	No	Yes	Yes	Yes
5	I/O-Schema	Evidence	No	Yes	Yes
6	Roles/Responsibilities	Yes	Evidence	Yes	Yes
7	Tools	Yes	No	Yes	Yes
Pragmatic Criteria					
8	Success Factors	Evidence	Yes	No	No
9	Ratios (Effectiveness)	Evidence	Yes	No	No
10	Ratios (Efficiency)	No	Yes	No	No
11	Implementation Guide	Yes	Yes	Yes	Yes
12	Clarity/Simplicity	No	Yes	Yes	Yes
13	Flexibility	Yes	Yes	Yes	Yes
14	Enhancements	Yes	Yes	Yes	Yes
15	Pervasiveness/Utilisation	High	Medium	Medium	Medium

they can be used jointly. "The intention is to explain to business users and senior management the value of IT best practices and how harmonisation, implementation and integration of best practices may be made easier" (ITGI, 2005, p. 7).

In this study, five basic principles, which are seen as the precondition for a successful implementation, are given (ITGI, 2005):

1. Tailoring
   The frameworks have to be tailored to the specific needs of an organisation.
2. Prioritising
   Organisations have to fix priorities and define where, how, and for which aim the frameworks are used. Furthermore, management support has to be assured as well as the fact that IT governance issues have to be discussed and decided on the highest firm level.
3. Planning
   The planning of the implementation includes organisational questions, raising and analysis of risks, development and implementation of measures of improvement as well as preparation of the measuring of achievements.
4. Avoiding pitfalls
   Here, it is recommended to follow the pragmatic management rules, e.g. the implementation of the governance initiative in the organisation as a project (beginning, end, milestones, etc.), to follow the change management, the management of expectations, etc.
5. Alignment of Best Practices
   The last principle recommends the common and integrated usage of different best practice models, ITIL, ISO 17799 and COBIT.

In the following we will show some examples of different mapping initiatives and present their methodology.

Example: "Aligning COBIT, ITIL and ISO 17799 for Business Benefit" (ITGI, 2005)

The aforementioned study "Aligning COBIT, ITIL and ISO 17799 for Business Benefit" (ITGI, 2005) published in 2005 still refers to COBIT 3.0, which is the predecessor model of the actual COBIT 4.1. Even if this restricts the practical relevance, the study is still interesting because of the method used, as the relations between the models are established on a detailed level.

The integration of the models occurs in two directions: On the one hand, relevant so-called "supporting details" of ITIL and ISO 17799 are assigned to the COBIT control objectives. Thus, the COBIT component control objectives serve as a reference point of the integration. For example, paragraph "5.2 Requirements" in the ITIL book "Application Management" is assigned to the detailed control objective PO2.4 in "PO2 Define the Information Architecture". Bold print of details from other models (as in Figure 6 in column "ISO 17799") refers to the standard being superior to the related objectives in COBIT. Therefore, it has to be preferred, should the models be implemented at the same time. In this respect it is not surprising if ISO 17799 compared to COBIT is considered the superior model when it comes to security aspects.

On the other hand, the study relates COBIT to ITIL. Here, the ITIL contents ("supporting details") serve as basic reference points (see Figure 7). The other column provides reference to COBIT's high-level control objectives (e.g. AI1) and detailed control objectives can be found.

However, it is not clear how these contents and the "supporting details" have been extracted from the ITIL documents, as no list with the assignments named in Figure 7 in the left column is provided by the ITIL document "Application Management". Insofar, no real mapping on ITIL components is available which is due to ITIL not featuring a similar clear and constant structure in reference to COBIT.

Figure 6. Mapping ISO 17799 and ITIL to COBIT (Adapted from ITGI (2005))

COBIT Domain: Plan and Organise
PO2 Define the Information Architecture

Defining the information architecture satisfies the business requirement of optimising the organisation of the information systems. It is enabled by creating and maintaining a business information model and ensuring that appropriate systems are defined to optimise the use of this information.

COBIT Control Objective	Key Areas	ITIL Supporting Information	ISO 17799 Supporting Information
PO2.1 Information architecture model	Information needs analysis information architecture model maintaine, corporate data model and Plans	*ICT Infrastructure Management,* Annex 2B, The Contents of ICT Policies, Strategies, Architectures	10.1 Security requirements of systems
PO2.2 Corporate data dictionary and data syntax rules	Corporate data dictionary		
PO2.3 Data classification scheme	Information classes, ownership, access rules		**5.2 Information classification**
PO2.4 Security levels	Security levels for each information class	Applications Management, The Application Management Lifecycle, 5.2 Requirements	**5.2 Information classification** 4.1 Information security infrastructure 5.1 Accountability for assets 8.6 Media handling and security 9.1 Business requirement for access control

Due to the differing and, to some extent, missing structure of the frameworks and standards it is difficult to define mapping-relations. In Figure 6 it becomes apparent that control objectives from COBIT can only be related to activities, processes, or entire chapters of the ITIL document in a fairly diffuse way.

Example: The Integration Project COBIT Mapping

Currently ISACA - as the owner of COBIT - is undertaking further efforts to compare and integrate frameworks. The goal is described as the following:

"Although many of these questions can be addressed using the openly available COBIT guidance, several have remained unresolved until now. This project addresses the gaps by mapping the most important and commonly used standards to the COBIT process and control objectives" (ITGI, 2007b).

In this project ISACA follows top-down integration, using COBIT, which has been edited by them, as a reference point for integration (ITGI, 2006c). This seems reasonable because COBIT effectively constitutes the top of the hierarchy of the IT governance frameworks due to its business-oriented perspective.

Figure 7. Mapping COBIT and ITIL

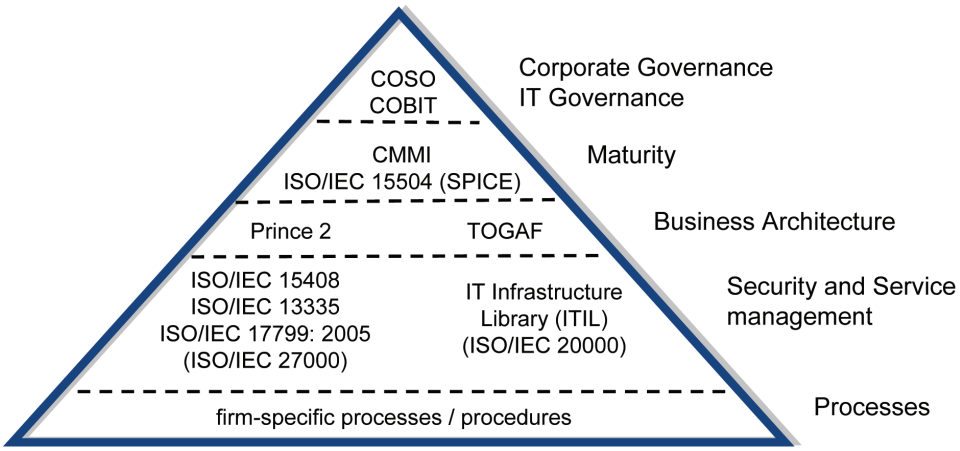
4. Application Management			
Develop models that demonstrate business and IS strategic alignment	PO2	PO2.1	Information architecture model
Assess IT capabilities	PO6	PO6.4	Policy implementation resources
Ascertain the delivery strategy	AI1	AI1.2	Formulation of alternative courses of action
Align delivery strategy with business drivers and organisational capabilities	AI1	AI1.3	Formulation of acquisition strategy
Prepare to deliver	AI1	AI1.13	Procurement control
Determine application life cycle	AI2	AI2.1	Design methods
Align application management and service management	AI2	AI2.13	Availability as a key design factor
Plan deployment	AI5	AI5.3	Implementation plan
Plan handover and support	AI5	AI5.3	Implementation plan
Review application portfolio	AI2	AI2.17	Reassessment of system design
5. Service Level Management			
Undertake service planning	DS1	DS1.2	Aspects of service level agreements
Produce service catalogue	DS1	DS1.1	Service level agreement framework
Establish service level requirements	DS1	DS1.2	Aspects of service level agreements
Negotiate SLAs	DS1	DS1.1	Service level agreement framework
Manage customer expectations	DS8	DS8.1	Help desk

The business perspective of COBIT regarding IT is not an isolated one, but is maintained in context of the market and customer oriented activities of a company and its business processes respectively. It therefore underlines the business orientation of IT and its supportive role. The rather operative assignments in conjunction with the operational IT are covered by a range of further frameworks, which are subordinate hierarchically by COBIT (see Figure 8).

At present there are two sorts of documents in which project results are publicised:

- A high-level overview document (COBIT Mapping: Overview of International IT Guidance, 2nd Edition (ITGI, 2006c)).

Figure 8. Top-down framework integration (Adapted from ITGI (2006c))



- A multitude of detailed mapping documents each of which deals with a single framework and its reference to COBIT (i.e. Mapping of ITIL with COBIT (ITGI, 2007b)).

High-Level Mapping

In addition to the characterisation of the models, their relation to COBIT is described. This happens on a process level by identifying those COBIT IT processes/control objectives, which the particular framework addresses in its content. In Figure 9 the mapping in the case of ITIL is indicated by the darkly framed COBIT IT processes. High-level mapping also contains illustrations of the particular relations between ITIL and COBIT. First of all the particular framework (ITIL) will be decomposed into so-called "information requirements". An information requirement is defined as a piece of information from the source document that can be mapped to a control objective of COBIT. It is about sections or information modules from the frameworks which shall be mapped to COBIT.

A significant match (+) means that more than 30 requirements were mapped to a COBIT process. A minor match (o) is between 15 and 29 information requirements and if fewer than 15 requirements were mapped it is called an unrelated focus (-). The grey fields in Figure 10 represent that a related COBIT IT process does not exist. For example, the minor match (0) between ITIL and PO5 is justified with the reason that parts of the ITIL process finance management are comprised in "PO5 Management of IT Investments". A significant match (+) from ITIL to AI6 (Acquire and Implement 6 Change Management) is due to ITIL strongly addressing change management. In total, 35 information requirements can be assigned to the AI6. The nearly continuous strong relations of ITIL to the processes of the domain "deliver and support" are due to the books "Service Support" and "Service Delivery" having their main focus on this topic.

Detailed Mapping

As mentioned above in addition to the overview model, there are various single documents for the detailed mapping of the different frameworks in COBIT.

For comparison, the following steps for each framework are carried out:

1. First of all the particular framework will be decomposed into the aforementioned information requirements.

Figure 9. Relationship between COBIT and ITIL processes

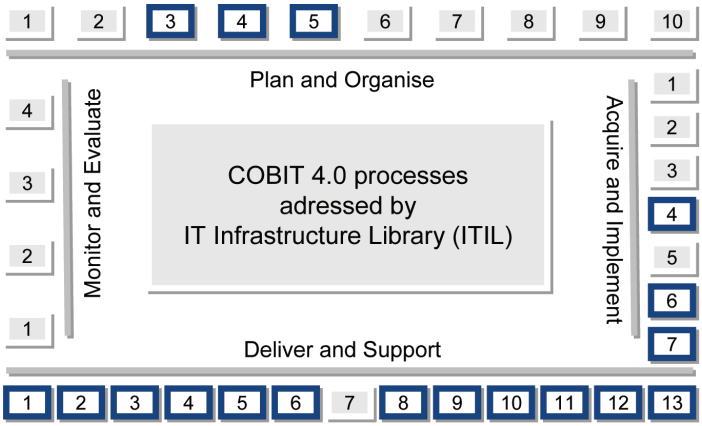


Figure 10. High-level mapping ITIL and COBIT

COBIT Processes \ Domains	1	2	3	4	5	6	7	8	9	10	11	12	13
Plan and Organise	-	-	-	-	o	-	-	-	-	-			
Acquire and Implement	-	-	-	-	-	+	+						
Deliver and Support	+	o	+	+	--	+	-	+	+	+	-	-	-
Monitor and Evaluate	-	-	-	-									

2. The information requirements are mapped to the COBIT control objectives. For example, for the COBIT ITIL mapping the following ways are distinguished:
   a) A 1-to-1 mapping was done for information requirements that fit a single control objective
   b) A 1-to-n mapping was done for information requirements that fit more than one control objective.
   c) If the information requirement covers a complete COBIT process, it was mapped to the respective COBIT process (control objective)
   d) If a, b and c have failed, COBIT does not cover the requirement of these specific information requirements. The most appropriate process has been selected and the information requirement has been mapped to control objective 99 (not existing) of the process.
3. The requirements described by the information requirements were detailed (for our example detailed from ITIL) and the result was sorted as defined by the COBIT framework.

The detailed mappings describe the relation between COBIT and other frameworks more specifically. This comes about by the mention of the information requirements and due to the reference to each position in ITIL. COBIT itself is no longer observed on the level of IT processes but the detailed control objectives are consulted. The relations are substantiated by indicating whether the descriptions in ITIL reach beyond the ones in COBIT (E, exceed), are congruent with them (C, complete coverage), partly address (A, some aspects addressed) or do not address at all (N/A, not addressed). Thus, for the ITIL sections from the book "Service Delivery (SD)" (subsection release management) 9.6.1 Release Planning, 9.6.3 Communication, preparation and training, it is observed that they partly address the objectives described in AI4.2 (knowledge transfer to business management) (see Figure 11). With the help of tables, relatively detailed sections from ITIL are assigned to COBIT. In this respect this mapping demonstrates a substantial profit for the parallel application of ITIL and COBIT.

The mapping according to the introduced constant scheme also eases the comparison of the different frameworks and their selection for certain functions and sub areas.

The hitherto existent mapping approaches among COBIT, ITIL, and ISO 17799 have mainly emerged from the COBIT perspective. It is reasonable to start the integration with COBIT being the reference point. Therewith, the dominance is definite from a business perspective.

Here the question of what will be lost if COBIT is consulted as a reference point for the integration emerges. As a result the different models would not be able to show their full specific potential and competitive advantages – which might even exceed COBIT.

Figure 11. Detailed mapping of ITIL and COBIT

COBIT 4.1 Control Objective		ITIL	
		Coverage	Requirements
AI3	**Acquire and maintain technology infrastructure.**	A	SS-Relation 2.13
AI3.1	Technological infrastructure acquisition plan	A	SS-Relation 2.13 SD-Relation 2.12
AI3.2	Infrastructure resource protection and availability	N/A	
AI3.3	Infrastructure maintenance	A	SD-AvaMgmt 8.2.3 SD-AvaMgmt 8.5.3
AI3.4	Feasibility test environment	N/A	
AI4	**Enable operation and use**	A	
AI4.1	Planning for operational solutions	N/A	
AI4.2	Knowledge transfer to business management	A	SD-RelMgmt 9.6.1 SD-RelMgmt 9.6.3 SD-RelMgmt 9.6.4 SD-RelMgmt 9.6.5

Furthermore, the question of how the information requirements are achieved remains open. E.g., there is no basic determination as to what granularity is suitable, since the size of the assigned sections varies considerably. Furthermore it should be mentioned that these mappings only compare control objectives, disregarding other components such as metrics or roles. But if a holistic integration is the goal, integration of these, and further elements of the frameworks, should be considered as well.

These approaches are especially useful for cases of application in which a "greenfield"-implementation is considered. This is due to the hierarchy of the framework that have been described above. In such situations the desired governance structures can be planned top-down based on business needs. In cases in which frameworks are already in use, there are mappings missing, which start from the lower levels of hierarchy. Therefore, a considerable amount of research and development still has to be performed until frameworks can be established as integrated best practice method.

In this context we would mention a German initiative of ISACA Germany Chapter and itSMF (ITSMF & ISACA, 2008). In a fairly detailed approach they tried to combine various mapping methods. In essence, mapping is done by focusing on a set of attributes rather than a single one:

- roles and responsibilities,
- processes,
- keys performance indicators (KPI) and metrics.

This undertaking results in a very detailed work of more than 500 pages.

A drawback is the overwhelming complexity of data usable only for e.g. completeness checking of an integration approach but however not for planning purposes.

INTEGRATION WITH CONCEPTUAL METAMODELS

As at one hand a comparison based on lists of high-level criteria is not sufficient detailed to detect

overlapping or incoherent areas of frameworks and on the other hand the mapping of frameworks' components leads to a level of detail with little practical use in integration planning situations (however of greater use in integration itself), we propose a third way to close the gap in-between.

We aim at becoming able to model frameworks with a methodology that will support multiple capabilities:

- Identify overlapping areas in solution spaces of frameworks
- Identify missing areas i.e. "empty spots" not covered by a combination of individual frameworks applied in parallel as e.g. COBIT and CMMI in the area of application software development
- Identify incoherent approaches of frameworks used in combination however addressing same issues differently as e.g. COBIT and ITIL in value management
- Creation of subsets of frameworks in order to create issue-adequate solutions of combined subsets as e.g. subsets of COBIT, ITIL and ISO 2700x for improving service delivery.

The proposed way to compare and integrate IT governance frameworks are conceptual metamodels. The simplification of comparison and integration is one of the several advantages accrue from representing IT governance frameworks like COBIT, ITIL or CMMI as conceptual metamodels. From our point of view metamodels can be a helpful support for analysis and further advancement in the research on IT governance frameworks. In the following we will discuss some results of our research and present our metamodel of the COBIT framework.

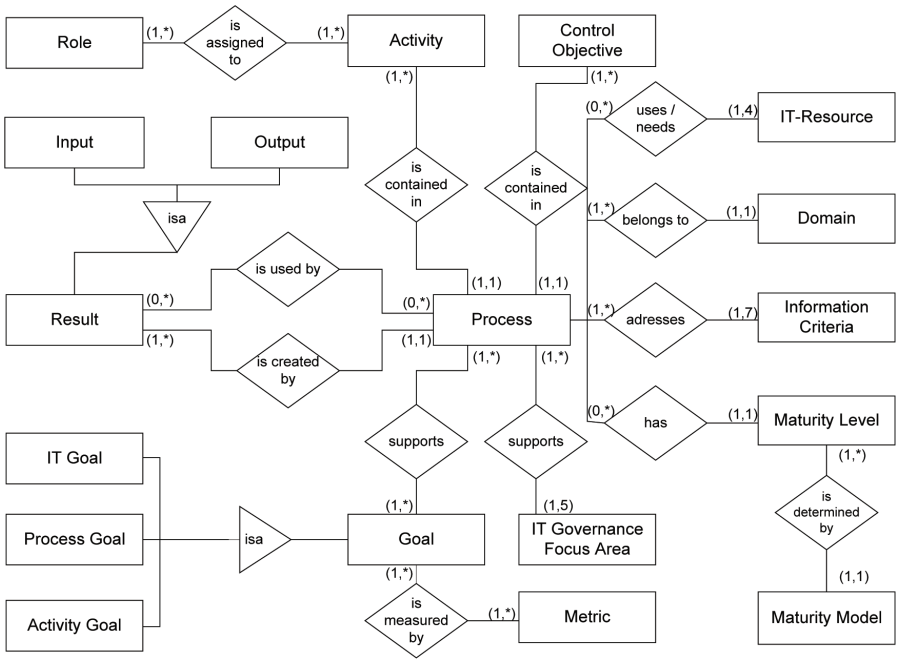
Generally spoken, a metamodel is a model of a model. That means that initially there might be a model, which represents the real world or some part of it. COBIT in this respect is a normative to-be model, which provides best practice for IT governance. The metamodel is the illustration of this model on a next higher level of abstraction. Here we use an abstraction mechanism which extracts the components of the underlying model (ontological metamodelling). This must be distinguished from the most common language abstraction, which is used when the syntax of a modelling language is represented in the metamodel (Strahringer, 1996).

We use the well known ER notation to represent our version of the COBIT metamodel (Figure 12).

In COBIT, 34 *IT processes* are presented which creates one or more *outputs* which vice versa are used as *inputs* in other processes. Input and output are *results*. According to this, the entity type result 'isa' output or input of a process. Typical results on instance level are documents like reports on costs, risks or plans on IT strategy.

Moreover, a *process* consists of *control objectives* which are statements of desired results or purposes to be achieved by implementing control procedures in a particular process. These control procedures should provide 'reasonable assurance', that business objectives will be achieved. Furthermore, a process includes *activities*, which give a detailed description of what is done. These activities are assigned to specific *roles* like the CFO, the CIO, or an architect. Therefore, we link activities to the concept *role*. Each process of the framework has *goals*, which can be divided into *IT goals*, *process goals* and *activity goals*. The goals again are in relationship with each other. Thus, IT goals activate process goals, which in turn end up in activity goals (e.g. IT goals define what the business expects from IT; process goals define what the IT process must deliver to support ITs objectives etc.). Each goal is measured with the aid of different *metrics* (key goal indicators and key performance indicators). Furthermore, a process contains *information criteria*, which are abstract business goals. The information criteria proposed by COBIT are effectiveness, efficiency, confidentiality, availability, compliance and reliability. For every process COBIT states if these

Figure 12. The ontological metamodel of COBIT



criteria are addressed. It is distinguished between a primary and a secondary addressed relationship.

In addition, each process is assigned to one out of four *domains*, which are arranged according to the life cycle. Further components of COBIT are a *maturity model* and *IT resources*. Each process can be assessed by a maturity model to determine its level of maturation. This is the starting point for a continuous process improvement of the process maturity and its controls. In order to achieve results, a process needs the entity type *IT resource*.

Furthermore, each process supports a specific *IT governance focus area*. These IT governance focus areas describe the topics executive management needs to address to govern IT within their enterprises. For each process there is an indication if it addresses the focus area. As above, it is distinguished between a primary and a secondary relationship. Implicit components as the life cycle orientation of COBIT could enter the metamodel as *principles*. However, a principle cannot be dedicated to one single entity type. Implicit basic principles form the framework as a whole on another level.

Finally, each process has the attributes *process code* and *process description*. A unique identifier of the process, the process code consists of the abbreviation of the domain and a number. Figure 12 shows our ontological metamodel of COBIT (Goeken & Alter, 2008b).

The representation as conceptual metamodels allows the analysis and comparison of one or various frameworks on an abstract level. An analysis of the presented metamodel of COBIT may raise questions such as:

- Why are activities related to a role while control objectives are not assigned to a role or a person?
- Why are results not measured by metrics?
- Why are activities and control objectives not directly related?

By use of another metamodel one framework can be checked for completeness. Accordingly,

one can deduce that ITIL – in contrast to COBIT - does not provide metrics and other components for assessment to the extent COBIT does.

We believe that metamodels might be a sound basis for comparison of different frameworks. In a further step, the integration of the frameworks like COBIT, ITIL and CMMI will also be based on conceptual metamodels. This might be important if one framework covers aspects which are missing in another one. E.g. the new developments of the SEI (CMMI for Services; CMMI for Acquisition) can be a complement for COBIT, as acquisition, like outsourcing, is not covered adequately by COBIT. An integration based on metamodels will allow a closer fit and can guide the models amalgamation on a lower (model) level.

CMMI is commonly perceived as a maturity model. COBIT also includes a maturity model. At first glance this component might be a starting point for mapping the frameworks. But after a closer look at the metamodels in Figure 13 it becomes obvious that the CMMI standard includes components like *goals* or *procedures,* which are not part of the maturity model of COBIT. This shows the difficulties caused by linguistic defects (homonyms, synonyms, antonyms) and underlines the advantages of integration by using metamodels.

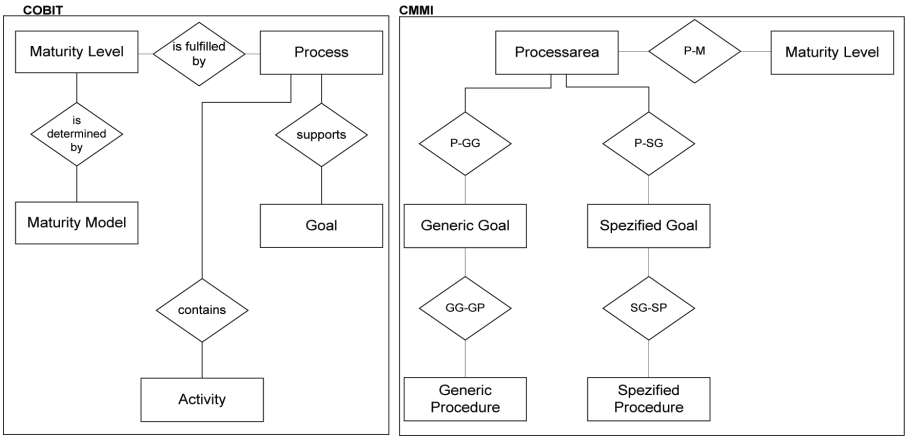
A metamodel in our approach serves us the starting point for the integration of different frameworks. By modelling different frameworks with the same representation technique (i.e. metamodel) we extract components and logical and semantic relationships of individual frameworks. This allows the detection of redundancies and gaps on that level. On a lower level we implement a software representation of modeled frameworks, interlinking these based on information generated on the higher level.

We are currently developing a framework representation based on semantic networks. This technology allows flexible navigation within framework structures and the implementation of various views across components.

CONCLUSION

Best practice models for IT governance and related tasks have been developed in recent years numerously and to considerable extent. Beside the effort of implementing those frameworks, the potential user is left with the choice of which model fits what purposes best and in which order - if any - to implement them. There is no "silver bullet" for the integration of frameworks and it is a difficult tasks because it needs to unite expertise from various fields. With a top down approach we have created a point of view on the similarities and differences

Figure 13. Comparison of COBIT and CMMI. (Freely adapted from Kneuper (2007))



of frameworks. Based on this point of view we show that the technique of metamodelling allows us to express features of frameworks in adequate detail to support systematic comparison and integration. With our approach we gain the ability of using the same semi-formal representation for describing aspects of different framework with the capability to detect overlapping areas, components and redundant functions. Thereby we are closing the gap between comparing frameworks using a high-level list of criteria and detailed approaches of mapping functions and processes.

A recently started project aims to map this unified representation into a system providing semantic networks. The overall approach will allow integrating best practice frameworks in a more efficient and user friendly way, providing tool support by leveraging a knowledge base derived from multiple frameworks. This could improve quality of IT management because of decreasing implementation effort, less redundancies which tends to result in an increasing user efficency.

NOTE

All mentioned mapping documents are available under: http://www.isaca.org

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Chapter 6
Quality-Oriented IT Service Management:
A Theoretical Approach Towards High-Quality IT Services

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INTRODUCTION

Due to the increasing importance of the tertiary sector, information technology (IT) organizations need to face up to new challenges, since their daily business has changed from development and operation of information technology to the customer oriented provision and management of IT services. In order to survive in the market, service providers need to offer and manage competitive and distinctive IT services. The "Profit Impact of Market Strategies" (PIMS) program has emphasized the need for service quality as being a crucial, strategic competitive factor. However, IT service providers do not have guidance of what quality requirements are supposed to be fulfilled to provide high-quality IT services. Different reference models and frameworks such as ITIL (Information Technology Infrastructure Library), COBIT (Control Objectives for Information and related Technology) and ISO 20000 are widely used by many IT organizations for improving service management processes and performance. However, these reference models do not address the improvement of service quality in a consistent manner and it is not clear whether these models have the capability to close quality gaps which may arise within a service provider environment.

Therefore, this chapter proposes an IT service quality model for identifying potential quality gaps and quality dimensions in an IT service provider environment. Furthermore, it proposes a set of different quality requirements combined in a "Quality Requirements Model for IT Services" that are needed in order to close the respective quality gaps and fulfill the individual quality dimensions. The model is developed by mapping the reference models ITIL v3, COBIT and ISO 20000 to the previously developed quality model. The results of the mappings emphasize that all three models are partially capable to close the individual gaps of the quality model as well as

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to guarantee the fulfillment of respective quality dimensions. The fulfillment of these developed quality requirements can be utilized as a guideline for providing and managing high-quality IT services in the long term.

Finally, the maturity level is analyzed and pointed out that most of the quality requirements are assigned to maturity stage 2 or 3. This implies that an IT service provider does not necessarily have to reach a maturity stage 4 or 5 being able offering high service quality.

In summary, the chapter provides guidance and quality-oriented IT Service Management to answer the following questions:

- What kind of quality gaps exist in a service provider environment?
- Do reference models such as ITIL, COBIT and ISO 20000 have the capability to close quality gaps which may arise within a service provider environment?
- What processes, activities and functions from which reference model are needed in order to close the respective gaps?
- What quality requirements need to be implemented in order to provide high-quality IT services?
- What maturity level do service providers need to reach in order to fulfill quality requirements?

MOTIVATION

Studies by the "Statistisches Bundesamt Deutschland" (destatis) and the "Statistical Office of the European Communities" (Eurostat) have shown that new and technical services, such as Information Technology services, are becoming more and more important during recent years (Eurostat, 2006).

Due to the increasing importance of the tertiary sector, IT organizations need to face up to new challenges, since their daily business changed from development and operation of information technology to the customer oriented provision and management of IT services. In order to survive in the market, service providers need to offer and manage competitive and distinctive IT services. The "Profit Impact of Market Strategies" (PIMS) program (Buzzle & Gale, 2004) has emphasized the need for service quality as being a crucial, strategic competitive factor. However, neither academics nor practitioners have agreed upon a consistent definition of the term "service quality" and IT service providers do not have guidance of what quality requirements are supposed to be fulfilled to provide high-quality IT services (Schmidt et al., 2007). Moreover, intangibility as characteristic of a service complicates the assessment and evaluation of service quality.

Different reference models and frameworks such as *ITIL v3* (Office of Government [OGC], 2007), *COBIT* (IT Governance Institute, 2005) and *ISO 20000* (International Standardization Organization, 2007) are widely used by many IT organizations for improving service management processes and performance. However, these reference models do not address the improvement of service quality in a consistent manner and it is not clear whether these models have the capability to close quality gaps which may arise within a service provider environment.

Therefore, the goal of this chapter is to propose an approach which can support IT organizations to identify potential quality gaps and to define quality requirements which have to be fulfilled for closing these gaps and providing high-quality IT services.

At the beginning, the chapter proposes an IT service quality model by adapting a widely used gap model and identifying quality dimensions in a service provider environment. Based on this quality model, the reference models ITIL, COBIT and ISO 20000 are mapped to the identified quality gaps and dimensions to develop a set of quality requirements. To analyze the expense and time for fulfilling these quality requirements, a

CMMI (Capability Maturity Model Integration) based quality allocation model is developed and maps each quality requirement to a maturity level. Finally, the chapter gives a conclusion and outlook for further research.

SERVICE QUALITY AS A STRATEGIC SUCCESS FACTOR

The *"Profit Impact of Market Strategies" (PIMS) program* that has been administrated by "The Strategic Planning Institute" (SPI) in Cambridge since 1972, was initiated to analyze the relationship between business strategies and profitability (Buzzle & Gale, 2004). In the context of this study, it was analyzed whether service quality can influence business profitability. The results of the PIMS program have established that companies with a qualitatively excellent product or service clearly beat companies with lower quality products with regard to "Return on Investment" (ROI) and "Return on Sales" (ROS) as a measure of profitability. *"In the long run, the most important single factor affecting a business unit's performance is the quality of its products and services, relative to those of competitors."* (Buzzell & Gale, 1987, p.7)

Figure 1 demonstrates that companies with an increasing service quality achieve an increasing return on sales as well as an increasing market share.

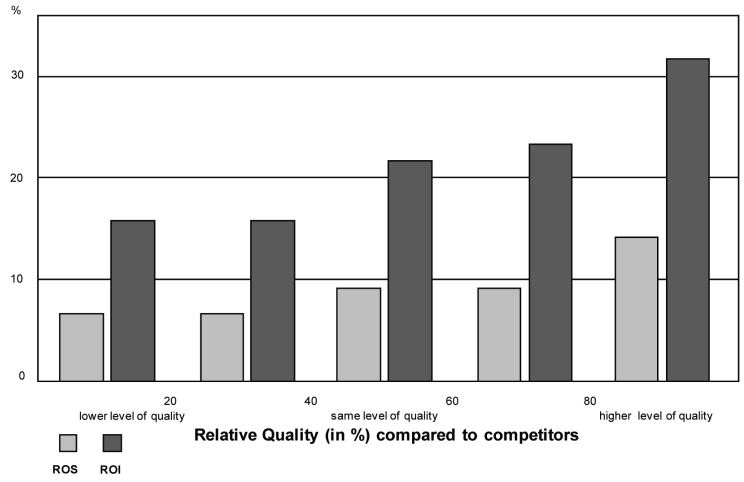
Consequently, a company can differ from its competitors through providing better service quality.

Therefore, the PIMS program has emphasized service quality as being a crucial, strategic competitive factor.

IT SERVICE QUALITY MODEL

With the increasing significance of the tertiary sector, a multitude of *service quality models* and definitions have been developed in literature (Zeithaml, 1981; Grönroos, 1984; Brandt, 1987; Meyer & Mattmüller, 1987 etc.). A detailed review of service quality models is provided by Seth et al. (2005). The authors examined nineteen conceptual service quality models reported during the period 1984 to 2003 to derive linkage between them. The authors concluded that *"majority of models and definitions support the view of evaluating service quality by comparing their service quality expectation with their perceptions of service*

Figure 1. A higher level of service quality results in higher returns (Buzzle & Gale, 2004)



quality they have experienced" (Seth et al., 2005, p. 934). Additionally, the review emphasizes the significance and importance of the *gap model* (1985) and *SERVQUAL approach* (1988) developed by Parasuraman et al. since almost half of the reported models in the review can be classified as gap model/SERVQUAL-based.

With its fifth book "Continual Service Improvement" ITIL v3 also introduces a service quality model based on the gap model (OGC, 2007). It has to be noted that ITIL indicates that gaps in the communication between customers and service provider can occur, which results in a discrepancy between the expected service and perceived service (see Figure 2). However, the model also has shortcomings by neither pointing out which gaps influence which processes of a service provider nor by providing guidance how these gaps can be closed. Moreover, the model is based on a very abstract level and contains no clear explanation of what the respective gaps exactly represent. Therefore, an own IT service quality model is proposed in the following.

First of all, five quality models were selected which are academically accepted and widespread in literature (see Table 1). Afterwards, it was examined which of the quality dimensions of the selected models are most qualified for fulfilling the specific characteristics and demands on an IT service provider. As a result, it was decided to develop an *IT service quality model* based on the quality dimensions according to SERVQUAL (1988) in combination with the gap model by Parasuraman et al. (1985) and to adapt these to an IT service provider's environment needs. Consequently, the quality dimension "tangibles" was substituted by the dimension "security" which was part of the original ten SERVQUAL dimensions.

According to this adjustment, service quality is divided from a customer's point of view into the following five quality dimensions which must be fulfilled by an IT service provider:

- Reliability: Ability to perform the promised service dependably and accurately.
- Responsiveness: Willingness to help customers and to provide prompt service.
- Assurance: Possession of the required skills and knowledge to perform the service.

Figure 2. ITIL v3 service gap model (OGC, 2007)

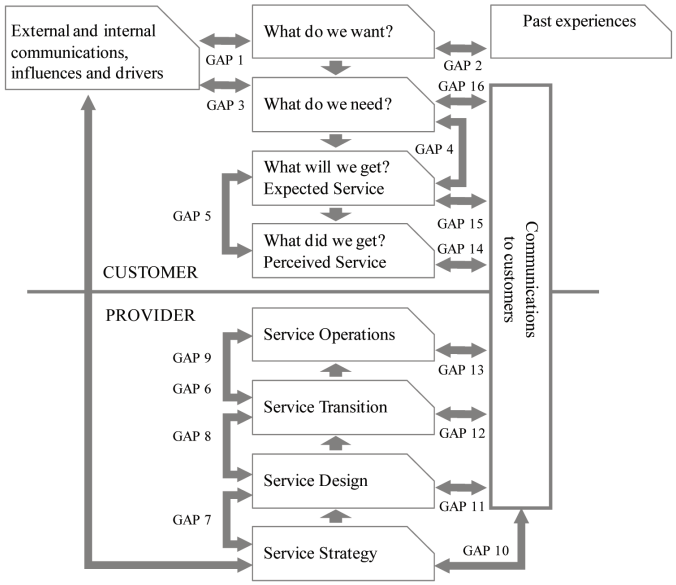


Table 1. Service quality models

Service quality model	Quality dimension
Donabedian (1966)	Structure, process and outcome quality
Zeithaml (1981)	Search, experience and credence quality
Grönroos (1984)	Technical (what?) and functional (how?) quality
Meyer & Mattmüller (1987)	Potential quality of provider, potential quality of client, process quality and final process result
Parasuraman et al. (1988)	Reliability, assurance, tangibles, empathy and responsiveness

- Empathy: Understanding the customer and its needs. Readiness to deal with individual customer requests.
- Security: Security of IT infrastructure and information. Compliance with laws and regulations.

Another assumption of the developed quality model is that IT service quality results from the difference between customer expectations and customer perceptions. Therefore, a service must at least correspond to customer expectations in order to obtain a positive quality perception about the delivered service. An insufficient service quality originates from discrepancies between customer expectations of a certain service quality level and the level actually received. This discrepancy is called a "gap" in the following. Parasuraman et al. (1985) have identified five gaps in their quality model, four on the service provider's side (gap 1-4) and one on the customer's side (gap 5):

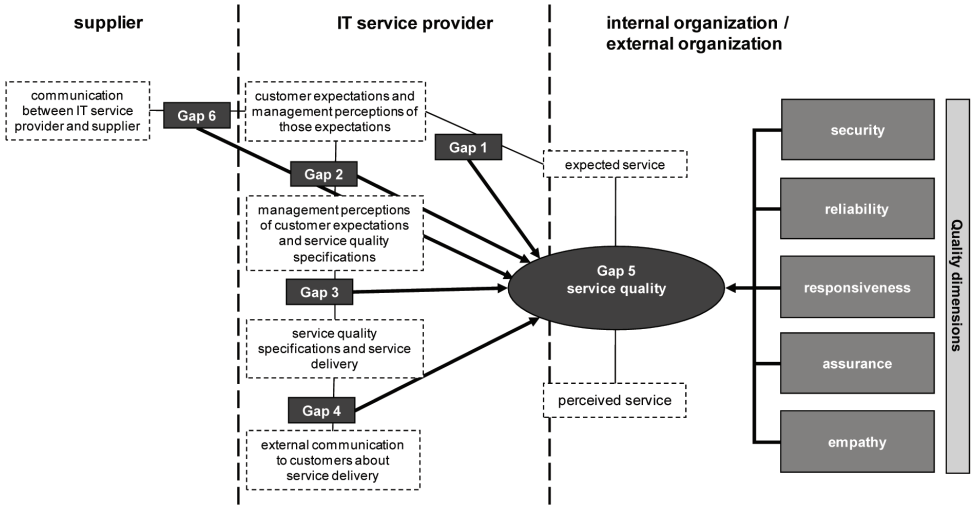
- Gap 1: Discrepancy between customer expectations and management perceptions of those expectations.
- Gap 2: Discrepancy between management perceptions of customer expectations and service quality specifications.
- Gap 3: Discrepancy between service quality specifications and service delivery.
- Gap 4: Discrepancy between service delivery and external communication to customers about service delivery.
- Gap 5: Discrepancy between expected service and perceived service.

Service quality is thereby represented by gap 5, the difference between the expected service and the perceived service. This gap is influenced by the other gaps and is made up of the total of the other four gaps. The larger the sum of the other gaps, the stronger the perceived service quality differs from the actually expected service level.

Due to the fact that the complexity of an IT service is obviously higher than a classical service, the two original stakeholders "customer" and "service provider", called "internal/external organization" and "IT service provider" in the developed IT service quality model, are completed by another stakeholder (see Figure 3). This participant is designated as "supplier" and takes the role of a business partner of the IT service provider. One or more suppliers are involved in the service production at that time when the service is not completely produced by the IT service provider itself and subtasks are fulfilled by one or more suppliers. Thereby, a supplier can also be involved in the service production as an IT service provider at the same time. With the existence of another participant, the quality model must be extended by another gap. This gap 6 is consistent with gap 1 when the IT service provider takes the role of the supplier's customer and vice versa. Since gap 2, gap 3 and gap 4 can occur on both the service provider and the supplier sides, these gaps are only considered from an IT service provider perspective in the quality model.

However, gap 6 and gap 1 can differ from each other as soon as for instance contractual regulations determine the participation of a supplier or an additional IT service provider within the service production. Such a constellation can evolve when the customer joins the involvement of a supplier on the IT service provider. Moreover, supplier or

Figure 3. IT service quality model



outsourcing contracts can be closed, meaning that certain services must be accomplished collectively. These contractual obligations require a different kind of communication from service provider to supplier than to its customer. Therefore, an IT service provider must also consider the following gap during service production:

- Gap 6: Discrepancy between IT service provider expectations and supplier perceptions.

Furthermore, the IT service provider must establish together with its suppliers a supply chain along services, information and money flow. The main idea is that not only internal business processes are considered but also all business processes between the stakeholders of the supply chain. It is important to think about the complete value chain and to make a decision based on the maximized added value of the complete chain instead of maximizing only values of internal business processes within one company.

According to Kalakota and Robinson (2001) these relationships are more and more important for being competitive on a market. *"With the shift in focus from internal to external process improvement, competition of manufacturer versus manufacturer has become competition of supply chain versus supply chain"* (Kalakota & Robinson, 2001, p. 275). Particularly, the information flow between the stakeholders of the value chain plays a decisive role because it enables the communication of customer requests and the understanding of customer needs.

Consequently, the gap between the IT service provider and the supplier increases if the IT service provider cannot communicate customer requests and necessary information accurately. This might negatively influence the customer's perceptions of service quality at the end of the service production cycle.

Figure 3 summarizes all 6 gaps, which must be closed during an IT service production, in order to provide high-quality IT services. In addition, the illustration shows into which quality dimensions the service quality from a customer's point of view can be divided.

Further gaps besides gap 5 can occur on the customer's side, which might negatively affect the perception of service quality. For instance, if a coworker states from uncertainty, that a certain transaction cannot be implemented due compatibility reasons, even though this would be never-

theless possible, this might affect the perception of the service quality in a negative manner. The customer is not satisfied with the quality of the received service, even though the employee's uncertainty and not the service provider's incapability is responsible for this discrepancy.

However, these gaps are not considered in the quality model consciously, since for the further approach it is only of interest what an IT service provider can contribute to ensure optimized service quality.

In the first book, "Service Strategy" ITIL v3 defines a service as delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific costs and risks (OGC, 2007). According to ITIL such a value added can be created whether the two factors "utility" and "warranty" are fulfilled by an IT service provider (see Figure 4).

On the one hand, "utility" ensures that the service attributes have a positive effect on the performance of tasks associated with desired outcomes and is useful as well as practical for the customer ("fit for purpose"). On the other hand, warranty means "fit for use" and is derived from the positive effect being available when needed, in sufficient capacity or magnitude, and dependably in terms of continuity and security (OGC, 2007). Summarized, warranty refers to quality aspects of a service such as availability, reliability or security (itSMF Deutschland e.V., 2009).

Adapting these two factors to the previously developed IT service quality model, correspondence is clearly recognizable. Fulfilling the six quality gaps ensures that the service is "fit for purpose" and is consistent with the customer expectations. Therewith, the quality gaps represent the factor "utility" as defined in ITIL v3. By contrast, the quality dimensions of the developed model focus on "fit for use" and correspond consequently with "warranty".

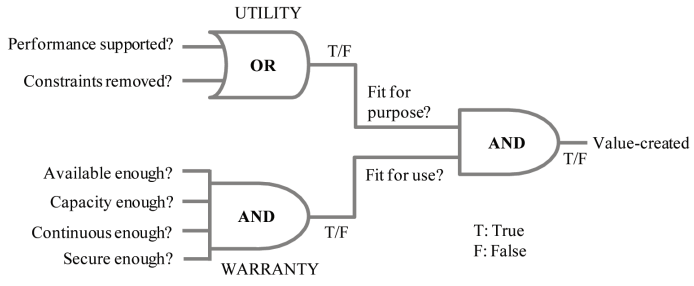
According to ITIL v3, value creation is the combined effect of utility and warranty and value for customers can be increased by either of the two factors (OGC, 2007). Therefore, an IT service provider has to focus not only on closing quality gaps or fulfilling the quality dimensions, but both factors have to be considered by a service provider to deliver high quality services to its customer.

QUALITY REQUIREMENTS MODEL FOR IT SERVICES

Approach

In the following section, IT service reference models are mapped to the previously developed IT service quality model to analyze, if these models can be used practically to close the gaps of the quality model and fulfill its respective quality dimensions. For this purpose, processes (P), functions (F), activities (A), which involve recommendations given within a process or function, and control objectives are assigned to the respective gaps and dimensions of the quality

Figure 4. Logic of value creation through services (OGC, 2007)



model in a first step. Afterwards, common quality requirements from the mapping are deduced and consolidated in a quality requirements model, in order to propose a set of requirements for providing high IT service quality. As a last step, these quality requirements are mapped to the widely practically used "Capability Maturity Model Integration" (CMMI) and combined in a quality allocation model to analyze the required maturity level. Figure 5 illustrates the described approach.

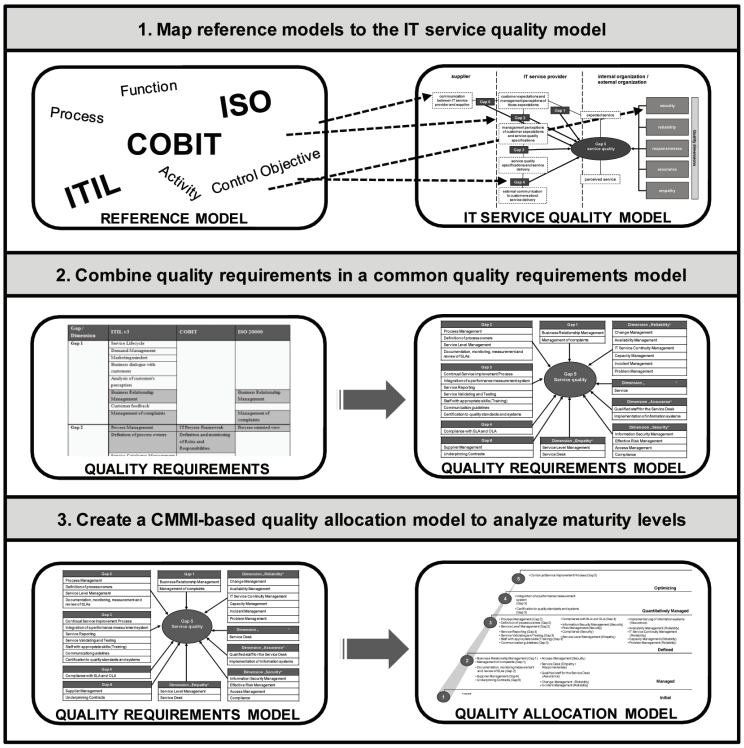
Concerning the reference model mapping, this theoretical approach focuses only on the three *public-domain IT service reference models* ITIL, COBIT and ISO 20000. According to current studies, these reference models are most frequently used in practice (Blum, 2007).

Mapping ITIL v3 to the IT Service Quality Model

The approach of developing a quality requirements model for IT services includes a comprehensive analysis and mapping of more than 70 service management processes including a large number of associated functions, activities and recommendations. At first, a quality requirements model for each service reference model was developed and afterwards merged into a common requirements model for IT services. For instance, the requirements model for ITIL v3 includes 19 assigned processes, 21 activities and 1 function. Therefore, the following subsection exemplarily explains the mapping of ITIL v3 to gap 1 of the previously developed IT service quality model.

ITIL (Information Technology Infrastructure Library) was developed during the 1980s and is a set of best practices guidance for IT Service Management. ITIL is owned by the OGC and

Figure 5. Theoretical approach for developing a quality requirements model for IT services



consists of a series of publications giving guidance on the provision and management of IT services, service processes and facilities needed to support them. In June 2007, the latest version of the ITIL framework, ITIL v3, was released.

In order to close the gap between customer expectations and management perceptions, it is particularly important that an IT service provider comprehends customer requests correctly, analyzes its conception of these expectations and adjusts this correspondingly. Thereby, a feedback and a complaint management system play a crucial role, because the IT service provider must consider experiences and earlier misconceptions of customer expectations.

The realization of these requirements becomes particularly apparent in ITIL v3 by the adjustment of a service to a service lifecycle. Thus, a continuous feedback and learning between the individual processes and functions, as well as within the organization, is supposed to be guaranteed. Moreover, ITIL v3 points out clearly that customer expectation must be understood correctly for a successful service production and provision. Therefore, it is particularly important that IT service providers recognize which factors may affect customer expectations on IT service quality. An intensive dialogue between the customer and the IT service provider is crucial for the understanding of those factors. In addition ITIL v3 prescribes that during service production earlier experiences with the same or similar customer must be considered. An important activity thereby is taking care of customer relations, called "Business Relationship Management" in ITIL v3. This usually covers taking care of personal relations to business managers, the allocation of inputs to the service portfolio management as well as the guarantee that the IT service provider fulfills the customers' business requirements. Furthermore, the IT service reference model demands a marketing-oriented way of thinking, called "marketing mindset", since customer expectations are to be regarded as from an outstanding perspective. Simple questions, such as "What is our business?", "Who is our customer?", "How do they use our services?" or "Why are they valuable to them?" contribute to understanding a customer's desires and demands by putting itself in a customer's position. Furthermore, ITIL v3 emphasizes the importance that managers must gain deep insights into the business they serve. This includes the identification of all possible outcomes and advantages for every customer as well as market space. This can be guaranteed by classifying and codifying outcomes with reference tags.

A gap between customer expectations and the management perceptions can also occur if the IT service provider is incapable to provide the required capacities. In order to avoid this, ITIL v3 contains a "Demand Management" that reduces overcapacities or capacity constraints by forecasting, planning and coordination with the customer. A further crucial role plays the analysis of customer requests. Therefore, models such as the Kano model are recommended to acquire customer requirements and requests and to classify these into different requirement types. In addition, ITIL v3 emphasizes a monitoring of customer expectations by methods as periodic questionnaires and customer surveys, customer feedback from service review meetings, telephone perception surveys, and analysis of complaints (OGC, 2007). Finally, the management of complaints plays a crucial role for compensating gap 1. Thus, all complaints must be recorded and be passed through affected places, in order to achieve a customer satisfaction through counter-measures and proposed solutions in a timely manner (Kalakota & Robinson, 2001).

The following table highlights exemplarily the most important quality requirements according to ITIL v3, which are necessary to close gap 1 - discrepancies between customer expectations and management perceptions:

After mapping ITIL v3 to the remaining gaps, as well as the quality dimensions of the previously developed IT service quality model, Figure 6 summarizes all quality requirements, that ITIL

Table 2. ITIL v3 and gap 1

ITIL v3 quality requirements for Gap 1:
Service lifecycle
Extensive dialogue with customers
Business Relationship Management
Marketing mindset
Demand Management
Analysis of customer perceptions
Customer feedback
Management of complaints

v3 recommends for closing respective gaps as shown in the quality model and for assuring individual quality dimensions.

Quality Requirements Model for IT Services

Besides ITIL v3, also the two other reference models COBIT 4.0 and ISO 20000 were mapped to the developed IT service quality model. In total, 33 mappings were accomplished (18 gaps and 15 quality dimensions). The results of the mappings emphasize that all three models are partially capable of closing the individual gaps of the quality model, as well as of guaranteeing the fulfillment of respective quality dimensions (see Table 3).

Furthermore, the results of these mappings have shown that all three reference models include similar quality requirements and recommendations such as the implementation of "Problem Management" or "Service Level Management" processes - despite their different history of origins and fields of application. Finally, the *Quality Requirements Model for IT Services* in Figure 7 summarizes all common quality requirements which are contained in the reference models ITIL v3, COBIT and ISO 20000. A quality requirement was included in the model if at least two reference models demand this requirement. The fulfillment of these developed quality requirements can be utilized as a guideline for providing and managing high-quality IT services in the long term.

Figure 6. Results of mapping ITIL v3 to the IT service quality model

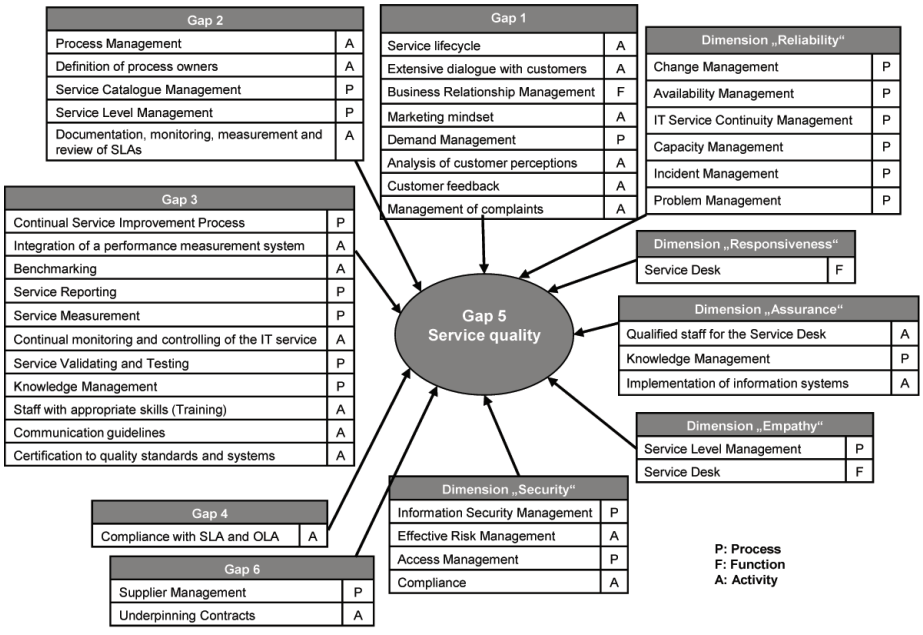


Table 3. Comparison of the three reference models ITIL, COBIT and ISO 20000 based on mapping these to the IT service quality model

Gap / Dimension	ITIL v3	COBIT 4.0	ISO 20000
Gap 1	Service Lifecycle		
	Demand-Management		
	Marketing mindset		
	Business dialogue with customers		
	Analysis of customer's perception		
	Business Relationship Management		Business Relationship Management
	Customer feedback		
	Management of complaints		Management of complaints
Gap 2	Process Management	IT Process Framework (PO4.1)	Process-oriented view
	Definition of process owners	Roles and Responsibilities (PO4.6)	
	Service Catalogue Management		
	Service Level Management	Service Level Management Framework (DS1.1)	Service Level Management
	Documentation, monitoring, measurement and review of SLAs	Service Level Agreements (DS1.3) - Definition and Measurement	
		Review of Service Level Agreements (DS1.6)	
		Monitoring and Reporting of Service Level Achievements (DS1.5)	
Gap 3	Continual Service Improvement Process	Continuous Improvement (PO8.5)	Continuous Improvement
	Integration of a performance measurement system	Integration of a performance measurement system (Key Performance Indicators, Key Goal Indicators, IT Key Goal Indicators)	
	Benchmarking		
	Service Reporting		Service Reporting
	Service Measurement		
	Continual monitoring and controlling of the IT service		
	Service Validating and Testing	Testing (AI7.2; AI7.4; AI7.6; AI7.7)	
	Knowledge Management		
		Manage IT Human Resources (PO7)	
		Employee Job Performance Evaluation (PO7.7)	
	Staff with appropriate skills (Training)	Personnel Training (PO7.4)	
	Communication guidelines	Communicate Management Aims and Direction (PO6)	
	Certification to quality standards and systems	Quality Management Systems (PO8.1)	

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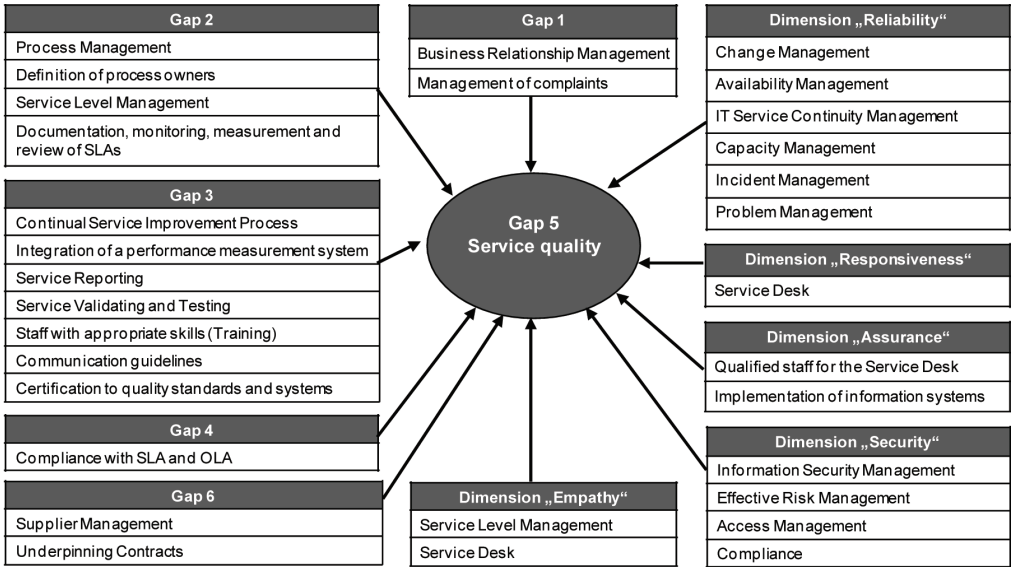
Table 3. continued

Gap / Dimension	ITIL v3	COBIT 4.0	ISO 20000
Gap 4	Compliance with SLA and OLA	Service Level Agreements (DS1.3) and Operational Level Agreements (DS1.4)	Compliance with SLA and OLA
Gap 6	Supplier Management	Supplier Relationship Management (DS2.2)	Supplier Management
		Manage Third-party Services (DS2)	
		Supplier Performance Monitoring (DS2.4)	
		Supplier Risk Management (DS2.3)	
		Supplier Contract Management (AI5.2)	
		Supplier Selection (AI5.3)	
	Underpinning Contracts	Review of Contracts (DS1.6)	
Security	Information Security Management	Management of IT Security (DS5.1)	Information Security Management
	Effective Risk Management	Assess and Manage IT Risks (PO9)	
	Access Management		
		Segregation of Duties (PO4.11)	
	Compliance	Ensure Regulatory Compliance (ME3)	
Empathy	Service Level Management	Service Level Management Framework (DS1.1)	Service Level Management
	Service Desk	Service Desk (DS8.1)	
Assurance	Knowledge Management		
	Qualified staff for the Service Desk		
	Implementation of information systems		
Responsiveness	Service Desk	Service Desk (DS8.1)	
Reliability	Change Management	Change Standards and Procedures (AI6.1)	Change Management
	Availability Management	IT Resources Availability (DS3.4)	Service Continuity and Availability Management
	IT Service Continuity Management	IT Continuity Framework (DS4.1)	
	Capacity Management	Performance and Capacity Planning (DS3.1)	Capacity Management
	Incident Management	Incident escalation (DS8.3)	Incident Management
	Problem Management	Manage Problems (DS10)	Problem Management

CMMI BASED QUALITY ALLOCATION MODEL

In the following section, the maturity level of the IT service provider was analyzed, which is necessary to fulfill the quality requirements developed in the previous section. For that purpose, the quality requirements are assigned to the individual maturity levels considering the widely practically used "Capability Maturity Model Integration" (CMMI) (Ahern et al., 2003). Although CMMI is primarily a concept for software development, the current release of CMMI, version 1.2, provides with the *CMMI for Services (CMMI-SVC)* model guid-

Figure 7. Quality requirements model for IT services



ance for the application of CMMI best practices by the service provider organization and focuses on activities for providing quality services to the customer and end users (CMMI for Services Team, 2009).

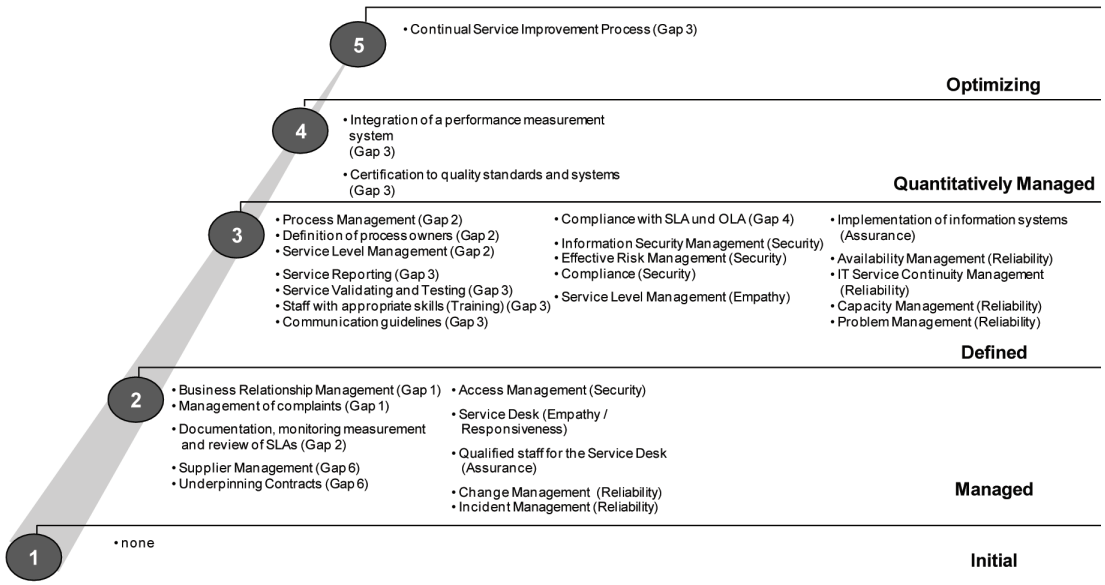
The starting point for this section was a detailed assignment of the developed ITIL v3, COBIT and ISO 20000 quality requirements from the previous section to the CMMI process areas, goals and practices provided by CMMI-DEV (CMMI Product Team, 2006) and CMMI-SVC (CMMI for Services Team, 2009).

As a consequence, Figure 8 assigns all common quality requirements of ITIL v3, COBIT and ISO 20000 to the respective CMMI maturity level in the staged representation. The developed CMMI based *quality allocation model* illustrates that with exception of three quality requirements, “integration of a performance measurement system”, “certification to quality standards and systems” and the implementation of a “Continuous Service Improvement Process”, maturity level 3 is sufficient for an IT service provider to fulfill the previously developed quality requirements. Furthermore, the mapping of ITIL v3, COBIT and ISO 20000 quality requirements to the CMMI maturity levels shows that most of the quality requirements can already be realized on the stages 2 and 3. This implies that an IT service provider does not necessarily have to reach a maturity stage 4 or 5 being able offering high service quality. Therefore, an IT service provider can save costs and time, since by achieving a higher maturity level, the expenses as well as implementation costs increase exponentially (Kittel et al., 2006).

Moreover, the mapping clarified that gap 3 - discrepancy between service quality specifications and service delivery - involves the highest effort to an IT service provider and can only be closed on maturity level 5.

However, it must be considered that the quality requirements “integration of a performance measurement system” and “Continual Service Improvement Process” included in gap 3 not only refer to the transfer into the service operation, but also to the entire service contribution and therefore represent a large barrier for an IT service provider.

Figure 8. CMMI-based quality allocation model



PRACTICAL IMPLICATIONS

The proposed IT service quality model and the Quality Requirements Model for IT Services provide guidance in delivering high quality services.

On the one hand, the IT service provider can adapt the IT service quality model to its service organization and environment. Therefore, potential service quality gaps and weaknesses in the service production can be identified. After analyzing the service environment, the service provider can focus on the identified gaps and initiate appropriate measures by implementing the described Quality Requirements Model for IT Services. The quality requirements model provides different activities that are required to close the identified gaps and to ensure that expected quality dimensions such as security or responsiveness are fulfilled. Furthermore, the results of the previous sections have shown that all three reference models, ITIL, COBIT and ISO 20000, include similar quality requirements as well as recommendations and have therewith the capability to close quality gaps which may arise within a service provider environment. For this reason, a service provider can decide to implement only one reference model or a combination of all of them. Finally, the service provider can use the CMMI based quality allocation model to prioritize which quality requirements have to be implemented at the beginning of a service quality optimization project. According to its maturity stage, the provider can implement the respective quality requirements and increase continuously its maturity stage by focusing on requirements of higher levels.

On the other hand, the developed Quality Requirements Model for IT Services can be used as a checklist to analyze which requirements are already fulfilled and which have still to be implemented. Such a quality assessment removes the intangibility of a service and makes it possible to measure as well as to evaluate a provider's service quality.

In summary, the primary goals of the previously developed Quality Requirements Model for IT Services are to assure that IT generates a high service quality and a business value for customers and service provider. Moreover, the model helps service provider to achieve a successful

operational IT service management and leads to quality-oriented IT services.

CONCLUSION & OUTLOOK

The chapter proposed an approach for developing quality requirements for IT services based on widely practically used reference models ITIL, COBIT and ISO 20000 in order to provide high-quality IT services. Therefore, an IT service quality model was developed for identifying potential quality gaps and quality dimensions in an IT service provider environment. Furthermore, different quality requirements were defined by mapping reference models to the previously developed quality model and combined in a Quality Requirements Model for IT Services. Finally, the maturity level was analyzed and pointed out that most of the quality requirements are assigned to maturity stage 2 or 3.

In summary, the chapter provides guidance and *quality-oriented IT Service Management* for identifying quality requirements and answering the following questions:

- What kind of quality gaps exist in a service provider environment?
- Do reference models such as ITIL, COBIT and ISO 20000 have the capability to close quality gaps which may arise within a service provider environment?
- What processes, activities and functions from which reference model are needed in order to close the respective gaps?
- What quality requirements need to be implemented in order to provide high-quality IT services?
- What maturity level do service providers need to reach in order to fulfill quality requirements?

The results in this chapter propose further research opportunities and potential values for practice: Firstly, the developed quality requirements need to be evaluated to appoint their acceptance among IT service providers. Based on this approach a questionnaire could be developed for evaluating the quality requirements. In this context, a weighting could be introduced for each requirement. Furthermore, key performance indicators included in the reference models could be implemented in an IT dashboard in order to measure and control the Quality Requirements Model for IT Services. Finally, a certification mark could be developed as evidence for the provision of high-quality IT services. On the one hand, it would be a positive reference for a consumer about service quality. On the other, it would emphasize the reliability and capability of the service provider.

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Section 3

Process Based Concepts and Models for IT Service Quality Management

Chapter 7
Collaborative Modelling of ITIL Service Management Processes

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ABSTRACT

The chapter describes the results developed by the special interest group Operational Service Management (OSM), a part of the German Chapter of the IT Service Management Foundation (itSMF Deutschland e.V.). The chapter describes the results, that have been created in the special interest group. Starting with the description of the problem based approach, the creation of the metamodel, an evaluation of the fundamentals and a summary of the lessons learned, an introduction in the activities of this special interest group is given.

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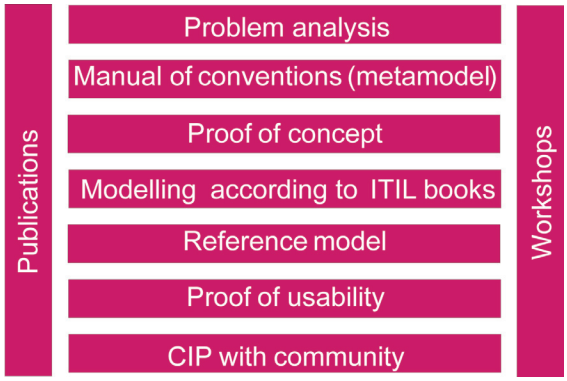
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INTRODUCTION AND REASONS FOR MODELLING IT INFRASTRUCTURE LIBRARY PROCESSES

Motivation and Proceeding

When the IT Infrastructure Library (ITIL™) is implemented for practical processes, there is a need for more detailed process descriptions. This chapter describes the results developed by the special interest group Operational Service Management (OSM), a part of the German Chapter of the IT Service Management Foundation (itSMF Deutschland e.V.). Figure 1 gives an overview on the objectives and the approach followed in this special interest group. After the initial problem analysis, the group moved on to define a metamodel describing the language and guidelines for the process models, that were created in the group. Different tools were then used to demonstrate that the metamodel works and that all of the models can be created independent from specific tools. After that, ITIL processes were described according to the metamodel, taking the diagrams and the text of the ITIL books into account. Afterwards, the group discussed and identified the gaps in the current version of ITIL. After that, a full-blown reference model is going to be used in a real project to prove its usability and value-add.

Figure 1. Agreed proceeding in special interest group



This chapter describes the results, that have been created in the special interest group. Starting with the description of the problem based approach, the creation of the metamodel, an evaluation of the fundamentals and a summary of the lessons learned, an introduction in the activities of this special interest group is given.

Problem Based Approach

Our starting point was a problem analysis, based on different sources: research publications, experience from ITIL users as well as official statements from the Office of Government Commerce (OGC) and the itSMF. This chapter of the book explains which preconditions have to be considered, when ITIL processes are modeled, in order to achieve reasonable results. The chapter closes with the application of these guidelines in two exemplary process models. It is furthermore demonstrated how the pilot model complies with the Guidelines of Modelling (GoM) by mapping the process to the GoM. The final section of this chapter describes the experience, the special interest group members could gain from developing the modelling guidelines.

The formal nature and content quality of the currently available IT Infrastructure Library versions (ITIL™ v2 and v3), regarding the design of operational processes is questioned by a number of authors (Brenner 2006, 24; Hochstein/Zarnekow/Brenner 2004; OGC 2005; Probst 2003, 88f.). It is unclear how an enterprise, wanting to use ITIL, is able to transfer the predominantly text-based descriptions in ITIL v2 (OGC 2001; 2002b) or ITIL Version 3 (OGC 2007) into usable process models. ITIL itself gives limited and generic advice, e.g. in the ITIL v2 book on "Planning to implement Service Management" (OGC 2002a). Therefore developing guidelines and instruments, which can be used to assure the consistency of ITIL process descriptions, has been chosen as

objective for the special interest group, in order to enable consistent modelling of ITIL processes to simplify and speed-up their application.

Looking at the ITIL publications from the OGC, there are a number of weaknesses which hinder the operational use of ITIL in process models. Subsequently, the current state of literature from the existing IT Service Management literature as well as the view of the special interest group members from the German Chapter of the itSMF (itSMF Deutschland e.V.), is described.

ITIL contains a collection of so-called "Best" or "Common Practices" for IT Service Management processes. When these processes are implemented, problems arise, which are very often related to missing elements in the current ITIL documentation. The process descriptions in ITIL are mostly text-based descriptions, partly supported by some illustrations and simple flow-charts. A lot of the described processes are formulated as an option or a proposal (Brenner 2006, 24). In some parts of ITIL inconsistencies can be found e.g. between text and illustrations. Furthermore there are a number of other reasons, why problems arise, when ITIL processes are implemented in practice (Hochstein/Waters 2004, 162-165). Most often problems are addressed, which are either related to the organizational implementation of ITIL in different enterprises, or that are related to the consistency and illustration of the ITIL processes in the OGC books.

A formal look at ITIL reveals the following characteristics. ITIL is a originally English documentation of IT Management concepts, processes and methods, consisting of multiple volumes (Hochstein/Zarnekow/Brenner 2004, 383). It was originally developed and issued by the British Central Computer and Telecommunications Agency (CCTA), the IT provider of the British Government.

Since the 1980's, this collection was published under the label "ITIL". In the meantime, the CCTA is integrated into the Office of Government Commerce (OGC), who is nowadays responsible for the maintenance and further development of the "Library". For creating new versions of ITIL, the OGC is now working closely together with Consulting and IT management firms, the British Standards Institute (BSI), the ITIL users associated in the IT Service Management Forum (itSMF), as well as the certification bodies offering ITIL certifications.

In the ITIL books, the authors describe their view on „Best-Practices" for IT Management. Hochstein et al. (2004, 382) state, that the declaration of „Common-Practice" is more adequate, as using ITIL does not automatically lead to competitive advantages. Several authors have already examined ITIL based on formal criteria and have proved, that ITIL does for example not comply to the Guidelines of Modelling (GoM) as stated by Schütte (1998). A number of different authors agree, that ITIL does not fulfill a number of guidelines and specific criteria, needed to describe a reference information system model (Hochstein/Zarnekow/Brenner 2004, 387; Probst 2003, 88f.).

The usage of natural language in the ITIL books leads to differing understanding of processes and therefore allows for misleading and contradicting interpretations. The semi-formal description of the ITIL processes is not specific enough to directly implement these processes into an information system. Over the years, this brought about the fact, that the same topics are described in different places within ITIL and therefore a consistent overall picture is hard to see. The same holds true for ITIL tools, where different providers have chosen differing design approaches. Based on that, there are a huge number of diverging, provider-specific ITIL process models and solutions, which all claim to be conforming to ITIL.

As a result, ITIL is only an organizational reference model, whose volumes represent well-known and accepted "Common-Practices" (Probst 2003, 88). Yet, due to not conforming to the GoM, ITIL is not an information system reference model. Nevertheless, ITIL can serve enterprises as a valuable, domain-specific source for designing

information systems and is therefore a good example for advantages and disadvantages of formal reference modelling. ITIL does not meet the GoM, but due to its universality, ITIL is widely-known and accepted in practice (Probst 2003, 88).

Deficiencies in the IT Infrastructure Library

If one tries to derive a consistent, applicable process model from the generic ITIL "processes", a lot of problems arise due to deficiencies and inconsistencies in the process descriptions and illustrations published in the original ITIL v2 and ITIL v3 books.

When focusing on the visual representation of ITIL v2 processes it appears that even at the highest level, there is really no standardized visual representation for processes (Figure 2).

When looking at the original ITIL v2 illustrations (Figure 3) showing the interaction between three Service Support processes it appears that graphical symbols can have different meanings. When looking at the rectangles it appears that a rectangle can represent different objects like process activities (e.g. "Assess") or process resources like documents (e.g. "Reports on CIs..").

Arrows for example, are used in different ways. On the one hand, they are used to describe a process flow, i.e. one activity is logically followed by the next one, and on the other hand they are used to describe an information flow, i.e. information is provided / transferred to support an activity, e.g. "Reports on CIs...".

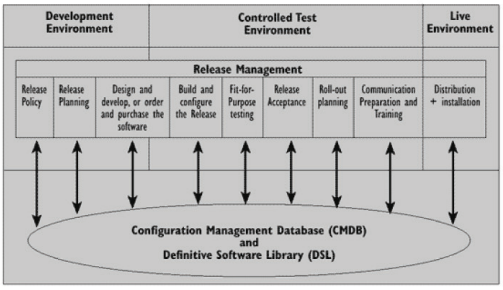
But what does the double arrow mean between "Implement Change" and "Release and distribute new versions...."? Which activity comes first? In addition, it is unclear what the meaning of double arrows is at all? There is no support in the text helping to specify or detail what kind of information is exchanged with the CMDB.

Figure 2. Different visual representations of processes in ITIL v2 (OGC 2002b, OGC 2001)

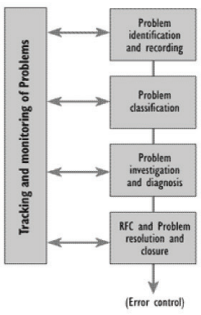
Configuration Management:

No visual representation!

Release Management:



Problem Management:



Capacity Management:

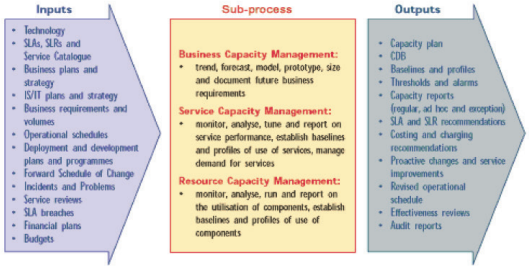
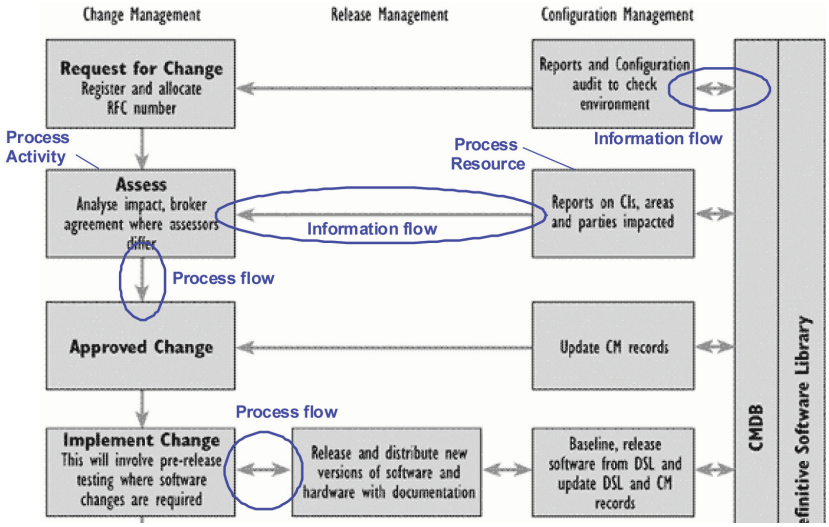


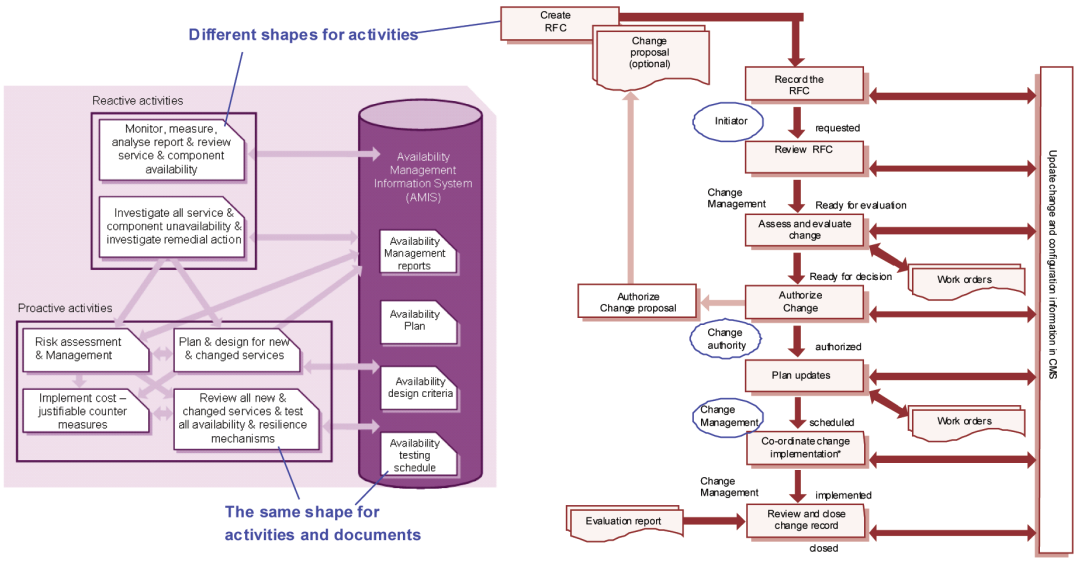
Figure 3. Relationship between Configuration, Change and Release Management (OGC 2002b)



In the ITIL v 3 books many deficiencies mentioned above are still present. There is still no set of defined graphical symbols in order to depict processes in a standardized way. E.g. different symbols are used to depict the same class of objects, be it in a single process representation (Figure 5) or in different process representations in different books of the library (Figure 4).

You can find various symbols for the representation of a process activity. If you would like to start a fruitless discussion, you could argue that the punch-card shapes represent aggregated activities whereas the rectangles represent activities

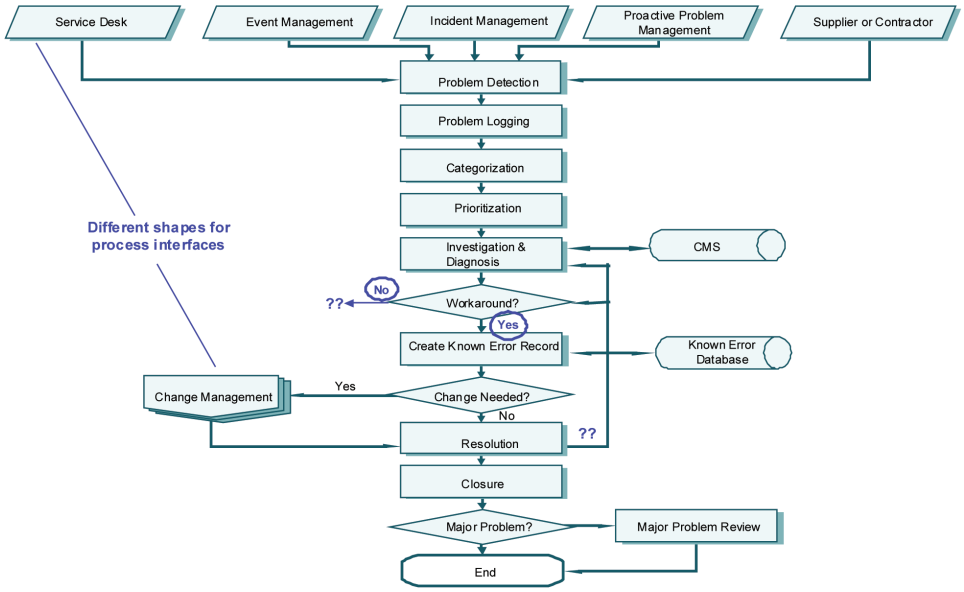
Figure 4. Visual representations of two different processes in ITIL Version 3 (OGC 2007a, OGC 2007b)



Service Design Book: „Availability Management process“

Service Transition Book: „Change Management process flow“

Figure 5. Visual representation of the Problem Management process flow in ITIL Version 3 (OGC 2007c)



at a lower level, but is there really a difference in the process layer when you compare "implement cost-justifiable countermeasures" with "coordinate change implementation"?

In the part of Figure 4, once again the same shape is used for different classes of objects (activities and documents). In the Change Management diagram on the right hand side you see some roles loosely assigned to some activities. But is "Change Management" really a role similar to "Initiator" and "Change Authority"?

The question is also, what all the unidirectional and bidirectional arrows are representing?

The lack of syntax and semantics promotes inaccuracy, which leads to misunderstandings and a broad variety of interpretations, especially if the text does not fully explain the facts shown in the process diagram, which is often the case.

As shown in Figure 5 you can find two different shapes indicating a process interface. Furthermore, one wonders how the flow might continue if **no** workaround is found? On the other hand, under which *condition* will the process *activity* "Resolution" initiate a "Closure", and when will it initiate a loop back to the activities "Investigation & Diagnosis"?

PROBLEM ANALYSIS AND SUMMARY

There is obviously a lack of syntax and semantics concerning the visual representation of processes. In addition, there is not always a complete textual explanation. Thus the description of processes in ITIL v2 and v3 is not standardized, sometimes unclear and in some cases contradictory.

The following deficiencies can be identified:

- Unclear assignment of process flow vs. information flow
- Unclear meaning of graphical symbols (including lack of textual clarification)
- Inconsistent usage of graphic symbols
  - Different graphical symbols for one class of objects
  - One graphical symbol for different classes of objects

- Inconsistencies between text and process graphics
- Incomplete textual specifications and descriptions
  - assignment of roles,
  - assignment of process interfaces and
  - the content of documents.

Because of the fact, that the above listed problems have to be resolved on an individual basis by interpreting graphics and/or text and by filling gaps, a lot of partly incompatible "ITIL dialects" are generated, if one attempts to derive a consistent graphical and textual description of executable processes from the ITIL literature. One adverse effect of having different "ITIL dialects" becomes obvious, when encountering a large mismatch between a customer's process model based on ITIL and the interpretation of ITIL processes by a tool manufacturer offering his "ITIL compliant" off-the-shelf workflows.

CONCEPTS FOR DERIVING A CONSISTENT PROCESS MODEL FROM ITIL

In order to derive a consistent process model from the ITIL literature the special interest group defined a set of special aids, which were then used in a real-life test:

- **Metamodel:** In order to enable consistent modelling a metamodel for IT Service Management processes was developed, which defines specific model elements (classes) and relations between these classes. A whitepaper (Langemeyer/Schmidt/Walter 2006) describing the details of this metamodel can be obtained from the German Chapter of the itSMF (itSMF Deutschland e.V.).
- **Process modelling conventions:** A small handbook with basic conventions was created in order to describe unambiguous rules for modelling, i.e. rules how to use defined graphical symbols, relations and wordings.
- **Definition of a layer structure:** The definition of different process layers is a means to structure processes. Per layer, there is a definition of the level of detail and thus a complete definition of all information which has to be described at that level.
- **Reality check:** The above mentioned aids were used for the consistent modelling of two ITIL processes using two different process modelling tools.

Metamodel

Besides the definition of all process elements (classes) and their relations, the metamodel contains the semantics of each process element, which ensures that all process models based on this metamodel use identical process elements, relations and terms.

In order to fully describe IT Service processes, eight different perspectives in every type of IT Service process were defined.

- The functional perspective describes the goal of the process and what has to be done. For each process, there are inputs, outputs and compliance rules.
- The operational perspective describes the activities executed during the process as well as their relations. Among other relations roles are assigned using the RACI concept.
- The control perspective describes when, and under which conditions activities are performed.
- The organizational perspective describes how roles, organizational units, etc. are related to each other.

Figure 6. Eight different perspectives contained in every type of IT Service process (Langemeyer/Schmidt/Walter 2006)

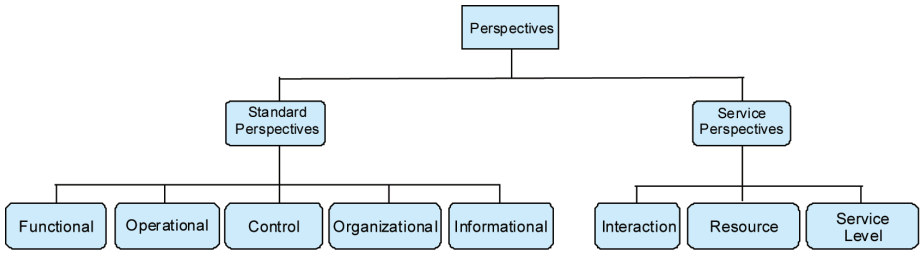
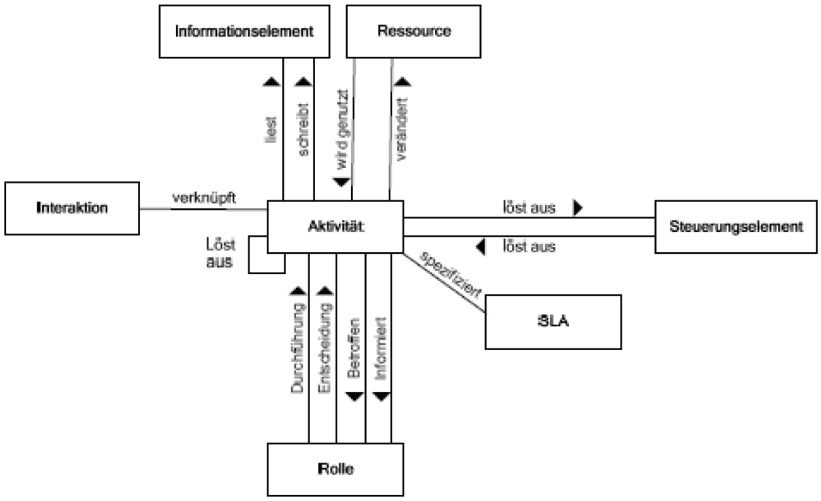


Figure 7. Operational perspective in the metamodel (Langemeyer/Schmidt/Walter 2006)



- The informational perspective describes which kind of information is related to activities.

Besides the well-known standard perspectives three additional perspectives (service perspectives) have been defined in order to reflect the specific functionality of IT Service processes:

- The interaction perspective describes unidirectional, bidirectional or complex interactions between different parties (e.g. internal service provider, customer, external support organization,...). When using the interaction perspective, interactions can be abstracted and standardized.
- The resource perspective describes the integration and administration of external resources, which can be much more complicated, than the management of internal resources.
- The Service Level perspective describes the rights and duties of customers and service providers, the defined quality of a service and the means to measure OPIs (Operational Performance Indicators).

Unfortunately the work was not finished completely, due to the complexity of the model and

due to the fact that the members of the special interest group changed several times. Each time, the new members of the work group had to familiarize themselves with this complex matter first, which ended up in slowing down progress dramatically. Thus the description of the metamodel was not fully completed. A complete overview of the service perspectives can be found in the publication "Ontology-based modelling of service processes and services" (Schmidt/Bartsch 2007). A further reason for not completing the work on the metamodel was the request to start with more practical work after many exhaustive discussions.

Therefore, the supporters of a "less academic approach" proposed to start modelling using a standard tool for process modelling. The advantage was, that one could pick defined, proven objects for process modelling and use the functionality of the tool for checking syntax and semantics.

For this reason the work group documented some necessary modelling conventions and defined a layer structure in order to define the level of detail to be described at each level of the ITIL Service Management processes, when drilling down from a high-level description to the activity level.

Manual of Conventions

General Requirements

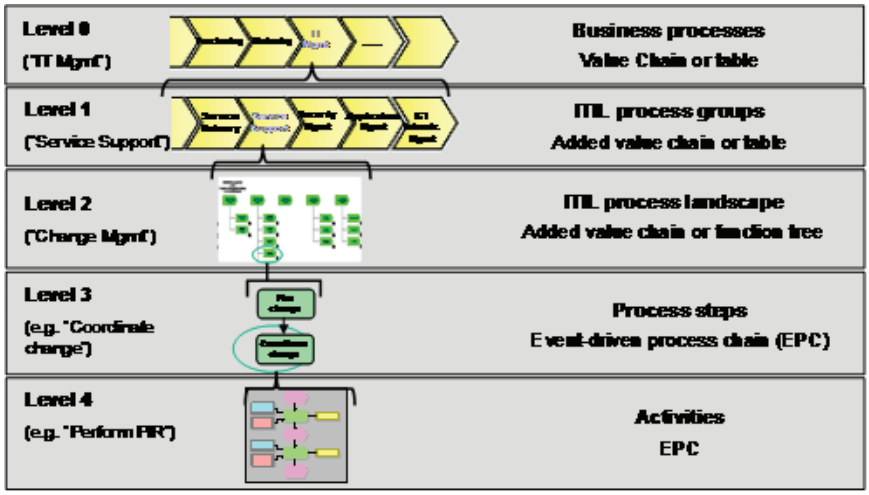
In order to ensure a uniform and consistent process model, conventions need to be defined. The process modelling conventions are typically described in a manual. The manual divides itself into the following chapters:

- layer structure
- symbols
- name conventions
- layout
- change management and versioning

Layer Structure

The use of clearly defined layers for process modelling leads to a structured, hierarchical presentation. Beginning with the process overview at the high-

Figure 8. Layer structure



est layer, a more and more detailed description of processes is following in the lower layers.

Level 0
The highest level of the layer structure shows the value-chain of the major business processes and the integration of the IT processes, represented by a value chain or alternatively as a table.

Level 1
On this level, ITIL processes are arranged in accordance with the individual ITIL books (v2) or the life cycle model (Version 3). The representation is an added value chain or alternatively a table, in which the processes are assigned to life cycle phases.

Level 2
On this level, ITIL processes (e.g. Incident or problem management) are described in a „process map". The process map shows the process parts which are in scope. Processes are represented by a function tree or an added value chain.

Level 3
On this level, individual process steps per process are described. The representation is an event-driven process chain (EPC). The process steps are described as a sequence of main process activities, if not necessary, without connectors. The main goal is it to obtain an overview of WHAT is made during the process execution. For each process the necessary process steps with their starting and final events in the temporal succession are represented.

Level 4
On this level the activities per process step are described, which are executed at this step. The main goal is the description of HOW the activities are executed. On this level the roles are defined and if necessary additional metrics are defined. This level details the generic processes into different scenarios in the form of an extended event-driven process chain (eEPC). The process model shows interactions of functions and events including the interfaces to other processes. Each process step in scope is detailed by activities in level 4.

This level shows the individual activities of the process step with their starting and final events in the temporal succession. Additionally roles responsible for the activity and transactions supporting the activity are indicated. If controls and/or metrics are relevant for an activity, this is represented likewise. The illustration is an event-driven process chain (if necessary supplemented with metrics).

The processes in level 4 may contain only activities, to which exactly one role and one transaction can be assigned.

Symbols

As another important component of the convention manual, symbols are defined including their relations (connectors) for each view. In the tabs below, different views are exemplarily shown.

Functional View
Symbols are presented as an added value chain. (Figure 9)

Operational View
Presentation as event-driven process chain. (Figure 10)

Organizational View
Presentation as organizational chart. (Figure 11)

Name Conventions
Object names have to be taken from a central dictionary, in order to avoid the use of synonyms. ITIL terms have to follow the itSMF glossary (see bibliography).

For the naming of processes on higher levels, nouns have to be used. For the lowest level activity words are used as object names in order to stress the operational character of the activity. For new object names, clear spelling rules are

Figure 9. Functional view

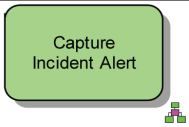
itSMF element	Symbol / Shape	symbol type	Connection types (relationship types)			
			type	type	type	No.
ITIL process	 + assigned model	Value added chain	Value added chain	Is pre-decessor of	Value added chain	1
Process step	 + assigned model	Function	Function	Is pre-decessor of	Function	1

Figure 10. Symbols of the operational view

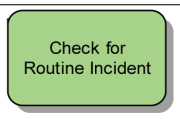
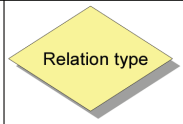
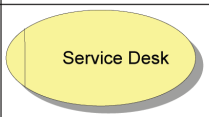
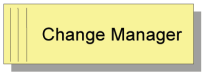
itSMF element	Symbol / Shape	symbol type	Connection types (relationship types)			
			type	type	type	No.
Activity		Function	Function	Is pre-decessor of	Function	1
Infor-mation element Entity		Entity type	Entity type Entity type	reads changes	Function Function	1 1
Infor-mation element Relation		relationship type	relationship type relationship type	reads changes	Function Function	1 1
Ressource		File	File Function	delivers Input for creates output on	Function File	n n

Figure 11. Symbols of the organizational view

itSMF element	Symbol / Shape	symbol type	Connection types (relationship types)			
			type	type	type	No.
Organi-zational unit		Organizational unit	Organi-zational unit	Is composed of	Position	n
Role		Role				
Position		Position	Person	Is assigned to	Position	1
Person		Person	Person	Performs	Role	n

defined (e.g. upper and lower case, use of special characters, etc.).

New object names have to be added to the central dictionary using a defined process including an owner for the dictionary, who is responsible for the overall maintenance process.

Clear conventions for the use of modelling file names ensure a structured file deposit and supports model versioning by indicating the actual version (e.g. version number x.y with x for main version of a model that is agreed upon by the whole community, y for intermediate results agreed upon by the special interest group and z for individual changes).

Layout

If not already predetermined by the modelling tool, conventions were defined regarding the layout. These conventions include, among others fonts, colors and arrangement of symbols.

Change Management and Versioning

Changes to the process models are controlled by a change management process. A clear assignment of work packages has taken place during the process modelling. Intermediate results were agreed upon by the respective special interest group under the management of the respective special interest group leader. These model versions were presented, discussed and finally released by the community during the regular community meetings.

Modelling versions are clearly marked using the file name (see name convention) and all changes are described in a change history log.

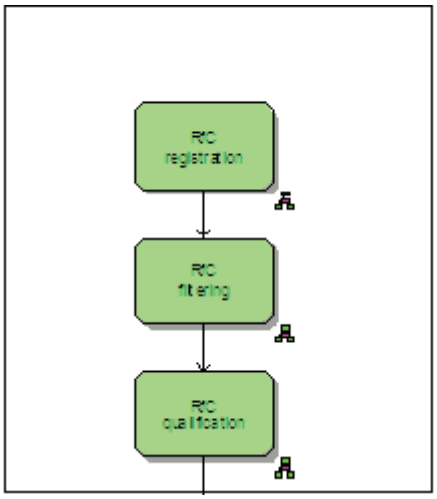
MAPPING OF THE GUIDELINES OF MODELLING (GOM) TO THE PILOT MODEL

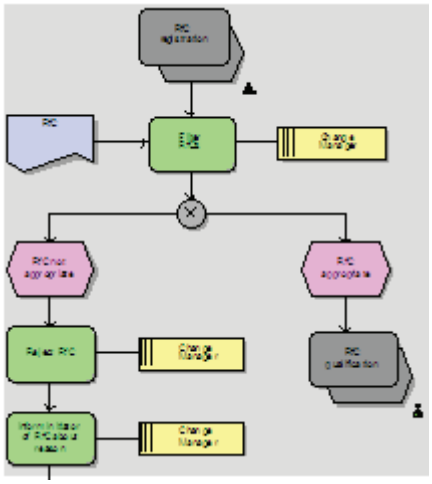
Basics

After the metamodel had reached a mature status, a process model was constructed according to these guidelines. The pilot was the Change Management process according ITIL v2 and that process was created in numerous sessions with different experts. The result is represented in the figures 12 – 16 in this chapter.

However the purpose of this section is not to show the results in detail but to demonstrate how the constructors of the model comply with the GoM. The Guidelines of Modelling and the six

Figure 12. Naming convention for level 3 and 4





constituting principles were published in 1995 by Becker, Rosemann and Schütte (Becker/Rosemann/Schütte 1995), expanded by Schütte in 1997 and 1998. The application of the principles by different modelers should result in models, which are consistent and can be merged to bigger process models even if they were produced by different persons. As a prerequisite, the modelers need to agree on a set of common arrangements like a metamodel and a thesaurus which have to be applied in the process of modelling. Also the models should emerge in a way, that they can be understood by the recipient to whom they were addressed.

These are the six principles:

- principle of correctness
- principle of relevance
- principle of economics
- principle of clarity
- principle of comparability
- principle of systematic construction.

In the following section, the application of these principles in the pilot model will be discussed.

The Principle of Correctness

The principle of correctness comprises of a semantic and a syntactic component. The syntactic component is covered mainly by a metamodel, which describes all notations and the elements of the syntax. The metamodel was implemented in a modelling tool and used for the pilot model.

The semantic component is covered by the application of naming conventions and the application of a thesaurus. The thesaurus was made available by the itSMF UK (See bibliography).

The naming convention describes how subprocesses or activities have to be named on the respective levels of the process decomposition. The lower levels are using verbs to demonstrate the operational characteristic of the level, while the higher levels use nominalizations to differ from the lower level.

The Figure 12 shows an extract from level 3 with the names i.e. “RfC Qualification“ while the drill down to level 4 for this activity expresses the operational level with the verbs like “Filter RfC“ or “Reject RfC“.

The Principle of Relevance

The principle of relevance is referring to the purpose of the model, the adequateness of the model language and the relevance of the elements to the model. Depending on the target audience it is important to use the appropriate modelling language: from a business perspective it is a proven technique to use eEPC or BPMN notation to represent processes, while for simulations a Petri net may be the language of choice. To select the right language is an important factor to produce a model which is readable for the target audience.

To comply with this principle, the notation of eEPC was selected and a subset of the shapes, which the tool provided, was selected for the model. This subset was expanded by some shapes for specific dimensions like the service level dimension, as described earlier.

Schütte (1998, 4) stresses the importance of consensus between the involved experts for the construction of a model. Starting with the definition of the purpose of the model and the problem to be solved with the model, consensus between the experts is a key element. To achieve this consensus is a time consuming exercise, but an important experience.

The intention of the special interest group and the scope of work were published in conferences for several times, the last time at an IIR conference in 2008. The intention was to show the dimensions process and organization, not other dimensions like data or IT.

To achieve consensus was an important goal of the special interest group, to come to that point it took numerous sessions and telephone confer-

ences. The model was constructed online using collaboration tools, the extracts in this publication show the most recent version.

The Principle of Economics

This principle is not described in detail by the inventors of the GoM, however the importance of such a principle is evident. The authors of GoM refer to general economic principles and the re-usage of models such as in reference models.

For the purpose of the exercise described here, the compliance with this principle was achieved by a clear scope, and a systematic approach: first the metamodel was created, afterwards the manual of conventions and finally the model of the change management process. All these aimed to reduce the effort for other modelers. And finally the portability of the model into another tool is also tied to this principle.

However in practice, one aspect was not guided by the principle of economics, but other psychological aspects like group dynamics: the discussions to achieve consensus were so time-consuming, that the desired expansion of scope to all the processes of IT service management according ITIL could not be achieved.

The Principle of Clarity

Models are representing an extract of reality, using a language for the construction of the models. However the results should be readable and understandable by the addressed target audience. To achieve compliance with the principle of clarity, it is necessary to represent the complexity in an adequate way and construct the model as simple as possible. Design guidelines in the handbook of conventions are elements to comply with this principle.

In the model, it is important to keep the semantics in the wording and the notation (including syntax) synchronized. The following Figures 13 and 14 show an example. In the activity „Filtering“, the formal correctness of a RfC is being checked, in the next activity the RfC is being qualified and distributed to the appropriate queue for further processing. These processing queues are represented on level 3 in separate branches according the qualification of the RfC.

Per branch different activities need to be applied to the RfC, and different organizations or groups need to be involved to gain approval for the RFC. Semantics, notation and syntax in level 3 and level 4 reflect the same circumstances and represent these appropriately according to the level.

Figure 13. Extract from level 3

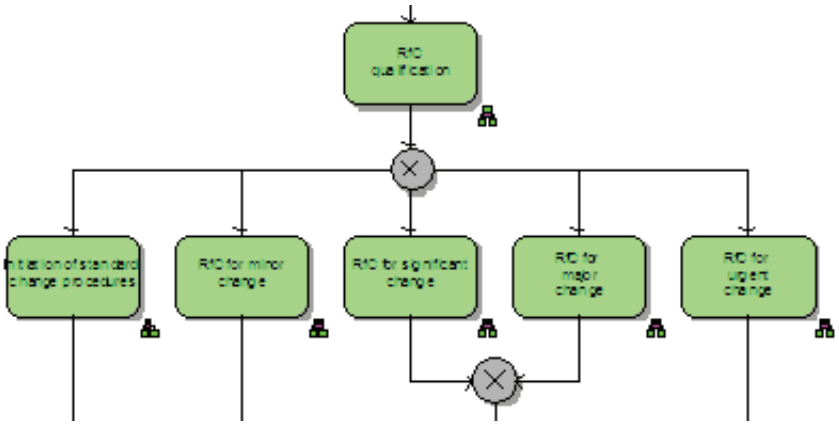
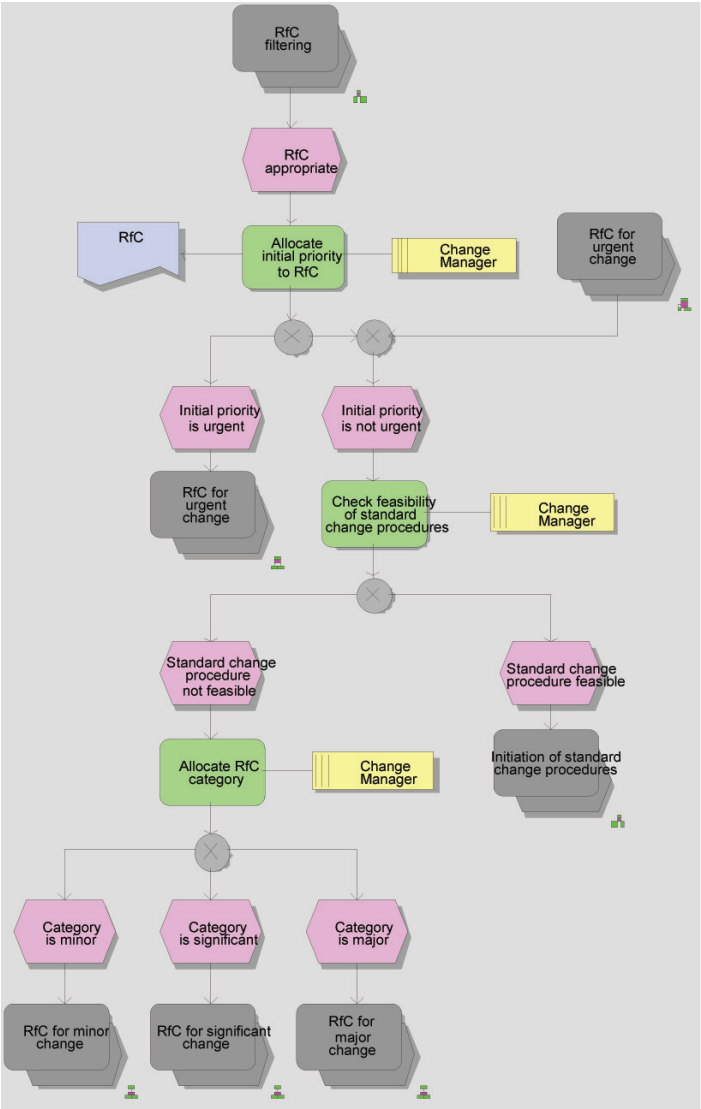


Figure 14. Level 4 with process interfaces



An element to improve the readability of the model was the avoidance of retraces on level 3, i.e. a retrace from the activity "Urgent RfC" back to the step qualification. Retraces were not represented in form of lines however represented as process interfaces in level 4 as is visible in figure 14.

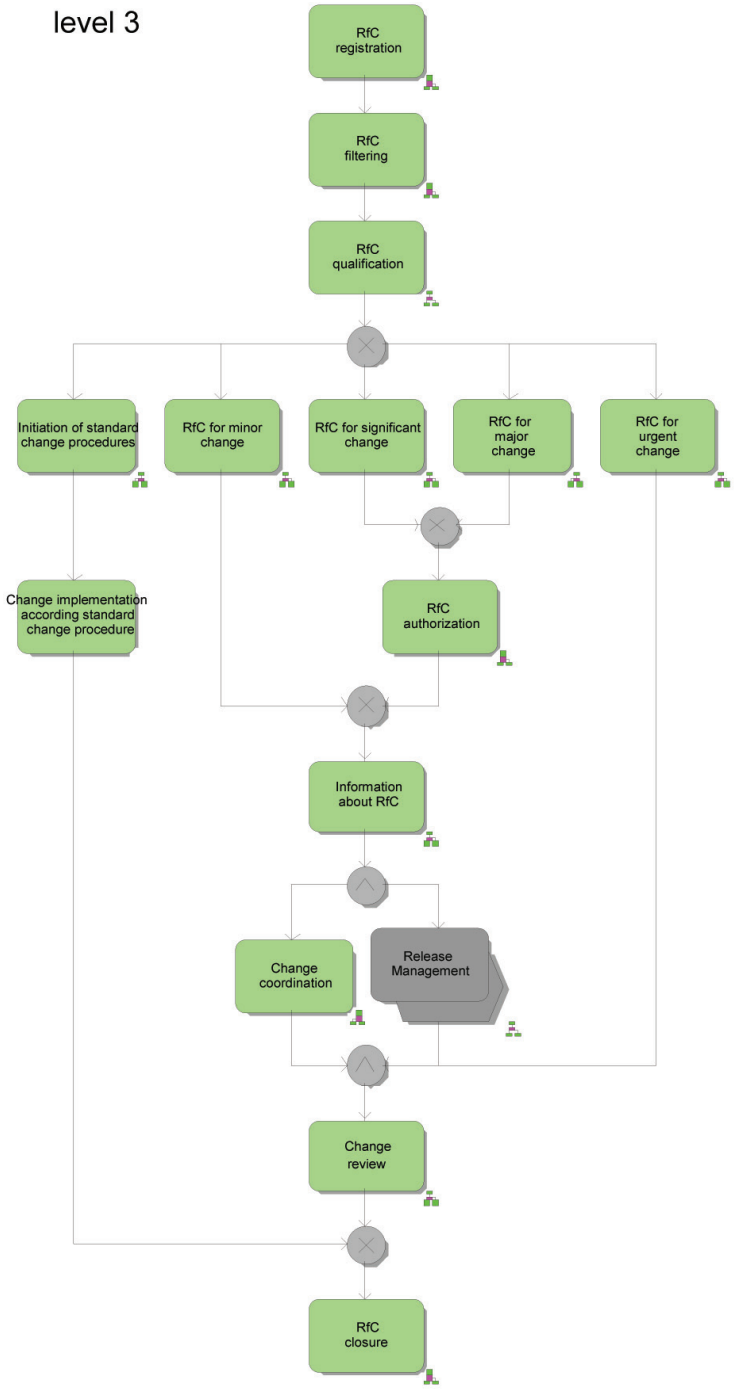
An important element to enable systematic modelling and drill down capabilities is the definition of levels. This definition enables the decomposition of an enterprise wide model with a high level process map down to detailed and granular work flows representing operative doing.

For the defined levels, standards how to use the notations are existing. There are also recommendations, which additional contents per level can be added and add value to the respective level. Metrics make more sense on the granular levels, while KPIs demonstrate the performance of a process and are of better use in higher levels than in lower ones.

The Principle of Comparability

This principle addresses the comparability from a semantic perspective and also the portability of a model into other methods i.e. from eEPC into Petri nets. In this case the model was manually transferred to another tool with a different notation – BPMS – and thus the portability checked.

Figure 15. Process model constructed with standard tool and implemented metamodel



The results showed, which value other tools or notifications might add to a model. The other tool was used with its off-the-shelf capabilities. The metamodel was not implemented although the tool has the capability to implement a metamodel.

The Figures 15 and 16 show the change management process in the two tools in level 3 and the congruency is easily identified. However the tools show differences, the second tool delivers an interesting representation with swim lanes, which shows the relation to the organizational dimension and helps to analyze the flow of information and documents through the organization. It also supports the analysis of a process from a process cost perspective as cost drivers and organizations can be associated easily and calculated. The first tool contains the organizational dimension as part of level 4.

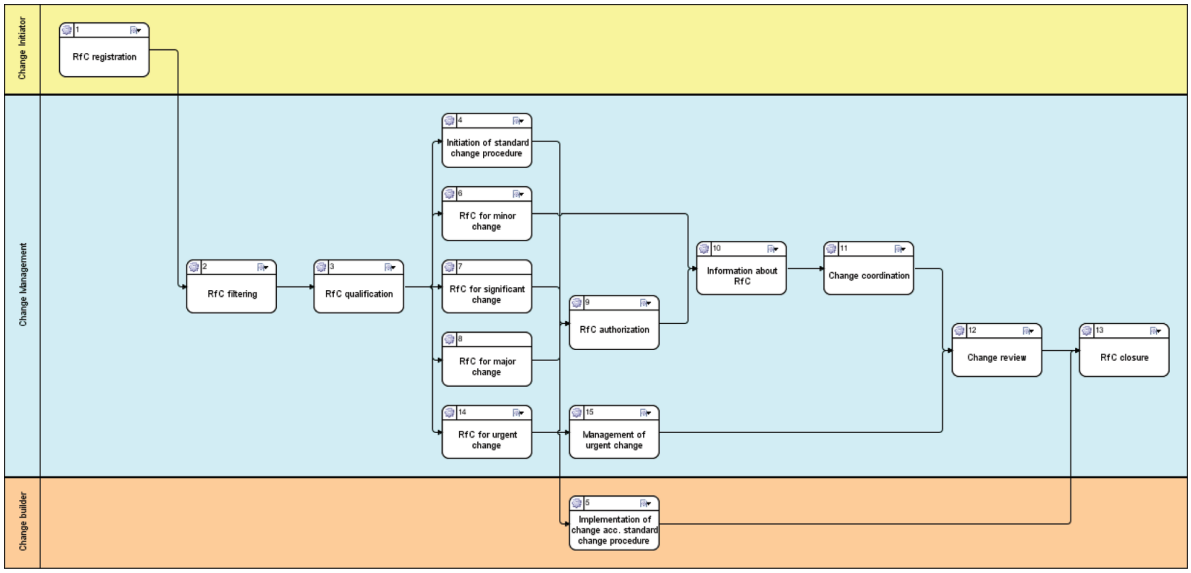
The Principle of Systematic Construction

This principle aims to ensure, that for all dimensions, a consistent architecture is available, i.e. one for the organization, one for IT or one for the service level dimension or every other dimension which is used in the model. The availability of the respective architecture ensures, that within the model all elements can be referenced which are described in their architecture.

Regarding the organizational dimension, the ITIL library delivers no structured organization, but role descriptions, which do not relate to hierarchical relationships. For that and other reasons, an own diagram for the roles was not used: There were also too few roles for the change management process in scope, and the relation between these roles was not specified.

However all these roles were defined and the activities were referenced to these roles. Depending on the set up of the tool, the referencing happened on different levels: on level 4 or level 3 depending on the tool. The roles were represented in the tools as objects and they were consequently referenced where appropriate.

Figure 16. Process model with second standard tool without implemented metamodel



EXPERIENCE AND OUTLOOK

Experience

The special interest group "operational service management" was founded in 2005 as a think tank within the German Chapter of the itSMF. Its initial idea was to get together some ITIL process modeling enthusiasts to share their knowledge and strongly think into the future – to evaluate the current state of ITIL process models and the related transition models for going live. The primary objective of the group was then agreed the "Development of a method to design and model IT processes", whereas the result had to be independent from tool manufacturers, vendors and proprietary standards. The secondary objective was to proclaim the joint effort & consensus in the community promoted by stringent "democratic" collaboration.

Because the work in the group was voluntary, all members of the special interest group depended on the support of their employers or were self-employed absorbing the opportunity costs. Looking back, the special interest group was very effective in creating and discussing methods due to the theoretical and abstract nature requiring more intellectual work. Content was difficult to create in the group because it requires time for actual and concrete documented work, few were able to put in efforts, without receiving an immediate kickback. The special interest group made the commitment to create a jointly agreed result and not accepting the work of a single person, since this would simply create another ITIL dialect and not an independent high level language.

One of the biggest challenges was intellectual property. Because of the fact that the special interest group was started within the German Chapter of the itSMF, all the results would become property of the itSMF. Many consultants' core capability is the knowledge of closing the gaps in ITIL, therefore consultants and companies were very reluctant to handing out information, due to personal or legal restraints with their employer. Many of the temporary group members were merely trying to gain knowledge without much contribution – others were disappointed that their specific need or view dissolved in the lengthy community discussions. Some of the members attempted to spin off with the topic and integrate the insights into their own consulting portfolios. The many opposing objectives and expectations in the group led to many unfortunate discussions, also powered by the chance of an individual business model for some members. The shortcut to develop the content by a few people was not taken even though tempting at times.

Motivating the employers or participants in the special interest group for a long time was difficult, since results were not produced on a short term. The objectives of the group were rather complex and the group only met quarterly (with the exception of biweekly telephone conferences for some time to develop content). Hence the special interest group experienced a permanent change of members. This lead to many setbacks, since discussions that were already done were restarted. On the other hand, new members delivered valuable new insights to the topic. Nevertheless the special interest group was perceived as an exchange platform; therefore this objective was fully met.

Outlook

As time went by and the understanding of the difficulty of the initial objective became more transparent, the focus shifted from a metamodel-based approach to the pilot model. And the ambitious goal to create a reference process model based on ITIL could not be achieved within this special interest group. The group has attempted much to gain the initial objective – some of the paths travelled were not successful – others were. Compared to other frameworks and standards, ITIL has one significant problem: the methods and the content of ITIL do not fully correspond or require one another.

What kept the special interest group going? The final and temporary results were presented on a regular basis within itSMF conferences and outside presentations. Participation was always high and interest in the results was surprisingly high, signaling an ongoing need for the group. Many of the audience members became members or discussion partners for the special interest group, delivering new ideas. The feedback for the necessity of the special interest groups was an ongoing source of inspiration and motivation. Again, this was vital for the group because there was no direct (financial) kickback for the contribution, the work was fully voluntary.

The group must be seen as a very fruitful medium to discuss and exchange the problems associated with ITIL. The itSMF Germany has established a community to talk about theoretical constructs without being in an academic environment.

In the end, a new plan was formulated to reach out to the initial goal the special interest group had. A fundamental finding was the special prospects of collaborative versus cooperative modeling. Collaborative modeling means working on the same time together on the same object versus cooperative modeling where time and object may differ. The special interest group has learned much about collaborative modeling as for example how this is a potential enabler for process reengineering because it is a valid approach to overcome the innate problems of modeling: that reality and model start to differ in the course of time and getting both together requires much effort. By constant collaboration, we found out that the constant diverse and often contradictory input of everybody in the group created an imminent gravitation back to the real operational processes. The group eventually realized, that the initial stage based approach defined in Figure 1 is not optimal, even though popular, because it is fully separating the design and the implementation process.

The objective of the group has moved from an elaborate and complete reference model to contributing something of value to the itSMF community. It was always the core pretention of the group to deliver something tangible to be distributed through the itSMF and creating an added value for all itSMF members.

One of the results is offering trainings that deliver the experience and results of the group to a bigger audience. These will be offered via the itSMF to spread the lessons learned and content according to the itSMFs fundamental principles of pushing service management forward.

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Chapter 8
Continual Process Improvement Based on ITIL and Process Mining

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ABSTRACT

The inherent quality of business processes and their support through information technology (IT) increasingly plays a significant role in the economic success of an organization. More and more business processes are supported through IT services. In order to provide IT services with the required quality and at minimum costs, the importance of effective and efficient IT service management (ITSM) processes is crucial. In this contribution, the authors present a new approach, which allows the continual process improvement by the interconnection of the ITIL reference model, the 7-step improvement process, and process mining. On the basis of the reference model, to-be processes are set and key indicators are determined. As-is processes and their key indicators derived by process mining are subsequently compared to the to-be processes. This new approach enables the design, control, and improvement of ITIL based customer support processes, which will be trialed in practice.

INTRODUCTION

Reference models such as ITIL and COBIT (Control Objectives for Information and related Technology) represent proven best practices and provide key indicators for the design and control of ITSM processes. The idea behind the development of ITIL is the recognition that organizations are becoming increasingly dependent on IT in order to satisfy their corporate aims and to meet their business needs (Office of Government Commerce, 2007). The integrated view on business and IT has evolved from a more process-oriented view of ITSM to a consequent service lifecycle

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approach. This new approach lines up still more strongly upon the business requirements. Instead of executing a collection of processes efficiently and effectively, ITIL v3 pursues the aim of integrating ITSM processes, people, and tools with the business strategy according to the IT service lifecycle. What becomes clear throughout the whole lifecycle is the orientation of the IT services at the business requirements and the actual need of the customers.

ITSM has therefore risen to the major challenge of aligning the IT services with the business and to produce high-quality IT services. The IT services are offered to customers and provided to users by an IT service provider. Within the last years, the number of organizations, which act as service providers, has increased due to the popularity of shared services and outsourcing. This in turn has strengthened the practice of service management and at the same time imposed greater challenges upon it (Office of Government Commerce, 2007). In today's highly competitive environment, the IT service providers are on the one hand judged on their ability to deliver in time and at agreed service levels. The enormous pricing competition further puts pressure on them to reduce total costs of ownership in order to provide their services at an adequate cost-benefit ratio. The business environment on the other hand often increases the frequency, complexity, and the extent of changes and, thus, requests utmost flexibility with respect to the IT services and the customer requirements to ITSM.

Because of these pressures, quality enhancement and cost reduction have become mainstream thinking of IT service provider. Not only it is important that this commitment to quality and costs is targeted to the production processes, but also to the IT service management activities. A vivid demonstration of the importance of the quality of both IT services and ITSM processes is the internet service provider (ISP), which represents a special variant of an IT service provider. Since IT-based internet services are its products, IT processes moves beyond support processes. As a result of the relevant IT production processes and ITSM processes being the production processes of the ISP, the importance of IT services and ITSM processes is considerably higher.

To deliver and maintain services in a timely, cost-effective and reliable manner, organizations are advancing the automation of their ITSM processes and making use of emerging technologies. Considering that by now a considerably high effort is put into the aim to continually improve the process quality it is of equal importance to develop further the "continual improvement process" itself. This is required for both continuity and cost effectiveness of an efficient process management. Also the automation not only of the operational processes themselves but also of the process management activities is a prerequisite for high maturity levels (The IT Governance Institute, 2007). Process mining, for example, facilitates the analysis of processes by extracting a process model from log files, which have been recorded during the execution of the ITSM processes. Process mining also opens a considerable potential of automation, whose utilization can vastly improve cost and time factors.

ITIL can be used with existing methods and tools, especially since this framework strongly recommends that organizations adapt its practices within their own context. Therefore, the question arises how procedures and emerging techniques, such as process mining, can be seamlessly integrated into ITSM processes in order to continually improve ITSM processes.

In front of this background, this publication analyzes how ITSM processes can be improved on the basis of ITIL and process mining. Section 2 initially describes the fundamentals of ITIL and process mining and incorporates a literature review. Section 3 opens up with an initial discussion on the controversies and problems with quality management of ITSM processes. Next, the possibilities of quality management based on ITIL and process mining are explained through

an example of the incident management, a central ITIL service operation process. Section 3 closes with the design and control of an ITIL-based incident management process of a German ISP. Afterwards, Sect. 4 describes the central conclusions, which were reached in the implementation in practice. Finally, this contribution ends with addressing future research directions.

BACKGROUND

This section provides broad definitions of ITIL and process mining and incorporates views of other researchers into the discussion of the continual processes improvement.

Fundamentals

This section introduces ITIL and process mining.

ITIL

The British Office of Government Commerce (OGC) has been developing a process-oriented collection of best practices for design, control, and improvement of IT services since 1989. The focus of the best practices is the consequent orientation based on customer demands. ITIL has developed into a de-facto international standard. In the third version, the contents are described in an anthology of five books, which illustrates the entire lifecycle of IT services.

The book *Service Strategy* (Taylor, Iqbal & Nieves, 2007) comprises the strategic elements of ITSM and outlines the connection of IT services to business requirements. Design methods of IT services are introduced in the book termed *Service Design* (Taylor, Rudd & Lloyd, 2007). The volume *Service Transition* (Taylor, Lacy & Macfarlane, 2007) describes the actions to develop necessary abilities to implement new or altered services. Duties in the management of service operation are summarized in the *Service Operation* (Taylor, Cannon & Wheeldon, 2007) publication. Lastly, the book *Continual Service Improvement* (Taylor, Case & Spalding, 2007) provides instruments for both the adaptation of IT services to the constantly changing business requirements and efficiency improvement of the IT services. Each lifecycle consists of integrated processes. The processes within the lifecycle *Service Operation* and *Continual Service Improvement* are described in detail in the "Procedural Model of IT Service Operation according to ITIL" in Section 3. Since the other lifecycle periods are not in the focus of our contribution, we refer interested reader to the respective books.

Process Mining

Process mining can be considered as specific data mining, the goal of which consists in the extraction of process knowledge from large data pools. Initial origins are the recordings of goal-oriented process execution culminating in process knowledge, which consists of the information as to what, how, when and where something had to be done. This knowledge is automatically derived in the form of process models (van der Aalst, Dongen, Herbst, Mâruşter, Schimm, Weijters & Alves de Medeiros, 2003; Alves de Medeiros, 2006) showing the ordering and frequency of activities. Additionally, process mining can be used to actualize the process models of an information system (IS) to display changes and to analyze process knowledge from various perspectives (van Dongen, Alves de Medeiros, Verbeek, Weijters & van der Aalst, 2005). The control flow describes the sequence in which single activities are executed. A point of view, tailored to the organization, reconstructs a behavior of the entities who are executing respective activities. The instance perspective examines the specific process execution. Within our study, we selected the process mining platform ProM (van Dongen, Alves de Medeiros, Verbeek, Weijters & van der Aalst, 2005), developed by the Technical University of Eindhoven.

The Mining Extensible Markup Language (MXML) format is designed to store the recordings of the process execution. MXML is a generic XML-based format, which serves as an input format for all process mining algorithms available in ProM. The root node of each log file is the *WorkflowLog*, which can contain several *Processes* and optional information about its *Source*. Each *ProcessInstance* can have an arbitrary number of *AuditTrailEntries*. The *AuditTrailEntries* represent the events of the process. They are assumed to be in chronological order. The *WorkflowModelElement* describes the process activity. The *EventType* delineates the state change of the *WorkflowModelElement*. Every level of the hierarchy has the optional element *Data*, which can be used to store additional arbitrary information.

Literature Review

Our work can be related to different streams of research in the discovery and verification of process models. Checking compliance assumes the presence of a given process model. Therefore, process mining, which aims at the discovery of such a process model, is closely related to the work presented in this chapter. Various algorithms (van der Aalst, Dongen, Herbst, Mâruşter, Schimm, Weijters & Alves de Medeiros, 2003) have been developed to discover different types of models based on a log file. For more information on process mining we refer to a special issue of Computers in Industry on process mining (van der Aalst & Weijters, 2004) and a survey paper (van der Aalst, Dongen, Herbst, Mâruşter, Schimm, Weijters & Alves de Medeiros, 2003).

In the context of process model verification there are several notions for equivalence of process specifications such as behavioral equivalence (van Dongen, Dikman & Mendling, 2008; van der Aalst, Alves de Medeiros & Weijters, 2006), trace equivalence (van Glabbeek & Weijland, 1996), and bisimulation (van Glabbeek & Weijland, 1996), which have been developed. The classical equivalence notions like bisimulation or trace equivalence are defined as a verification property, which yields a yes-or-no Boolean, but no degree of equivalence. When comparing a reference model with a process model, it is not realistic to assume that their granularities are the same. Therefore, the equivalence analysis with classical equivalence notions will most likely not be equal. Notions searching for behavioral similarity, e.g. causal footprint (van Dongen, Dikman & Mendling, 2008) and fitness function (van der Aalst, Alves de Medeiros & Weijters, 2006), are applicable in the context of process mining. In (van Dongen, Dikman & Mendling, 2008), the authors introduce an approach for determining the similarity between process models by comparing the footprint of models. The footprint identifies two relationships between activities that are called look-back and look-ahead links and returns the degree of the process similarity expressed in [0, 1]. This value is little expressive and hard to explain. It is not possible to trace the missing or dissenting activities. Since traceability is an important requirement of the continual process improvement, the approach is not suitable. In (van der Aalst, Alves de Medeiros & Weijters, 2006), the authors introduce the behavioral and the structural precision and recall. The behavioral equivalence approach compares a process model with respect to a particular behavior, which has been recorded in log files. The structural precision and recall equate the term "structure" with all instances, which may occur in a process model. We introduce the corresponding fitness function in Sect. 3. For a detailed overview of existing equivalence notions we refer to (van der Aalst, Alves de Medeiros & Weijters, 2006).

The work presented in this chapter can furthermore be related to process improvement and process compliance. The notion of compliance has also been discussed in the context of business alignment (van der Aalst, 2005) and process redesign (Măruşter & van Beest, 2009). It can be stated that the utilization of process mining

is not yet causally related to continual process improvement, though. A promising approach for quality improvement in compliance is, however, IT supported compliance evaluation (Sackmann & Kähmer, 2008).

MAIN FOCUS OF THE CHAPTER

This section introduces the main issues, controversies, and problems and discusses solutions as well as recommendations in dealing with the identified issues and problems.

Issues, Controversies, Problems

Reference models offer a set of generally accepted processes, which are sound and efficient. Their adaption is generally motivated by the following reasons: First, they significantly speed up the design of process models by providing reusable and high quality content. Second, they optimize the design as they have been developed over a long period and usually capture the business insight of experts. Third, they ease the compliance with industry regulations and, thus, mitigate risk. Fourth, they are an essential mean to create a link between the business needs and IT implementations (van der Aalst, Dreiling, Gottschalk, Rosemann & Jansen-Vullers, 2006).

Reference models have to be adapted to the organizational needs. Behind this tailoring we identified two reasons: For one thing recommendations are frequently specified in natural language, and for another, reference models are often partially applied or they are used with other best practices compositely (Kütz, 2009). The combination of ITIL with COBIT provides a pertinent example. There is no denying the fact that reference models are useful, but to which extent are these best practices adapted and implemented in a specific business context? Another challenge lurks in the checking of reference process execution as well as in assuring compliance of ITSM processes with changing business needs.

To answer these questions, organizations require transparency of their ITSM processes. However, in many organizations, a description of the processes is not or only insufficiently available, the reason often being a time-consuming, fault-prone, and generally expensive process modeling stage. Very commonly, the process model is not maintained after the implementation, so that it no longer corresponds with operational reality. Also the implementation within the workflow management system (WfMS) might vary unintentionally from the documented to-be processes. Additionally, organizations require transparency of the performance of the ITSM processes. Organizations have the ability to measure the efficiency and effectiveness of their ITSM processes with key indicators. Target value compliance allows detection of whether the reaching of a process goal might be jeopardized.

The lifecycle *Continual Service Improvement* provides instrumental guidance in creating and maintaining value for customers through better design, transition and operation of services. However, it should be further stressed that the degree of automation in the active handling and development of the ITSM processes is still unsatisfying. Key sources of problems are missing or unexploited tools between the various perspectives and the various stages in the lifecycles of processes. Typical examples are incompatible representations of the managerial perspective versus the working level perspective or the gap between normative modeling for compliance purposes and the actual execution of a workflow.

Solutions and Recommendations

The issues and problems presented in the preceding section can be solved through continual process improvement (CPI) process by the interconnection of the ITIL reference model, the 7-step improvement process, and process mining. To explain

our approach in detail, we start explaining the possibilities and potentials of the CPI based on ITIL and process mining through an example of the incident management process. Afterwards, we verify our approach with an industrial application of an ITIL based incident management process of a German internet service provider (ISP).

Continual Process Improvement in Concept

Using the example of an incident management process, a central ITIL service operation process, we will describe how a process conforming to ITIL criteria, is actively managed based on process mining.

Today, numerous organizations with intensive customer and user contact already use ITIL based processes for the optimization of their IT services. Since the focus of this publication is the continual improvement of ITSM processes, the lifecycle phases *Service Operation* and *Continual Service Improvement* are described.

Procedural Model of IT Service Operation according to ITIL

The interface to the user is represented by the service desk. Its duties include the receiving, processing, and monitoring of incidents and service requests. The goal of incident and problem management is to identify complications from which malfunctions arise and to solve them or even better to take preventive actions. In this context incident management concentrates on restoring unexpectedly disrupted services as quickly as possible, whereas problem management focuses on sustainable improvements to prevent future problems. Request fulfillment process is a separate process similar to the incident management process but with separate request fulfillment records to handle service requests (Taylor, Cannon & Wheeldon, 2007). Access management is the process of granting authorized users the right to use a service. Event management monitors normal operation in order to detect and escalate exception conditions. Service operation processes are accompanied by functions, which sustain a stable infrastructure and appropriately skilled workforce. Technical management provides detailed technical skills and resources needed to support the ongoing operation of the IT infrastructure. IT operations management executes the daily operational activities. Application management is responsible for managing applications throughout their lifecycle (Taylor, Cannon & Wheeldon, 2007).

Procedural Model of IT Service Improvement according to ITIL

The volume *Continual Service Improvement* demands a continual improvement of IT services. We will adapt this procedural model to continually improve ITSM processes. In order to control either IT services or IT processes, it is of utmost importance to understand what and why something needs to be measured: First, verification of key goal indicators (KGIs) and target values needs to be performed in order to determine whether process goals and associated effectiveness will be reached (The IT Governance Institute, 2007). Key performance indicators (KPIs) define measurement ranges, which, in conjunction with trend data and benchmarks, display whether process performances endanger the reaching of a process goal and its associated efficiency. Key indicators include, for example, the number of incidents and the reaction time. The permanent confrontation between to-be and as-is condition is delineated in seven steps (Taylor, Case & Spalding, 2007):

1. Define what should be measured: Define criteria and goals through the design of processes, while simultaneously verifying the process in respect to quality, performance and compliance.
2. Define what can be measured: In the framework of given goal obligations, relevant boundary numbers are identified from the

requirements of business processes: IT resources and available budget.

3. Gather the data: Data aiding in the identification and proving of causes for deviation is collected.
4. Process the data: In order to compare findings from dissimilar sources, data has to be transformed into a consistent format.
5. Analyze the data: Key indicators are integrated as measurement points in the process management and analyzed periodically while always displaying them as a trend and in contrast to the to-be values. In the framework of such benchmarking, a common basis for comparison needs to be assured.
6. Present and use the information: Necessary corrective actions need to be communicated to the organization and subsequently analyzed according to cost-benefit factors and resulting effects.
7. Implement corrective actions: A thorough implementation plan is devised and implemented according to the recommendations of the ITIL volume *Service Transition*. Subsequently, the improvement process starts anew.

Procedural Model of Service Operation based on Process Mining

Figure 1 shows the procedural model based on process mining. Many organizations use IS for the support of their ITSM processes, which are configured based on to-be process models M_2 (2). Process models formally describe business processes. Reference models M_1 provide initial hints for the implementation of these processes (1). ITIL, SCOR (Supply Chain Operations Reference Model), or COBIT are, amongst others, examples of reference models. At the beginning of a process execution, an instance is decided, which may consist of various activities (3), for example the receiving of a user's incident. Generally, the execution is recorded through the IS and saved in log files (4). Figure 1 shows that all instances are recorded with the exception of process P_b. Log file L_a solely contains activities A and B since activity C is manually executed. For the formalization of the log files, MXML (van Dongen & van der Aalst, 2005), required by ProM, is used. On the basis of log file L_u, the process mining engine derives the implicitly present knowledge (5) in an as-is process model M_3 while considering key indicators and goals. The evaluation engine (6) compares the as-is processes M_3 with the reference model M_1 and the to-be process model M_2, aiming to continuously determine the degree of compliance of the latter. Therefore, as-is processes may be analyzed with respect to weaknesses and potential sites of improvement. Furthermore, being integrated into the procedural model, maturity models determine the level of quality of the customer support process and provide action recommendations to improve process quality. According to each level of abstraction, an adaptation on either a model level M_1 or M_2 or an instance level may be necessary (Gerke & Tamm, 2009).

Continual Process Improvement based on ITIL and Process Mining

Figure 2 represents a two-phase approach to continually improve ITSM processes. Fundamental to the approach is the use of process mining and the application of the ITIL-recommended 7-step procedure.

In the first phase, each ITSM process is continuously monitored as part of the service operation processes. The word "process" implies that it refers to a workflow. The role of operational monitoring and control is to ensure that the ITSM process functions exactly as specified. This is why the first control cycle (CPI 1) is primarily concerned with the verification of key figures (KPIs and KGIs) against target values and with the compliance of the as-is processes with to-be processes. This control cycle inherits steps three to six of the 7-step procedure. All steps are supported by process mining techniques, which allow to automatically measure, compare, and alert the

Figure 1. Procedural model of service operation with process mining (Gerke & Tamm, 2009)

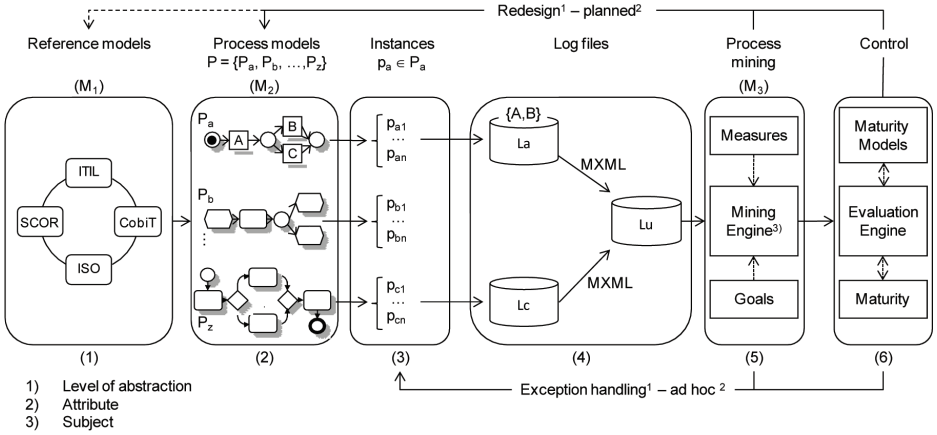
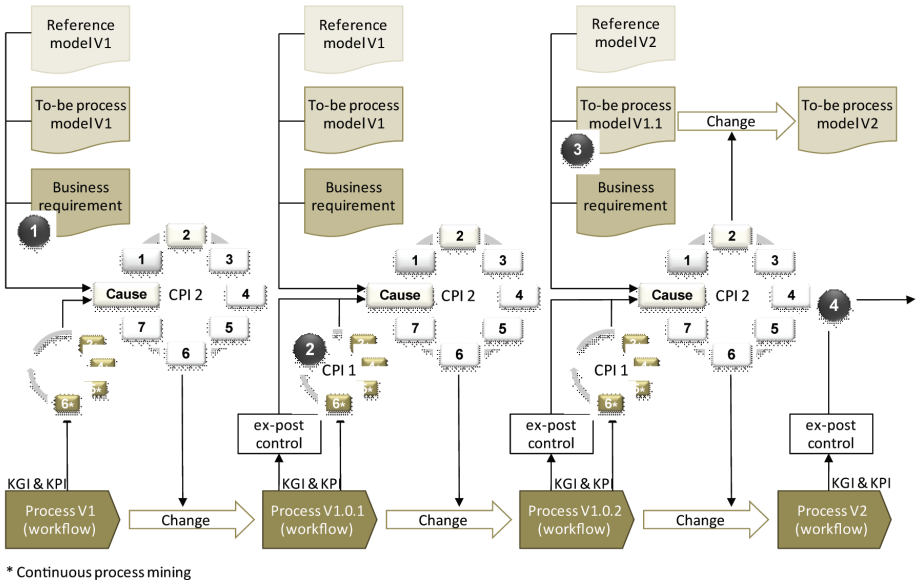


Figure 2. Continual process improvement approach



meeting of the to-be specifications. It follows that this control cycle contributes to a continual inter-departmental and inter-organizational process approach to quality improvement of ITSM processes. Once the process identifies a likely deviation the second phase is triggered. The second phase (CPI 2) is a continual improvement approach, which can be applied in a semi-automated way. It passes through all steps of the underlying 7-step procedure. The phase is also initiated by both changing business requirements and changes in the to-be process model, or the reference model. We have identified four different main changes, which can release the second phase of the CPI.

1. Changing business requirements might entail adapting the design as well as the underlying implementation of the to-be process model. For one thing, it could be that the service

is too expensive, and for another, it could result from the business needs to change the service portfolio. The changes further cause a new definition of the key indicators and the connecting target values for the KPIs and the KGIs. Consider, for example, rising expectations about the 1st kill rate. They might result in additional tool support and obviously in higher target values for the respective KPI.

2. The changes mentioned before can also be initiated by the identification of deviations between both key indicator values and their target values or between the as-is process and the to-be process model. Returning to our example, the continuous control of the adapted target values might reveal the constant underperformance of the 1st kill rate.
3. Finally, the further development of the reference model (i.e., a new version) can also trigger the changes mentioned before. The segregation of incident management und event management in ITIL v3 of the incident management process provides one recent example.
4. The approach supports the ex-post control of measures taken according to the intended success. For example, it will detect whether a workflow step still exists although it was designated to be removed. Deviations can appear, because the corrective actions are not appropriate or executable, or because of a lack of education. The ex-post control enables the process manager to revise or supplement the measure taken.

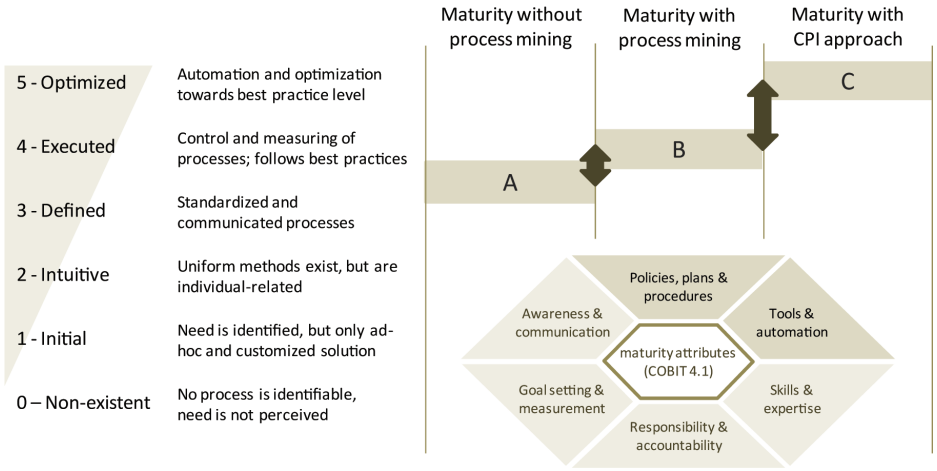
The two-phase approach shows that the quality of the ITSM processes greatly depends on how they are monitored and measured in service operation. CPI may be strived for through various concepts of measurements (e.g., Deming cycle, Six Sigma, DMAIC). For details, we refer to the literature provided in the additional reading section. We applied the ITIL recommended 7-step procedure (Taylor, Case & Spalding, 2007) and underscored the procedure with utilization of process mining.

Since we have already stated that reference models are often used with other best practices compositely, we now prove that the integrated use of process mining within CPI is particularly suitable to improve the maturity level of the ITSM processes from the view point of COBIT. Figure 3 presents the assessment of the maturity of the ITSM process *Incident Management* both without process mining and with process mining, and finally with the CPI approach. The maturity model consists of six maturity levels (0-5). The classification into a maturity level is carried out based on six attributes of maturity (The IT Governance Institute, 2007), which are shown in the hexagon of the figure. As examples of the influence of the attributes on the classification, consider the two attributes *policies, plans & procedures* and *tools & automation*. According to the maturity attributes *policies, plans & procedures,* maturity level four is achieved if the as-is process model M_3 comply with internal best practices. In our case, the internal best practice is represented by the to-be process model M_2. The maturity level rises to level five, if not only internal but also external best practices are applied. The external best practice equals the ITIL reference model M_1. Therefore, the combination of process mining with the ITIL reference model is crucial for the compliance with maturity level five requirements. The maturity attributes *tools and automation* require tool utilization for process management and monitoring at maturity level four, which is addressed by applying process mining. The application of the CPI approach fulfills even the requirements of maturity level five demanding process improvement and automated detection of control exceptions.

Continual Process Improvement in Practice

The service management of a German ISP was analyzed for its IT service production. The ISP

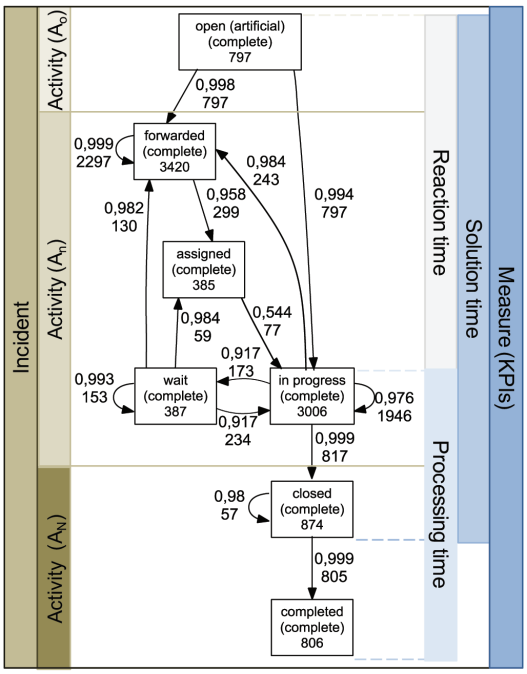
Figure 3. Maturity assessment of the ITSM process incident management



manages both incidents and service requests, and also handles communication with the users via a service desk. After a service request has been reported to the service desk a ticket is opened in the WfMS, which is initially handled through the incident management process. The ticket is passed through various processing steps until the incident is disposed or the problem is solved and the ticket can be closed. In general, the processing consists of the steps *Receive incident*, *Categorize incident*, *Analyze incident*, *Resolve incident*, and *Close incident*. During the ticket flow, the WfMS stores information of the actual processing status as well as the corresponding time stamps in a history of action. In addition, the support groups involved with the incident handling will fully document all details of any actions taken to try to resolve the incident, such as the originator of the action, the affected service, the concerned product, the description of the incident, the prioritization as well as the solution statements, and if applicable, cross references to master and slave tickets. The underlying process has a structure, which captures all possible actions of the WfMS. We refer to this structure as the transaction schema, which is depicted in Figure 4.

The schema was derived from the history of action by the process mining algorithm *Heuristics Miner* (Weijters, van der Aalst & Alves de Medeiros, 2006). As we found two starting actions, we included an artificial start event named *open (artificial)*. When an incident is created, its action is either *in progress* or *forwarded*. The processing of a ticket directly starts with the action *for-*

Figure 4. Transaction schema and its relationship to activities of the incident and measures



warded in case the ticket has been initiated from one technical interface of the event management. The way otherwise is to create a ticket engendering an action *in progress*. After the forwarding, the incident can be assigned to a certain support group. The assignment is documented in the history of action as *assigned*. During the remedy of an incident (i.e., *in progress*) tickets can be related as a slave ticket. A typical scenario is if there is one incident and many users call and open a ticket. In this case, one of the tickets will be the master ticket, and all others are slave tickets, which wait (i.e., action *wait*) until they are automatically closed together with the master ticket. Subsequently, the incident can get closed after it has been solved. The closure action leads to the action entry *closed*. After a final quality assurance the support group has to complete the incident, which is associated with the action *completed*. Regardless of the actions taken, the WfMS records the actions accordingly with all relevant information so that a full history of action is maintained.

The model uncovers the relations between actions and activities, which is pointed at the left hand side of Figure 4. The start action initiates the proceedings of the incident to which we refer to activity A_0. The action types *in progress, forward, assigned* and *wait* succeed the start action and belong to one activity. An optimal incident management process goes through at most one of the actions, respectively. The activity is denoted as A_n. In practice, however, we found repetitions of various action types of the activities, which we hereby summarize A_n. For example, it is possible to reassign an activity to a different support group (i.e., *in progress* to *forward*) or to suspend and resume an incident (i.e., *in progress* to *wait)* several times during the ticket flow. The actions *closed* and *completed* belong to the final activity expressed with A_N. This relationship can best be explained by an example. The activity *Incident Creation (in progress)* is followed by the activity *1st Level Support*. The latter activity consists of the processing steps *forwarded, assigned*, and finally again *in progress* before an new activity is invoked.

A further advantage of the history of action is that appropriate measures can be used upon to judge the efficiency and effectiveness of the incident management process, and its operation (Kütz, 2009). The right hand side of Figure 4 provides a prime example of the relationship between the history of action and quality measures. Points in time of the intersection of the actions are used to measure various key performance indicators. For example, the solution time corresponds to the period of time between the opening and the solving of an incident, which is derived by the actions *open* and *closed*. The processing time can be calculated from the solution time less the reaction time plus the time, which is spent for quality assurance and closure actions (i.e., from *closed* to *completed*). We now move on to apply the 7-step procedure based on process mining.

Definition of What Should Be Measured

The successful and efficient handling of incident management counts to the main operational challenges of the ISP. Once a customer or a user voices a complaint, the service operation processes have failed their first objective of incident prevention. It is of crucial importance that potential incidents are identified and prevented prior to negative influence on user experience. Costs for the often staff-intensive activities have to be kept under control at the same time. These aims are closely tied to the goal to optimize incident processing in order to simplify and standardize incident handling. Therefore, the following should be measured:

- The extent of compliance of the ITSM process *incident management* with the ITIL v3 reference model.
- The degree of compliance of the as-is process model and its WfMS support with the to-be process model, which corresponds to the goals of the ISP.

- The efficiency of the as-is process and its WfMS support.
- The effectiveness of the as-is process and its WfMS support.

Definition of What Can Be Measured

Three levels of processes and their descriptions are available at hand: an ITIL based reference model denoted as M_1, a to-be model corresponding to the goals of the ISP to which we refer to as M_2 and an as-is model mirroring the genuine incident processing in the WfMS denoted as M_3.

- Statements about compliance with a specification are derived from the comparison between two models, respectively: The comparison between model M_1 and model M_2 provides insight pertaining to the degree of ITIL compliance of each of them, while the comparison between model M_1 and model M_3 allows an additional analysis of the technical maturity of the WfMS. An evaluation of the compliance of the actual incident management process with the to-be process is made possible through a comparison between model M_2 and model M_3.
- The data required for the analysis of the as-is process model M_3 are extracted from the WfMS. The WfMS is workflow-oriented and aggregates all process activities, which are done by one person in one workflow step. Therefore the as-is process model M_3 is documented on a higher aggregation level than the to-be process model M_2.
- The WfMS provides a complete history of actions for each incident. It is possible to extract the required data from the WfMS in an automated way.
- From the results of the compliance analysis, the as-is condition can be derived and subsequently be contrasted to the to-be condition. Action alternatives for the improvement of ITSM processes can be deduced from the determined discrepancies.
- The calculation of the defined KGIs and KPIs is also done based on the WfMS data. Therefore, the results of the compliance analysis and the key indicators can be considered consistent regarding the base data.
- The utilization of the data from the WfMS also ensures the reproducibility of findings and the comparability of data (a) of different periods of time or (b) before and after changes of the as-is process.

Gathering of the Data

The reference model M_1 was derived manually in the form of an event-driven process chain (EPC) according to the conceptual guidelines of ITIL. Amongst others, various activities include *create incident*, *categorize incident*, and *prioritize incident*. The to-be process model M_2 was similarly conceived in coordination with the ISP. It is based on existing documentations and mirrors the incident collating system, which is aligned with the company's strategy and goals. The as-is process model M_3 has to be derived by process mining. From a large set of the ISP's IT services we selected incidents, which fulfilled our criteria: the incidents needed to be completed within a specified period of time, belong to the service e-mail.

Each processing step in the workflow system produces an entry in the history of action. Each line includes information about the incident, among which are the identification, the point of time, the description of the processing step, the process, the product, the type of incident, the priority, the service, the status, the significance, and the support group. Take, for example, the following processing step. The quality of incident T1580624 was assured at 15:52:49 on the 10th of June 2009. The incident was prioritized *middle* because of its *local* effect on the ISP's customers. The underlying process *Retrieve e-mail from PO Box* belongs to the service *email*. This processing step is executed by the *back office.*

Processing of the Data

From the selected history of action, single events were generated according to the process mining requirements described in (Schonenberg, Weber, van Dongen, Pesic, Günther & van der Aalst, 2007). Afterwards, the events were translated into the MXML format introduced in Sect. 2 by a custom-built converter plug-in for the ProMImport framework. ProMImport facilitates log transformation tasks and provides converter plug-ins for a wide variety of systems. We considered the incident identifier T1580624 as the *ProcessInstance* to which we refer to as the process mining case. A case basically captures the behavior of one particular execution sequence of activities according to the rules of a process model. The description of the processing step corresponds to the *WorkflowModelElement*. The type of incident, the underlying process and service, the priority, and the significance were summarized in the *Data* element, respectively. The support group was mapped to the *Originator*; the status is assigned to the *EventType* and the time to the *Timestamp* element. The log file consists of 797 cases, 8,878 events, and 52 originators.

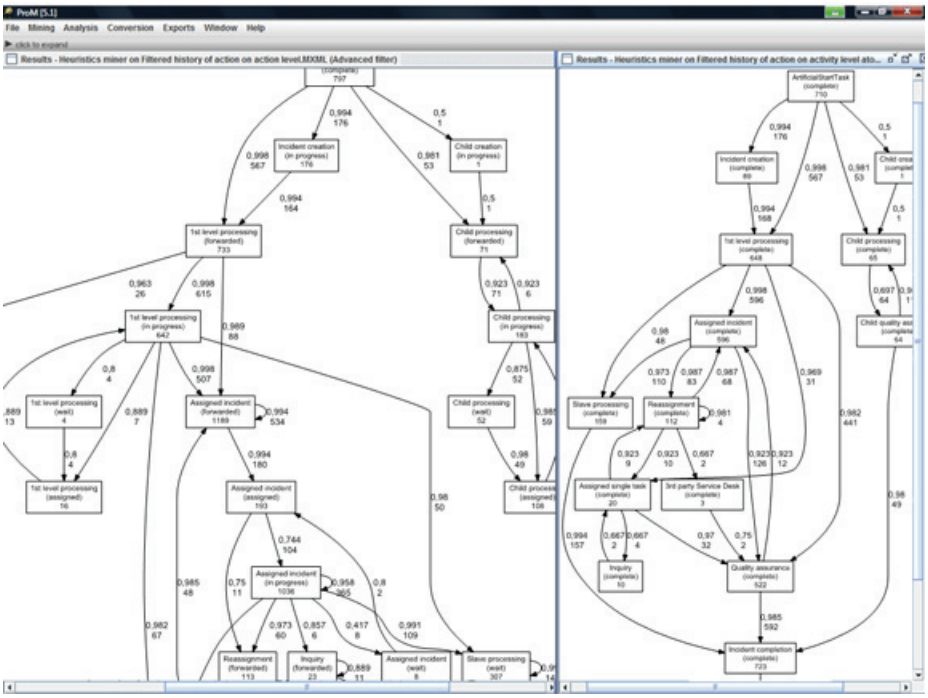
Based on the MXML log file, the as-is process model M_3 was constructed by the *Heuristics Miner* (Weijters, van der Aalst & Alves de Medeiros, 2006). Generally, process mining algorithms imply the presence of noise in the underlying log file, which needs to be eliminated. To resolve the influence of noise, most of the algorithms provide threshold parameters indicating the conditions under which relationships are displayed in the process model. In our case, we do not focus on common behavior but also consider infrequent behavior as it may hint at exceptions or deviations from the specified incident management process. In order to construct a process model, which is able to produce a precise illustration of the behavior in the WfMS, we adjusted the threshold parameters for the Heuristics Miner. Let us take the positive observations parameter. It indicates how often a relationship between two activities needs to be observed to establish a relationship between them in the heuristic net. Consequently, decreasing this threshold parameter reveals more infrequent flows.

Each of the nodes in the heuristic net, shown in the left-hand side of Figure 5, corresponds to an action entry expressed with current status and associated frequency of occurrence. The number inside the nodes shows how many times an action has been executed. Nodes are connected to directed arcs, which indicate the existence of relationships between action entries. The numbers next to these arcs illustrate how often the relationship was observed in the log file, whereas the lower numbers indicate how sure the relationship between the activities exists. The higher the number is, the stronger the relation. Since the log file contains various start and end events, two artificial events *ArtificialStartTask* and *ArtificialEndTask* indicate the start and end of the entire process.

The heuristic net provides the continuous semantics fitness (CSF) measure (Weijters, van der Aalst & Alves de Medeiros, 2006) to indicate the quality of the generated process model. This fitness metric evaluates how precise the process model actually covers the observed actions in the log file. It is the result of replaying the actions in the log file. Whenever a parsing error occurs, the error is registered and the parsing is continued. Generally the fitness measure implies the number of correctly parsed instances over the total number of instances in the log file. The fitness value ranges from 0 to 1. The closer the value is to 1, the better the quality is. In our case, the as-is process model M_3 yields a CSF of 0.39 indicating a moderate to low alignment between the process model and the log file. The low CSF value could be attributed to the fact that there is no unique generic navigation pattern through the incident management process caused by the fine-grain level of detail in the history of action.

Since the level of detail of the history of action is too fine, we applied a combination of filtering techniques to subsume the fine-grain actions to

Figure 5. As-is process model on different granularity levels

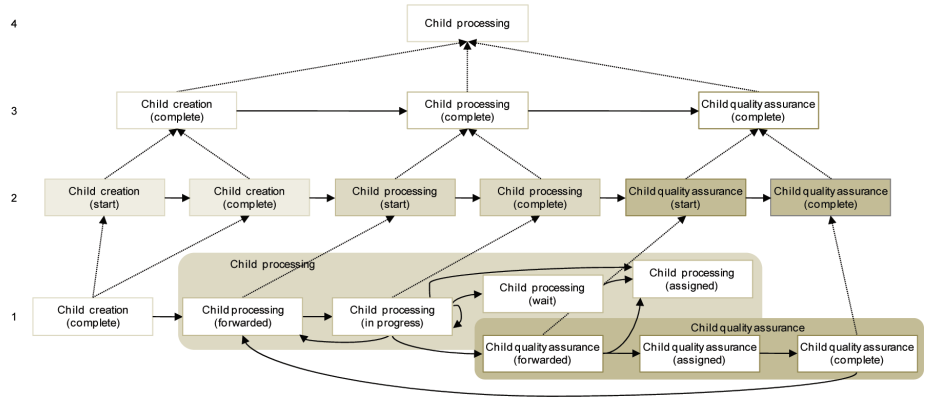


the granularity level of the ITIL activities in order to allow us to compare the history of action with the ITIL activities. Figure 6 illustrates the effect of the filtering techniques, which are available in ProM. The bottom line shows a fragment of the parent/child processing on action level. The parent/child relationship represents a group of change requests (i.e., children), which are linked to one parent change request. All children have to be processed to close the parent change request. The second line shows the child processing after the *Repetitions-to-Activity Filter* is applied. This filter replaces all direct repetitions of the same action, for example *Child processing (in progress)*, *Child processing (wait)*, and *Child processing (assigned)* by one start event with the time stamp from the first occurrence and a complete event with the time stamp of the last occurrence in the sequence of repetitions. If there is only one single occurrence of one type of action (e.g., *Child creation (complete)*), it will be replaced by a start and complete event with the same time stamp. As a result of the Repetitions-to-Activity Filter, the amount of cases decreased from 797 to 176 reflecting a more generic process flow. Next, we discarded the start events with the help of the simple filter (see line three), which led to atomic activities depicted in the top line of the figure. Please note, that we refer to the as-is process model on activity lever as to M_3'.

By applying the filtering techniques, the CSF increased to 0.97. This result indicates that the alignment of this process model M_3' with the filtered log file is considerably higher than the previous process model M_3 based on the initial log file. The high value shows a very good fit between the as-is process model M_3' and the history of action indicating that most of the actions are successfully parsed by the mined process model. Therefore, we can rely on the model as being a good representation of the ticket flow in reality.

The left hand side of Figure 5 shows the fine-grain as-is process model M_3 on the action level

Figure 6. Differences in the granularities between actions and activities



and the right hand illustrates the coarse-grain as-is process model M_3' on activity level. In preparation for the compliance analysis, the process models were converted into Petri nets through ProM. Then, mapping between the events was manually performed, since events were still present in different granularities.

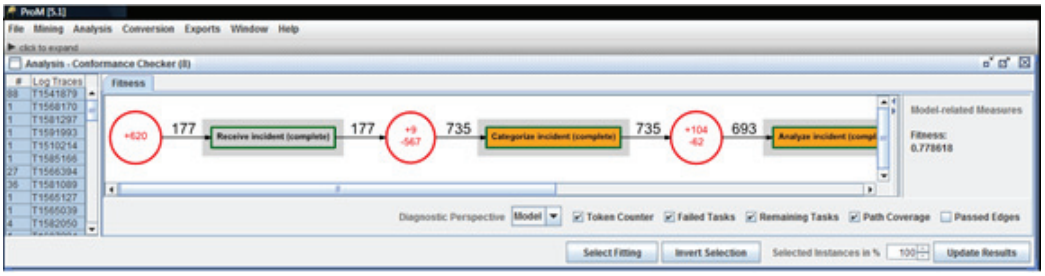
Analysis of the Data

The analysis of the data is twofold: the process model based on the history of action M_3 and the process model based on activities M_3' are at hand.

Since model M_3' corresponds to the activity level, the compliance analysis can be carried out automatically. To quantify the compliance with the aid of fitness, the ProM plug-in *Conformance Checker* (Rozinat & van der Aalst, 2007) was used. Figure 7 depicts the comparison between model M_2 and model M_3. The positive values in the circles display as to how often activities were not performed, although they should have been executed (heavily-shaded). Negative values provide the number of activities, which were performed, although their execution was not planned (lightly-shaded). The number of edges denotes the complete number of executions. For example, the activity *Categorize incident* was executed 735 times, whereas in 9 processes a classification was not performed. In 567 cases, a classification was performed although this activity was not planned (-567). If one would subtract executed activities from skipped activities and adds those, which were performed in deviation to the model, one arrived at the sum of executed predecessor activity: 735-567+9 = 177.

The fitness of model M_2 and model M_3' amounts to 0.779, that of model M_1 and M_3' to 0.600, and that of model M_1 and M_2 to 0.923. These absolute

Figure 7. "Conformance Checker" plug-in



numbers indicate a moderate to high compliance with each other. The comparison provides valuable information, which will be incorporated into the maturity model as initial estimates of the as-is situation.

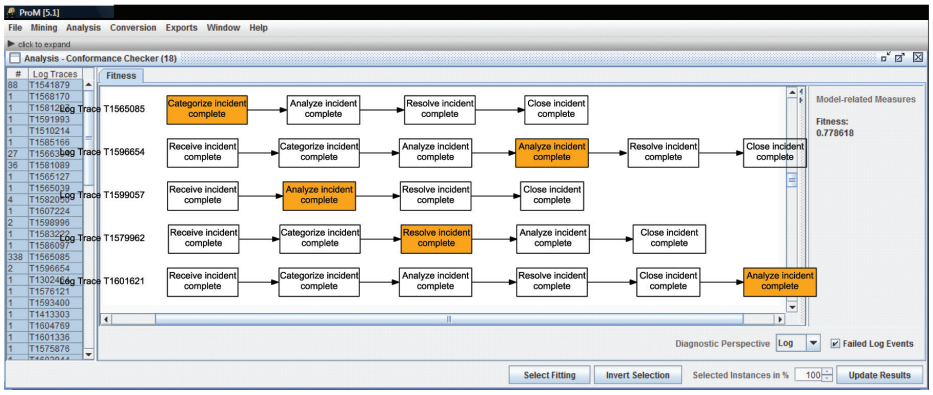
We will first discuss the results of the comparison of model M_2 and M_3'. Upon inspection of the resulting log analysis it can be diagnosed that the log traces differ from the to-be process model M_2 in several ways. Figure 8 shows where replay problems occurred in the log. The activities, which indicate failures, are heavily-shaded.

First, even if the beginning of the incident processing is precisely described, we found log traces, such as T1565085, which started with a different start activity than *Receive incident*. Second, log trace T1596654 represents log traces, which included a repetition of activities (i.e., *Analyze incident*). Thirdly, we observed log traces like T1599057, in which one or more activities (i.e., *Categorize incident*) were missing. Fourth, we detected traces in which the right activities were executed in a sequence regardless of the specified order of model M_2. An illustration is trace T1579962, in which the activity *Resolve incident* was erroneously followed by the activity *Analyze incident*. Last but not least, we found log traces, which were not properly closed with the designated activity *Close incident*, as in log trace T1601621.

To explain the deviations identified, we fell back upon the fine-grain model M_3. Its diagnosis is performed manually by inspecting the action flow. We found actions such as *Child processing*, which were supposed to be disused. The intersection of the individual actions provided valuable information about the routing of the incident tickets within the workforce of the ISP. Not only the structure but as well the frequency of the occurrence of actions are informative. The activity *Reassignment,* for example, is designed to reopen erroneously completed incidents. This activity is therefore provided only by exceptions. The frequency, in which the activity occurred in model M_3, indicates that the closure procedure should be improved. We conclude that both models M_3 and M_3' are important for the continual process improvement.

Returning to the log analysis, the analysis reveals two additional measures: the ratio of log traces, which are successfully executed and properly completed. In our case, the successful execution and the proper completion yield 0.180. These low values and the high number of log traces (i.e., 620), which skipped the required start activity *Receive incident* (see Figure 7) induces us to judge the impact of the start activity on the overall fitness. First, we deleted all existing activities *Receive incident* using the Event Log Filter and next, we inserted the required start activity

Figure 8. Diagnosed deviations between log traces and model M_2



with the help of the Artificial Start Task Filter. By applying the conformance checker again, the fitness value increased to 0.936 and the amount of log traces, which were successfully executed and properly completed to 0.647. This little experiment shows, that the ISP can considerably improve the compliance of the as-is process model M_3' with the to-be process model M_2 by assuring that the start activities are executed as specified in the to-be process model M_2.

Now let us change to the behavior itself. We want to study the effect of rare behavior on the fitness value. Excluding rare behavior allows us to analyze the common behavior. When we excluded 10% of the most infrequent instances, the fitness increased from 0.936 to 0.938. Excluding 23% of the behavior, yields a fitness value of 0.945. The main reason of the small increase stems from the small number of activities of the to-be process model M_2 and the aggregation of various behavior patterns of model M_3 into more common patterns of model M_3´.

Moving now to the comparison of model M_1 and model M_2, we found that the fitness of the to-be process model M_2 and the reference model M_1 is very high. This result conforms that the major objective of designing the ITSM processes according to ITIL has been accomplished successfully.

The comparison of the reference model M_1 with the as-is process model M_3' provides a rather moderate result. This result stems from the adaption of the reference model M_1 to the business needs of the ISP and the fact that the as-is process model M_3' only reflects information, which are recorded by the WfMS. Manual activities, for example, are hereby excluded from the compliance analysis. Since the ITIL framework particularly recommends an adaptation to the needs of the organization, reference values for a benchmark would be very helpful for the interpretation of the indicator. Unfortunately, no reference values are available from the literature due to a lack of examples from practice. Nevertheless, the fitness values will serve as reference values for further comparisons. We expect that the compliance analysis will yield higher fitness values if the quality of ITSM processes increases.

Presentation and Utilization of the Information

The necessary measures to improve the ITSM processes were determined in a series of workshops within the organization. Through the aid of the derived transparency the standardization in the field of incident processing, the integration of process mining, the controllability of IT services as well as the assurance of compliance of business processes are sought after.

Implementation of Corrective Actions

Based on the identified weaknesses the corrective actions are twofold: first, an adaption of the WfMS, and second a change in the behavior of the WfMS user. The former will be communicated to those who are affected by the changes. The latter is required since the user of the WfMS occasionally circumvent intended working methods by using the application in a wrong way. For example, the possibility to initiate a request for change (RfC) via the incident management process will be disabled in the WfMS. The adaption of the WfMS will be accompanied with training for the users. Subject to the training is not only the standard procedure for handling changes but also the importance of compliance with the change management process.

Together with the responsible process manager, we also verified that the utilization of the CPI approach clearly enables a growing maturity of the ITSM process according to the COBIT maturity model (see Figure 7). The growing maturity is justified on the grounds of various maturity attributes, which can be seen in the case of the attributes *tools & automation* and *awareness & communication.* According to the maturity attribute *tools & automation* the ITSM processes achieve a higher level of maturity because of the CPI approach. The approach intensifies not only the tool support (i.e., maturity level four) but also enables the automation of several resource-

intensive parts of the improvement process (i.e., maturity level five). The automation is enabled by the first phase of the CPI approach in which steps three to seven are automatically performed in an automatic way. The presentation of the as-is process models M_3 and M_3' in step six strongly supports the maturity attribute *awareness & communication*.

FUTURE RESEARCH DIRECTIONS

A further future line of research will be the utilization of the derived information for the continual improvement of inter-departmental and inter-organizational processes.

Based on our experiences with the continual improvement of ITSM processes of the air travel industry (Gerke & Tamm, 2009) and the experiences with the ISP we have proven the validity of our approach of continual improvement of incident management processes. Next, we will apply it to both further more complex IT service operation processes (e.g., problem management) and to processes of other lifecycle steps such as the change management, which belongs to the lifecycle *Service Transition*. We also aim to learn, if it is possible to apply the CPI approach to arbitrary IT processes (e.g., software development process) when we apply our approach to other business and industry domains.

ISPs perform ITSM through an appropriate mix of people, process and information technology (Taylor, Case & Spalding, 2007). Up to now, the focus of our research has been on quality improvement and the effectiveness of processes. Therefore, we will examine how the approach can be extended for the improvement of the process efficiency. Especially the most effective utilization of limited resources in terms of people and financial resources will be the focus of our studies.

Finally, we are striving to study how traceability can be incorporated into the continual process improvement approach to enable organizations to quickly identify problematic parts of their running processes.

CONCLUSION

A procedural model to continually improve ITSM processes through the aid of process mining and ITIL was trialed based on a practice example. Process modeling with process mining allows an objective and automated determination of the as-is condition, whose utilization may improve cost and time factors significantly. Here, the ISP obtains transparency of its current incident management process, the latter being continuously evaluated based on quality indicators and sorted by degree of maturity. Quality-reducing and -improving factors are determined within the ITSM processes. The organization uses compliance as an indicator pertaining to relevance, applicability and practicability of ITIL reference processes. Measures for the continual process improvement contribute to an optimization of IT service quality as perceived by the user. In summary, the following benefit potentials can be described:

- Transparent incident management process
- Control of process quality through quantifiable information
- Measureable degree of applied reference processes
- Reproducible, repeatable, and comparable key indicator measurements as base for improvement measures and the corresponding ex-post control
- Improvement of maturity level with reference to the COBIT process maturity model
- Good cost-benefit ratio through high level of automation

The following measures proved themselves to be critical for the implementation in the respective organization:

- There is data, which lies beyond the scope of process mining. Activities, such as the prioritization, are documented as important activities of the to-be process M_2. Since these activities are partly automated and consolidated within a single workflow step of the WfMS, they have no time stamp assigned and are not recorded as an entry in the history of action. Therefore, unrecorded activities are not recognized in the procedural model and limit the expressiveness of current processes and of the compliance analysis.
- Because of missing examples from practice, no benchmarks are currently known for the interpretation of fitness.
- Generally, reference and process models are available in different granularities. As mapping is not sufficiently supported, a comparison is currently only possible with high manual effort.
- An overemphasis of sequential adherence within executed activity is prevalent. In order to derive generic recommendations, best practices are created by expert monitoring and abstraction of procedures. Such methodology does not have to be mandatory for a specific organization.

Utilization of process mining requires processes, which are derived from so-called "cases". A case consists of a sequence of activities between, which relations of dependence exist. A procedural model can therefore only be transposed to case-oriented processes.

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KEY TERMS AND DEFINITIONS

Continual and Continuous: Continual typically marks a close and unbroken succession of activities, rather than absolute continuity. Continuous is the stronger word, and denotes that the continuity or union of activities is absolute and uninterrupted (Taylor, Case & Spalding, 2007).

Incident Management: The incident management is the process for dealing with incidents. An incident is an unplanned interruption to an IT service or reduction in the quality of an IT service; this can include failures, questions or queries reported by users, technical staff, or automatically detected and reported by event monitoring tools. Incident management concentrates on restoring unexpectedly degraded or disrupted services to users as quickly as possible, in order to minimize business impact (Taylor, Cannon & Wheeldon, 2007).

IT Service Management: IT service management (ITSM) deals with the implementation and management of quality IT services to ensure IT service delivery matches business requirements in an efficient and effective manner. An IT service is a service provided to one or more customers by an ISP. It is based on the use of IT and supports the customer's business processes (Cannon & Wheeldon, 2007).

Process Compliance: Process compliance is the degree, to which a process model behaves in accordance to a reference model. The behavior is expressed by the instances, which can be generated by the model (Gerke, Cardoso, & Claus, 2009).

Process Mining: The basic idea of process mining is to learn from observed executions of a process, which is recorded by various IS, such as WfMS or Customer Relationship Management (CRM) systems. The records also known as event

logs can be used to (1) discover new models, (2) check the conformance of a model by determining whether the modeled behavior matches the observed behavior, and (3) extend an existing model by projecting information extracted from the logs onto some initial model (e.g., show bottlenecks in a process model by analyzing the event log) (Rozinat, Günther, & van der Aalst, 2009).

Quality Management: Quality management is an integral part of business process management, which is a structured, coherent and consistent way of understanding, documenting, modeling, analyzing, simulating, executing and continuously changing end-to-end business processes and all involved resources in the light of their contribution to business improvement (Australian BPM Community of Practice, 2009). Quality management comprises all activities organizations use to direct, control, and coordinate quality.

Reference Model: Reference models are generic conceptual models, which formalize recommended practices for a certain domain (Rosemann & van der Aalst, 2007). They are often labeled with the term best practices.

Service: A service is a means of delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific costs and risks (Office of Government Commerce, 2007).

Service Desk: The service desk is the single point of contact (SPOC) between the service provider and the users. It facilitates the restoration of normal operational service with minimal business impact on the user within agreed service levels and business priorities.

Chapter 9
Process Assessment as a Means to Improve Quality in IT Services

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1. ABSTRACT

The main objective of this chapter is to present how a formal and standard process assessment - thanks to its repeatable approach and its comparable results - can be an invaluable contribution for improving the IT services in a continual way. This chapter introduces ISO/IEC 15504, the international standard for process assessment. As a generic process assessment framework, ISO/IEC 15504 can be used for determining the capability of processes of any domain. The authors of this chapter have applied this framework in the field of IT Service Management. Their works (described below) have enabled to develop the TIPA® methodology, based on ITIL® version 2. The chapter then discusses the impact that assessments can have on the quality of the assessed processes and, as a consequence, on the services supported by these processes. The chapter finishes by presenting an example of the results and the lessons learnt as perceived by adopters of TIPA.

2. INTRODUCTION

The IT Service Management (ITSM) frameworks lay a series of recommendations, good practices, or guidelines to be followed by IT organizations in order to improve the quality of their services. Moreover, these frameworks rely on quality management principles (like the ISO 9000 principles supporting quality management systems) and on the formalization of the processes used for managing the IT infrastructure and services (i.e. processes described in the ISO/IEC 20000 standard). However, when trying to apply an IT

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service management framework, IT managers and consultants are often challenged with the fact that they have a list of goals or requirements to be achieved but do not know how to achieve them. In other words, they know the 'what to do' but not the "how to do". It is true that such means may change from organization to organization according to the business context. However for the consultant or manager trying to set up a service improvement project, it is important to have a methodological and systematic approach to reach the goals previously mentioned.

Three phases can be roughly identified when trying to apply an IT service management framework to an organization:

1. Knowing where the organization is with regards to the selected framework.
2. Setting up of the project to implement the changes that will bring the organization to work according to the selected framework, taking account the business context.
3. Implementing the previously mentioned project to achieve the targeted improvements.

Each phase mentioned above is dependent on the previous one. Thus, in order to succeed in the improvement project, the project has to be correctly defined, and in order to get the project correctly defined, we need to know accurately what processes need to be improved (i.e. what their current levels of maturity, and what the targets are). This chapter addresses phase 1 and the first steps of phase 2.

The purpose of this chapter is to allow readers to perform process assessment for ITSM frameworks like IT Infrastructure Library version 3 (ITIL® v3) and the ISO/IEC 20000 standard. We will also discuss how such assessments can influence the quality of IT services.

This chapter assumes that the best way to assure that ITSM assessments are impartial and repeatable is to perform them in accordance to international standards. In 2003, the ISO/IEC 15504 standard was revised and became a generic process assessment standard addressing effectively this issue. Public Research Center (known by its acronym in French language CRP) Henri Tudor has used this process assessment standard to build compliant process assessment models based on the ITSM best practices in order to develop a common approach for ITSM process assessment and improvement, as shown in section 3.

Initially based on ITIL v2, the AIDA research project (AIDA stands for Assessment and Improvement integrated Approach) broadened its scope in 2009 to support ITSM process assessments based on either the ISO/IEC 20000 standard or ITIL v3. Since then, AIDA was renamed TIPA®: Tudor's ITSM Process Assessment, presented in section 4.

Section 5 discusses how the improvement cycle, set up from process assessment results, impacts the assessed organization regarding quality of service and customer satisfaction. It presents the impacts of such improvement cycle on the processes and on the metrics. Additionally it is discussed how to estimate the Return on Investment of such a project, which is always useful to justify when selling the idea and the results to the management of the organization.

Finally, the section 6 will show an example of an industry assessment that was conducted during the experimentation phase of the AIDA project, which gave birth to the TIPA methodology.

3. PRESENTATION OF THE ISO/IEC 15504 STANDARD

3.1 History: From SPICE to ISO/IEC 15504

The origins of process management come from the publication of Watts Humphrey's book "Managing the Software Process" and the first assessment questionnaire by the Software Engineering Institute (SEI). In 1991, the International Organization for Standardization (ISO) raised an urgent need for

a new Standard to support the harmonization of existing process assessment approaches developed by various organizations, projects and initiatives.

Based on the conclusions of an ISO study group, the SPICE project (SPICE stands for Software Process Improvement and Capability dEtermination) was launched the next year to support the development, validation and transition into use of an International Standard for software process assessment. The first version of the Standard (a technical report) was released in 1998 after a three years trial period, which enables to gain significant empirical evidence for validating the assessment approach. While the initial version was informative and expressly focusing on the assessment of software development processes, the international standard published in 2003 (International Standards Organization, 2003) is normative and generic. Today this standard can be applied in a wide variety of domains thanks to the high-level definition of all requirements and concepts involved in process assessment. The standard provides generic guidelines and rules on how to perform process assessments and, for a specific domain, it requires the processes of this domain to be described as domain-specific process models. The process model developed during the SPICE project (for software development) is still present in the 2003 version of the ISO/IEC 15504 standard, but only as an exemplar process model (International Standards Organization, 2006).

Currently a new exemplar process model is under development for IT Service Management (International Standards Organization, 2007). This future part of the ISO/IEC 15504 will be based on the part 1 of the ISO/IEC 20000 standard (International Standards Organization, 2005). These activities show that there is a real need from the market for approaches combining process assessment and ITSM practices.

3.2 Process Models Requirements

According to the requirements given in the ISO/ICE 15504 standard, it is possible to describe any process in a standard way (under a process model form), in order to cover the two dimensions of process assessment: the process dimension and the capability dimension. The process dimension is dedicated to process specifics and describes what the process is supposed to do. The capability dimension is dedicated to standard features and describes how the process is supposed to be efficient. The resulting process model is based on a structured written description of processes, the representation of relationships between processes and the description of generic aspects common to all processes included into the process model.

3.2.1 Process Reference Model (PRM)

*"**Process Reference Model** is a model comprising definitions of processes in a life cycle described in terms of process purpose and outcomes, together with an architecture describing the relationships between the processes."*

ISO/IEC 15504 – 1 (International Standards Organization, 2004)

A Process Reference Model (PRM) is a document that groups the structured textual descriptions of processes for a particular domain. The processes are organized into meaningful groups to symbolize the strongest relationships or interactions between processes (i.e. a process map). The domain is also described in a few sentences and its boundaries are clearly identified. So, a Process Reference Model (PRM) addresses only the process dimension for a domain.

In a PRM, each process is described according to a precise structure composed of:

- **A process ID and name:** The process ID is a short and unique identifier for a process into the process model while the process name is a meaningful short label that expresses the scope of the process as a whole.

- **A process purpose:** The process purpose is a single sentence that describes the high-level objective of performing the process.
- **A set of process outcomes:** The process outcomes convey the observable results expected from the successful performance of the process. They are related to the production of an artifact, a significant change of state or a specified constraint. Process outcomes are the necessary and sufficient items that demonstrate the successful achievement of the process purpose.

The PRM shall also document the community of interest that has validated its content.

3.2.2 Process Assessment Model (PAM)

*"**Process Assessment Model** is a model suitable for the purpose of assessing process capability based on one or more Process Reference Models."*

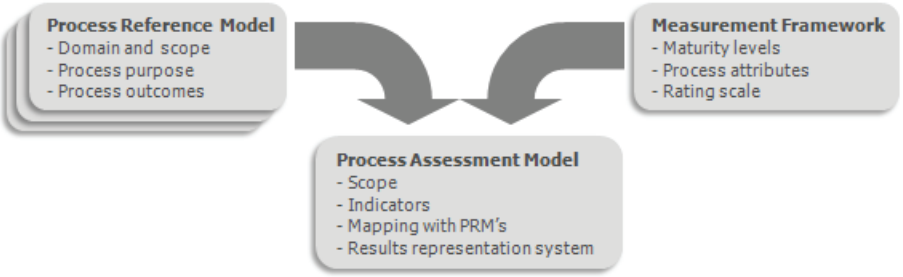
ISO/IEC 15504 – 1 (International Standards Organization, 2004)

This high-level description of the process objectives is most of the time not sufficient to get a precise analysis of the level of implementation of a process in a particular organization. The process specifics from the PRM (dealing with the core business of the processes) are thus completed in a Process Assessment Model (PAM) with lower level details on each process (indicators). This additional information enables to assess any process of the process model in a systematic, objective and repeatable way (Figure 1).

The Process Assessment Model includes a list of indicators of the implementation for each process. Those indicators are:

- **A set of process base practices:** The process base practices are the usual activities that are recommended to perform in order to reach the process outcomes. As indicator, they have to be described with an abstraction level and focus on "what should be done" rather than "how it should be done". The base practices use the Input Work Products and contribute to the production of Output Work Products.
- **A set of input and output work products:** Work Products are items that are either utilized or produced (or both) when performing the process. They are the particular inputs and outputs of the process. They might not be the main objectives when executing the process but rather supporting material to the performance of the process. The process anyhow produces them. The typical content of a work product is described once for all in a table describing the features of each work product.

Figure 1. TIPA process assessment model[1]



These indicators enrich the process descriptions given in the PRM and the whole set enables to assess the process dimension of a process assessment conformant to ISO/IEC 15504 standard.

The assessment of the capability dimension is addressed by the measurement framework described in the ISO/IEC 15504 standard, which is plugged into the PAM after the extensive process descriptions.

3.3 Standard Measurement Framework

The measurement framework described in ISO/IEC 15504 to assess the process capability is broken down into 6 levels. The levels 0 and 1 focus on the process purpose achievement and thus are still related to the process dimension (see above). On the other hand, the levels 2 to 5 are related to the capability features that are common to all processes. Measuring the capability of a process consists in assessing the process against each feature and in positioning the process on the capability scale.

It is important to understand that each level builds up on the foundations laid by the previous one. During an assessment, a process could only reach a capability level if it masters the capability features related to this level but also all those of the lower capability levels. The Figure 2 summarizes the objective of each capability level of the measurement framework.

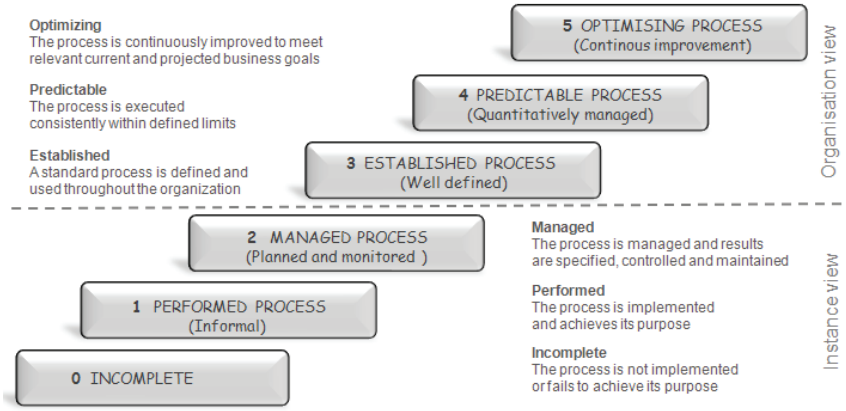
Each capability level from 2 to 5, shown in Figure 2, is featured by two attributes, which are used to measure a specific aspect of the overall capability of a process. Each of these attributes is described similarly as the way a process is described, by its name, a general objective and a list of achievements. However, as for the process dimension, these high-level descriptions of the capability attributes are not sufficient to enable to assess the extent to which they are achieved for a given process. For that a set of generic practices and work products is described for each attribute. This enables a pragmatic assessment of each of them.

3.4 Rating Scale

A process assessment is not based on a dual rating (i.e. OK or not OK) but on a four-point ordinal rating scale described into the ISO/IEC 15504 standard (International Standards Organization, 2003):

- Not achieved: there is little or no evidence of achievement of that indicator;
- Partially achieved: there is evidence of a partial achievement of that indicator, but some aspects are unpredictable;

Figure 2. ISO/IEC 15504 measurement framework (©2009, Van Haren Publishing. Used with permission)



- Largely achieved: there is evidence of a sound systematic approach to and significant achievements of that indicator, but some weaknesses can exist;
- Fully achieved: there is evidence of a complete systematic approach to and full achievement of that indicator.

The advantage of this scale is both to have a more detailed result bringing some shades, and to avoid the "middle range" rating, by forcing assessors to decide on a clear-cut rating. The "Not-Partially-Largely-Fully" (NPLF) rating scale can also be understood in a quantitative way, as shown in Figure 3. This enables to objectify the assessor's judgment by give him boundaries for each rating according to the achievement of the indicator to be rated. For example, if assessors consider that only one incident in two is effectively recorded, they would rate the "incident recording" indicators to Partially.

Based on this rating scale and the requirements of ISO/IEC 15504 regarding the capability level determination, a capability level is reached by a process when all attributes related to the lower levels are fully achieved and the attributes of the current level are at least largely achieved.

3.5 Process Assessment Process

Next to the structuring elements described above, the ISO/IEC 15504 standard also defines the requirements to perform the process assessment process itself, which is based on those elements. The Figure 4 summarizes the requirements related to the assessment process.

4. PRODUCING AN ISO/IEC 15504 BASED PROCESS ASSESSMENT MODEL

4.1 Overview

An ISO/IEC 15504 based process assessment approach consists of a structured method used to determine the capability of each assessed process in a consistent, reliable and repeatable way.

For that, the requirements of the ISO/IEC 15504 standard defines the main concepts to use in order to assess processes, by concentrating on the achievement of the process purpose and process capability indicators. This structured way to assess processes, used in combination with process models enables these processes (whatever their business domain) to be clearly positioned on a capability scale.

Using an ISO/IEC 15504 based process assessment approach requires each assessment to be based on a *Process Assessment Model* (PAM), itself based upon a suitable reference source of process definitions – one, more or parts of *Process Reference Models* (PRM). The part 2 of the ISO/IEC 15504 standard (International Standards Organization, 2003) sets out requirements to create those two kinds of process models but no guidelines is given on how to build them.

The following part will present a methodology experimented during the creation of the first TIPA model, based on ITIL v2, and which can today be used generically to build PRMs and PAMs. This methodology is actually in use for the creation of process models based on ITIL v3 and the ISO/

Figure 3. Rating scale (©2009, Van Haren Publishing. Used with permission)

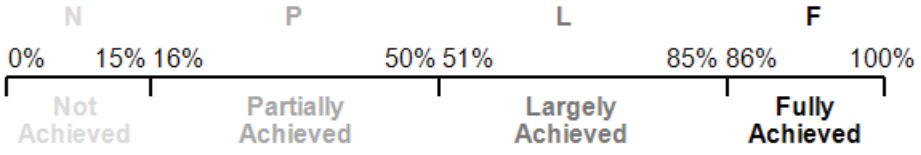
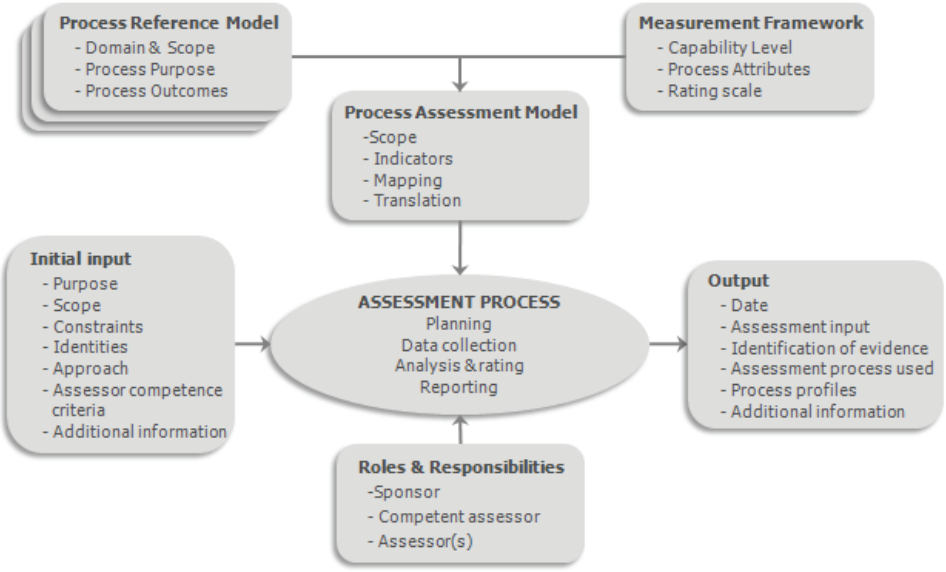


Figure 4. Process assessment process (©2009, ISO. Used with permission)



IEC 20000 standard (International Standards Organization, 2005).

4.2 Producing PRMs and PAMs

Since 1996, the CRP Henri Tudor has been involved in R&D projects aiming at modeling PRMs and PAMs and, with a wealth of experience behind it, has developed a methodology (Barafort, Renault, Picard, & Cortina, 2008), based on goal-driven requirements engineering (Rifaut, 2005), leading to the construction of PRMs and PAM. The main activities of the methodology are shown in Figure 5.

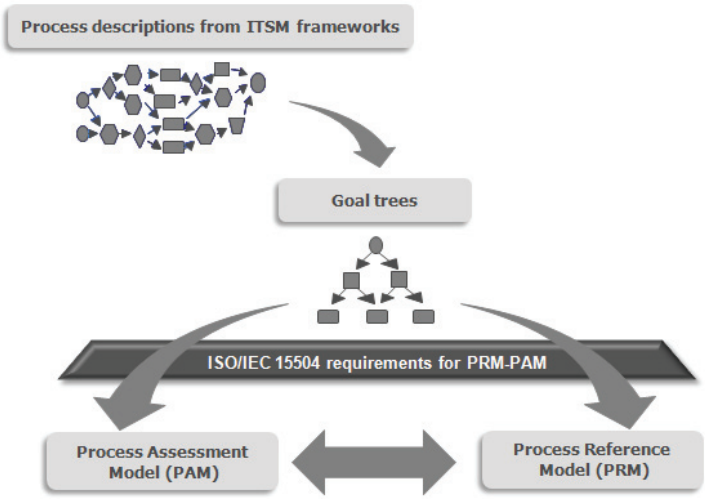
This methodology is dynamic, and many refinements are necessary to ensure consistency of information and coverage of all the requirements. As depicted below, it consists in collecting the requirements from the ITSM framework reference documentation (like the ISO/IEC 20000 standard or the ITIL® core books), in transforming them into requirements trees, then into goal trees to finally create a PRM and/or a PAM covering the whole scope of the framework.

Presenting the processes, initially described in an ITSM framework, under the form of a PRM/PAM does not alter the essence of these processes. ISO/IEC 15504 compliant process models are just another way of describing processes in order to have a sound basis for performing process assessments in an objective and repeatable way.

The methodology is composed of 9 steps leading to the construction of an ISO/IEC 15504 compliant PRM or PAM. The first five steps of this methodology deal with the transformation of a collection of requirements into a Process Reference Model (PRM):

1. Identify elementary requirements;
2. Organize, and structure the requirements;
3. Identify common purposes upon those requirements and organize them towards domain goals;
4. Identify and factorize outcomes from the common purposes and attach them to the related goals;
5. Phrase outcomes and process purpose;

Figure 5. Overview of the PRM & PAM building methodology (Adapted from the book entitled "ITSM Process Assessment Supporting ITIL")



The next four steps lead to the development of the final Process Assessment Model (PAM):

6. Group activities together under a practice and attach it to the related outcomes;
7. Allocate each practice to a specific capability level;
8. Phrase the Base Practices attached to Outcomes;
9. Determine Work Products among the inputs and outputs of the practices.

Finally, descriptions of the process attribute indicators, associated with capability levels from the part 2 of ISO/IEC 15504, are added to complete the PAM. Tables 1 and 2 show the ISO/IEC 15504 compliant process description resulting from the application of this approach on the Incident Management process such as described in ITIL v2.

The quality of the models created by following the above methodology can be improved. Indeed, during the PRM/PAM construction, the main concepts of the domain to be assessed are depicted as requirement trees and goal trees. Under these forms, any inconsistencies and incompleteness in the domain requirements can easily be identified and corrected. Moreover, it is essential, during the construction of the process models, to keep the traceability between the initial domain requirements and the final process descriptions. This enables the developed models to be maintained in cases of changes of the initial requirements. As process models are the basis of the TIPA assessments, it is crucial to keep the process models as precise and up-to-date as possible.

5. DESCRIPTION OF TIPA

In 2000, CRP Henri Tudor observed that more and more often assessed organizations started using ITIL as the reference standard for their IT service management (i.e. IT operations) in addition to the exemplar process model from ISO/IEC 15504-5 (International Standards Organization, 2006) (for software development). The following research subject was thus logically raised by CRP Henri Tudor's specialists: "*Does the combined use of ITIL and ISO/IEC 15504 truly increase effectiveness and efficiency and can it be adapted to the need of flexibility of today's organizations?*"

The TIPA methodology described below is the result of several years of research, development, experimentation and validation. Today it is being transferred to the business market and is already used by several early-adopters from the private sector in several countries around the world.

5.1 Overview

Tudor's ITSM Process Assessment (TIPA) combines, on the one hand, a description of ITSM processes (like ITIL version 2 (Office of Government Commerce, 2001) (Office of Government Commerce, 2000), ITIL v3 or ISO/IEC 20000) and, on the other hand, the ISO/IEC 15504 standard (see Figure 6). The first one sets our goals whereas the second one allows the consultant or manager to know where the organization's processes are. Using this methodology, the organization can move from the phase 1: Where are we, to the phase 2: Where we want to go, as mentioned in the Introduction of this chapter. It first assesses the current situation of the organization comparing its actual processes to a description of ITSM processes. The comparison determines a clear set of objectives that have to be reached by the improvement project defined in phase 2.

There are several possible approaches to combine ITSM processes and ISO/IEC 15504 into a process assessment framework and to run process assessments. The TIPA assessment methodology detailed in this section represents one way of implementing that combination and running an assessment project. It relies on several empirical facts raised from previous CRP Henri Tudor's experience in process assessment:

- Information from interviews is more prominent to the one from document review to perform process improvement focused assessments. ISO/IEC 15504 recommends collecting information through indicators to assess processes but does not specify the nature of these indicators. TIPA assessment

Table 1. Extract from the TIPA's PAM: incident management process

Process ID	INC
Process Name	**Incident Management**
Process Purpose	The purpose of Incident Management is **to restore *normal service* operation as quickly as possible and minimize the adverse impact** on business operations (with *normal service* defined in a Service Level Agreement -SLA- if existing). NOTE 1: The incidents described here are (Any **event** that is not part of the standard operation of a service and that causes, or may cause, an interruption to, or a reduction in, the quality of that service): • incidents (automated system incident recorded or incident notified at the Service Desk) • service requests NOTE 2: A service request may be a request for information/advice/documentation, or a request for a forgotten password. NOTE 3: Incident Management defined here is relatively similar to the Problem management described in ISO/IEC 15504-5. NOTE 4: The scope of the Incident Management depends on the strategy adopted. Most of time the ICT (Information and Communication Technology) infrastructure is concerned; telecommunication is optional.
Process Expected Results	As a result of successful implementation of the Incident Management process: 1. An Event Management Strategy is developed; 2. Events are recorded and classified (e.g. Incident – Service Request); 3. Service Requests are treated; 4. Incidents are prioritized (Impact and urgency) and initial support is provided; 5. Actions are performed for incident resolution in order to restore the normal service operation as quickly as possible, if necessary a work around solution is implemented or an escalation is performed; 6. Incidents are tracked all along their life cycle; 7. Incidents and service requests are closed (with all associated records).

Table 1. continued

Base Practices	INC.BP1: **Establish Event Management strategy:** determine the event resolution strategy for ensuring that incidents are detected, recorded, described, analyzed, solved and closed; and that service requests are treated and closed. [Expected Result 1] INC.BP2: **Detect and record the event:** record the basic details of the event. [Expected Result 2] NOTE 1: The details of the event should be recorded in the "Incident" (Event) Database. NOTE 2: Characteristics about the event record are detailed in the Work Product characteristics (Annex IV). INC.BP3: **Classify the event:** assign the events to a type (e.g. Service Request or Incident), a category and some sub-categories [Expected Result 2] NOTE 3: Examples of Service requests are requests for information / advice / documentation, new software installation under control. NOTE 4: Example of categories of event: application, hardware, software, network … NOTE 5: Incident is defined as any event that is not part of the standard operation of a service and that causes, or may cause, an interruption to, or a reduction in, the quality of that service. INC.BP4: **Handle the Service Request**: manage the Service Request. [Expected Result 3] INC.BP5: **Prioritize and provide initial support to the incident:** assign impact and urgency to the incident (priority), match against the Incidents, Problems, Known Errors or list of planned changes (change schedule); assess the incident details to find a solution to continue business, via a degraded service or a temporary solution if needed (Example: Work-around solution). [Expected Result 4] NOTE 6: The priority of an Incident is primarily determined by the impact on the business and the urgency with which a resolution or Work-around is needed. NOTE 7: The goal of a Work-around is to temporarily minimize the impact of the Incident on the business and to provide more time to investigate and devise a structural resolution. INC.BP6: **Escalate the event to specialized or authority lines**: Route to n-line support or authority (iterative process) if the (n-1)--line cannot resolve the incident, or cannot satisfy the service request. [Expected Result 5] NOTE 8: Functional escalation concerns a lack of knowledge or expertise. Hierarchical escalation is done when the resolution of the incident will be not in time or satisfactory (e.g. against a SLA). NOTE 9: The first support line generally performs INC.BP2 to INC.BP6. NOTE 10: Second or third-line support groups have more specialist skills, time or other resources to solve Incidents. Time spent by each line is defined in the SLA. INC.BP7: **Investigate and diagnose the event (Second or third-line support):** analyze and investigate events by the appropriated line support. [Expected Result 5] INC.BP8: **Implement incident resolution:** implement incident resolution actions to resolve the incident. [Expected Result 5] NOTE 11: If needed, a Request For Change (RFC) can be raised for incident resolution through the Change Management Process. NOTE 12: Standard changes can be initiated by the service desk INC.BP9: **Track and monitor event:** track and monitor the event until closure. (Ref. *ISO/IEC 15504-5:2006, p. 54, SUP.9.BP10*) [Expected Result 6] INC.BP10: **Close incident and Service Request:** close the incident or the service request, update the records with any relevant details. [Expected Result 7] NOTE 13: The first support line generally performs the base practices INC.BP9 and INC.BP10.

results are mainly based on the analysis of information collected during interviews, which enables to collect strengths, weaknesses, existing good practices that can be later spread around the organization in the improvement phase.

- Interview performance is more objective by pair of assessors. The assessors' subjectivity is a human feature that can be mitigate by the participation of (at least) two assessors in each interview. In addition, a pair of assessors reduces the risk of missing (i.e. losing) some relevant information during the interview.
- Process assessment is mainly used as basis to improvement. Even if a process assessment could be used for a capability determination, most of the time and especially for IT service management, process assessment is an organization's internal initiative aiming at improving their way to deliver and manage the IT services.

Table 2. Extract from the TIPA's PAM: incident management work products

Work Products	
Inputs	**Outputs**
	3-11 Incident (event) Management Strategy [Expected Result 1] [INC.BP1]
	4-01 Service Request procedure [Expected Result 1] [INC.BP1]
5-07 Incident database	5-07 Incident database
2-01 All documentation available [Expected Result 2] [INC.BP2]	
	5-01 Incident (event) record [Expected Results 2, 4, 6, 7] [INC.BP2, 3, 5, 9, 10]
5-11 CMDB [Expected Results 4, 7] [INC.BP5, 7, 10]	5-11 CMDB [Expected Results 4, 7] [INC.BP5, 7, 10]
5-08 Knowledge database (including Work-around) [Expected Result 4] [INC.BP5]	
5-10 Known Error database [Expected Result 4] [INC.BP5]	
5-09 Problem database [Expected Result 4] [INC.BP5]	
5-12 Change database [Expected Result 4] [INC.BP5]	
	5-05 RFC record [Expected Result 5] [INC.BP8]
	5-02 Work Around record [Expected Result 4] [INC.BP5]
	6-01 User satisfaction survey [Expected Result 6] [INC.BP9]
	6-08 CMDB error notification [Expected Results 4, 6, 7] [INC. BP5, 9, 10]
	6-02 Incident Management report
	6-03 Process Improvement opportunities

An ITSM process assessment performed according to the TIPA methodology is broken down in six phases as illustrated in Figure 7.

The phases are described separately in more detail in the following sub-sections. Only the objective and the main tasks of each phase are explained for giving a pragmatic view on what would be performed in each phase and why it would be done. The full methodology includes also detailed roles and responsibilities as well as a supporting toolkit enabling a more efficient usage of the TIPA methodology. For further information on the TIPA methodology, we invite the reader to turn toward the TIPA handbook (Public Research Center Henri Tudor, 2009).

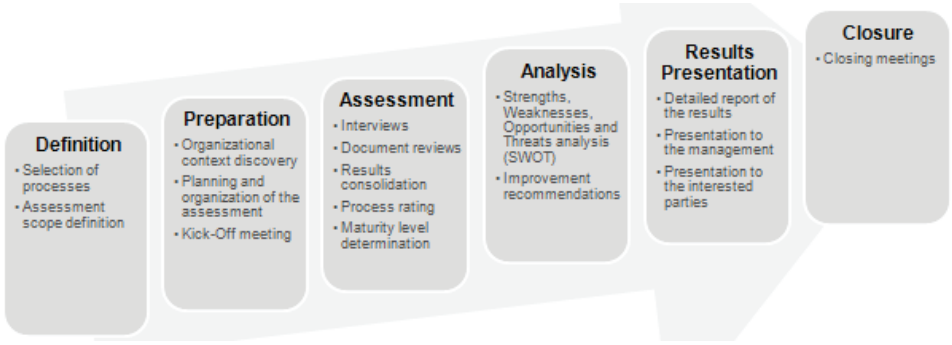
5.2 Definition

The objective of the "Definition Phase" is to agree with the client on the assessment service

Figure 6. TIPA approach is based on ITSM frameworks and ISO/IEC 15504[2](Adapted from the book entitled "ITSM Process Assessment Supporting ITIL")



Figure 7. Phases of a TIPA project[3] (Adapted from the book entitled "ITSM Process Assessment Supporting ITIL")



offer (from a contractual point of view) and on the detailed assessment scope.

The scope of the assessment has to be delimited by defining precisely the organizational unit to assess, by selecting the ITSM processes to assess and by determining the target capability level for each selected process. The selection of ITSM processes and target capability levels would be mainly based on the business context (business impact and objectives) of the organizational unit. In addition, the client has to become aware that the number of interviews for each selected process will influence the confidence level on and the cost of the assessment results. The selection of key persons to be interviewed is also essential for the reliability of the assessment results and the quality of improvement recommendations.

Based on the above criteria, the workload of the project has to be estimated and a service offer has to be contractually agreed with the client. A more practical document, the Assessment Scope Agreement, is also produced during this phase. This document summarizes all constraints to take into account, the high-level objective and the scope of the assessment, non-disclosure rules, the assessment team members with their associated roles, and an overall project plan.

At the end of the "Definition Phase", the foundations of the TIPA assessment project are laid and its preparation can begin.

5.3 Preparation

The objective of the "Preparation Phase" is to prepare the assessment team, the supporting documents used during the assessment, and the people that will be interviewed.

The standard TIPA toolbox has to be reviewed to be adapted to the organization's context and the agreed assessment scope. In particular, it is essential to the organization's staff supporting the project that the vocabulary used by assessors is as close as possible to the one used within the organization. This effort can help to open discussions during interviews and avoid resistance to change through the future improvement project. In case the whole assessment team has not been involved in the definition phase, now's the time to brief it on the context and scope of the assessment (scope and objective of the project, changes made to the TIPA model and to the assessment questionnaires).

The determination of the interview plan is an important task that has to take into account the availability of both assessment team members and interviewees. Then, the interview plan has to be communicated to all involved parties and time slots have to be booked to avoid waste of time and to support a smooth course of the on-site assessment phase.

Finally, the assessment kick-off meeting has to be held. This meeting deals with the assessment objectives, the assessment team, the assessment methodology, the processes to assess, the steps of the project, the roles and responsibilities, the interview planning, and the main key success factor of this kind of project. During this meeting some important aspects should be underlined: the confidentiality of each interview and the fact that the subject of the assessment is the process and not the interviewee's work.

At the end of the "Preparation Phase", the TIPA assessment project is prepared and everything is ready for the assessment.

5.4 Assessment

The objective of the "Assessment Phase" is to determine the achieved capability level of the assessed processes by collecting information and documents all along interviews.

The more time consuming activity of this phase is the interviews. In addition to the awareness raised during Kick-off meeting, each interview starts with a reminder of the context, scope and duration of the assessment, and the non-disclosure agreement. The assessors question then the interviewees on the process (on base and generic practices, attributes, improvement opportunities…) and collect all the documents identified as relevant for the assessment scope.

All information and documents gathered during (or following) an interview are used to rate individually each interview based on the "Not-Partially-Largely-Fully" (NPLF) rating scale. The review of collected documents may be used to confirm the interviewees' testimony, and so to improve the confidence level of the ratings. For each process, after the pair of assessors has agreed on the individual ratings of all interviews, they have to consolidate them to get an overall rating. Therefore assessors should use the 80/20 rule: leave out the lowest rating if its frequency is less than 20% then, select the lowest common denominator from interviews process ratings.

Finally, the capability level of each assessed process can be deduced by the application of rules defined in the TIPA methodology (Public Research Center Henri Tudor, 2009).

After the "Assessment Phase", comes the time for analysis of the findings.

5.5 Analysis

The objectives of the "Analysis Phase" are to perform a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis and to propose some recommendations based on its findings.

During this phase, the analysis of the information collected during the Assessment Phase (capability level achieved by each process, base practices ratings, attributes ratings) is performed. This analysis enables the assessment team to identify, for each process, its strengths (well-implemented practices), weaknesses (gap between the current practices and the ideal reference processes), opportunities (favourable exploitable conditions), threats (factors that might jeopardize potential improvements) and improvement recommendations. It is also possible to identify a set of strengths, weaknesses, opportunities, threats and improvement recommendations that are transversal to several processes or that are general to the assessed organizational unit (e.g. lack of training or communication).

At the end of this phase, the assessed organization can review, prioritize and assess the improvement recommendations previously determined. By taking into account the priorities and the constraints of the organization, an improvement project can be initiated based on some combined recommendations. Concretely, an improvement plan can be drafted, based on the results of this phase, to support the improvement project.

After the "Analysis Phase", the findings are analyzed and the results of the assessment project

can be formalized and presented to the involved parties.

5.6 Results Presentation

The objectives of the "Results Presentation Phase" are to summarize the assessment results in an agreed report and to present these results during a presentation meeting.

For this purpose, the assessment team writes the assessment report documenting the findings of the whole assessment project and presenting, at least (to ensure ISO/IEC 15504 conformance), the objective and scope of the project, the context of the assessment, a synthesis of the results of this assessment, the detailed results (comments, SWOT and recommendations) for each assessed process, the overall analysis and some recommendations on how to implement an improvement plan. In particular, the assessment report includes the assessment overall profile, the graphical representation summarizing the capability profiles and the resulting achieved capability level of all the assessed processes (see Figure 8). The assessment team has to pay attention that no interviewee's personal statements (according to non-disclosure rules) can be deduced from the assessment report contents.

After report validation by the assessment sponsor (client), the results presentation, showing in a synthetic and visual manner the key information contained in the assessment report, is performed to all involved persons. The assessment results should be presented in a neutral way, starting by a reminder of the basic concepts of a process assessment, the organizational context and the different business constraints, then going on with the findings of the assessment project (showing both positive and negative aspects) and finishing by a few words of thanks.

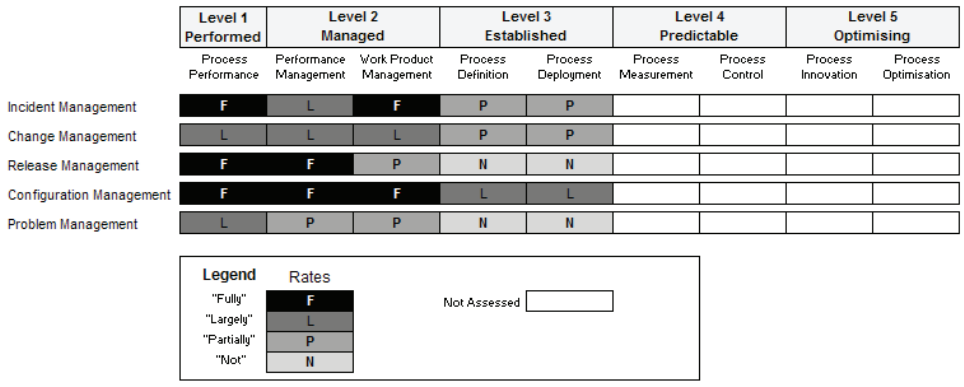
At the end of the "Results Presentation Phase", the results of the assessment project are reported and presented to all interested parties. The assessment project can now be formally closed.

5.7 Assessment Closure

The objectives of the "Assessment Closure Phase" are to organize two closure meetings both internal (only the assessment team) and external (with the client) and to ensure the administrative and effective closure of the assessment project.

In addition to the usual administrative tasks related to a project closure (deliverable receipt, bill charging, documents archiving…), a project closure meeting is held with the sponsor (client). This meeting aims at providing him the last deliverables, getting his feedback, and comparing the objectives and requirements of the assessment project with the service effectively delivered.

Figure 8. Overall assessment profile (©2009, Van Haren Publishing. Used with permission)



Ideally, a project closure meeting with only the assessment team is also held to discuss the results of the assessment project and to share feedback.

Finally, a project closure report is written. This report documents the different aspects of the assessment project (schedule management, cost management, quality management and lessons learned). This report will be used, during the next projects, to improve the ITSM process assessments.

The TIPA "Assessment Closure Phase" represents the end of the assessment project but can also be seen as the better moment to officially start an improvement cycle.

5.8 Starting the Improvement Cycle

At the end of the assessment project the organization knows what is the effectiveness of its ITSM framework, what is its ITSM processes capability level, how they are implemented, how they are diffused. But in order to work according to the selected framework, to change the work habits by implementing the needed changes, the organization has to launch an improvement project.

The step "starting the improvement cycle" of the TIPA methodology consists in a set of advices to take into account the recommendations made by the assessment team and to structure them into a structured improvement plan.

For that, the improvement project should follow the steps described below:

- To set up the objective of the improvement cycle (deadline, target level).
- To review the proposed improvement actions and to prioritize them by following such criteria as urgency, cost of implementation, ease of implementation, relevance of the action, expected added value, impacted services…
- To appoint a quality department that will be in charge of the management of the improvement project (planning, monitoring, reporting) and a support structure (help desk, training, coaching).
- To identify the roles and responsibilities involved in the project (sponsor, coordination committee, project team, working groups).
- To form working groups for best practices collection and templates production.
- To identify and implement actions to support change management (appropriation of practices and tools by all stakeholders)
- To monitor improvement actions, defined with the following information: number, name, description, impacted process, resulting capability level, responsible, outcomes, priority, estimated workload, start date, end date…

The timing and scope of the improvement cycle will be influenced not only by the resources dedicated and by the priorities fixed by the organization but also by the involvement of stakeholders. Focusing on the "quick wins" enables to demonstrate the benefits of an improvement project, thanks to short-term results.

6. THE IMPACT OF THE IMPROVEMENT CYCLE ON THE QUALITY OF THE IT SERVICES

Nowadays there is a generalized acceptance of the importance of the processes when it concerns the quality of the product. In the space industry, for instance, the qualification process is rarely done in the product (because very often the testing implies stressing the product until its destruction) but it is done instead by verification of the quality of the manufacture process. The *Six Sigma* methodology is maybe the best example of this approach as it focuses in reducing defects by improving and strictly controlling the processes. Some experiences integrating ITIL and Six Sigma show how industry is aware of the importance of mature

processes for the quality of the IT services (Probst & Case, 2009) (Fry & Bott, 2004).

The section 3 describes how to define a process assessment approach based on the ISO/IEC 15504 standard. This standard "incorporates the intent of the ISO 9000 series to provide confidence in a supplier's quality management" (International Standards Organization, 2004, p. 4). This means that behind the whole process assessment methodology defined in ISO/IEC 15504, the principles of quality management as defined in ISO 9000 are respected. This is true as well for ITIL that has a "strong relationship with quality systems such as ISO 9000 and a total quality framework such as European Foundation for Quality Management (EFQM) (Office of Government Commerce, 2000, p. 2).

The TIPA methodology discussed in the section 4 is the result of the application of the ISO/IEC 15504 process assessment standard to the ITIL v2 processes. However, the ITIL process assessment itself is not sufficient to improve the capability of the processes of the organization. It merely helps to know how mature these processes are at a particular time stamp. The actual benefit of this activity relies on allowing the organization setting-up a coherent *service improvement cycle*. This cycle allows the organization to increase the capability of the ITIL processes and, as a result, to improve the quality of the services provided to the clients. To make it short, the ultimate goal of all these linked activities (process assessment, service improvement cycle, and the increase of capability of processes) is *to improve the quality of the services to the users in order to fulfill the Service Level Agreements signed with them.*

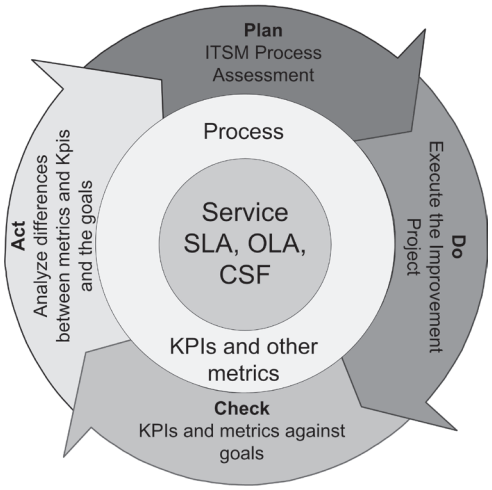
If we think about the *Deming Cycle*, the first ITSM process assessment (and therefore TIPA) can be placed in the "Plan" phase i.e. it can serve as the trigger of the continuous improvement program. The Plan-Do-Check-Act in this context is shown in Figure 9.

The figure shows that at the core of the cycle there is the service. Any improvement project that is launched must bear in mind that the ultimate goal is improving the service that is the actual product of the IT organization. Around the service there is the process used to provide that service. As discussed before, it is known that the quality of products can be improved by improving the processes used to produce them and services are no exception. Finally, around the processes, there is the Deming cycle, that aims at continuously improving the process and as a consequence improving the service provided by that process.

The ITSM process assessment places itself at the Plan phase of the Deming cycle because its result will be the improvement plan that will be executed during the Do phase. At the Check phase an ITSM reassessment can be conducted and its results will be analyzed during the Act phase. The resulting improvement plan of the reassessment constitutes the Plan phase of the new iteration of the Deming cycle.

A basic principle of management is that any goal fixed in an organization must be defined unambiguously and quantitatively measurable. In ITSM the main parameter for measuring the quality of services are the Service Level Agreements (SLAs) that are high level engagements between

Figure 9. The deming cycle for the ITSM process improvement cycle



the IT organization and its client. The SLAs have to be translated into Operational Level Agreements (OLAs) that involve other parties responsible for providing parts or the whole service and that define Critical Success Factors (CSF).

Metrics designate measures taken from a process. If the metrics are pertinent, these quantities should be representative of the quality of the service supported by the measured process. As we expect the service improvement cycle to have a positive impact on the IT processes of the organization, an improvement on the metrics associated to these processes should be noticed.

Key Performance Indicators (KPIs) are customer facing metrics of the process. However, they have the disadvantage that they come **after** the service has been delivered, for instance, once a month. The management can indeed have a good vision but this will not necessarily imply an improvement on the service as perceived by the client because the information comes too late. Therefore other metrics are necessary for the day-to-day management of the service. Such metrics will be evaluated, let's say, daily. They are used to tune up the service so that, when the KPI is calculated, it will reflect better results. A comparison between a SLA, OLA, CSF, KPI and metric for the Change Management process can be seen in Table 3.

Metrics are not mentioned in the TIPA model description and in the process assessment in general as metrics should not be considered as goals by themselves (itSMF International, 2006) during ITIL implementation projects. However improving the value of metrics (or rather improving a particular process monitored by some metrics) could be a legitimate goal for the service improvement cycle. In addition, the existence of some metrics can help in achieving a determined capability level as it is possible both to monitor process performance (capability level 2) and to quantitatively manage the process (capability level 4) and its improvements (capability level 5).

Most of the metrics have a tendency to be highly technical and though important they should not overshadow those that are less technical but equally (or maybe even more) important. These are the metrics related to Financial Management. They provide a perspective of the economical performance of the services: do we want to improve the quality of the services no matter the cost? If costs are the key driver, does it make sense to start an Improvement Cycle at all? Although not directly linked to quality, these metrics can be determinant for taking the decision of launching an improvement cycle or not.

There are plenty of metrics that can be applied to the ITIL processes. You can refer to the two *IT Service Management Forum* (itSMF) publications dedicated to that subject (itSMF International, 2006), (itSMF International, 2008) to have a look in a nicely defined set of metrics and how they can be implemented. Moreover, each organization can set its own metrics as needed.

Finally, by improving the quality of the processes, an improvement cycle contributes to increase the quality of the service provided. It is this increase of quality that justifies the investment on implementing such cycle. Some costs or ben-

Table 3. Example of SLA, OLA, CSF, KPI, and metric for the change management process

Type of measure	Example
SLA	All the changes (100%) have to be closed. This is true for any change that has been either done or refused.
OLA	As proof of the client's awareness of the results of the changes 100% of the Requests for Change (RFC) have to be closed by the client in the Change Management System.
CSF	Engagement of the client's management in order to require its staff to close all the RFCs in the Change Management system.
KPI	The ratio of open RFCs to closed ones (only RFCs older than one month at the moment of the calculation of the KPI will be considered).
Metric	The amount of RFCs opened at any moment.

efits, particularly those dealing with customer's satisfaction, are hard to estimate. The expected *Return On Investment (ROI)* from improving services depends on the reduction of the costs of poor quality. Both, internal and external costs (expenses paid to compensate for the defect in service delivery and loss of future revenue) will be reduced thanks to the service improvement cycle. This cost reduction has to be compared with the costs of the cycle to determine the potential ROI.

7. AN EXAMPLE OF A PRACTICAL APPLICATION OF TIPA[4]

7.1 Dimension Data's Context

Founded in 1983 and headquartered in South Africa, Dimension Data is a specialist IT services and solution provider that helps customers plan, build and support their IT infrastructures. Dimension Data applies its expertise in networking, security, data centre and storage, converged communications, operating environments, and contact centre technologies. In 2006 Dimension Data began a service improvement and alignment initiative across its Global Service Centers (GSC). The centers are located across the world (Johannesburg, Frankfurt, Bangalore, Melbourne and Boston) and provide 24-hour follow-the-sun Managed Services to regional and international customers.

The objective of this initiative was to improve the quality of service and to ensure a consistent customer experience from Dimension Data throughout the world. Also important was the alignment to ITIL®, the sharing of best practices across all GSCs, and the reduction of costs. Gaining a thorough understanding of current Service Support and Service Delivery process capability in the GSCs was quickly identified as a priority.

CRP Henri Tudor was validating the TIPA® methodology, and was looking for reference partners. The TIPA® methodology clearly met Dimension Data's objectives. It was agreed that an assessment of five GSCs, on five continents would be undertaken using the TIPA® methodology.

The objectives of conducting a process assessment were to:

- Determine the capability level of the processes in the selected GSC;
- Identify best practices, which could potentially be shared across the GSCs;
- Propose recommendations for improvement and alignment (i.e. starting a Continual Service Improvement cycle).

7.2 Results

The results of the TIPA® Assessment Project provided a valuable insight into the respective process capability levels of the GSCs and highlighted the importance of aligning processes across all regions.

The assessment results included recommendations on how the Global Service Centers could be driven to achieve greater Capability Levels. However, Dimension Data realized that its GSCs' resources were stretched to the maximum – these centers are faced with the challenges of managing rapid business growth, exceeding customer satisfaction, and consolidating operations – on an ongoing basis. In order to ensure that the improvement plan received the right level of attention, a solution had to be found, which would allow regional GSCs to dedicate the necessary resources to the improvement plan. Therefore, once the first assessment was completed, Dimension Data created a decentralized virtual office called the Process Centre of Excellence (Process COE). This office was to cope with the difficulty of driving high business growth, to exceed customer satisfaction, and to align and improve operational processes and procedures, all at the same time.

The Process COE is part of the continuous Service Improvement initiative, where Global Service Centre process assessments, based on the

TIPA® methodology, provided baseline information to understand "where we are". The role of the Process Centre of Excellence is to follow up process improvement and alignment initiatives in order to take us "where we want to be". The Process COE regional representatives work as a virtual team to define and to support deploying coherent operational processes and procedures based on ITIL® best practices, taking into account each Global Service Center's regional business context and customer requirements.

7.3 Lessons Learnt

Identify and Agree on Common Business Drivers

Before starting any improvement program it is essential to identify the key business drivers, in other words, to clearly understand what is driving the initiative from a business perspective. The alignment and improvement of operational processes are a time-consuming and costly exercise and it is worth identifying what the business expectations are. In the case of the project under discussion, the business drivers were clearly discussed and agreed with all stakeholders:

- Aligning all regional service operations to global best practices
- Detecting, qualifying, and implementing best practices
- Minimizing the delivery cost
- Through systems and process alignment & optimization
- Managing the highest affordable service quality
- Management framework & compliance/ certifications
- Delivering consistent services to multinational accounts
- Facilitating the introduction of new solutions worldwide

The experience showed that defining and sharing business drivers amongst the participants upfront could greatly reduce resistance to the program. Furthermore, identifying contextual business drivers can generate additional enthusiasm and support for the program.

Sharing of the Project Objectives

The sharing of common project objectives is essential to the success of the project especially in a multinational context. For example, the required level of Process Capability is different from region to region: the adoption and deployment of ITIL is an absolute pre-requisite for any service provider in Asia whereas in the United States ITIL is still seen as a business differentiator among service providers. Therefore, common global business drivers should be defined with regional project objectives in order to ensure regional adoption. However the long-term target has to be common across regions but the prioritization of actions to reach the target is a regional decision. The importance is not the way you take to reach the destination but reaching the destination at the expected time within the expected budget.

Importance of the Definition and Preparation Phases

The objectives of the preparatory phase are to explain the approach to the Assessment Sponsor, to identify local resources allocated to the project, to agree on the project objectives, to ensure that the right message will be communicated to the interviewees and that all local staff understands the reason of the assessment, to select the interviewees, and to prepare the planning of interviews.

Experience shows the importance of having a clear understanding of the customer business model, organization, scope of services, and local terminology before beginning the on-site assessment. This allows improving the credibility of the assessment during the on-site interviews

and facilitates an open discussion, which in turn benefits the final outcome.

Use of the TIPA® Methodology

The use of the TIPA® methodology benefitted the project, in the following ways:

- A standard and structured approach: The methodology provides the objectivity required to compare outcomes and to measure improvements periodically. In addition, a standard approach based on ISO specifications makes the project easy to sell to customers.
- Public domain methodology: The use of a public domain methodology ensures continuity and evolution based on user community experience.
- Pertinence of the TIPA® model: The TIPA® model is based strictly on ITIL best practices. The advantages and disadvantages of ITIL were accepted before the start of the project.
- Availability of ISO/IEC 15504 resources across the world speaking the same ISO/IEC 15504 language: This is essential when implementing an assessment in a multi-national company, such as Dimension Data.

Select a Representative Set of Interviewees

This experience confirmed the importance of the interviewee selection process. As the objective was to obtain a 360° view of the organization and its operational processes, the interviewee pool needed to comprise a mix of management and operational resources. Whenever possible, interviews should start with the individuals who can provide the most holistic overview of the formal process. This is key to help the assessment team gaining an understanding of the organization's particular environment. An adequate selection of interviewees boosts the credibility of the assessment results, as they will provide a true representation of how the organization works on a daily basis.

Prove the Effectiveness of the Approach by Example

It is always difficult to convince an internal organization to participate willingly in a process assessment as it might be seen as an intrusion into the organization. The Assessment Sponsor should first concentrate the selling effort on one entity (a department, a part of the organization, a local center) and prove the effectiveness of the approach by example, using the success of the first assessment to sell the next one(s).

Follow Up Results

While the objective of the assessment is to understand the process capability level of the current organization, it is also (and even more) important to provide recommendations for improvement. The implementation of recommendations is the responsibility of the organization itself, due to its budget implications.

Even if the assessment initially gains momentum internally, it might wane quickly. The pressures of day-to-day business quickly return. All individuals involved in the interviews should be kept informed about when the assessment results will be available, and informed of any subsequent actions that could impact them.

Importance to Have the Buy-In of the Management and the Team

The buy-in of the management team is one of the key success factors. The management team has to be in the right mindset to motivate the team. The assessment has to be seen as an opportunity for improvement and not as a "yet another useless project". This could be particularly true if the local management team is not volunteering for the

assessment, but the global executive committee has imposed the assessment.

Presentation of Draft Results Right After the Assessment

Experience shows that it is worth presenting the results in two steps: One presentation of draft results just after the assessment, where it is clearly explained that the analysis phase is under way, and a second (and more formal) presentation of results after the analysis phase. This approach gives time to the management team to contextualize the results of the assessment and to take the positive out of it. Managers tend to be optimistic and constructive people but they are usually impatient to have some indications as early as possible on the outcomes of the assessment. The draft results of the assessment can be presented right after the assessment if the right tools to summarize the results of the interviews are available (TIPA® provides an appropriate toolset). However, the right balance should be found between going too much into details and ensuring that what is being said will still be valid after the analysis phase.

Process Rating is a Difficult Exercise

Process rating is a difficult exercise, which requires not only a good understanding of the rating scale, but also some experience and expertise in the assessed domain. The understanding of the rating scale is normally achieved during the TIPA® methodology training and the evaluation of skills. It should be verified, before starting the assessment, that the assessment team has a consistent and coherent understanding of the rating scale in order to avoid different interpretations that would invalidate the assessment results. The rating scale is well described, but can be subject to interpretation.

The rating is particularly tricky for the rating "Partially" and "Largely". Most of the time the assessment team will easily agree for the rating value "Not Achieved" and "Fully". The discussion starts for partially and largely, when the glass is half-full or half-empty. The Lead Assessor should avoid endless expert discussions and ask the right questions to the team in order to be able to decide which rating level is the most appropriate. It could also be during this discussion that it is decided to park the rating of the process for one specific attribute if it is estimated that the right information to judge is missing. In such case, the interviewee should come back for a brief complementary session.

The TIPA® rating tools also provide a good support during the on-site assessment. The process rating tool lists the base practices for the specific assessed domain and the process attributes as defined by the TIPA process model. The tool structures the rating approach and facilitates your work by automating the creation of reports and analysis of results. This is particularly useful when providing draft results right after the assessment.

Rate Right after the Interview

As explained before, rating is a difficult exercise. All the interviews related to one specific process should be grouped together and the rating of the process capability should be done right after the interviews. It is useful to regroup the interviews related to one specific process altogether and to finish one process before starting the next one if possible. Jumping from one process to another is a brain killer and makes the assessor's life very difficult (i.e. confusion risk).

Dimension Data's experience shows that the assessors have to be experts on the assessed domain. It should be kept in mind that the final objective of the assessment is to identify improvement areas and to provide recommendations to move the assessed organization at the expected level of process capability. In order to provide recommendations, the assessors should have some expertise in both, the process assessment and ITIL.

The Intellectual Property (IP) of the Results Belongs to the Local Organization

The assessment report remains the IP of the assessed organization. Promoting this statement helps generating a sense of ownership on the part of the organization and helps preventing the adoption of a 'wait-and-see' attitude. Identify the process assessment report owner e.g. the Assessment Sponsor and make it clear that you will not distribute the final report before prior authorization. During Dimension Data's project the assessors received numerous requests to share the results of the process capability assessment. It was agreed beforehand with the document owners that requests would be forwarded to them and that it would be their decision to share the work.

8. CONCLUSION[5]

The service provider organizations have for a long time acknowledged the benefits of ITSM frameworks and the positive contribution that they have on the quality of services provided to their customers. Nevertheless, they are still facing a challenge when they need to implement, harmonize or improve ITSM practices within their organizations. One of the many difficulties is to promote the project to top management since it is knotty to request budget for a project in which the start point, project steps as well as targets are most of the time based on subjective judgments. External consultants can help but this approach prevents an IT organization from having a full control over the improvement project and so over the budget.

Nowadays, the ISO/IEC 20000 certification is the only way for an organization to get an international recognition for the quality of its internal ITSM practices. Unfortunately, the certification is focused on the compliance of ISO/IEC 20000-1 requirements and not on the way to increase the efficiency and the soundness of practices according to the specific context of an organization. A certification is an objective means to get a snapshot of the current status of ITSM practices, it is however not the best way to prepare an improvement programme.

The TIPA methodology described in this chapter gives a pragmatic answer for starting an ITSM improvement project based on a foundation as solid as possible. The methodology is completely open and focused on objective evidences and judgments, and over all, it involves effectively staff members from the beginning of the improvement project. TIPA enables an organization to assess its ITSM processes in such a way that improvement recommendations rising from the assessment are directly acknowledged by both, staff and management team.

The Dimension Data case study is a good example of how an ITSM assessment can be carried out. The case describes the factors that affect a TIPA assessment and what has to be considered in order to perform a successful assessment, keeping in mind the following ITSM improvement programme. It shows as well how the TIPA methodology can be relevant and useful for any ITSM organization inclined to evolve to more efficient and stable operations.

The main benefit of an objective and repeatable ITSM process assessment methodology is that it allows starting and maintaining a process improvement cycle with the aim of increasing the maturity of the processes. Ultimately, high maturity processes implies services of a higher quality. Therefore, a sustainable process improvement cycle implies that the quality of services will be constantly maintained and even improved.

The advantage of using a generic and standard method for process assessment is that the same approach can be followed when new process frameworks are published, or new versions of existing standard edited, which is periodically the case for ISO standards for example. Following the evolutions of the ITSM practices and standards,

TIPA works continue with the perspective of developing and using several IT Service Management based models in the context of the framework. The ISO/IEC 20000 based PAM, as well as the one for ITIL v3 are currently under development and will be published during 2010.

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10. KEY TERMS AND DEFINITIONS

ISO/IEC 15504: Formerly known as SPICE, it is a generic process assessment methodology presented in the form of an ISO/IEC standard.

ITIL: The IT Infrastructure Library "is the workside de facto standadard in IT Service Management, developed by the UK Office of Government Commerce (OGC)" (Public Research Center Henri Tudor, 2009)

PAM: The Process Assessment Model is "a model suitable for the purpose of assessing process capability based on one or more Process Reference Models" (International Standards Organization, 2004)

PRM: The "Process Reference Model is a model comprising definitions of processes in a life cycle described in terms of process purpose and outcomes, together with an architecture describing the relationships between the processes" (International Standards Organization, 2004)

Process Assessment: "A disciplined evaluation of an organizational unit's processes against a Process Assessment model." (International Standards Organization, 2004)

Process Attribute: "A measurable characteristic of process capability applicable to any process" (International Standards Organization, 2004)

Process Capability: "Characterization of the ability of a process to meet current or projected business goals" (International Standards Organization, 2004)

Process Profile: "The set of process attribute ratings for an assessed process" (International Standards Organization, 2004)

TIPA®: Tudor's ITSM Process Assessment methodology is a process assessment methodology whose goal is to allow an objective and repetitive assessment of ITSM processes. At its current state, it combines the processes defined by ITIL v2 and the process assessment principles laid on the ISO/IEC 15504 standard.

ENDNOTES

1 For further information, see TIPA website (http://www.tipa-itsm.com) or TIPA book (Public Research Center Henri Tudor, 2009)

2 For further information, see TIPA website (http://www.tipa-itsm.com) or TIPA book (Public Research Center Henri Tudor, 2009)

3 For further information, see TIPA website (http://www.tipa-itsm.com) or TIPA book (Public Research Center Henri Tudor, 2009)

4 Based on the business case presented on the book ""ITSM Process Assessment Supporting ITIL" (Public Research Center Henri Tudor, 2009)

5 We would like to thank Ms. Béatrix Barafort, Ms. Valérie Betry, and Mr. Marc St-Jean from the Public Research Centre Henri Tudor for their time and effort for reviewing this chapter. We thank as well Dimension Data and Mr. Rudy Hilbert as their experience using the TIPA methodology was the basis for the section 6 of this chapter.

Section 4

Infrastructural Aspects in Context of IT Service Quality Management

Chapter 10
Quality Management of Corporate Data Assets

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ABSTRACT

Corporate data assets such as customer, material, and supplier master data are critical when it comes to fulfilling business requirements such as compliance to regulations, integrated customer management and global business process integration. Surprisingly, companies do not treat corporate data as an asset, but rather focus on reactive quality management measures only. As a response to that, the chapter reports on the design of a reference model for Corporate Data Quality Management (CDQM). Following the principles of Design Science Research (DSR), the design process involved professionals of fourteen corporations headquartered in Germany and Switzerland. The reference model consists of six design areas which altogether comprise fifteen goals and 43 related practices. It supports practitioners during the establishment and optimization of their CDQM initiatives.

INTRODUCTION

Motivation

Companies tend to refer to their *corporate data* (e.g. customer, supplier, and material master data) as a "true asset" for business. However, in the majority of cases, corporate data are not treated as such. This is particularly surprising considering the impact high-quality corporate data has on business:

- Telecommunication companies use multiple sales channels for their products and services, e.g. the Internet, resellers, and shops. Despite this variety of sources of customer data, the company has to ensure availability of consistent, accurate, complete, and timely customer data (e. g. addresses, contracts, bills etc.) when a call center agent receives an inbound call.

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- Similar challenges regarding customer, contract and benefit data can be found in the insurance industry (Pula, Stone, & Foss, 2003). In addition to that, the European Commission has sharpened the requirements for management of market, financial and core business data through by issuing a new directive (Solvency II) (Salchegger & Dewor, 2008).
- In the automotive industry, companies need to conduct global spend analysis in order to manage total company purchasing volume across different divisions and locations. Prerequisites for that are consistent use of supplier identification numbers and good availability of all hierarchy relations between a supplier and its subsidiaries (Gordon, 2005; Otto & Hinderer, 2009).

In contrast to the high relevance of corporate data for both efficient and effective business operations, the typical strategy to manage corporate data is "fire fighting", i.e. companies usually follow a purely reactive approach. Research to shed light on this issue seems to be in its infancy, since only partial explanations for this phenomenon are given. Among those are:

- Quality management of corporate data is always delegated to the information and communication technology (ICT) department (White, Radcliffe, & Eschinger, 2008).
- Tools and methodologies to measure and control performance of corporate data quality management do not exist or are not used (White et al., 2008).
- Companies neglect the issue's complexity and demand "quick wins" without taking into consideration the medium- and long-term perspective (Karel, 2007).

Research Objective and Chapter Structure

The chapter takes up on current shortcomings in quality management of corporate data assets. It aims at the development of a Reference Model for *Corporate Data Quality Management* (CDQM) and at the illustration of its use in a practical context.

The chapter takes up existing work in the field of data quality management and contributes to the scientific body of knowledge by expanding state-of-the-art concepts with experiences from the practitioner community and by applying business engineering as a foundation to establish CDQM within an organization. Practitioners can benefit from the CDQM Reference Model when using it as guidance for their CDQM efforts.

BACKGROUND

Data and Related Terms

Pieces of data describe characteristics of objects and processes from the real world (Boisot & Canals, 2004; Spiegler, 2000). In this sense, data is free of context. When data is used within a context or when data is processed, it turns into information (Van den Hoven, 1999).

Data can be divided into master data, transactional data, and inventory data. Master data refers to the characteristics of core business entities within an organization (White, Newman, Logan, & Radcliffe, 2006). Typical master data classes are material and product master data, supplier and customer master data, and master data regarding employees, assets, and organizational units (Mertens, 2000). Transactional data represents input and output of business processes. It comprises purchase orders, invoices, shipping notes etc., and does not exist without a reference to master data. Inventory data refers to stock and account levels, e.g. to bank account balances or reserved stock

Table 1. Forms of data

	Time reference	Change frequency	Volume volatility	Existential independence
Master Data	low	low	low	high
Transactional Data	high	medium	high	low
Inventory Data	high	high	low	low

of finished goods (Stahlknecht & Hasenkamp, 2005). Table 1 compares the different forms with regard to time reference, change frequency, volume volatility, and existential independence.

Master data itself can also be divided further. While corporate master data are used across an entire organization, local master data are valid only within a particular organizational unit. In the example of finished goods, a unique material number would be a piece of corporate master data, whereas country specific packing information would be treated as local master data.

Besides that, reference data is another term frequently used in the practitioner community. While it lacks an unambiguous definition, it often describes data which is defined outside of organizations (DAMA, 2008). Examples are country or currency codes, which are specified by the International Organization for Standardization (ISO).

Resource-Oriented Approaches

In the early 1980s, first initiatives were started proposing to treat information as an asset. A prominent example is KPMG's IMPACT program, which resulted in the so-called Hawley report. The report identified seven key principles for both efficient and effective use of information (Horne, 1995). According to the report, information assets comprise, among other things, market and customer information, product information, specialist knowledge, and supplier information.

In principle, an asset is characterized by the following requirements (Wilson & Stenson, 2008):

- It must be identifiable.
- It must promise economic benefits.
- It must be under the organization's control.
- Its cost must be measurable.

In the past, companies found it difficult to assign cost figures to information assets, preventing information assets to appear in the balance sheet, for example. This led to the current practice to refer to information as "a valuable but unvalued" asset (Moody & Walsh, 1999). However, recent research has found that absence of intangible assets in general - and information in particular - is mainly due to a failure of the accounting profession to provide generally accepted guidelines (Wilson & Stenson, 2008), and not so much a result of an inability to transfer the "asset" concept to information resources.

However, there can be no doubt that information needs to be treated like any other asset in a company, e.g. physical and financial assets. Information has to be subject to the same budgetary, managerial, and audit disciplines as any other resource is (Wilson & Stenson, 2008).

In this sense, information management comprises all activities related to information resources (Krcmar, 2000), while data management is the business function that develops and executes plans, policies, practices, and projects that acquire, control, protect, deliver, and enhance the value of data and - indirectly - information (DAMA, 2008).

Information and Data Quality

Despite the existence of an accepted discrimination between information and data, the notion of quality is applied to both terms without much differen-

tiation. Also, there is no unambiguous definition for information quality and data quality, for what quality actually means usually is determined by the individual user and / or user groups. Accuracy of information, for example, always depends on the type of information and how this information is used. In the financial industry, 100 percent accuracy might be mandatory for account information, whereas an accuracy of 80 percent might be sufficient with regard to an employee's e-mail addresses (Moody & Walsh, 1999). Information quality and *data quality* always refers to "fitness for use", which can be perceived in different ways (so-called data quality dimensions). The research group around Richard Wang at the Massachusetts Institute of Technology (MIT) identified more than one hundred different dimensions (Richard Y. Wang & Strong, 1996). Among the most important ones are (DAMA, 2008):

- accessibility as the degree to which data or information are available when actually needed,
- accuracy as the degree to which a piece of data correctly describes a certain business entity instance,
- completeness as the degree to which data is captured, with fact completeness comparing attributes implemented in a database against all known requirements, and value completeness as a measure for absence of null values in a database column,
- consistency as the degree to which data values are identical across redundant databases.

Data Quality Management (DQM)

The Data Management Association (DAMA) defines *Data Quality Management* (DQM) as the "application of Total Quality Management (TQM) concepts and practices to improve data and information quality, including setting data quality policies and guidelines, data quality measurement (including data quality auditing and certification), data quality analysis, data cleansing and correction, data quality process improvement, and data quality education"(DAMA, 2008). In combination with concepts of quality management in general (Zhang, 2000), the following criteria can be applied to compare existing DQM approaches:

- management function (C1),
- company-wide orientation (C2),
- continuous improvement process (C3),
- enabling and empowerment of employees (C4),
- provisioning of techniques and guidance (C5).

Table 2 shows the results of a comparison of the most prominent frameworks.

The Complete Data Quality Methodology (CDQM) (Batini & Scannapieco, 2006) interprets DQM as a set of singular data quality improve-

Table 2. DQM approaches

	CDQM	DQS	TDQM	TQdM
C1	○	●	●	●
C2	●	●	●	●
C3	○	●	●	●
C4	◑	◑	◑	◑
C5	●	◑	◑	●

Key: ● − completely fulfilled; ◑ - partially fulfilled; ○ - not fulfilled.

ment projects and focuses on case-wise business process improvement at optimal cost. In particular, organizational aspects are left out of scope.

The Data Quality System (DQS) was introduced by Redman (Redman, 2000). It comprises all efforts of an organization aiming at the improvement of data quality by setting an organizational environment and defining business and technical capabilities. While the former comprises aspects such as data quality strategy, training concepts, and assignment of responsibilities, the latter covers data quality planning, measurement, improvement, and assurance, as well as maintenance of a data quality handbook.

Total Data Quality Management (TDQM) is the name of a research program at the MIT. The overarching approach of TDQM, which is to treat information as a product, is called the Information Product (IP) approach, saying that companies usually treat information as a by-product, i.e. they are focused on systems or events that produce information rather than on the information itself. The IP approach is supposed to help manage information in the same way a manufacturing company would manage its products - information manufacturing is seen as processing systems acting on raw data to produce information products. The IP approach consists of four principles, namely (1) understanding of consumers' information needs, (2) management of information as a result of a production process with a (3) lifecycle, and (4) appointment of an information product manager (Richard. Y. Wang, 1998; Richard Y. Wang, Lee, Pipino, & Strong, 1998).

Total Quality data Management (TQdM) is a method which provides guidance for business-driven information quality improvement. It also makes use of the information product concept and focuses on an organization-wide view in a sense that information products need to fulfill the demands of all users ("fitness for all purposes") (English, 2003). This requires transparency on all data consumers along the "data supply chain", including users in subsequent business process activities, in other organizational units, and outside the organization.

RESEARCH APPROACH

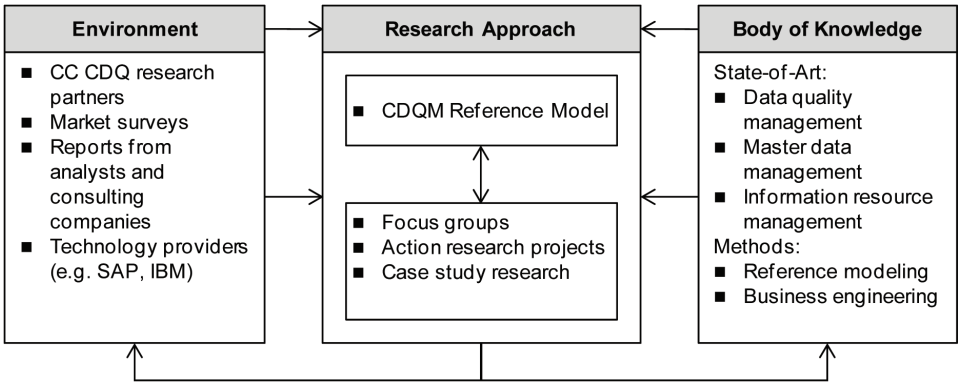
The aim of our research is to develop a Reference Model for CDQM. A model is a simplified and abstract representation of an original object, allowing analysis, education or communication. Being the result of a design process, it addresses a well-defined group of stakeholders (Schütte, 1998). Reference models, more specifically, constitute a basis for company-specific models to be applied in a well-defined domain. In this sense, they can be considered solution blueprints for practice (vom Brocke, 2007). The CDQM Reference Model is an adaptive reference model, i.e. it allows for flexible, company-specific instantiation, which was necessarily reflected by the modeler through configuration parameters.

Reference models are typical results of design-oriented Information Systems (IS) research (March & Smith, 1995), which aims at delivering artifacts of both practical and scientific value. Hevner et al. propose principles by which design-oriented research should be guided (Hevner, March, Park, & Ram, 2004).

Figure 1 shows the research approach. The design of the CDQM Reference Model follows the methodological principles of reference modeling and the concept of business engineering as a methodology to support business transformation. This corresponds with the idea of a reference model to support the establishment of CDQM within an organization. The "environment" constitutes both the source for business needs and the field for application of the reference model.

The Competence Center Corporate Data Quality (CC CDQ) determines the research setting. It is a collaborative applied research project (Österle & Otto, 2009) and consists of a consortium of fourteen research partner companies and the Institute of Information Management at the Univer-

Figure 1. Research approach



sity of St. Gallen (IWI-HSG). Table 3 shows key data of the research partner companies.

The research activities follow accepted guidelines for design-oriented IS research as proposed by Peffers et al., who have explicated a research process which comprises six phases, from problem identification and motivation to conduct research to communication of results (Peffers, Tuunanen, Rothenberger, & Chatterjee, 2008). The project's preparation started in mid 2006as a joint activity of researchers from IWI-HSG and IBM. By that time, IBM had made first experiences with the

Table 3. Research partner companies in the CC CDQ

Research Partners	Industry	Revenue 2008 [bn. EUR]	Employees 2008	CDQM Scope	Reporting Line of CDQM	CDQM Function	Internal Name	CC CDQ Participation
Bayer CropScience	CHE	6.4	18,300	Corp.	CFO	est.	MDM	11/06 - today
Beiersdorf	PHA	6.0	22,000	Corp.	SCM	est.	MDM	01/09 - today
Daimler	AUT	95.9	273,216	LoB	CIO	new	CDM	11/06 - 10/08
DB Netz	PUB	4.0*	36,058*	LoB	CTO	new	IDM	07/07 - today
Deutsche Telekom	TEL	61.7	235,000	LoB	CTO	new	MDM	11/06 - today
E.ON	UTI	86.8	93,538	LoB	CIO	new	IM	11/07 - 10/08
ETA	MAN	n/a	8,000	LoB	CFO	est.	MDM	11/06 - 10/08
IBM	SER	n/a	n/a	n/a	n/a	n/a	n/a	11/06 - today
Migros	RET	17.2	84,096	Corp.	SCM	new	MDM	04/09 - today
Nestlé	COG	73.3	283,000	Corp.	GLOBE	est.	BDM	10/08 - today
Novartis	PHA	29.2	100,000	Corp.	SCM	new	MDM	01/09 - today
Syngenta	CHEM	8.2	24,000	Corp.	SSC	new	MDM	12/08 - today
ZF Friedrichshafen	AUT	12.5	61,000	Corp.	CIO	new	MDM	09/07 - 10/08
Partner "Automotive"	AUT	n/a	n/a	Corp.	CFO	new	MDM	12/07 - 10/08

Key: CHE - Chemicals; PHA - Pharmaceuticals; AUT - Automotive; PUB - Public Sector; TEL - Telecommunications; UTI - Utilities; MAN - Manufacturing; SER - Services; RET - Retail; COG - Consumer Goods; Corp. - Corporation; LoB - Line of Business; CFO - Chief Financial Officer; SCM - Supply Chain Management; CIO - Chief Information Officer; CTO - Chief Technology Officer; SSC - Shared Services Center; MDM - Master Data Management; CDM - Corporate Data Management; IDM - Infrastructure Data Management; IM - Information Management; BDM - Business Data Management.

so-called Data Governance Council, which is a group of large corporations mainly from the financial services industry in the US aiming at the promotion of organizational concepts for corporate data management (IBM, 2007). IBM believed that there were still questions open that would have high research potential, especially in the area of business-driven, corporate-wide approaches to establish CDQM in companies. The competence center approach was considered an appropriate setting so that talks with potential partner companies could start. The feedback was very encouraging, and so the project was officially launched on November 1st, 2006.

The second phase, namely the definition of objectives of the solution, ran from November 2006 to February 2007. It covered the definition of the requirements and the scope of the CDQM Reference Model. Two main techniques were applied here: First, a focus group interview (Morgan, 1993) was conducted with all members of the consortium, and second, a series of expert interviews was carried out comprising three to five representatives from each partner company in order to identify the requirements and the "baseline" within the practitioner community.

The design and development phase started in the first quarter of 2007 and was finished in mid 2008. To reflect practitioners' requirements on a model supporting not only regular operations but especially the "build" phase of CDQM, business engineering as a methodological approach for business transformation was chosen (Österle, 1996). Knowledge about "things that worked" as well as about "things that did not work" was continuously incorporated by means of case studies, covering the establishment of CDQM at Ciba (Weber & Ofner, 2008), the data quality program at BT Group, the data quality controlling system at Karstadt (Schemm & Otto, 2007), and the master data management program at Andritz (Vogel & Osl, 2007).

In parallel, the demonstration phase and the evaluation phase started. The CDQM Reference Model was applied in action research projects (Baskerville & Wood-Harper, 1996; Susman & Evered, 1978) at the research partner companies. In addition to evaluation activities taking place in the action research projects, the CDQM Reference Model was evaluated in two focus groups, the first one conducted within the 7th CC CDQ workshop in April 2008 in Stuttgart, and the second one carried out in the pre-workshop of the IIR Data Management Congress in Cologne in February 2008.

In total, more than 70 meetings took place in the context of the action research projects, and 11 workshops were held within the consortium to make design decisions for and evaluate the current status of the CDQM Reference Model.

Besides that the CC CDQ started first communication measures both to the scientific and the practitioner community. Preliminary versions of the CDQM Reference Model were published at the Australasian Conference on Information Systems (ACIS) 2007 (Otto, Wende, Schmidt, & Osl, 2007) and at the ACM SAC 2009 (Hüner, Ofner, & Otto, 2009). Communication measures to the industry included presentations at the "DSAG Jahreskongress" in September 2008 and the "Stammdaten-Management Forum" in September 2007.

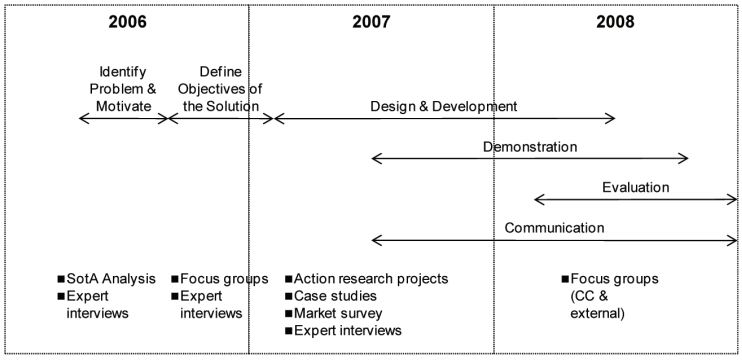
Figure 2 summarizes the research process. While the first cycle of the CC CDQ started in November 2006 and ended in October 2008, the second cycle started in November 2008 and is currently still in progress.

REFERENCE MODEL FOR CDQM

Scope and Requirements

The CDQM Reference Model aims at the advancement and promotion of quality management of corporate data assets. Corporate data is defined as master data which is used in more than one organizational unit (e.g. line of business, depart-

Figure 2. Research process



ment, and division). In terms of the concept of information products, corporate data is an input to the production process. Corporate data comprises both "atomic" data elements which cannot be further detailed (e.g. material group codes) and component data as a combination of atomic data elements (e.g. a customer address consisting of data on street, street number, ZIP code, country code etc.) (DAMA, 2008; Richard Y. Wang et al., 1998).

Figure 3 demarcates the scope of the CDQM Reference Model. In this sense, the model does not include the following aspects:

- transactional data and inventory data, and quality aspects related to these,
- information products, and quality aspects related to these.

Initial requirements on the model were derived from the first consortium workshop in November 2006:

1. business orientation in order to create awareness of the relevance of corporate data quality in the company / in the practitioner community,

Figure 3. Scope definition

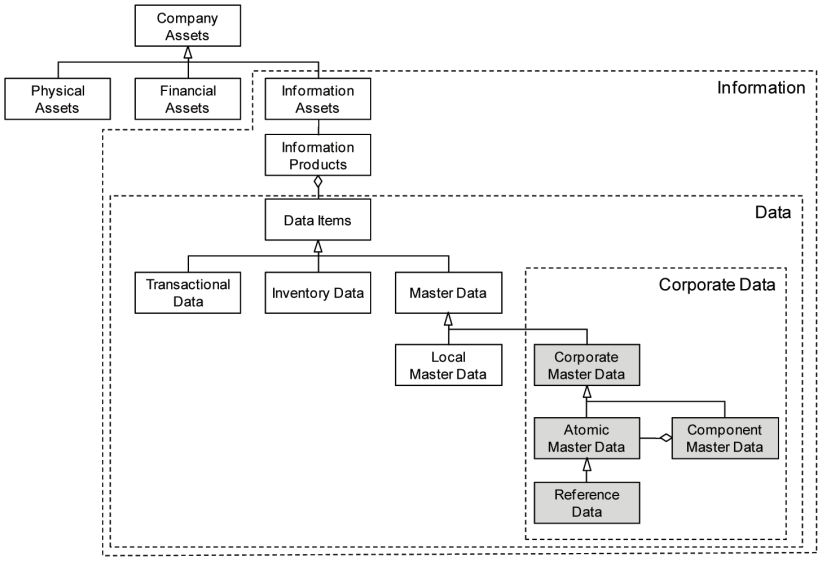
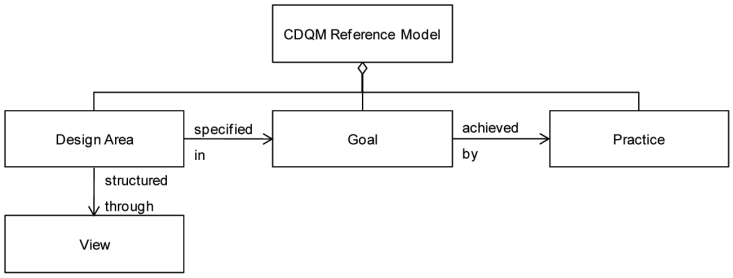


Figure 4. Structure and components of the CDQM reference model



2. integration of business aspects and information systems aspects to rule out isolated approaches,
3. provisioning of tools and methods to be able to apply the model in practice,
4. integration of experiences made and "best practices",
5. integration of innovative technological (e.g. Semantic Web) and organizational (e.g. shared services for data maintenance) concepts, if deemed appropriate.

Model Design

The CDQM Reference Model provides a structured view on the CDQM domain. Following the CMMI specification, the reference model consists of the following three components (SEI, 2006):

- a design area, which is a cluster of related "best practices" in a certain area, which when implemented collectively meet a set of goals considered important for achieving significant improvement in that area,
- a goal, describing characteristics that must be present to satisfy the design area,
- a practice, describing an activity that is considered important for achieving the associated goal.

As a fourth component, views from the concept of business engineering are incorporated, namely "Strategy", "Organization", and "Systems", in order to reflect the need for business orientation. Figure 4 shows the structure plus components of the CDQM Reference Model.

Figure 5 shows an overview of the CDQM Reference Model, comprising six design areas and their assignment to the three views. The design areas are "CDQ Strategy", "CDQ Controlling", "CDQ Organization", "CDQ Operations", "Integration Architecture for CDQ", and "Applications for CDQ".

The first design area, "CDQ Strategy", aims at aligning the management of corporate data quality with the overall strategy of an organization. It links all CDQM measures and activities

Figure 5. CDQM reference model overview

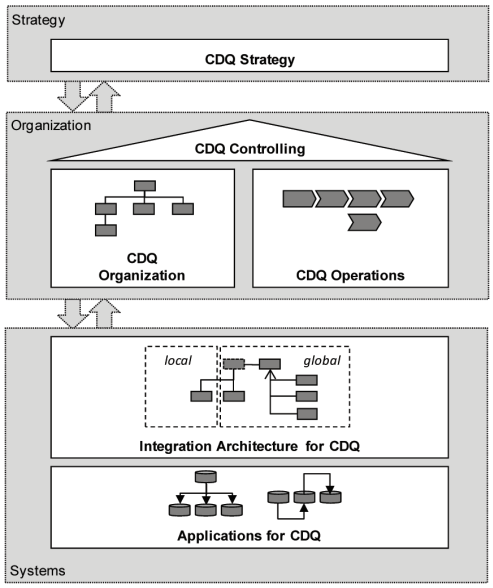


Table 4. Design area "CDQ strategy"

Goals	Practices
Impact of corporate data quality on company goals determined	• Identify company goals • Determine impact of corporate data on company goals
Mandate for CDQM assigned within the organization	• Appoint organizational unit to be responsible for the CDQM initiative, or put up a CDQM project
Strategic scope of CDQM defined	• Develop and update mission statement for CDQM • Determine organizational units to be included • Determine corporate data classes to be included
Strategic action plan developed	• Determine strategic objectives and principles • Develop time plan

to the company's business drivers. The goals and practices of this design area are shown in Table 4.

Based on the CDQ Strategy, "CDQ Controlling" allows for measuring, analyzing, planning and improving both corporate data quality itself and - even more important - the impact of corporate data quality on business performance indicators. Table 5 shows the goals and related practices of this design area.

"CDQ Organization" aims at the organizational establishment of CDQM. It identifies necessary tasks and roles involved in CDQM, and it assigns decision rights to these roles. Roles include data stewards, data owners, and others. Committees, such as a Corporate Data Quality Board, are needed to balance the different interests of all stakeholders involved (Weber, Otto, & Österle, 2009a). Table 6 shows the goals and practices of this design area.

Table 5. Design area "CDQ controlling"

Goals	Practices
Impact of data quality on business performance indicators identified and related data quality measures defined and managed	• Identify and define data quality dimensions aligned to the CDQM strategy • Specify data quality metrics (e.g. scales, points of measurement, methods of measurement) based on cause-and-effect relationships between data defects and business performance indicators • Identify critical levels and target values for data quality measures
Quality of data permanently monitored and improved	• Develop, implement and improve methods of measurement for data quality metrics • Define maintenance processes and responsibilities for data quality measures • Monitor threshold values and initiate improvement projects or activities
Effectiveness and efficiency of CDQM operations continuously evaluated	• Perform cost-and-benefit analysis for every improvement project or activity • Prioritize projects and activities and control achievement of benefit

Table 6. Design area "CDQ organization"

Goals	Practices
Organizational structure for CDQM established	• Determine CDQM tasks and decision areas • Establish committees and determine roles • Ensure availability of human resources • Prepare job instructions and guidelines
Stakeholder expectations regarding CDQM managed	• Identify and evaluate CDQM stakeholders • Develop communication and training plan • Execute communication and training measures

Table 7. Design area "CDQ operations"

Goals	Practices
CDQM processes designed, managed, and improved	• Design and provide CDQM services to internal customers (e.g. information product managers) • Define and maintain business metadata for corporate data objects
Corporate data creation, use, maintenance, and deletion in business processes identified, managed, and improved	• Identify and manage customers of corporate data to meet their requirements regarding the use of corporate data • Model and document the corporate data lifecycle • Design, implement, monitor and improve creation, update, use, and deletion activities within the corporate data lifecycle

Table 8. Design area "integration architecture for CDQ"

Goals	Practices
Integration object model designed, managed, and improved	• Identify integration objects • Define integration objects • Develop the integration object model • Define business rules for the use of corporate data as a physical representation of integration objects
Integration architecture designed, managed, and improved	• Document existing integration architecture • Evaluate design options of new integration architecture • Develop architecture pattern • Plan and implement new architecture

The objective of "CDQ Operations" is twofold. On the one hand, it analyzes, designs and controls the lifecycle of corporate data, i.e. creation, update, use, and deletion of corporate data elements. On the other hand, it comprises the processes which are carried out by the CDQ organization. Whereas the latter focuses on the organizational structure for CDQM, the former emphasizes the process view. Table 7 shows the goals and practices of this design area.

"Integration Architecture for CDQ" has two goals. First, it defines the integration object model which describes a company's core business entities and the relationships between them. In this sense, it is a conceptual data model of corporate data objects, creating the basis for providing a semantically unambiguous understanding of both entities and their relationships. Second, it designs the integration architecture, which consists of application systems needed for creation, use, update, and deletion of corporate data and the data flows between them (Periasamy & Feeny, 1997). In practice, different architecture patterns derive from the combination of data storage and data distribution. Among them are centralization, harmonization, and repositories (Legner & Otto, 2007). Table 8 shows the goals and practices of this design area.

The sixth design area, "Applications for CDQ", deals with software support for CDQM. It identifies necessary system architecture components on a functional level and it plans and executes an implementation plan (Otto & Hüner, 2009). Software systems for CDQM include master data management software, data cleansing and data quality monitoring systems, workflow systems to support the corporate data lifecycle, and business data dictionaries (White & Radcliffe, 2008). Table 9 shows the goals and practices of this design area.

Table 9. Design area "applications for CDQ"

Goals	Practices
System architecture for CDQM tasks planned	• Identify CDQM activities that need software support (e.g. data cleansing, data creation) • Document and understand the gap between current and future system landscape • Classify, evaluate and select CDQM software from vendor basis
System architecture implemented, managed, and improved	• Define, implement and monitor workflow management systems to support data lifecycle operations • Define, implement and manage data quality performance measurement systems • Implement and manage business metadata management systems • Implement and manage data storage and distribution systems

MODEL APPLICATION

The model CDQM Reference Model's application aims at demonstrating its applicability in a practical context and evaluating as to how well it helps solve the problem identified at the beginning of the whole process (Peffers et al., 2008). Both activities were mainly carried out in the form of action research projects with research partner companies.

Table 10 shows the respective design areas of the different action research projects. In no case was the CDQM Reference Model applied in its full scope. Due to specific conditions in the research partner companies, selected design areas were focused in each case. For reasons of space the action research projects cannot be described in detail here. Instead, the following section will focus on the overall findings with regard to the requirements which were identified to be met by the CDQM Reference Model.

Table 10. Model application in action research projects

Research Partner	CDQ Strategy	CDQ Controlling	CDQ Organization	CDQ Operations	Integration Architecture for CDQ	Applications for CDQ
Bayer CropScience	◑	◑	●	◑	○	○
Beiersdorf	(no action research project)					
Daimler	○	○	○	◑	●	○
DB Netz	●	○	●	●	●	◑
Deutsche Telekom	○	◑	●	◑	○	○
E.ON	◑	○	◑	○	○	○
ETA	○	●	○	○	●	●
IBM	(co-organizer, no action research project)					
Migros	◑	○	●	●	○	○
Nestlé	◑	○	○	○	●	○
Novartis	●	○	○	◑	●	◑
Syngenta	●	●	●	◑	○	○
ZF Friedrichshafen	○	◑	●	◑	○	○
Partner "Automotive"	◑	◑	○	◑	◑	○

Key: ● - Focus topic; ◑ - marginal topic; ○ - out of scope in the action research.

Requirement 1: Regarding business orientation, the CDQM Reference Model proved well. In particular, CDQ Strategy is considered critical in cases where different lines of business are involved. CDQ Strategy works as an instrument to achieve a mutual agreement on scope, funding, cooperation between different organizational units, and time planning. Taking into account overarching business drivers, which the company as a whole is confronted with, helps to get "power play" discussions back to the facts. During the process of applying the CDQM Reference Model, in the cases of Deutsche Telekom, ZF and partner "Automotive" demand arose for a maturity model for CDQM in order to be able to better assess the current situation and to monitor the progress of the CDQM initiative (Radcliffe & White, 2009). The overall approach to consider establishment of CDQM as a business engineering task was strongly welcomed. The prevailing opinion in the consortium has been that while corporate data management and corporate data quality per se was nothing new, a business oriented approach to the topic indeed was. However, one research partner company has stated that the goal of being able to show the business value of corporate data quality has not been achieved to a sufficient extent so far.

Requirement 2: To ensure integration of business aspects and information systems aspects, the concept of business oriented data quality metrics was introduced. For example, it is considered more beneficial to use "First pass yield" as a process quality metric and link data quality dimensions to it than just measure completeness of customer address data. The concept has been taken up by Bayer CropScience, Deutsche Telekom and ETA. However, skepticism has been articulated regarding availability of data on business performance indicators and ability to determine a correlation between data quality metric values and business performance indicator values. Apart from that, it has been mentioned that the CDQM Reference Model so far has not included goals and practices which relate to management of business rules. Other open points articulated refer as to how to demarcate business rules effectively from other concepts (such as business process control parameters) and how to define ownership for business rules.

Requirement 3: As far as tools and methods for application of the CDQM Reference Model are concerned, this requirement seems to provide biggest ground for future work. Whereas all major topics turned out to be addressed by the CDQM Reference Model, research partner companies have expressed the need for more research to provide a toolbox in order to be able to operationalize the practices. To some extent this demand has been taken up already, since there is now a reference model for data governance (Weber, Otto, & Österle, 2009b), a method to identify and define integration objects (Schmidt & Otto, 2008), and a first version of a maturity model (Hüner et al., 2009). What was identified as missing is support in identification and management not only of data sources but also of data sinks. In the majority of cases the users of the CDQM Reference Model are responsible not for management of information products, but for input to them, namely component data. In a complex business process and application landscape, the question is as to how the person responsible for e.g. material master data can keep track if and where the data from a central (but not necessarily leading) system is used ultimately? He or she cannot just simply invite all information product managers (Richard Y. Wang et al., 1998) to a workshop, because in many cases this role is not assigned to employees.

Requirement 4: The need to integrate practical experiences and "best practices" will never be fully accomplished, as this is always an ongoing process. However, the concept of preventive CDQM has been appreciated very much as a transfer of knowledge from the domain of manufacturing processes to the domain of corporate data. The MIT study "The machine that changed the world" from the 1980s, which investigated on the suc-

cess of Japanese automakers, provided evidence that the Western method of "reactive" quality management – i.e. when the cars were already off the assembly line - only rarely achieved the same results as Japanese Total Quality Management approaches, and in no case achieved the same quality cost levels (Womack, Jones, & Roos, 1991). The same is considered to be valid in the domain of corporate data quality management.

Requirement 5: The integration of innovative technological and organizational concepts has been considered in multiple ways. Although the CDQM Reference Model leaves it to the user how to instantiate certain practices, Semantic Web approaches were used at Bayer CropScience for the business data dictionary. The concept allows for integration of employees when it comes to defining and maintaining metadata, and in this sense it supports the need for an integrated view on business aspects and information systems aspects. Also, the concept of establishing dedicated roles for CDQM has been strongly welcomed. However, difficulties occurred when it came to assigning roles within an organization. Since in the majority of cases the roles (e.g. data steward, data owner) were to be taken over by existing personnel, people often considered CDQM activities assigned to them as additional work and were skeptical about the feasibility.

SUMMARY AND OUTLOOK

There are a number of business drivers demanding high-quality corporate data. Since these business drivers cannot be managed by a separate business unit on its own, a corporate-wide approach to ensure corporate data quality is needed. The research presented in this chapter aims at the development of a Reference Model for CDQM. It takes up on accepted quality management principles (e.g. prevention of business problems) and on existing approaches in the data quality management domain (e.g. the information product concept from TDQM). The CDQM Reference Model uses the concept of business engineering to structure design areas in three views, namely a strategic, an organizational, and a systems view. The model consists of six design areas, and it comprises fifteen goals and 43 related practices. The CDQM Reference Model has been developed in the CC CDQ, which is a collaborative applied-research project within the research program Business Engineering at the University of St. Gallen (BE HSG).

Further work on the topic can refer to a multitude of aspects. First, the model itself is a "living" artifact, i.e. it must continuously be adapted in order to reflect practitioners' needs. To open the process for the community, a wiki-based website was launched under http://www.cdqm.org. Second, companies require a tool to measure their "baseline" in the area of CDQM and to measure progress appropriately. To respond to this demand, a Memorandum of Understanding (MoU) was signed by IWI-HSG and the *European Foundation for Quality Management* (EFQM) to incorporate the domain knowledge into the EFQM Model of Excellence. Third, emphasis will be put on the development of tools to support the different practices which are outlined in the model. Since this would mean an expansion of the CDQM Reference Model towards a set of methods, it would be of substantial benefit for the user community, supporting subsequent acceptance and dissemination of the model in the market. Fourth, a research focus should be put on novel organizational and economic concepts, which should be incorporated in the model to foster its applicability. One aspect would be to anticipate new organizational forms for the establishment of CDQM, e.g. shared services or outsourcing concepts (Weber et al., 2009a). Fifth, another research question deals with introduction of market mechanisms to the concept of corporate data lifecycle management.

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Chapter 11
Quality of Cloud Services

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ABSTRACT

Cloud Computing has become the predominant paradigm in information technology for the use of distributed resources. It enables the Internet of Services where different provider offer services and compose services to new value added services. For the emerging service value chains the quality the services plays an important role. Therefore, beside software engineering methods aspects like quality of services, business models, and the interaction with the customer have to be considered during the development of cloud services. This chapter describes how these aspects can be integrated in the development process by combining software and service engineering methods and considering quality as a critical success factor in the design time.

CLOUD COMPUTING

Cloud Computing has become the predominant paradigm for the use of distributed resources like computing power, storage capacities, data and software applications. But still there is no uniform definition of cloud computing. One reason why the term cloud computing is difficult to capture is the missing classification with regard to other approaches like grid computing, software as a service, platform as a service and infrastructure as service.

In the last years, *grid computing* is being widely accepted when the distribution of high performance computing is needed in virtual organizations. Research on *grid computing* started in research when the need for high performance processing and management of a great amount of data became necessary in disciplines like high energy physics, climate research, astrophysics, engineering, medicine and life science [Schwiegelshohn 2008]. From research grid computing went to industry. This leads to additional requirements

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like specified availability and performance, scalability and beside high performance computing also the support of transactional processing. Also, the type of users changed. In the first grid application developer and user were mostly identical. In industry, the user is normally not the developer of the application. The users expect a user friendly and task appropriate user interface in order to perform their tasks efficiently on the basis of a grid. Hiding the complexity of the infrastructure is therefore a basic requirement for acceptance. The transition from research to industry implicates the change from specific high performance application areas to multipurpose infrastructure for business application. This transition advances *cloud computing*. Beside the characteristics which apply for grid as well as for cloud computing like virtualization, security, scalability, and reliability some other characteristics play an important role for cloud computing. These include usability, multi-tenancy and businesses models in form of pay-per-use models. Furthermore, the quality of services is an inherent feature of cloud computing.

According to [Vaquero et al. 2009] *cloud computing* can be described as follows: "Clouds are a large pool of easily usable and accessible virtualized resources (such as hardware, development platforms and/or services). These resources can be dynamically reconfigured to adjust to a variable load (scale), allowing also for an optimum resource utilization. This pool of resources is typically exploited by a pay-per-use model in which guarantees are offered by the Infrastructure Provider by means of customized Service Level Agreements."

Depending on the type of the provided capability the cloud service can be arranged in three different levels according to the layer of a service-oriented architecture. *Infrastructure as a Service* (IaaS) provides resources like computers and storage as a service. Examples are the Amazon Web Services Amazon Elastic Compute Cloud (EC2) and Simple Storage Service (S3). *Platform as a Service* (PaaS) stands for a platform upon which applications and services can be developed. Examples of such platforms are the development platform Force.com by salesforce, the Google App Engine or the Microsoft Azure Service Platform. Applications and services on top of the infrastructure and the platform which are used according to a pay-per-use model are summarized in the term *Software as a Service* (SaaS).

The development of cloud services demands more than merely software engineering methods. Aspects like quality of services, business models [Laudon, Traver 2006] comprising value proposition, revenue models, market opportunities, competition environments, as well as the interaction with the customers have become more important. This chapter describes how these aspects can be considered during the design of a service. Therefore, methods applied in service engineering as a part of the research field service science are used to bring in the user perspective in the design of a service. Furthermore, different perspectives of the quality of cloud services are discussed and a possibility is shown how quality as a critical success factor for cloud services can be considered very early in the design of a service.

SERVICE ENGINEERING FOR CLOUD SERVICES

The research field of service science evolves as the significance of services has grown and a systematic way to develop services has become necessary. Service science deals with the use of resources of one or more systems for the benefit of another system in economic exchange [Spohrer 2008]. Service science comprises many areas of research like service management, service marketing, service economics, management of service innovation, service supply chains, and contracting.

Service engineering is the specialist discipline which focuses on the systematic development and design of service products with the aid of appropriate procedures, methods and tools [Spath et al.

2007]. The *service engineering* approach is based on three dimensions which characterize services [Fähnrich, Meiren 2007] (Figure 1). These three dimensions are potential, process and outcome. In order to develop cloud services using sustainable business models the three dimensions ought to be taken into account during the development.

The potential dimension describes the ability and willingness to provide a service. The outcome of the potential dimension is the resource model. It groups together development tasks which describe the provision of services. This includes the different roles which are involved in the development and provision of the service as well as the required material, software and hardware resources. The software architecture model composes a high level view of the resource model. A role model is defined according to the layers of the software architecture.

The process dimension focuses on the process for the provision of a service. The outcome of the process dimension is a process model. An important point is the integration of the customer as an external factor in the service delivery process. For the description of the processes the service blueprint method [Spohrer, Kwan 2008] is an appropriate method. It distinguishes the process steps according to their visibility to the users. Furthermore, the service blueprint method shows the process steps according to the role which carries them out.

The outcome dimension examines the material or immaterial consequences of the service. The outcome of this dimension is the product model. This provides a description of the characteristics of the service. In particular, a definition of the service content and outcomes are part of the product model as well as quality and performance standards. For the description of the service the Unified Model Language (UML) or Business Process Modeling Notation (BPMN), and standards like the web service definition language (WSDL) can be used.

Roles in a Cloud Value Chain

The major benefit of *service engineering* is that it provides a clearly structured methodical approach for the development of new services. It comprises the investigation of customer preferences and the interactions of service components as well as user interfaces. The different views on service processes, product flows as well as on the resources and actors involved help to find the way from a useful application to a commercially successful service which also takes into account the operation efforts and costs as well as the quality of services.

The analysis of applications for the purpose of creating end user services surrounding them requires a systematic approach in establishing the procedural and technical components.

Having a look at the basic roles involved in such a service provision, as shown in Figure 2,

Figure 1. Dimensions for the development of services, according to [Fähnrich, Meiren 2007]

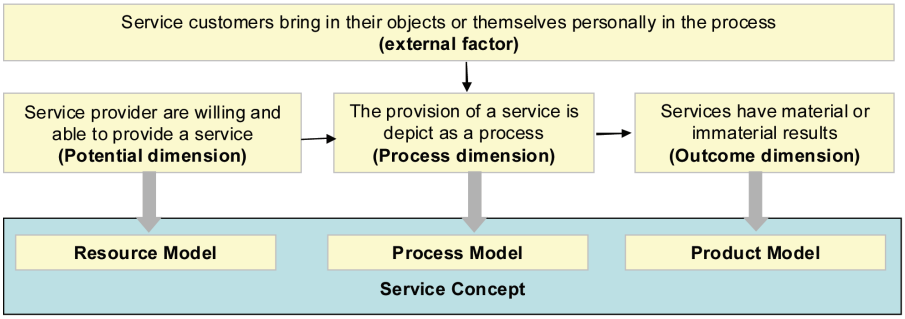
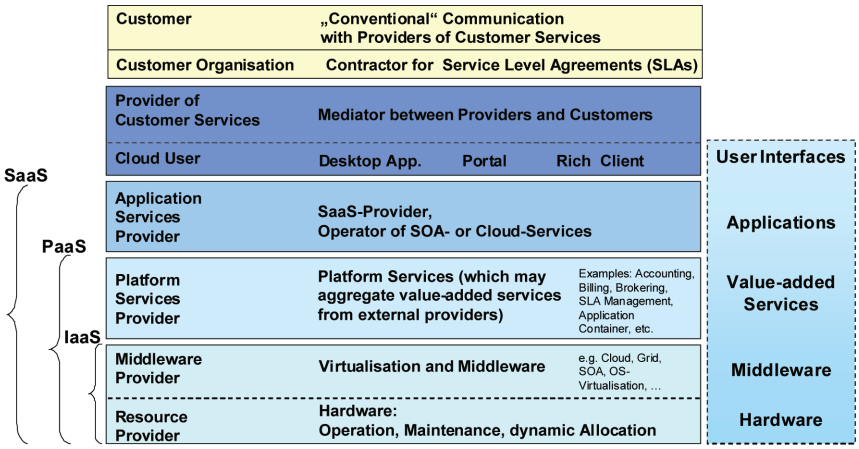


Figure 2. Roles in the grid value chain SaaS: Software as a Service; PaaS: Platform as a Service; IaaS: Infrastructure as a Service



gives a hint about their interactions and interdependencies.

The resource providers deliver hardware in forms of compute resources, storage, network connections, data bases and devices. They provide and operate the resources.

The middleware providers make sure that the different resources can communicate with each other. On top of and in conjunction with the middleware many infrastructure services are needed. These services are provided by infrastructure service providers. The application service providers supply services based on application area. They provide not only software services but value added services which may consist of application services, the compute power and consulting services.

A special focus of these considerations is on the users. As members of the customer organization the users need an easy and user friendly access to the grid services to fulfill their tasks.

These mediators provide customer services which may also combine the offer for resource consuming IT applications together with classic services.

The customer organization stands for the customer view and their requirements on cloud services. This includes technical, organizational, economical and quality aspects. A customer organization must answer the question whether it shall run a service on its own or whether the services shall be bought from a service provider, considering all important aspects like reliability, security and costs.

Service Blueprinting for the Engineering of Cloud Services

For the design of a service the important step is the identification of all process steps necessary for the use of the application that is to be provided as a cloud service. This includes everything from security requirements and providing or installing user interfaces to the deployment of applications, the communication with services or resources and the final billing of resource usage. *Service blueprints* [Shostack 1981] are a special form of displaying process models that provide the opportunity to clearly visualize the roles involved in these processes as well as their interaction depth. This is particularly important for the interaction between the customer and service providers. The actions of the customer are central for the design of a service. Regarding the creation of a *service blueprint* and in order to visualize the process model of a service, first the actions of the user

are laid out and all other activities are seen as supporting activities within value proposition offered to the customer [Bitner, Ostrom, Morgan 2008]. The process steps in which the customer is directly involved in, are shown above the line of interaction. The line of visibility separates the process steps which are visible to the customer from those which are invisible. The basis for optimizing service processes is defined through identifying not only the line of interaction but also the line of visibility, i.e. those process steps of which the user is aware of.

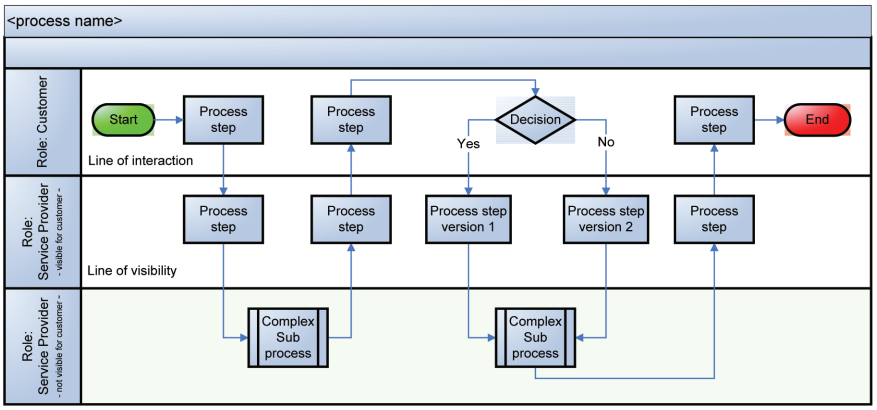
The requirements and the different views of the roles involved in the service have to be considered. Based on this analysis the service blue print method can be used for the process description of the service.

Figure 3 gives an example *service blueprint* that shows the different types of symbols used for process steps, sub-processes, decisions and the connectors between these symbols. The different participants in the processes are represented by their roles in the process. For each role at least one horizontal swim lane is reserved. From top to bottom, the visibility of process steps decreases for the role in the upper swim lane. The *lines of interaction and visibility* show the respective event horizons for the top role which is, in most cases, the customer. In case one role performs both (actions that are visible and actions that are invisible to the customers) there may be several swim lanes for one role. The *lines of interaction and visibility* are particularly important as the main goal of service engineering should be to reduce the complexity for the customer as much as possible in order to lower the barriers for adopting the new service. The complexity of clouds itself should not been visible to the user.

Once the processes are modeled as service blueprints they need to be discussed with the main stake holders. Potential candidates for all the necessary roles and the resources behind them need to be identified. The processes need to be viewed from an end user perspective as well as from the provider perspective and need to be simplified as much as possible – not only but in particular for the customer. Furthermore, the *service blueprint* provides the basis for the review of the quality requirements. It makes it possible to find the fail point where quality is perceived as inferior from the customer point of view as well as from the service provider point of view. This provides a basis for the definition of *quality factors* and key performance indicators which may be essential for the cloud service.

As a result, service blueprinting is an iterative process itself. In this process the services are optimized constantly and the service quality will be improved. During the optimization the necessities for the ingredients of possible business

Figure 3. Legend for of service blueprints



models become visible. As there are typically several dependencies between different services provided by different players with different roles, the establishment of business models in cloud environments requires the detailed knowledge of all process steps – subsequent to their optimization.

In addition to the process view which is only one part of the service engineering toolset, the views on the results produced by a service offer and the resources needed to provide a certain service have to be taken into account [Meiren, Barth 2002]. The resources include potentials, abilities and willingness of the different participants as well as the technical premises in terms of infrastructure and the skills needed for the different roles. These additional views can and also need to be added as further dimensions to the process view described with the service blueprints.

QUALITY OF CLOUD SERVICES

Quality is crucial for user acceptance of a cloud service and even more so for the entire success of such a service. According to ISO 9000, quality is defined as the degree to which a set of inherent characteristics fulfills requirements [ISO 9000 2005]. The *quality of cloud service* can be seen from different perspectives.

Quality Approaches in Service Engineering

One perspective is taken from *service engineering*. The different approaches for *service quality* are distinguished in two main classes: event-based approaches and attribute-oriented approaches. The event-based approaches deal with the detection and analysis of critical events, positive or negative. In the attribute-oriented approaches, the user examines multiple attributes individually and then derivates from these the overall assessment.

According to three dimensions for the development of services Donabedian [Donabedian 1980] defined a quality model for services. The model not only focuses on the quality of the result, but also on the process of the service and includes the customer quality evaluation. The potential quality focuses on the resources which are necessary for the service. This includes infrastructure, technical equipment, employees and their capabilities, as well as know-how of the provider. The process quality combines the internal factors of the provider with the external factor, namely the customer. This shows the influence of the customer on the service quality. The outcome quality refers to the quality of the result.

Another widespread approach is SERVQUAL [Parasuraman 1988] which measures different quality dimensions using indicators. In SERVQUAL, quality is defined as the gap between the real value and the target value. The five dimensions for service quality in SERVQUAL are:

- Tangibles: comfort of the environment in which the service is performed, e.g. technical equipment, appearance of the employees
- Reliability: accurate and reliable execution of the service as well as reliability of the provider
- Responsiveness: open mindedness in order to support the customer by using the service
- Assurance: credibility of the provider
- Empathy: willingness to response to the customer requirements and wishes

The five dimensions of SERVQUAL can be assigned to the potential process and outcome dimensions [Parasuraman 1985]. Reliability corresponds with the outcome quality. Tangibles and assurance are assigned to the potential quality. Responsiveness and empathy have analogies to the process quality.

Software Quality Approaches

Another perspective of *cloud service quality* comes from software quality. For the definition of software quality factor-criteria-metrics-models can be used. Software quality is described by quality factors with can be refined with criterions or subcharacteristics. The criterions can be measured by quality indicators (metrics). The international norm ISO/IEC 9126 [ISO 9126-1 2001] defines a software quality model comprised of six quality characteristics subdivided in 26 subcharacteristics. Quality attributes are assigned to the subcharacteristics which are measureable.

Furthermore, ISO/IEC 9126 [ISO 9126-4 2004] describes a quality model for the quality in use. Quality in use is defined as the ability of software to empower particular users to reach specified goals within a defined context in a effective, productive, secure, and satisfied way. It comprises of four quality factors:

- Effectiveness
- Productivity
- Safety
- Satisfaction

Table 1. Quality factors and subcharacteristics for software according to ISO/IEC 9126

Quality Factors	Subcharacteristics
Functionality	Suitability Accuracy Interoperability Functional Compliance Security
Reliability	Maturity Recoverability Fault Tolerance Reliability Compliance
Usability	Learnability Understandability Operability Attractiveness Usability Compliance
Efficiency	Time Behaviour Resource Behaviour Efficiency Compliance
Maintainability	Stability Analyzability Changeability Testability Maintainability Compliance
Portability	Installability Replaceability Adaptability Co-Existence Portability Compliance

IT Service Management

The *IT Service Management* approaches like ITIL and CobIT bring in the third perspective.

The "Information Technology Infrastructure Library" (ITIL) is a best practice collection for the IT Service Management [OGC 2007a-d]. It has been developed and updated since 1989 on behalf of the British Central Computer and Telecommunications Agency (CCTA). In 2007, ITIL Version 3 was published by the British Office of Government Commerce (OGC), the successor organization of the CCTA. ITIL Version 3 looks at the added value for the customer which is provided by the IT. One goal of ITIL Version 3 is to ensure the compatibility with the ISO/IEC 20000 "Service Management". This standard demands a strategic planning process for the interlocking of IT Service Management and corporate strategy.

ITIL Version3 partitions IT Service Management into five core processes:

- Service Strategy
- Service Design
- Service Transition
- Service Operation
- Continual Service Improvement

In ITIL, quality is defined as the ability of a product, service or process to provide the intended value. In ITIL service quality is characterized by four broad perspectives [OGC 2007a]:

- Level of excellence
- Value of money

- Conformance to specification
- Meeting or exceeding expectations

Services in ITIL are seen as value-creating systems whose overall availability depends on a combination of factors such as reliability, maintainability, redundancy, capacity, and structure.

Control Objectives for Information and Related Technology (CobIT) is a framework which enhances IT Service Management in the direction of IT Governance [ISACF 2007a-c]. It is developed by the Information Systems Audit and Control Association (ISACA), and the IT Governance Institute (ITGI). CobIT is available in Version 4.1 and has 34 high level processes that cover 210 control objectives categorized in four domains: Planning and Organization, Acquisition and Implementation, Delivery and Support, and Monitoring and Evaluation.

The different *IT Service Management* approaches provide indicators for the measurement of the IT Services and IT Service Management processes. Table 2 shows exemplarily indicators which are useful for the measurement of service quality [Mörschel, Kopperger 2004], [Kopperger et al. 2009], [Kütz 2007], [Buchstein et al. 2007], [OGC 2007a-e].

Indicators for the process quality are not mentioned in the table. The indicators are grouped according to the processes of ITIL.

MEASUREMENT OF CLOUD SERVICE QUALITY

Definition of Key Performance Indicators

Quality is one of the critical success factors for *cloud services*. A critical success factor is, according to Rockart, defined as a success factor which is indispensable to achieve the organization goals [Rockart 1982]. For the measurement of a critical success factor *key performance indicators* have to be defined. For each organization it is important to identify their relevant *key performance indicators*. These may differ from business drivers and goals and may change over a period of time.

According to the service engineering dimensions, the software quality factors as well as the key performance indicator, e.g. from the ITIL processes, can be used as a basis to identify the relevant performance factors for a specific organization under consideration of its role in the service value chain.

In the outcome quality dimension the *software quality factors* and the *quality in use factors*, according to ISO 9126, can be used to define the individual quality factors for cloud services. Additionally the key performance indicators taken from the ITIL processes service level management and service catalogue management bring in the customer view. In order to achieve the expected quality of a cloud service, the quality factors and key performance indicators should be identified in a very early stage and thereby already considered during the design phase. Therefore, the definition of the quality factors and key performance indicators and their first examination should be part of the review service blueprint with the different participants of the service. The quality factors and the key performance indicators can be integrated into the description of a process step, or the service blueprint can be enhanced by a specific quality element (Figure 4).

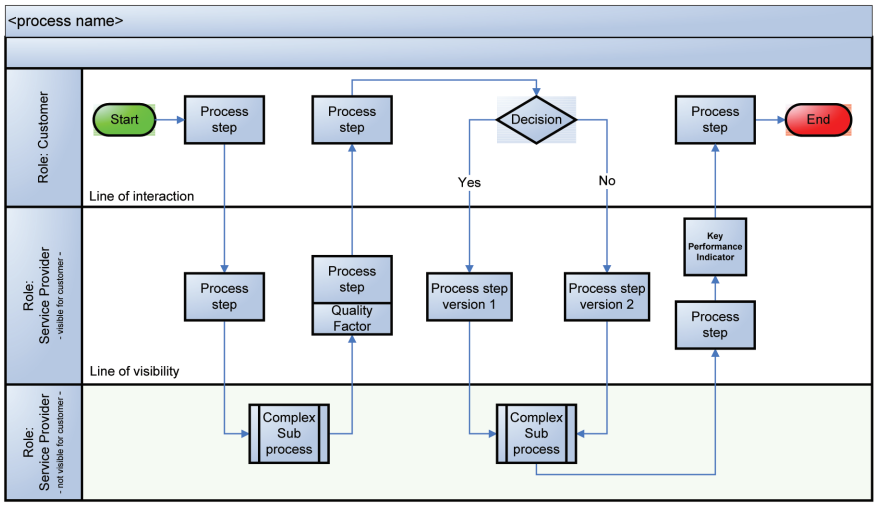
The *key performance indicators* for the process quality dimension can be derived from the ITIL processes change management, release and deployment management, transition planning and support, evaluation, incident management and problem management.

For the potential quality dimension, the *key performance indicators* of the ITIL processes service portfolio management, asset and configuration management, service validation and testing, and knowledge management can be used as a guideline.

Table 2. Examples for key performance indicators for the quality of services. [Mörschel, Kopperger 2004], [Kopperger et al. 2009, [Kütz 2007], [Buchstein et al. 2007], [OGC 2007a-e]

Processes	Key Performance Indicators
Service Strategy	
Service Portfolio Management	Number of delivered services Number of changes in Service Portfolio
Service Design	
Service Level Management	Compliance with SLA Number of breaches of SLA by OLA
Service Capacity Management	Percentage of insufficient response time
Availability Management	Availability of service Unavailability in critical business times Cost of unavailability Average downtime per service Number of downtimes per service Mean Time Between Failures Mean Time Between System Incidents Mean Time to Restore Service
Information Security Management	Number of detected security problems SLA conformance to security clauses
Service Catalogue Management	Number of services recorded and managed within the service catalogue as a percentage of those being delivered and transitioned in the live environment Number of variances detected between the information contained within the Service Catalogue and the real world situation Completeness of the Business Service Catalogue against operational service Completeness of the Technical Service Catalogue against IT components that support the services
Service Transition	
Change Management	Number of correct changes Number of unplanned changes and emergency fixes Number of changes in time Number of changes in cost
Asset and Configuration Management	Quality and accuracy of asset and configuration information Average time and cost of diagnosing and resolving incidents and problems
Release and Deployment Management	Customer satisfaction with implemented releases. Number of incidents against the service
Transition Planning and Support	Number of releases implemented that met the customer's agreed requirements in term of cost, quality, scope, and release schedule
Service Validation and Testing	Early validation that the service will deliver the predicted value that enables early correction Effective use of resource and involvement from the customer
Evaluation	Service performance required by customers Number of incidents against the service
Knowledge Management	Time and effort required to support and maintain services Time of find information for diagnosis and fixing incidents and problems Accessibility and management of standards and policies
Service Operation	
Incident Management	Percentage events to incidents
Problem Management	Number of incident Average reaction time

Figure 4. Legend of service blueprints with enhancement for quality factors and key performance indicators



Thus, each provider has to define its own *key performance indicators* and to build up a measurement system [Mörschel, Kopperger 2004], [Kopperger et al. 2009]. Therefore, across organizational strategies and tactical and operational goals the critical success factors are to be identified. Besides the critical success factor quality, cost and time are usually important. For each critical success factor, several *key performance indicators* have to be indentified. Next, the metrics have to be determined and the process for measurement has to be defined. The informational value of an indicator depends on its accuracy, reliability, completeness, unambiguousness, capability of interpretation, and actuality. The measurement is followed by the analysis of the determined data. Critical thresholds can be identified which call the attention to specific key performance indicators in case the threshold is overrun and forces corrective action.

For the visualization and monitoring of the *key performance indicators*, a service cockpit can be used. Such a service cockpit comprises several critical success factors and the key performance indicators accordingly.

Cloud Service Chain

In a *cloud value chain*, several services of different providers can be composed of new complex services. The quality of such composed services depends significantly on the quality of each subservice. For the service provider it is crucial not only to monitor the own services but also the services used by others. The monitoring of services through various providers tends to be a highly challenging task. One point is that monitoring data has to be defined and harmonized among the providers. Another point is to capture the data from the service and make it available to others.

This all demands specific know-how and an appropriate IT infrastructure. A possible solution for the required monitoring function is a service provided through a web platform offered by a specialized monitoring service provider. In [Vidackovic et al. 2009] an approach for an event-driven service chain monitoring is described which meets the requirements of the monitoring of cross-company service chains. This approach enables the providers to observe the *quality ofservice* of the whole service chain. Furthermore, it increases the transparency within a decentralized service chain.

Cloud services and the corresponding value chains lead to the growth of the *Internet of Services*. It has the focus on services which are offered and in some approaches even traded over the Internet. The Internet of Services enables organizations to improve their business processes and to enlarge their business by integrating services from various service providers. But tapping the benefits of the Internet of Services demands that the services fulfill the high quality requirements which are necessary for an unobstructed operating of the business processes.

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Section 5

Implementation and Practical Solutions

Chapter 12
Focused Improvements of IT Service Processes in a Complex Environment

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ABSTRACT

Comprehensive frameworks such as ITIL provide best practices in a context of IT Service Management but do not support the specific tailoring of processes in a practical setting. This problem has been attacked successfully for systematic IT Service improvement at a large telecommunication enterprise leading to a generalized approach for the improvement of IT Service Processes. In order to cope with multifaceted processes within a complex infrastructure an elected approach is necessary: key stakeholders must be identified and Quality Function Deployment may be used to elicit and prioritize requirements effectively. The requirements can be employed to focus the analysis on the most relevant parts of the given framework leading to a focused audit and yielding specific improvement measures. In combination with further analysis as Pareto and Portfolio analysis a well-thought-out solution portfolio could be proposed, dependent on the impact on the solution and the difficulty of implementation.

IT SERVICE PROCESSES AND BEST PRACTICES

The improvement of IT development processes has been the primary concern of quality initiatives (e.g. Humphrey 1989, Paulk 1995). Recently professionalization of *IT Service processes* gained increasing attention in business and academia (e.g. Forrester et al 2009) supported by the emergence of the process-oriented *IT Infrastructure Library (ITIL),* a best practice library which emerged from a British governmental initiative and is recognised as the international de-facto standard for IT Service Management and lead into ISO/IEC 20.000 (Office of Government Commerce 2007, p. 145). *ITIL* describes functions, processes and tools which

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should be employed, but not how they should be implemented. However, there are just five books on IT Services with at total of 1343 pages within the current Version 3.0 of ITIL, whereas IT Service Management only is one part of the Best Practices provided by the ITIL Framework. If ITIL is implemented in a specific business environment, the 'how' must be specified in detail increasing complexity by an order of magnitude.

CASE STUDY

Improvement of IT Service Processes

An extensive employment of such a complex framework like ITIL may lead to over-regulation. But which are the most important elements of ITIL for a specific environment? ITIL is a best practice library and does tell what is appropriate but not how to tailor it for a specific context.

This question has been addressed within a large telecommunication enterprise, solved with an innovative approach, and validated within a pilot project serving as the case for this chapter. The approach and the project have been devised to lead *IT Service improvement* initiative within the enterprises in different branches, cultures and countries. The results have been approved with regard to a complex environment which is typical for large IT Service providers based on the experience of the authors. The description of the approach and the case are omitting enterprise-specific details which have been considered to be irrelevant with regard to proven practices to be analysed by scientists or adopted by practitioners.

A leading telecommunication service provider in Germany has been experiencing major problems regarding the quality of IT Services Support: a substantial number of major incidents occurred causing strong dissatisfaction of customers. IT Service Support is embedded in a very complex structure and there are several interdependencies between internal and external customers and suppliers. Large effort has been invested into quality and process management since, whereas technical issues, i.e. the implementation of the helpdesk software played a central role in IT Service Design so far.

Several initiatives have been undertaken to alleviate service degradations but none had a significant impact on the perception of the customer. Management was searching for an independent analysis of causes and thorough measures in order to improve quality of IT Support Services sustainably.

AN APPROACH FOR FOCUSSED IT SERVICE IMPROVEMENT

Process Improvement Strategies in General

Several strategies, methods and instruments have been proposed for the improvement of IT processes (Ward et al. 2005, p. 135ff.) with different goals, scope and level of detail – most of them follow one or a combination of the following basic approaches to quality improvements:

- Evolutionary: step-by-step improvements (Evolutionary Changes: Ward et al. 2005, p. 142; Deming Wheel: Deming 1991, p. 86ff.; Scherkenbach 1991, p. 61ff.);
- Top-down: deriving requirements from problems, devising and implementing solutions based on requirements (Ward et al. 2005, p. 161; Six Sigma: Chrissis et al. 2007, p. 26f.);
- Best-Practices: relying on well-proven solutions from practice (Evolution of CMMI: Chrissis et al. 2007, p. 9ff.).

IT Service Processes have been established up to here within the described case at first *top down* employing the large body of knowledge within

the enterprise and several external consultants; then processes have been improved step-by-step (*evolutionary*) driven by problems. Since evolutionary and top-down approach did not lead to satisfactory IT Service quality, best practices were investigated. Considering the huge investments and achievements of the current quality and service management system, its abolishment has been beside the point, it should be compared and augmented based on industry standards. However, it was not expected that any industry standard or best practices would reflect the complexity and diversity of the technical infrastructure and organizational culture – the approach and practices must have been tailored.

The following three stages have been devised for the new process improvement initiative which is discussed below:

Stage A: Requirements and Focus

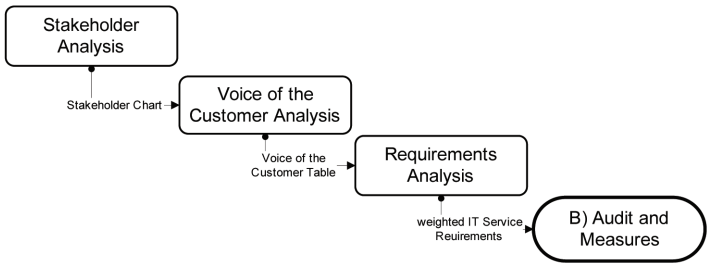
Figure 1 gives an overview on the first stage which is explained in the following in detail:

Identification of Key Stakeholders

Not only the underlying technical infrastructure has been complex; there were several levels of management, matrix functions, a multi-stage supply chain of hard-/software providers and service partners and several stages of production from different systems levels to end user service. In such a complex environment there are different answers to the question: who is the customer and who is the supplier of IT Services? From an external point of view, the consumers are the customers; they demand the service that has been defined by contracts (SLA, Service Level Agreement), i.e. the end user of a mobile phone demanding the availability of the GSM service. The suppliers are the originators or designers of the services, i.e. the IT department or an external provider of IT Services. From an (enterprise-) internal view the authorities that are responsible for the business processes that require a specific IT Service, i.e. departmental management, may be considered to be customers as well. Thus representatives of a subcontractor, i.e. a key account manager of an IT Service Provider, may be suppliers as well. There is a multi-stage supply chain of services; a supplier may be a customer as well and vice versa. The quality of the service provided to the end user is more than the sum of the services of all links of the chain – the service supply chain must be considered as a whole integrating all stakeholders.

Within the case, the knowledge about stakeholders has been distributed over many persons involved. All of them believed, that the structure is clear from their point of view – but there was no overall picture integrating all views. A simple union of all views would have been confusing and inconsistent. Stakeholder analysis within the case demanded an aggregation and generalisation of roles, positions and tasks with regard to their contribution to the improvement of the quality of IT Services. The process required several itera-

Figure 1. Overview on the first stage "stakeholders and requirements"



tions, resulting in a bubble chart which had to be approved by the involved parties. Figure 2 depicts a sample stakeholder chart with anonymous names.

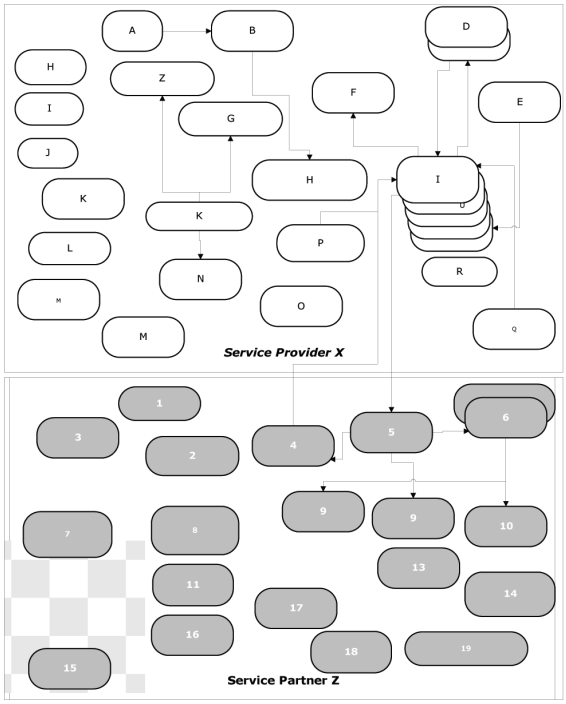
Analysis of Stakeholder Requirements

The analysis of stakeholders ensures that every relevant interest group will be considered. The next step is to identify their requirements.

- Which services are to be negotiated and what are the quality criteria to measure performance?
- Which hard- and software will be provided and maintained?
- Which additional services like training or a hotline will be offered?

Best practices such as ITIL provide a very good source for the elicitation of general requirements but do not address current and future business needs within the complex environment considered within the case. If IT Services are standardized thoroughly, they may become a commodity and market pressure may not reward complex infrastructures. Commodities are exposed to prices pressure and require highly effective operative but not necessarily complex infrastructures. In order to develop IT Service as a strategic asset, its strengths and opportunities in dimensions such as flexibility must be addressed properly. Business strategy must be translated into and / or aligned with service strategy. ITIL provides a simple top-down approach to strategy definition, which is not suitable in a complex environment in practice like in this case: judgments are biased heavily by the political power structure.

Figure 2. Sample stakeholder chart (anonymous)



Quality Function Deployment (*QFD*) has been chosen within the case to address those structures properly in order to achieve sustainable consensus. QFD is a quality method that has proven to translate *customer requirements* properly into engineering specifications even in complex environment (e.g. Mazur et al. 2007); it has been employed successfully for the specification of SLAs (Pietsch 2005, p. 84ff.) and IT processes improvements (Hierholzer et al. 1996, p. 86ff.). However, QFD employs a specific interpretation of requirements: typical Service Level Specifications (SLAs) refer to measures such as response time or availability. However, such criteria do not reflect the notion of customer requirements within QFD. The customer will not be satisfied if the service is available but useless. Availability is an intermediate measure to assess the quality of the service, but not what the customer demands originally. The customer may demand to keep up with a business task and may call the service desk for support in case of an incident. Availability is neither a requirement nor a function. QFD defines such non-functional measures as 'Quality Criteria'. This term sometimes leads to confusion due to different definitions of quality. Therefore such measures will be called 'IT Service Performance Criteria' with regard to IT Services. It should describe the way a service

Table 1. Elements of the voice of the customer analysis

Category	Explanation
IT Service Requirement	Primary customer requirement, independent of solutions.
IT Performance Criteria	Non-functional measure for the performance of IT Services.
IT Service Function	Specific task/system function that is part of the IT Services provided.
IT Service Improvements	Specific action suitable to improve the quality of IT Services.

is performed independently of its functions and components.

Within QFD analysis, customer needs are split up in different categories, i.e. customer requirements and product functions or quality elements. These categories have been devised for physical products and must be adapted for intangibles such as IT Services (Pietsch 2005, p. 84ff.). Original customer requirements will be interpreted as 'IT Service Requirements' and product functions will be interpreted for IT Services as 'IT Service Function'. QFD does not only support the design of products but also the *deployment* of process improvements. Process improvements are an important aspect of IT Service Management; actions aiming at the improvement of IT Service Performance (→ '*IT Service Improvements*') may be included into QFD analysis as well. The following Table 1 summarizes these different categories.

The QFD process that addresses the elicitation of the original customer requirements (IT Service requirements within the case) is the so-called *Voice of the Customer Analysis* (VoC; see Herzwurm et al. 2000, p. 61ff.). It provides a standard tool with six questions, the 5W1H-questionary, that has been employed for comprehensive requirements analysis within the software domain (see e.g. Herzwurm et al. 2000). Table 2 shows a 5W1H-scheme, which has been adapted for the analysis of requirements for IT Services. Any verbatim <request> of a customer regarding IT Services will be clarified employing the following questions resulting in three types of concepts, principal *Service Requirements* and two types of solutions, Performance Criteria and Service Functions (Pietsch 2005, p. 86).

Table 2. Adapted 5W1H-schema for IT-service requirements analysis

Interrogative	Question
Why?	What is the final purpose of the desired <request>?
What?	Which specific service is wanted with regard to <request>?
Who?	Which person or system does need <request>?
Where?	At which location / system is <request> needed?
When?	At which time will <request> be needed?
How much?	To what degree is <request> needed?

Prioritization of Stakeholder Requirements

The resulting list of IT Service Requirements may be more or less detailed. The resulting requirements refer to different levels of abstraction and must be clustered into a hierarchical structure for prioritization. Standard facilitation techniques may be employed for this step, e.g. affinity diagrams (Mizuno 1988, p. 3-30). The prioritization may be performed with standard techniques such as the Analytical Hierarchical Process (AHP) employing pairwise comparisons (Herzwurm et al. 2000, p. 59f.). The *VoC* results in IT Service Requirements according to the schema presented in Table 3.

Stage B: Audit and Measures

Focused Audit of Service Processes

Within the given environment, several particular audits and assessments have been performed before. It is common practice within best practice

Table 3. Sample sketch of an IT service requirements table (see Pietsch 2007)

Primary	Secondary IT Service Requirement	Weight
A) Improved Work Productivity		
A1) Minimize idle time when entering customer documents		10%
A2) Find customer documents quickly		15%
…		…
B) Improved Effectiveness of Work		
B1) Availability of services independent of place		10%
B2) Support for advanced system customization		05%
…		…
C) Competent Support Services		
C1) Understanding of work environment		25%
C2) Social competence		15%
…		

models to perform an overall and in-depth analysis first. This would not have been possible and not practicable in this case because of the complexity of the subject and the existing retention throughout most stakeholders. Hence not everything could have been analysed in detail; the analysis must have been focused on those items that were most significant. Figure 3 gives an overview of the second stage.

The first stage has been devised to establish the foundation of the focus. At the beginning of the second stage, the multitude of requirements will be screened and then condensed employing stakeholders and requirements: existing process definitions e.g. the mandatory incident management procedure and relevant standards, such as the requirements of ITIL regarding incident management processes are summarized and evaluated with regard to its relevance for certain requirements and for certain stakeholders. The QFD schema for matrix correlation has been employed for this purpose – the following Tables 4 and 5 provide simplified examples.

The more important a requirement is (with regard to the requirements of the stakeholders) the more it ought to be focused within analysis and design. Requirements have been classified for planning purposes: A-requirements are a must for any interview and analysis; B-requirements should be addressed if A-requirements have been elaborated. C-requirements could be addressed but are not planned explicitly.

Figure 3. Overview of the second stage "audit and measures"

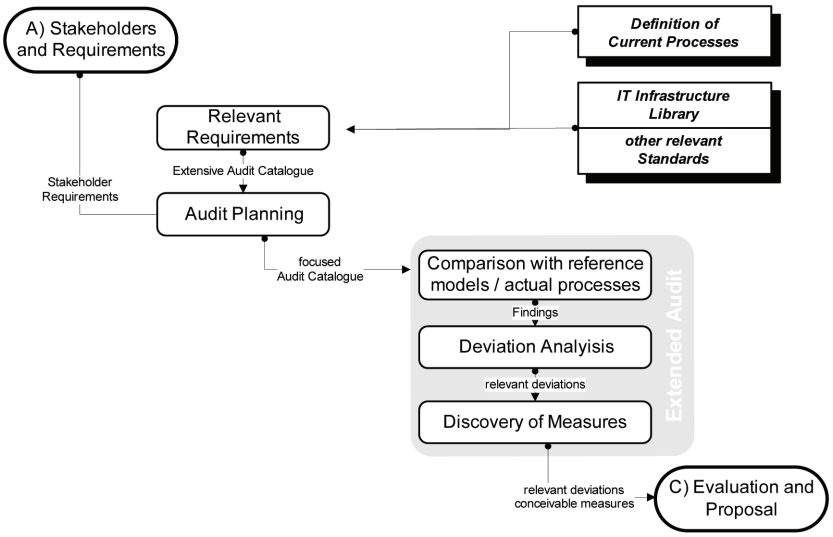


Table 4. Sample assessment of requirements importance

Best Practice Requirement	*ITIL: Incident Management*			**Stake-holder**
Stakeholder Requirements	*Keeping users informed*	*making an initial assessment of requests*	**…**	**Priority**
...				…
Credibility of support staff	1	9		0,2
Damage prevention	0	3		0,1
...	…	…	…	…
Importance	0,2	2,1		…
Class	C	A		…

Table 5. Sample assessment of stakeholder importance

Stakeholder Requirements	**…**	*Call Agent*	*Facility Manager*	**…**	**Priority**
...					…
Credibility of support staff		9	0		0,2
Damage prevention		1	3		0,1
...		…	…	…	…
Importance		1,9	0,3		…
Class		A	A		…

Since time is short, the number of participants and the duration of interviews must be planned parsimonious. Hence, a similar table has been set up for the assessment of stakeholders, depicting the impact of stakeholders on requirements: a call agent has major impact on the perception of credibility unlike the local facility manager. Otherwise the facility manger is responsible for certain measures regarding damage prevention, which is a side-issue of call agents.

The following procedure goes beyond the scope of regular audits: it should not only observe deviations from a given standard but also question deviations and prepare for solutions. A deviation is to be considered as a flaw inevitably, if the standard is perfect. Neither ITIL nor internal process definitions are considered to be perfect, they are pragmatic and must be viewed under the light of the circumstances. Hence a deviation may indicate a requirement that is not appropriate in a certain situation. This applies especially in a complex environment ruled by elaborated rules from different sources and operated with scarce resources due to increasing overhead. Therefore not the deviation itself is the goal of interviews, but its questioning, i.e. causes, effects, alternatives and desirable actions.

Discovery of Improvement Measures

An extended audit as described above yields some measures besides deviations. Nevertheless, there is no systematic search and the interviewees have been selected with regard to their impact on requirement, which may not reflect that they are innovative, technological or creative. According to QFD, the discovery of solutions must be addressed analogous to the VoC in a *Voice of the Engineer* (*VoE*) Analysis. A VoC must not necessarily be tied to fulfil specific requirements; it may be desirable

to think out of the box in order to come up with breakthroughs.

Stage C: Evaluation and Proposal

The primary goal of the third stage is to harvest the results of the prior stages and to prepare the organization for improvement actions. Figure 4 gives an overview of this last stage.

Since a large number of external and internal requirements and stakeholders have been considered, there is a very large number of measures for improvement and there are very limited resources available for implementation. The higher the impact of a measure on *stakeholder requirement* the more likely it should be considered for implementation. The assessment may be performed with the same schema that has been employed for the assessment of requirements and stakeholders (see above). However the number of solutions must be limited so that the matrix can be handled properly. Furthermore, it is very important that the analysis of the impact is not filled-out by a single person but is a result of an intensive discourse between stakeholders representing different internal and external customers and stakeholders representing different kind of engineers with regard to improvement measures. Customers may not understand measures and engineering may not understand requirements. Consensus must be established between these groups regarding the impact of solutions on requirements.

The correlation of requirements and solutions yields an assessment of the importance of solutions. Now the most effective solutions can be identified; a popular tool is the *Pareto-Analysis* searching for the 20% of the solutions which promise to address 80% of the total impact. However, very often the most effective solutions are very expensive and / or risky. An easy measure with a medium impact can be a better choice than a very attractive solution which is very difficult to realize. The tradeoff between efficiency and effectiveness can be addressed within a portfolio analysis balancing impact and difficulty in an appropriate solution mix, the improvement portfolio which is the ultimate input for the proposal for improvement.

Deployment Synopsis: Sequence of Tables and Matrices

Several tools have been employed during the process. Figure 5 gives an overview on all tables and matrices with its interrelationships.

The process starts with the (augmented) stakeholder table, leading through different requirements to an audit catalogue and plan and ending in proposals for solutions arranged in a portfolio.

CASE FINDINGS: LESSONS LEARNT

The approach, process and methods have been described above in a schematic manner since the

Figure 4. Overview on the third stage "Evaluation and Proposal"

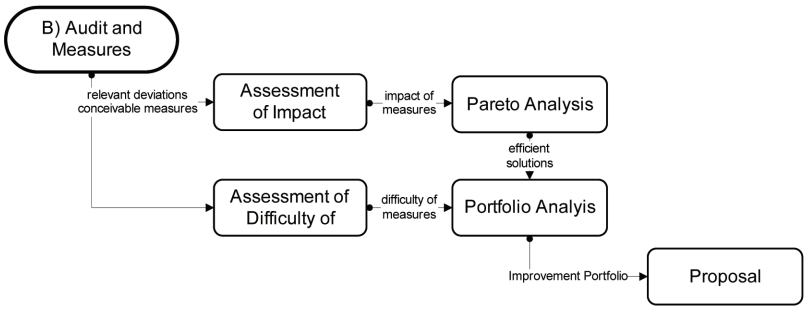
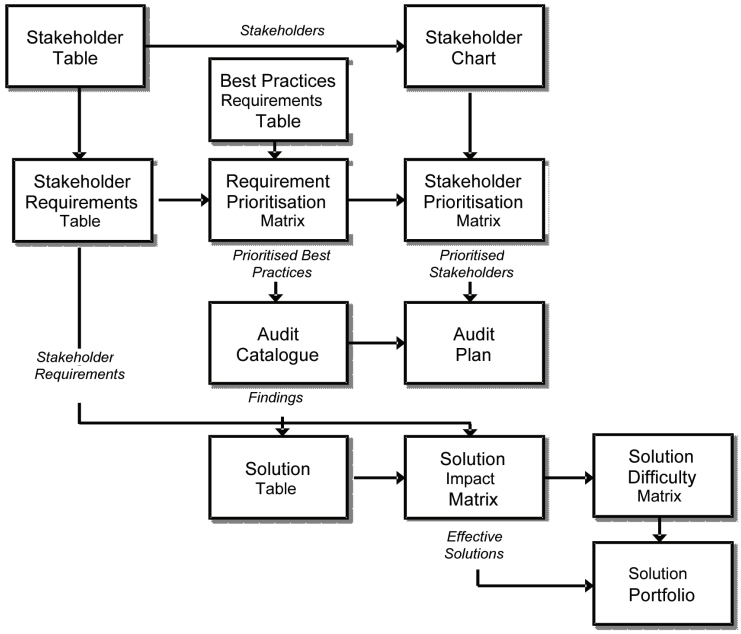


Figure 5. Deployment



project on which the case is based on has been very complex on one hand and details have not been disclosed for publication on the other hand. Nevertheless, the case yielded multifaceted findings besides methodology which may be characteristic for such a complex environment:

No Silver Bullet

The political situation of the project has been very difficult at the beginning, it seemed that several stakeholders did not believe in a positive outcome and seemed to have capitulating with regard to the complexity. The complexities of the environment lead to a voluminous analysis, among others:

- 32 stakeholders, 8 large matrices with up to 500 Cells
- 306 questions within the audit catalogue, 67 pages audit protocol
- 147 measures for improvement

It took a lot of discipline to elaborate these tables and matrices; nevertheless, the team has been showing a strong interest in a robust result and the process has been supporting the credibility of the conclusions. Figure 6 shows some posters of the final presentation.

In certain situations, complexity may be tamed by an appropriate type of complexity only. The *Pareto chart* shows that it takes about half of the solutions to address 80% of the total impact.

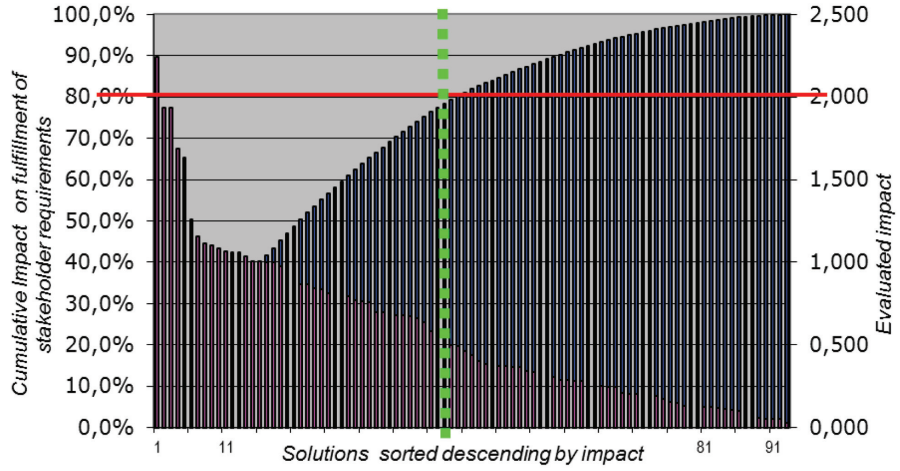
Methodological High-Jacking

Several solutions have been addressing the disposal of certain standards, rules or decisions regardless of its impact on requirements. Then again some solutions were not allowed to be discussed even if there has been an obvious impact on certain requirements. Some participants were trying to push-through specific solutions. Experience teaches that such effects cannot be avoided. Nevertheless they may be alleviated by a truly independent and strong moderator, which

Figure 6. Posters from the final presentation of the process improvement initiative



Figure 7. Pareto analysis of solutions



may in some cases only and in others not at all achieved by internal staff.

Organisational Culture

The outcome of the initiative may not be measured in the numbers of solutions or the avoidance of critical impacts only. A significant change of mind has happened during the project resulting in an improvement of communication between stakeholders. The method has served as a catalyst, breaking up lock-ins and utilising the potentials of many different stakeholders.

The complexity of the approach matches the solution culture within the complex environment and may be not transferred easily. Nevertheless, some of the steps may be omitted if there are not so many different stakeholders, requirements and solutions to be considered mandatory.

Authentic Insight

The technical complexity may have led to an underestimation of personal communication. The initiative led to surprising insights like improving exception handling and acceptance of processes. A survey of all stakeholders yielded has been supporting the hypothesis that the number of different perspectives had a positive effect on the satisfaction of stakeholders (R^2=42%). If a techni-

cal expert or business manager has experienced the daily stress within a call center, he or she may understand the necessity for certain measures and resources better.

OUTLOOK

An approach for process improvement dedicated for complex environments has been developed and validated in a specific environment. By employing QFD as an integral part of this approach it has been possible to an establish customer orientated agile quality initiative instead of norm-based and rigid approaches to quality improvement. Further research is needed to assess the transferability of this approach in different environment. Nevertheless, it has been devised for transferability and the authors are optimistic.

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Chapter 13
Application Management:
Provide Service Quality from a Business Perspective

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ABSTRACT

Quality is about meeting the stakeholder's expectations: the subjective perception is often more important than hard facts. Therefore, a common understanding between all involved parties – especially business owners as well as service providers – concerning the quality of a service is mandatory. Application Management is defined as the concept and all required techniques to monitor, measure and record data for operating services. It has a significant impact on the quality of an IT service. Based on the so-called value chain – a phased approach starting with a business point of view followed by IT development and operation – necessary activities as well as quality indicators are identified and described for each step in the software development livecycle. The aspects of Application Management are illustrated by using a real world example of implementing an output management system within a bank.

1 APPLICATION MANAGEMENT: AN INTRODUCTION

Quality is about meeting the stakeholder's expectations. Especially when providing individual services to the customer it is often not a matter of hard facts, but of subjective perception. Peter Ferdinand Drucker, a well-known business economist, stated in 1985 'Quality' in a product or service is not what the supplier puts in. It is what the customer gets out and is willing to pay for" (Drucker, 2007, pg. 206). A number of other definitions have been summarized by Hoyle (2009, pg. 24) including the definition given in the ISO 9000 standard which defines quality as the "degree to which a set of inherent characteristics fulfills requirements". A similar perspective is used within project management methodologies. The widely used Project Management Body of Knowledge (Project Management Institute, Inc., 2008) defines quality in the same way as the ISO 9000 standard.

Therefore, it is necessary to build a common understanding between all involved parties concerning quality in terms of IT service operation and consumption. A well established standard for providing IT services is the *IT Infrastructure*

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Library (ITIL®). ITIL® is a registered trademark owned by the British Office of Government Commerce (OCG). The IT Infrastructure Library provides "a set of Best Practice guidance for IT Service Management. ITIL is owned by the OCG and consists of a series of publications giving guidance on the provision of Quality IT Services, and on the Processes and facilities needed to support them" (Office of Government Commerce, 2007). The services are provided based on a *Service Level Agreement (SLA)* signed by the customer and the provider. A Service Level Agreement according to ITIL is defined as "an Agreement between an IT Service Provider and a Customer. The SLA describes the IT Service, documents Service Level Targets, and specifies the responsibilities of the IT Service Provider and the Customer" (Office of Government Commerce, 2007).

From a formal point of view the SLA forms the basis between the customer and the service provider and it defines which quality of service has to be delivered. In order to monitor and record the appropriate service delivery it is required that the service provides built-in functions or interfaces to record the agreed parameters. Most often, these so called key performance indicators (KPI) focus on technical aspects like response times and error logs, but the business perspective is just as important as the technical perspective. Looking at the indicators of a business process instance, like the average time required for a credit approval process or the average cash flow of an automated teller machine, provides important insights to the processes involved and allows the option to optimize these processes. The area of Application Management covers these aspects throughout the whole process of service design and delivery.

Our view of *Application Management* covers the concept and required techniques to monitor, measure and record data for operating one or more services. This data is also used for the analysis of the service operation from two points of view: the business perspective as well as the perspective of the service provider. In order to have appropriate Application Management functions in place, Application Management activities have to be included in the service design phase during the project as well as in service delivery during operations.

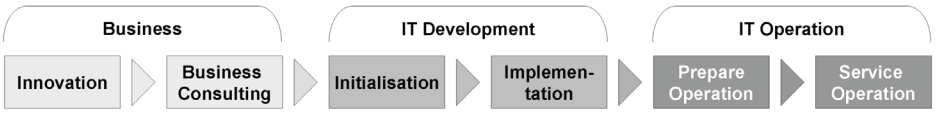
This covers at least but not only the following aspects:

- Measuring of the quality and availability of the user transactions provided by the service
- Layer independent measuring and monitoring of performance, resources, response times, etc.
- Technology independent solutions
- Integration of service workflows
- Coverage of development and operating phase of a solution
- Involvement of the business organization, the software development group and the service provider

During this chapter we will follow the so-called *value chain* (S&N AG, 2010) starting with the business oriented innovation and consulting phase, followed by the development centric initialization and implementation phase, and finally the preparation and actual performance of the IT operation.

This chapter will provide an in-depth view to Application Management and how Application

Figure 1. Value chain (Adapted from S&N AG, 2010)



Management can help to increase the quality of IT solutions and services. We will cover both perspectives: the point of view of the business owner of a service as well as the one of the service provider. After giving an introduction to the general aspects and requirements concerning Application Management we will first focus on the requirements specific to either point of view. Afterwards we will follow the process of software design and development to have a look to Application Management at the various steps in this process. Afterwards, we will take a short look at a real-world example.

2 REQUIREMENTS OF BUSINESS SERVICE OWNERS

Requirements of Business Service Owners are most often limited to the functional requirements supporting the business process. Business reporting capabilities might be included, but the scope here is often narrowed to process inherent data, not focusing on Meta data of the process like turnaround-time of a given process cycle.

For example, when specifying the requirements for a new solution of a credit application, requirements about the credit request, the necessary financial data are specified in detail. The reports provided include data about the credit volume in a given timeframe, the number of approved and rejected requests, and so on. But a workflow solution like this can provide additional information concerning the process itself. Some examples might be: How many requests have been sent back because of missing data or documents? How many approvals have been given different than the recommendation by the system and its underlying decision support systems? – This business oriented data gives an insight view of the process for further optimization.

But more requirements exist, which might be left unaddressed: The service should be easily adoptable to the business needs. This is important because for two reasons. First, change requests can be easily implemented at low cost. Second, if the business' market demands any changes, an easily adaptable solution will shorten the time to market.

During the review of the business requirements the following aspects should be used as a guideline to enhance their quality.

- Do all stakeholders understand and accept the requirements?
- Is the business process described on an appropriate detailed level?
- Are any – even imagined – scenarios for changes to the solution / business process given?
- Are requirements concerning the adaptation of the solution given, e.g. should some components be configurable?
- Which are the most important data concerning the process that should be measured and reported for further analysis?

3 REQUIREMENTS OF SERVICE PROVIDERS

Service Providers are focused on running and monitoring their service on a technical level in order to fulfil the uptime and other technical figures defined in the service level agreement (SLA).

The requirements a service provider demands from a service being operated are as follows:

- Easy to deploy: Easily deployable services reduce the downtime caused by updates as well as the overall release process, starting from design and ending with the deployment in production. Existing software distribution mechanisms should be used, existing components utilized in order to provide a smooth transfer to production.
- Easy to monitor: The service has to be monitored in production. A system monitoring environment including interfaces

for the integration of different applications and systems is state-of-the-art in today's business of service providers. Services, which do not integrate in the standard monitoring systems and processes, are difficult to monitor. The application's monitoring functions – if available – have to be observed individually. Therefore, the operating team has to be trained additionally; service processes have to be adopted, etc. All these special cases will cause higher effort, higher costs, and might result in less service quality.

- Easy to manage: Similar aspects as given above concerning the monitoring apply to the area of service management, too. Examples concerning the management of the components are the backup and the restore of data or user management (add users, change roles, etc.). If these processes are done using established components and integrated into the existing environment, costs will be reduced and the risk of decreased service quality inherent to "exotic" solutions will be mitigated.
- Easy to recover: In case of a disaster – a failure of one or more components necessary for the service provided – the solution should support fail-over and an easy recovery in case of a system crash. The downtime of a service during business hours is the most important cost aspect in terms of business impact. Therefore, it has to be clarified very early what impacts the non-availability of the service will have on business.

The classic system management methods (according to ITIL: "the part of IT Service Management that focuses on the management of IT Infrastructure rather than Process", Office of Government Commerce, 2007) are already established in the operating. These methods focus on the monitoring of the hardware systems and their availability. The aspects mentioned above focus on quantitative and – most often – objective aspects. But another aspect has to be taken into account: As mentioned in the introduction, quality is about expectations and service quality strongly depends on the expectations and the perception that end-users have about the provided service. Therefore, a successful Application Management approach has to focus on the end-users needs, their expectations, and their impression and especially their point of view.

This can be supported by an end-to-end-monitoring. Instead of monitoring only the service side and the data centre, one or more monitoring instances are placed on the client side. By executing special use cases this monitoring instance can simulate, measure, and log the system availability and performance from a user point of view. All components and layers between the client and the server are monitored. If any defined threshold has been reached an event can be generated and sent to the operation control in order to start the appropriate actions to get the service back on track.

4 APPLICATION MANAGEMENT IN THE SOFTWARE DEVELOPMENT LIFECYCLE

The *software development life cycle* focuses on the different phases required to provide a software solution starting from the original requests. Throughout this chapter we will follow the high-level phased process structured into the following steps:

1. Requirements specification
2. Design
3. Development
4. Deployment
5. Operation

This high-level structure can be used independent of the specific software development meth-

odology. It can be applied to projects following a strictly linear methodology as well as to iterative or agile approaches.

The quality of the results of each step influences the overall quality of the service. For example, starting with a requirement specification of poor quality will either lead to poor quality in the resulting service or to high costs in order to correct the errors. Therefore, during and especially after every step the appropriate degree of quality has to be assured. This can be done by defining quality indicators for each step and checking the fulfilment of these at the end of each step. This should not only be a formal review of the existence of certain documents; instead the degree of fulfilment of these quality indicators has to be checked.

As we are focussing on the context of Application Management we will give some examples of quality indicators useful to check the quality of each step with special attention to the Application Management aspects.

4.1 Requirements Specification

During the phase of specifying requirements for the new or adopted solution not only functional aspects focusing on the business process have to be taken into account but also non-functional requirements as well as requirements determined by the future operation of the solution.

Three major sources of requirements can be identified:

- Business Area: Each solution to be implemented has to support the business strategy and has therefore to fulfill requirements given by the responsible business unit.
- Enterprise Architecture: Even when implementing minor changes but even more so when introducing a new solution, the overall strategy for the application landscape defined by the enterprise architecture has to be taken into consideration.
- Infrastructure: As there are specific expectations on the future service operation the underlying infrastructure has to be taken into account.

Representatives of all three areas have to be involved into the requirements specification. Most often, stakeholders of the last two areas are not involved resulting in a lack of requirements and therefore in a solution, which does not meet the expectations of these stakeholders.

When specifying requirements concerning reporting and monitoring it has to be taken into account that thresholds as well as actions required when reaching these thresholds have to be defined. Using an automatic teller machine (ATM) for example, a typical figure to monitor is the number / value of banknotes available. If the value reaches a specific threshold, a message or an alert has to be generated in order to inform the unit responsible for the cash management that this device requires a refill.

By reviewing the requirements specified, an indication for the quality concerning the aspects of Application Management can be evaluated. Non-functional requirements especially for response times and availability should be documented for each business process to be implemented. For each business process the requirements for reporting have to be specified.

The requirements specification should be signed-off by the business, by the responsible enterprise or domain architect as well as by the future service operator.

4.2 Design

The requirements defined concerning the Application Management build the basis during the design phase for defining the appropriate solution architecture. As the requirements are most often given from a non technical viewpoint the design phase has to match the stakeholders' requirements to a technical design. The aspects of Application

Management have to be included in the different concepts, starting with the business concept, the software and architecture design as well as the infrastructure concept.

Based on the information, which data should be gathered, the appropriate method of measuring, storage and reporting of this data has to be identified.

Some aspects to be considered during the design are as follows. Gathering the data required for the reporting might impact the overall performance of the solution. Some data might not be included because of data privacy aspects, e.g. customer data. Enterprise standards for integrating the Application Management data into existing System Management solutions as well as Management Dashboards should be used.

4.3 Development

Integrating elements of Application Management seems to result in higher development efforts. But this investment can be compensated by utilizing the advantages Application Management features provide. In addition, an early integration of the necessary functions reduces the risk in implementation, because it will become an integrated and not an added part of the solution.

Further on, the technical design can be verified easily, because indicators, reporting, and monitoring are integrated and can be used to check the solution in detail. The same applies to the verification of business requirements and their realization in the application. During the test stage of the development the Application Management features help to analyze error situations.

Application Management features can not be seen as a ready-to-use component, these functions are always specific to the customer, adapted to the customer's infrastructure and needs.

4.4 Deployment

Typically the deployment of a new solution is done in a phased approach starting with a pilot. To apply results from the pilot to the later production environment detailed information concerning usage and performance of the solution is required. This data can be provided by the Application Management components integrated into the solution.

The pilot phase can be used to do a detailed evaluation of the application behaviour. Bottlenecks can be identified early and easily analyzed. Results are reproducible and well-founded. Based on these results figures for the future production can be estimated and – if required – adaptations can be made prior to the rollout.

From a software development and support perspective, the integrated Application Management features allow easy analysis of error situations and failures. A well-designed logging capability should provide all information required for the analysis. Beside the analysis itself, the previously defined actions to be taken, when a monitored figure reaches a defined threshold, can be piloted, verified and optimized as well.

4.5 Operation

After the rollout of the solution during the operation of the service the integrated Application Management components build the base for the well-known system management activities.

The service provider responsible for the operation has been involved throughout the whole project. Their requirements have been incorporated into the solution so that the integration into the existing system management environment has been easy.

The data provided by the Application Management components can not only be utilized during the daily operation, but also to identify changes in the usage of the service, which has to be dealt with.

4.6 Quality Indicators in the Software Lifecycle

Some example of *quality indicators* focussing on Application Management in the different phases of the software lifecycle will be given now. Aspects concerning the requirements phase have been already mentioned above.

Questions to be asked during the design phase are as follows:

- Does the design include aspects of monitoring and logging, e.g. by providing a central monitoring component? – This offers a central point for the operating personnel to check the application state.
- Does every component include an interface to request status information and monitoring data? – In this case an already existing monitoring system can request information from every single application component. This allows an easy integration into an existing monitoring infrastructure.
- Does the overall architecture include end-to-end-monitoring capabilities? – End-to-end monitoring provides not only the possibility to check the application and infrastructure status in case of user inquiries but also provides an early indication for upcoming issues by monitoring certain thresholds.
- Have any fail-over and load-balancing aspects been included in the system design, e.g. which type of fail-over has been selected (cold stand-by, hot stand-by, etc.)? – Already the system design has to take heavy usage and possible outages of components as well as disaster scenarios into account.

A successful development targeted at the objectives of the business owner as well as the service owner has to be proven by tests including typical aspects of Application Management, for example:

- Have any load tests been made? – The load tests have to be performed on a representative infrastructure, so that the future production load can be estimated on a solid basis. In addition, each new release has to be compared against the previous release in order to identify possible performance impacts early.
- Were the disaster scenarios been tested (including fail-over and backup / restore)? – Testing the disaster scenarios does not only provide information about the successful disaster recovery, it gives an indication about the time required for getting the future solution up and running after a major failure.
- Have the monitoring and logging components been tested in detail? – Are the written monitoring / logging entries meaningful and substantial? – The monitoring and logging information should be reviewed by the operating personnel as well as the production support team in order to check the usefulness of this information and make changes where necessary. In addition, thresholds for warnings can be evaluated during this test phase.

The deployment phase will serve as a pilot for the service as well as for the Application Management facilities of the new solution. Therefore questions like the following should be answered in order to get an indication of the coverage of Application Management aspects.

- Has the integration of the solution into the existing monitoring facilities been performed and checked? – The application will be running in normal operation mode for the first time in production environment. Therefore, the integration into the central systems has to be verified.
- Were the figures reported by the new solution checked for plausibility? – Reporting

information provided by the application has to be double-checked, whether the figures match the current pilot usage.

- Were the figures reported used to re-check the capacity planned for the production use? – The pilot usage provides a first indication of the usage and the load produced (concerning CPU usage, required storage, etc.) in the production environment. Based on these figures and the estimation for the future usage the capacity planned for production use should be re-checked in order to avoid any bottlenecks.

5 APPLICATION MANAGEMENT IN THE REAL WORLD

The following case study will transfer the aspects mentioned above to a real world example. The scenario will be as follows. A bank wants to consolidate and integrate the production of customer documents (like account statements) from different legacy applications into a central output management system. The documents printed from the core banking applications either using the mass printing system or the self service banking terminals should be produced using the same technology and providing the same look and feel.

Major objectives have been set by different stakeholders: the business side, the corporate marketing, the service provider as well as the customers. The business owner has two major objectives: the reduction of costs by consolidation and reduction of applications and systems to be maintained; second, a reduction of the time-to-market for new products, because the new Output Management System provides solutions for an easy definition and implementation of new document types. The corporate marketing department wants to have a unique document layout through all channels towards the customer as well as an additional option to include sales information on all documents based on their customer relationship management system already in place. The preferred service provider focuses on an integration of the new system into the existing monitoring and management solution. Last, but not least, the customers who will receive these documents have to be kept in mind. The documents have to be easily readable and – if requested on the banking terminal, these should be printed out quickly.

From an Application Management point of view some additional aspects have to be considered. In order to build a system, which is scalable, robust, and provides enough performance, some metrics concerning the usage are required: e.g. the total number of documents produced and a statistical distribution of the requests from the banking terminals. In addition, a complete trace of each document throughout the whole process of production has to be stored. From a business perspective, it should be possible to create reports of the number of documents produced, of the number of requests from the bank terminal etc. The service provider might be interested in evaluating the server load in conjunction with the documents produced (type and size). All these requirements can be easily fulfilled if known and considered from the beginning.

This will lead to a design with a tight integration of the monitoring, logging, and reporting features. The load figures identified during the requirements phase build the basis for the load balancing and fail-over concept covered in the system architecture. The capabilities of the already existing components, which have to be integrated, have to be considered, too. Especially, when implementing a system with high throughput as in this case study, the existing components might not be able to manage the additional load. Because of the widely distributed clients – the banking terminals on the branch' sites – the end-to-end-monitoring is important to identify any issues on the line between the banking terminal and the central systems. But not only failures have to be monitored; successful operations should be logged as well to offer in-depth reporting capabilities.

During the different stages of the development phase especially the fulfilment of the load requirements has to be tested after each major step or change. The design has to be verified to be suitable for the mass production and high performance requests. Special load test scenarios have to be designed; fail-over tests have to be performed. A real live test with production data can give a meaningful insight look.

Prior to the deployment into production a detailed pilot and rollout concept has to be developed including a fall-back strategy and well-defined criteria for taking the decision to make the next step in the rollout. Concerning the special aspects of the given case study special attention has to be paid to heavy load timeframes at the end of month or Christmas holidays, when many people will request account statements.

6 WRAP-UP

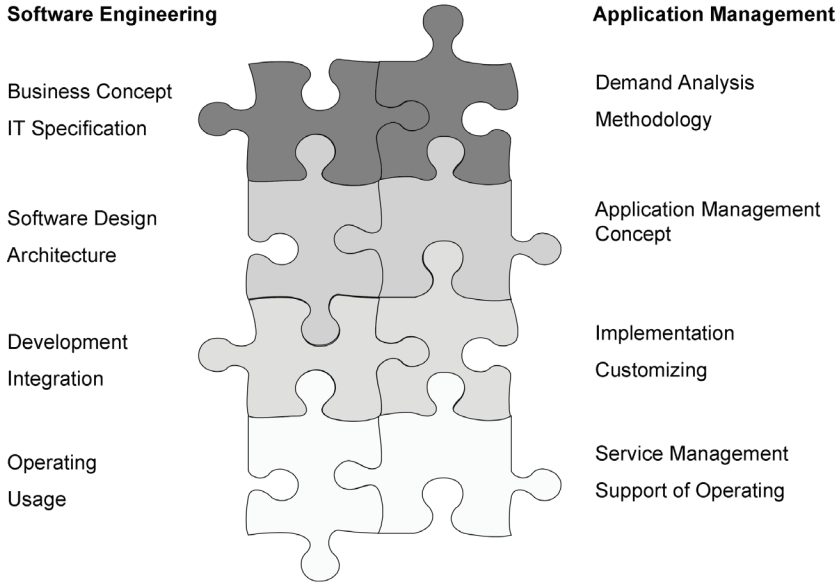
The continuous usage of Application Management throughout the whole value chain offers a lot of opportunities and advantages for both parties – business as well as IT.

A robust solution will support the end-user best during his business activities. The business organization can utilize reports to analyse process durations and bottlenecks in order to optimize the business process. This data can be aggregated in order to serve as a basis for upper management. The sponsor will get a well-founded feedback about the quality of the solution.

The solution will be well integrated into the existing infrastructure and operating environment, making the operation of the service much easier and therefore lowering the operating costs. Possible service failures might be identified in advance and avoided by taking the appropriate actions. Pre-defined service workflows in case of an incident ease the work of the support team. Analysis of error situations is supported by meaningful logging.

A best practise approach will cover the different requirements from each stakeholder involved in detail as well as the "big picture" for providing an end-to-end Application Management solution

Figure 2. Application management in the context of software engineering



across the borders of application components and systems.

The process has to start with a *demand analysis* covering the functional and technical aspects of the upcoming solution. The early involvement of all stakeholders will build a common understanding.

Based on the requirements identified concerning Application Management a *design of the future service* can be started. Sample solutions of already implemented services and the utilization of standards as well as the experience from similar projects of the involved parties are major success factors for design and development.

The *integration of the new solution* into the existing infrastructure will be done by implementing the identified changes or enhancements of the established components. The rollout is already supported by the Application Management features of the new service, so that a "smooth going live" can be achieved.

Application Management from the beginning builds the foundation for a successful project by assuring "built-in quality" for the solution.

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KEY TERMS AND DEFINITIONS

Application Management: All concepts, techniques, system and application components required to monitor, measure and record data for operating a service in order to provide the service to the customer as defined in the Service Level Agreement (SLA).

ITIL: A set of Best Practice guidance for IT Service Management. ITIL is owned by the OGC and consists of a series of publications giving guidance on the provision of Quality IT Services, and on the Processes and facilities needed to support them. See http://www.itil.co.uk/ for more information. (Office of Government Commerce, 2007)

IT Service: A Service provided to one or more Customers by an IT Service Provider. An IT Service is based on the use of Information Technology and supports the Customer's Business Processes. An IT Service is made up from a combination of people, Processes and technology and should be defined in a Service Level Agreement. (Office of Government Commerce, 2007)

Quality: The degree to which a set of inherent characteristics fulfills requirements. (Project Management Institute, Inc., 2008)

Service Management: Service Management is a set of specialized organizational capabilities for providing value to customers in the form of services. (Office of Government Commerce, 2007)

System Management: The part of IT Service Management that focuses on the management of IT Infrastructure rather than Process. (Office of Government Commerce, 2007)

Section 6

Economic and Social Perspectives of IT Service Quality Management

Chapter 14
Economic Aspects of Quality of Service for Internet Based IT Services

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ABSTRACT

In academic research there is a long ongoing and vital discussion on the evolution and design of technologies that enable the management and control of quality of service (QoS) for Internet based IT services. Whereas technological aspects have been extensively discussed, from an industry perspective, there is a strong need for a structured research on economic aspects of QoS. A clear understanding of IT service quality and its dependency on the quality of data transmission is a precondition for an effective design of future service distribution technologies. This work provides an overview on the state of the art in economic QoS research. It discusses economic aspects of QoS on four central economic dimensions: the product dimension, the customer interface dimension, the infrastructure dimension and the financial management dimension. Moreover, this article discusses future QoS prospects and challenges.

INTRODUCTION

Internet based IT services have become essential for businesses and private customers. The constant increase in capacities for data transmission, storage, and data processing enable the provisioning of sophisticated software applications, multimedia content and computing resources from remote locations over the Internet (*Internet service distribution*). A key advantage of this evolution is the opportunity to realize higher operational efficiencies and economies of scale. The downside of this trend is a higher dependency of consumers on the Internet and particularly on data transmission quality. The original design of IP networks and protocols was not aimed at supporting IT services with such high real-time requirements and data rates. Additionally, the integration of wireless networks and the immense growth of wireless data services imposes significant challenges to network operators as one can see for example in the case of complaints of iPhone users about AT&T's access

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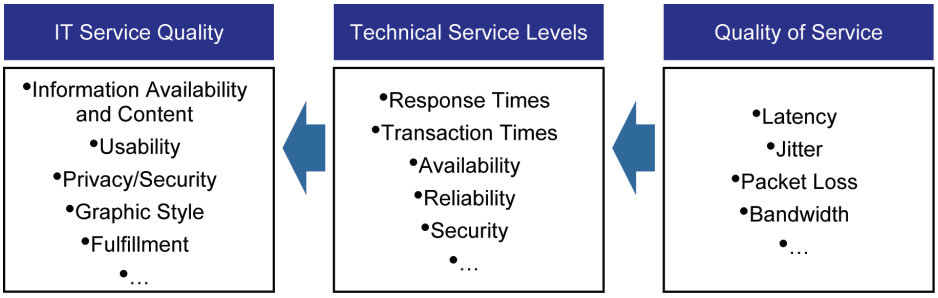
quality (Siegler 2009). Internet data transmission bases on the best-effort principle: all data packets are treated equally, regardless of their origin. The quality of transmission is therefore primarily determined by the transmission capacity provided by network operators. Capacities are regularly extended, according to a strategy which is oriented at the peaks of traffic utilization, referred to as over-provisioning. The actual quality of best-effort transport is therefore decided upon by network operators based on economic considerations. Complementarily to best-effort transport, a multitude of technological methods have been developed in order to improve the distribution of IT services over the Internet, few of which have up to date been applied in practice in what we refer to as content distribution business models (Wulf and Zarnekow 2010). The most prominent examples are content delivery networks (CDN) such as AKAMAI, which claims to 20% of total web traffic (AKAMAI 2009). In academic research there is a long ongoing and vital discussion on the evolution and design of technologies that enable the management and control of quality of service (QoS) for Internet based IT services. Whereas technological aspects have been extensively discussed, from an industry perspective, there is a strong need for a structured research on economic aspects of QoS. For example, a clear understanding of IT service quality and its dependency on the quality of data transmission is a precondition for an effective design of future service distribution technologies. This work provides an overview on the state of the art in economic QoS research: in the subsequent chapter, the influence of QoS on the overall IT service quality is described. Thereafter, economic aspects of QoS are presented on four central economic dimensions. This article concludes by discussing future QoS prospects and challenges.

THE INFLUENCE OF QUALITY OF SERVICE ON IT SERVICE QUALITY

The quality of Internet based IT services can be assessed by comparing a user's expectations and perceptions of the performance level for a range of service attributes (Parasuraman et al. 1985). The International Organization for Standardization states: The quality of something can be determined by comparing a set of inherent characteristics with a set of requirements […] A quality characteristic is tied to a requirement and is an inherent feature or property of a product, process, or system. (ISO 2005) A requirement is understood as an expectation or a need of a user. Various authors discuss the types of requirements which are to be taken into account in an IT service quality assessment (Liao and Cheung 2008, Liu and Arnett 2000, Zeithaml et al. 2000, Zeithaml et al. 2002). For instance Zeithaml et al. (2002) define the following attributes: information availability and content, usability, privacy/security, graphic style, and fulfillment. Such attributes represent the factors relevant to a user's perception of a service.

In telecommunications research, the term quality of service (QoS) is used heterogeneously to describe concepts of service quality. As discussed by Gozdecki et al. (2003), the term QoS is used to describe the customer's service quality assessment (*IT service quality*), technical parameters of service performance (technical service levels) as well as data transmission performance metrics (QoS in the narrower sense). Externally, i.e., in the relationship between service provider and user, service quality stands for the general comparison of inherent service characteristics as expected and perceived by users. Internally, i.e., among parties involved in service production, the service performance comprises all performance related parameters of a service described in technical terms (technical service levels), such as response and transaction times, availability and reliability. These parameters are affected by the inter-working of server, distribution, and client systems. The *quality of*

Figure 1. Quality of service and IT service quality



service in the narrower sense (Xiao et al. 1999, Zhao et al. 2000) can be characterized by the data transmission performance parameters bandwidth, delay, packet loss, and jitter. The bandwidth defines the effective volume of data per time unit being transmitted between communication end points. The delay comprises the length of time that a data package takes from the sender to the recipient. Packet loss defines the number of data packets that are lost in the transmission from the sender to the receiver. Jitter describes the fluctuation in the delay.

Figure 1 summarizes the interrelationships between Quality of Service, Technical Service Levels and IT Service Quality.

ECONOMIC ASPECTS OF QUALITY OF SERVICE

In addition to the definition of QoS and its influence on IT service management, multiple and very heterogeneous economic aspects have been discussed in academic literature concerning QoS. In the following, we provide a structured overview on these aspects (see Table 1) and discuss their

Table 1. Economic dimensions of QoS distribution services (based on Osterwalder 2004)

Economic Dimension	Description	QoS Issues
Product	Describes the characteristics of a service and its value proposition.	Quality of Experience, Classes of Service, SLAs (Soft- vs. Hard-Assurance)
Customer Interface	Describes the segments of customers a service addresses.	Regimes (Calling Party Pays, Sending Party Pays, Bill and Keep), Service Types (Unidirectional, Bidirectional)
Infrastructure Mgmt Value Configuration Capability Partnership	Describes the arrangement of activities and resources.	Distribution Value Chain
	Outlines the competencies necessary to provide a service.	Effective QoS Capabilities of Platforms, Content Delivery Networks, Network Management, Traffic Engineering
	Portrays the network of cooperative agreements with other companies necessary to efficiently offer and commercialize value.	Actors, Relationships, Modus of Cooperation, Inter Carrier Regime
Financial Mgmt Cost Structure Revenue Model	Sums up the monetary consequences of the means employed for service provisioning .	CAPEX and OPEX of QoS Platforms
	Describes the way services generate revenues..	Value or Cost based Pricing, Access or Volume based Charging, Implementation and Charging Complexity

relevancy with respect to IT service provisioning. The economic aspects are discussed on four dimensions (Osterwalder 2004): On the product dimension, the value proposition of services is discussed. On the customer interface dimension, the customers addressed by a service offering are identified. On the infrastructure management dimension, the value configuration, required capabilities and partnerships are described. On the financial management dimension, the cost structure and revenue model of a service is designed.

Product

From a product perspective, the value proposition of QoS technologies is to support the distribution of IT services by guaranteeing a satisfactorily data transmission performance. A key issue in QoS research is to determine what is considered as satisfactorily for specific IT services. The relationship of IT service quality, also referred to as Quality of Experience in telecommunications research (ITU 2007, Kilkki 2008, Moorsel 2001) and QoS is largely unknown and subject to ongoing research. For few IT services, such as voice and multimedia services, some authors analyze the contribution of QoS parameter values to the overall quality (Ghinea and Thomas 1998, Reichl 2007). Nevertheless, up to the present, a generally accepted framework on how QoS parameters influence the components of IT service quality has not been established. In spite of the existence of this knowledge gap, several authors define performance levels for classes of services (CoS, Marchese 2007 pp. 5-8, Gozdecki et al. 2003). CoS concepts define bounds for the QoS parameters to precisely describe what is considered an appropriate quality for specific service classes such interactive or multimedia services. Table 2 provides an exemplary classification of services.

Such CoS concepts base on subjective estimations rather than on empirical investigations and as such are subject to continous discussion and modification. An aggravating factor is that with

Table 2. Exemplary classification of services (Brenner et al. 2008)

Quality class	Typical services	Technical QoS parameters	
Interactive	Voice Telephony/Conferencing	Bandwidth:	16 - 500 Kbps
	Video Telephony/Conferencing	Delay (one way):	100 - 200 ms
	Online-Gaming	Jitter:	< 30 ms
	Interactive TV Feedback	Packet Loss:	< 1%
Multimedia	Broadcast TV	Bandwidth:	384 Kbps - 14 Mbps
	Video on Demand	Delay (one way):	400 - 1000 ms
	Streaming Audio	Jitter:	< 1000 ms
	Internet Radio	Packet Loss:	< 0.1%
	Voice Messaging		
Critical	Business Applications	Bandwidth:	16 Kbps - 16 Mbps
	e.g. SAP, eHealth	Delay (one way):	100 - 200 ms
		Jitter:	< 100 ms
		Packet Loss:	< 0.1%
Best Effort	E-Mail	Bandwidth:	up to line rate
	Web-Browsing	Delay (one way):	< 2000 ms
	P2P	Jitter:	n.a.
	Internet Downloads	Packet Loss:	n.a.

the further development of applications their requirements change as well. Hence, a CoS definition requires a continous adjustment.

Following the identification of Internet service requirements for QoS, such requirements are subject to QoS contracts between distribution providers and Internet service providers. QoS is defined in Service Level Specifications (SLS), the components of *Service Level Agreements* (SLA) which define the data transmission performance (Gozdecki et all. 2003). Generally, one distinguishes between soft and hard assurances (Xiao 2008. pg. 54). Soft assurances promise a QoS, which is generally superior to a basic QoS, but do not guarantee that specific QoS levels are generally met. This type of assurance offers the advantage to distribution providers, that they do not have to implement distribution technologies with a deterministic quality. On the downside, if the basic service meets the customer's requirements, such an offer does not provide a perceivable added value. In contrast, hard assurances offer QoS guarantees. As such, this type of SLA is suitable for Internet services with strict QoS requirements, e.g. business critical applications, eHealth services and the like. For distribution providers, offering hard assurances requires taking over the liability for QoS including the associated risks. While hard assurance provides a clear value added to a basic QoS such as best-effort QoS in the Internet, it requires more sophisticated technologies for service distribution.

Customer Interface

All participants of data communication, most frequently content providers and end customers, are potential customers of QoS offers. The determination of target customers is tightly connected to the way data is exchanged in the course of service provisioning: for unidirectional data streams, the sender is usually targeted as a QoS customer. For bidirectional data streams, heterogeneous models and approaches exist.

A good example for a QoS support of unidirectional data services is video delivery by content delivery providers. The sender, i.e., a content provider, tasks the CDN provider with delivering its content with high quality and pays him for its services.

Regarding bidirectional services, there is an ongoing discussion in academic research on who is the target customer and who should be charged: The traditional fixed-net telephony, for example, does not charge the data sender but the call initiator for a call (Calling Party Pays, Marcus 2006). The Internet architecture bases on the principle of a strict separation of data transport and services. As a consequence, service providers and end customers both pay for Internet access, i.e., the outgoing and incoming traffic. Shares of the resulting revenues are not passed through the chain of network operators involved in data transport in an end-to-end fashion (Bill and Keep). Considering QoS a value added access service, it could be charged for in the same manner. In such a scenario, both participants of the data communication represent customers of QoS offerings. In a third approach, often favored by QoS researchers (Brenner et al. 2008), the sender is considered to be responsible for the traffic it generates and therefore is charged for its outgoing traffic (Sending Party Pays, SPP). In this approach, both participants of a bidirectional communication are considered customers of QoS offerings, the customer interfaces nevertheless differ from the Bill and Keep approach. In a fourth approach, the Internet service provider is considered to be the customer of QoS business models regardless of its involvement in the bidirectional data communication. E.g., a provider of a communication service could be charged for QoS, even if the provider's servers are not involved in the data communication.

The identification of target customers of QoS offerings bases on two major aspects: technological feasibility and economic incentives: An SPP regime entails the necessity to charge senders for

the data load they generate. Such a charging and billing is potentially very complex to carry out. Regarding economic incentives, a customer of QoS offerings must be willing to pay for such a service. A requirement is the compliance to the cost-by-cause principle: A recipient of QoS traffic will hardly be willing to pay for it, if this traffic is not desired.

Infrastructure Management

The infrastructure dimension consists of three major aspects and their interrelations: it is described how quality based IT service provisioning is carried out (value configuration), which resources and capabilities are required and which players are involved in a cooperative service production (partnership).

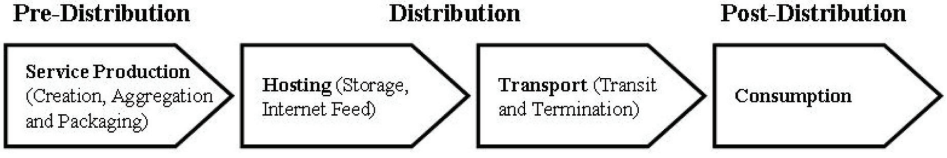
Value Configuration

Figure 2 provides an overview on activities required for QoS based Internet service distribution. QoS is predominantly determined by the transport activity, i.e., the transmission of data through carrier networks (transit) and the delivery of data to a communication end point (termination). In addition, hosting has influence on the QoS, in particular the placement and locating of hosting servers and the way, they are connected to the Internet. The general upstream activity is service production, i.e., the creation, aggregation and packaging of content. The downstream activity is consumption, i.e., the utilization of a service by a consumer.

Resources and Capabilities

There are manifold strategies to enhance QoS, and therefore also very different capabilities, which can be employed to enhance QoS of IT services within the hosting and transport activities (Wulf and Zarnekow 2010). For transport, QoS research generally differentiates between three types of strategies that determine QoS: data path operations, control path operations, and routing operations (Zhao et al 2000, Xiao and Ni 1999). Data path operations determine the actions individual routers take on data packets. It includes the classification and forwarding of packets, queue management and scheduling. Control path operations manage the allocation of resources and include admission control, policy control and bandwidth brokerage. Routing operations deal with the arrangement of traffic flows in telecommunication networks: to avoid congestion caused by uneven network utilization, traffic engineering activities and constraint-based routing are employed. For hosting, multiple technologies have been developed to place servers in communication networks, to distribute, cache and reproduce content among servers and to select servers for IT service distribution. Most of these concepts have been subsumed under the term *Content Delivery Networks* (CDN, Pathan and Buyya 2008). Whereas in academic research there are manifold technology propositions to improve QoS of IT services, there are few realizations presently being applied in practice. CDNs such as Akamai (AKAMAI 2009) are the most prominent example of an established QoS technology in the IT service market. A second mechanism regularly employed is the usage of

Figure 2. Value chain for service distribution



reserved capacities for IT service transmission, referred to as direct homing in this work. Examples for direct homing are the streaming of IP TV content or the commercial usage of virtual private networks over dedicated capacities that are not open to the public Internet traffic. A technology often discussed with respect to the further development of present Internet architectures (subsumed under the label next generation network design, ITU-T 2004) is differentiated services (DiffServ, Zhao et al. 2000), which is a technology for packet differentiation. The further discussion on required resources and capabilities focuses on these three approaches.

A CDN is a network of interconnected servers that are distributed around the Internet. They can be defined as *trusted overlay networks that offer high performance delivery of common Web objects, static data, and rich multimedia content by distributing content load among servers that are close to the clients.* (Vakali and Pallis 2003) The basis for content delivery are servers, which are strategically deployed across the Internet and which handle and forward data in ways that are different to the traditional Internet mechanisms (Internet Overlay, Clark et al. 2005). Modern CDNs are capable of handling a large variety of data, not only static web content, but also multimedia content and interactive applications. Applied techniques and technologies include content caching and replication as well as request routing, load balancing and surrogate selection. In the CDN distribution model, the service provider tasks a CDN with hosting its content and with managing IP transit. The CDN operates the network of hosting servers and maintains transit agreements with a multitude of network service providers. Ideally the CDN interconnects directly with the access provider of the end customers. The core technology of this business model is a complex network of hosting servers operated by CDNs. Content is distributed and cached on these servers based on an optimization strategy, which takes into account the location of the end customers. The quality of distribution is highly dependent on the CDN's efficiency of server management and route optimization. For cacheable content, significant improvements in the QoS can be realized in comparison to centralized Internet hosting. For non cacheable content, the CDN technology cannot tap its full potential, because no caching can be applied.

In the direct homing distribution model, a service provider directly contracts the access provider of its end customers for distribution. The access provider carries out hosting and data transport. As the access provider already maintains a relationship to the end customers, it regularly also manages billing and takes over content related tasks such as content aggregation in a content portal. Distribution via direct homing often is realized on dedicated networks. IP traffic is not routed as part of the best-effort Internet class, but as a privileged class or through reserved capacities. Routing through dedicated networks does not necessarily imply the need to install separate hardware, but requires at least a reconfiguration of routing systems. In contrast to centralized Internet hosting, the direct homing traffic is never routed through interconnections. In addition, the usage of dedicated networks enables a more reliable and configurable QoS. That is why direct homing distribution meets stricter QoS requirements and is especially suited for TV and video services.

A *Next Generation Network* (NGN) is defined as *a packet- based network able to provide telecommunication services and able to make use of multiple broadband QoS-enabled transport technologies and in which service-related functions are independent from underlying transport-related technologies. It enables unfettered access for users to networks and competing service providers and/or services of their choice. It supports generalized mobility that will allow consistent and ubiquitous provision of services to users* (ITU-T 2004). Compared to traditional communication network architectures, NGNs are predicted to offer a more effective provisioning of new services at

low costs for investments and maintenance. In the general overview on NGN, the ITU (ITU-T 2004) defined areas of key importance in the provisioning of NGNs, one of which is end-to-end QoS. Full end-to-end QoS is considered important to provide telephony and multimedia services in NGNs. It is realized by providing QoS control mechanisms between the service and the transport layer in NGNs ('vertical QoS') and QoS control between different domains and networks ('horizontal QoS'). The technology often proposed for realizing QoS in NGNs is DiffServ, which implements a class-based service discrimination framework using packet tagging. According to the information in these tags, packets are handled with different priority by the routers in the network (packet differentiation). The implementation of QoS mechanisms in NGNs require heavy infrastructure investments, because every router must be able to support and carry out packet differentiation.

Partnerships

Distribution providers are embedded in a complex network of cooperating companies, referred to as ICT ecosystem. The realization of a so called end-to-end QoS from data origin to recipient often requires cooperation between hosting providers and network providers as well as cooperation among network providers. Cooperation requirements differ largely with the applied QoS technologies: whereas for CDN provisioning, cooperation is restricted to standard IP transit interconnections of the CDN servers with multiple carriers' networks, the realization of NGN based QoS requires tight cooperation between carriers: to guarantee the functioning of QoS based data routing across various carriers' networks, technical and economical standards for QoS interconnection are necessary. This includes the definition of QoS classes and of charging mechanisms for QoS delivery. A major issue is the definition of a suitable interconnection regime: if various carriers are involved, how are the revenues shared and exchanged between them? The traditional interconnection regime bases on the Bill and Keep principle. For QoS realization, this regime does not set the necessary incentives (Brenner et al. 2008). With respect to the interconnection in NGNs, researchers discuss various regimes (Marcus 2006). The direct homing approach usually does not require an inter-carrier cooperation, but requires a tight integration of service provider and network operator: the network operator in this approach usually handles charging and billing. Thus, methods for revenue sharing between service provider and network operator must be clearly defined.

Financial Management

On the financial management dimension, the cost and revenue models of QoS based Internet service delivery are described.

QoS Cost Models

A major issue in the discussion about QoS methods is the comparison of costs for their realization. Holistic cost models for QoS based distribution include two aspects: capital expenditures (CAPEX, the costs for installing the distribution infrastructure) and operational expenditures (OPEX, the costs for operating a distribution infrastructure).

De Lope et al. (2008) carried out a comparative study of the OPEX induced by the implementation of capacity reservation, traffic differentiation and over-provisioning strategies for backhaul networks. As a result, the traffic differentiation strategy generates the least unit costs, i.e., equipment costs per user. Costs nevertheless are predicted to converge with the increase of backhaul bandwidth. According to this study, capacity related CAPEX is higher in backhaul compared to backbone networks. For this reason, it is well possible, that in backbone networks over-provisioning represents the most efficient QoS method, whereas in backhaul networks traffic differentiation should be applied. The results of this analysis base on

two significant assumptions: equipment costs are assumed to be invariant of whether they support QoS functionalities or not. Moreover, an invariant ratio of traffic classes is assumed: the results highly dependent on the ratio of real-time to best effort traffic. The higher the real-time ratio, the less efficient performs the traffic differentiation technology. A major flaw of this analysis is its focus on CAPEX. Additionally taking into account OPEX possibly changes the results: the over-provisioning strategy is characterized by small OPEX in comparison to capacity reservation and traffic differentiation, because, in addition to network dimensioning, no management effort for differentiated traffic handling is required. The analysis carried out by De Lope et al. (2008) is to date the only of its kind. As a consequence of the above considerations, this cost comparison of different QoS strategies does not clearly favor a specific strategy. More insights on the OPEX and CAPEX as well as on future traffic usage is required in order to generate more precise and accurate results.

Generally speaking, traffic priorization and differentiation technologies require implementation effort on the network layer, whereas so called over-the-top strategies such as CDNs require the installation of additional infrastructure. There are different CDN approaches which vary with respect to CAPEX: in the single-ISP approach, only a few servers are installed and operated in a single ISP's network (Pathan and Buyya 2008). In contrast, the multi-ISP approach requires the installation of multiple servers and is as such more CAPEX and OPEX intensive.

From an economic perspective, it might not even be efficient to provide technological solutions that meet the requirements of all types of IT services. Instead, an insurance for QoS related risks is potentially more suitable in some cases (Teitelbaum and Shalunov 2003).

Summing up, there are multiple OPEX and CAPEX related factors which must be taken into account in QoS cost models. The design of holistic cost comparisons, which at the same time take into account heterogeneous QoS technologies and cost components, remains an open research issue.

QoS Revenue Models

Revenue models consist of two central aspects: the target customer ("who to charge") and the pricing mechanism ("how to charge"). Whereas the former aspect has been analyzed in the customer interface section, the pricing mechanism is discussed in the following. We classify QoS pricing mechanisms as presented in economic literature (Falkner et al. 2000, Hosangar et al. 2008) with respect to 8 criteria in Table 3.

The first criterion classifies the pricing schemes according to their compatibility to the above presented QoS distribution models. The second criterion describes whether the specific pricing mechanism allows a value or a cost based pricing. Whereas value based pricing enables the setting of prices according to the user's willingness to pay for a QoS level, cost based pricing schemes focus on evaluating the costs incurred by a customer's traffic. As discussed by Varian (1997), value based pricing allows distribution providers to more efficiently skim prices. The distinction between access and volume based charging describes the basis of a pricing mechanism being either the pure access to a communication network regardless of the effective traffic exchanged or the traffic volume. Congestion control describes the characteristic of a pricing mechanism to serve as a means to control congestion independently of technical QoS implementations by influencing consumption behavior. Soft- versus hard-assurance describes the suitability of a pricing mechanism for these two different types of SLAs. The time frame of pricing setting describes the ability of this pricing mechanism to react to network congestion and dynamic usage behavior by allowing price adjustments. The implementation and charging complexity describes the feasibility of this pricing mechanism with respect to its in-

Table 3. QoS pricing mechanisms and features (based on Falkner et al. 2000)

Pricing Mechanism	Flat Rate	Paris Metro	Priority	Smart Market	Edge/Expected Capacity	Proportional Fairness	Percentile based pricing
Supported QoS Mechanisms	Direct Homing	None	Packet Differentiation	None	None	None	CDN
Value vs Cost based Pricing	Value	Cost	Cost	Value	Cost	Value	Value
Access vs Volume based Charging	Access	Access	Volume	Volume	Volume	Access	Volume
Congestion Control	No	Yes	Yes	Yes	Yes	Yes	Yes
Soft vs Hard Assurance	None	Soft	Soft	Soft	Hard	Soft	Soft
Time Frame of Price Setting	Long Term	Long Term	Short Term	Short Term	Average/Long Term	Short Term	Long Term
Implementation and Charging Complexity	Low	Low	High	Exorbitant	Moderate	Low/Moderate	Moderate
Network Efficiency	Low	Variable	High	High	High	High	Average

stallation and operation in distribution systems. Lastly, the network efficiency level classifies the pricing mechanisms with respect to the efficiency of network utilization they enable.

The results of this analysis of QoS pricing mechanisms summarized in Table 3 show that only three pricing mechanisms qualify to support the QoS mechanisms discussed in this article. Whereas the implementation of smart market pricing is not considered to be feasible, paris metro pricing, edge and expected capacity pricing as well as proportional fairness pricing are applicable to implement congestion control mechanisms, but not in the context of the QoS mechanisms presented above. Flat rate pricing is applicable for direct homing content distribution: the dedicated capacity is paid for with a flat rate price, which is individually negotiated, and hence oriented at the customers' willingness to pay (value based). Charging is carried out for access, not for traffic volume. A hard assurance can only be provided, if the reserved capacity is not overloaded. As the capacity is reserved regardless of the efficient capacity usage, this pricing model is considered to provide a low network efficiency. Priority pricing (Gupta et al. 1997) is considered suitable for packet differentiation in NGN networks. Heterogeneous traffic classes are defined. Traffic with higher priority is more expensive and will be treated with higher priority during network congestion. As customers choose their priority level from predefined classes and prices, this mechanism is not considered to be value based. Usage charges are imposed per volume of traffic. This implies a high complexity of implementation and charging. As priority prizing in conjunction with the technological ability to differentiate packets at the routers is a means for congestion control, a high network efficiency is possible. As only relative priorization levels are defined, only soft assurances can be given. Price setting can be carried out on a short term basis. Percentile based pricing is discussed in Hosangar et al. (2008) for CDNs: in order to take into account traffic volume as well as traffic burstiness, they propose to take the 95th percentile of usage as a basis for charging. This motivates customers to keep burstiness low and therefore it increase network efficiency and represents a means for congestion control. As prices are negotiated individually and on a long

term basis, value based pricing models potentially can be applied. Usage information must be collected for charging but can be realized at a single measurement point. Therefore the complexity for implementation and charging is considered moderate. Hard assurances on QoS levels can not be given, neither through percentile based pricing, nor through CDN business models in general.

FUTURE QOS PROSPECTS

The future of information service distribution is dependent on a multitude of factors causing large insecurities about the necessity for more sophisticated QoS distribution methods, technologies and business models. Among the most dominant influential factors are the evolution of Internet traffic and architectures, the technological and economic stability of the Internet, and future innovations in Internet services.

Some industry reports predict a pessimistic scenario for the future of the Internet: traffic volumes supposedly grow at such a fast pace, that transmission capacities will not be able to meet this demand any more at some point of time. Such argumentations suggest a change of the technological and economic Internet architecture. Technologically, a more efficient usage of capacities should be enabled by changing present Internet transmission methods, such as the introduction of packet differentiation. Economically, network operators should participate stronger at the revenues generated by Internet services in order to finance network infrastructure investments. This could be achieved through a differentiated pricing of multi-class transport services. In contrast, other authors do not predict an excess demand for Internet capacity: according to their opinion, technological innovations enable the expansion of access, backhaul and backbone capacities in a pig cycle like fashion. That way, temporary bottlenecks will always be resolved. In this area of conflict, network operators, Internet service operators and regulators must optimize their strategic actions. In this context, the further development of QoS based distribution methods and technologies for Internet services seem to represent a prosperous field.

A second area of discussion gaining increasing attention is the stability and liability of the Internet infrastructure. Internet outages due to undersea cable breaks and power outages have demonstrated the infrastructure's fragility in recent years. An even higher infrastructure redundancy certainly would create a higher overall robustness. Nevertheless, necessary fields of action are primarily identified from an economical rather than from a purely technological perspective. In this context, the introduction of QoS delivery, e.g., to enable the availability of business critical Internet services independent from temporary Internet outages might represent an efficient means.

A third field of continuous discussion is the role of Internet infrastructure as an enabler of innovations for IT services. The separation of transport from services undoubtedly constitutes the foundation for vast and ongoing innovations in the IT services field. At the same time, current Internet infrastructure provides a limited support for highly interactive services and services with high real-time and security requirements. While some consider the implementation of differentiated QoS mechanisms into Internet infrastructures a setback in the strict separation of transport from services, others regard it as a necessary instrument to construct the foundation for future IT service innovations.

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KEY TERMS AND DEFINITIONS

Class of Service (CoS): CoS concepts define bounds for the QoS parameters to precisely describe what is considered an appropriate quality for specific service classes such interactive or multimedia services.

Content Delivery Networks (CDN): CDNs are trusted overlay networks that offer high performance delivery of common Web objects, static data, and rich multimedia content by distributing content load among servers that are close to the clients.

Internet Service Distribution: the provisioning of sophisticated software applications, multimedia content and computing resources from remote locations over the Internet.

IT Service Quality: The quality of Internet based IT services can be assessed by comparing a user's expectations and perceptions of the performance level for a range of service attributes.

Next Generation Network (NGN): A Next Generation Network (NGN) is defined as a packet-based network able to provide telecommunication services and able to make use of multiple broadband QoS-enabled transport technologies and in

which service-related functions are independent from underlying transport-related technologies.+

QoS Pricing Mechanisms: QoS pricing mechanisms describe how to charge for differentiated QoS. Whereas value based pricing enables the setting of prices according to the user's willingness to pay for a QoS level, cost based pricing schemes focus on evaluating the costs incurred by a customer's traffic.

Quality of Service (QoS): QoS describes the performance of data transmission and is characterized by the parameters bandwidth, delay, packet loss, and jitter.

Chapter 15
Alignment of Perceptions in Information Technology Service Quality

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ABSTRACT

The chapter explains the importance of taking the expectations of customers and service providers into account with regard to IT service quality management. To do this, the author uses the SERVPERF method, which identifies expectations regarding service performance from the point of view of both the customer and the provider. Based on an empirical study, the author demonstrates the importance of aligning IT staff with staff from the customer company as far as quality management is concerned.

INTRODUCTION

Analyzing the effectiveness of IT service components is becoming increasingly important (Jiang et al., 2000). To meet growing user demands organizations allocate high investments toward IT. However, the measures generally analyze IT effectiveness based on products rather than on services. Thus, they provide inconsistent information for decision-making (Pitt et al., 1995; DeLone and McLean, 2003).

IT products like hardware, software, and information system (IS) applications are part of a process of services (development and maintenance of IS applications, management of operational systems, and maintenance of hardware and software), which determine client perceptions about quality (Gronroos, 2000). Quality may result in a competitive advantage for organizations (Porter, 1980), due to differentiation characteristics. Nevertheless, the competitive advantage of an organization starts in its internal processes, which are also the management of intraorganizational demands (Greenhalgh, 2001; Bhatt and Grover, 2005), such as those of IT services.

Therefore, an effective service analysis of the services produced by IT division for other organizational divisions, or IT client divisions, should take into consideration how these clients perceive IT services. According to Gronroos (1988, p. 10),

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"when the service provider understands how the clients evaluate its services, it can identify how to manage these evaluations and how to influence them in a desired direction." This situation requires "a model of how the customers perceive the service quality" (p. 10).

In this sense, Seth et al. (2005) analyze 19 models that evaluate *customer satisfaction* with services. They considered *SERVQUAL model* as the most influential of them, although not for IT services purpose. SERVQUAL has its origin in marketing discipline for services in general, but its applicability in IT discipline for IT services is increasing (Jiang et al., 2000; Carr, 2002).

DeLone and McLean (1992) developed an information system (IS) model that has been the base of different models with the aim to evaluate user satisfaction with IS services. Ten years after, DeLone and McLean (2003) revised the model to insert a functional dimension (how the service is delivered) based on SERVQUAL dimensions.

SERVQUAL evaluates service quality using a questionnaire containing 22 items divided into five dimensions, namely tangibles, reliability, responsiveness, assurance, and empathy. These elements evaluate both the expectations for agreed services and the perceptions of services previously provided. Both clients and suppliers respond this questionnaire (Parasuraman et al., 1991).

Thus, the applicability of the SERVQUAL model to the Brazilian banking sector as an instrument for IT service quality improvement is especially interesting, considering the intensive use of IT and the large amounts invested in technology. In 2004, Brazilian banks invested approximately $1.44 billion in IT, or in other words, 30% of their total investments (FEBRABAN, 2006). In 2006, the number of accounts in Brazilian banks totaled 102.6million, with clients independently operating over12 billion electronic transactions using devices like Internet Banking and Automated Teller Machines (FEBRABAN, 2008).The site of this research is one of the top five Brazilian banks that invest in IT. This investment is partly responsible for the bank achieving one of the largest net profits of the sector in 2004, besides being one of the 10 largest American banks in terms of assets. Consequently, its IT Division (ITD) receives, on average, over 250 IT service requests per month from its client divisions, which requires a complex infrastructure of physical and human assets. Based on this situation, managing the relationship between ITD and its clients raises the following question: How is the alignment of IT service quality perceptions between the ITD and its client divisions?

To answer this question, the main objective of this study is to evaluate the different perceptions of IT service quality by questioning ITD employees, here also identified as suppliers, and the employees of its client divisions, here also identified as clients, using the SERVQUAL model during a specific period of time. As secondary objectives, this research aims to analyze the perception gaps in the five dimensions of the SERVQUAL model and identify opportunities for the management improvement of the client supplier relationship in IT services. Because the model is not a common sense, the findings add new ways to continue the validity discussion of SERVQUAL, this time based on a sample characterized by intense and strategic IT development, and exploring conceptual elements unpredicted in the original instrument.

Four main sections develop the objectives of this study. The first section briefly reviews previous research about service quality emphasizing IT context, followed by the presentation of the SERVQUAL model, including gap analysis and considerations about factor stability for IT services. The second section presents the method of the research. The third section develops the empirical results, through quantitative and qualitative data analysis. The last section highlights managerial implications and suggestions for future research.

IT SERVICE QUALITY

According to OGC (2007, p. 11) a service is a "means of delivering value to customers by facilitating outcomes customers want to achieve without the ownership of specific costs and risks". Nevertheless, the definition of service quality is controversial, yet indubitably important to enterprises (Parasuraman et al., 1985). High quality services generate more customer satisfaction, customer retention, profit, cost reduction, and a good image of the enterprise (Buttle, 1996; Jiang et al., 2003). Teboul (2006, p. 77) presents three movements for quality: a) doing the thing right; b) doing right thing for the customer; and c) enable the customer voice inside all parts of supplier organization. Bloom et al. (2002) define quality services as being those that exceed customer expectations.

Expectations and Perceptions

The definition of expectations is elusive (Oliver, 1986). Parasuraman et al. (1988) state that the expectations of service quality provided to clients are client wishes or needs, or what the service supplier should provide. On the other hand, the perception of service quality performance, contrary to expectations, refers to services executed (Berry et al., 1990) at the very moment the consumer interacts directly with them (Bitner et al., 2000). Therefore, the perception of service quality is a consequence of an evaluative perception of the customer, when interacting with the service at a specific moment in time (Cronin and Taylor, 1994).

Characteristics of the IT Service

Three aspects justify the elusive and abstract nature of the service quality construct (Parasuraman et al., 1985; Cronin and Taylor, 1992): a) service quality is more difficult to evaluate than product quality; b) perceptions on service quality result from the comparison of client expectations and current service performance; and c) quality assessment is not only about the results of the service provided, but also about the process of providing the service. Gronroos (1988, 2000) considers that service quality must take into account both a technical dimension (what) related to results, and a functional dimension (how) related to processes. The former demands a more objective perception from the consumer, whereas the latter demands a more subjective one, considering the relational perspective of service providing.

In the IT context, the results are IT products provided by suppliers according to specifications given by the client. When the supplier does not meet this technical dimension, the client develops an objective perception based on tangible characteristics. However, the functional dimension concerns the process of client–supplier relationships related to the product, which involves intangible variables such as trust, commitment, cooperation, responsiveness, and empathy, among others. These characteristics provide a challenge to establishing quality assessment models for IT services that provide subsidies to IT governance (Pitt et al., 1995). SERVQUAL is a model that serves this purpose and is of interest to this study.

SERVQUAL MODEL

SERVQUAL is a model of *service quality measurement* and management (Buttle, 1996). SERVQUAL explores the intangible aspects of providing services, although the model also assesses tangible aspects, albeit in amore superficial manner. The model evaluates service quality using two instruments. Each contains 22 items, distributed into five dimensions (constructs), according to the definitions in Figure 1.

The first instrument, *SERVEXP*, assesses client and supplier expectations related to the service, whereas the second instrument, *SERVPERF*, assesses client and supplier perception of performance regarding the service provided. Van Dyke

Figure 1. The five dimensions of service quality

Dimensions	Definition	Number of Items
Tangibles (TANG)	The appearance of physical facilities, equipment, personnel and communication materials.	4
Reliability (REL)	Ability to perform the promised service dependably and accurately.	5
Responsiveness (RESP)	Willingness to help customers and provide prompt service.	4
Assurance (ASR)	Knowledge and courtesy of employees and their ability to convey trust and confidence.	4
Empathy (EMP)	The firm provides care and individualized attention to its customers.	5
Total		**22**

Source: Adapted from Berry *et al.* (1990).

et al. (1997) report that the performance perception assessment instrument is more adequate than the expectation assessment instrument, since the latter does not have better psychometric properties than the former.

Gap Analysis

The SERVQUAL model uses both client and supplier perspectives to find the *expectation and perception gaps* between respondents. A gap represents the mathematical difference between the assessment of performance perception and of expectations for the service required by each respondent, in each item of the five dimensions. The respondent might indicate a perceived service quality below or above expectations, which characterizes the paradigm of disconfirmation (Oliver, 1993).

Criticisms

Although widely accepted, the SERVQUAL instrument is object of some criticism, mainly: a) the operationalization of perceived service quality as a gap score (Cronin and Taylor, 1992); b) the ambiguity of the expectation instrument (Teas, 1993); and c) the use of a single generic measurement to measure service quality in different types of industry (Babakus and Boller, 1992). Nevertheless, SERVQUAL is still a marketing breakthrough for service quality measurement (Kettinger and Lee, 1999). Fisk et al. (1993) investigated seven marketing studies that use SERVQUAL and conclude that the instrument provides good predictability regarding general service quality. Parasuraman et al. (1988), the developers of the SERVQUAL, defend the model, stating that this model provides the basic structure to support service quality. They also suggest the modification of this structure in terms of item writing and adaptation to specific contexts.

SERVQUAL and IT

Studies of IT service quality measurement are in their initial stages, and some of them have used the SERVQUAL research instrument and marketing conceptual models (Carr, 2002). SERVQUAL may help IT managers identify the areas that need improvement in service quality, as well as help researchers searching for successful IT service measurements (Jiang et al., 2000). Some IT studies do not confirm the model factors, or confirm only part of them (Kettinger and Lee, 1997), and other studies that identify a different amount of factors (Pitt et al., 1995). Thus, the nonconformity of the SERVQUAL factor structure in IT studies suggests its continual evaluation in different IT contexts (Chin and Todd, 1995).

METHOD

This survey is descriptive exploratory of a large Brazilian retail bank and investigates a contemporary organizational phenomenon that is complex and closely related to real life contexts. ITD employees and the employees of its client divisions from business and administrative areas are the respondents. The ITD is responsible for the bank automation, has more than 1500 employees, and develops activities regarding the definition of infrastructure architecture (equipment, telecommunications, basic and support software) and IS (internal management and business; IS processing; and data administration). The ITD provides services to other business and support divisions, which directly affects the experience of its clients. The analysis unit of this research focuses on the quality perception of IT services, both from ITD and its client division standpoint, as well as the alignment between them.

This research applies a survey using the SERVPERF instrument, via an agreement/disagreement Likert scale, with an answer range from 1 (strongly disagree) to 7 (strongly agree). This instrument has greater psychometric properties than the SERVEXP instrument (Parasuraman et al., 1993; Van Dyke et al., 1999) and is more appropriate for transversal studies (Cronin and Taylor, 1992, 1994), which is the present case. In this sense, the gap evaluation is about the perception between ITD and its clients.

Selection of the Organization and the Respondents

Four aspects guided the decision to choose a large retail bank which boasts total assets of over $44.2 billion: a) the intensive use of IT in the products and services offered to its clients; b) the large number of projects of internal automation processes; c) the ITD services provided to other divisions for extended periods of time; and d) the easy research accessibility to the organization and its respondents. The study selected 708 ITD employees from the bank database with potential relationships with employees of other divisions, the clients.

These 708 employees perform mid-management and technical duties, such as those of system analysts or programmers. In regards to clients, the study selected 2409 employees from divisions requiring IT services who work in mid-management or technical areas such as that of the business analyst. These profiles allow a higher level of IT service interaction in that they lead the everyday tactical activities of the enterprise, besides being the main users of such services. Thirty five ITD employees and 105 employees from other divisions from the selected group of respondents participated in a training program and were the first to answer this survey.

Survey Instrument

The study adapted the survey instrument to the bank context, based on the SERVPERF instrument version applied to IT services (Pitt et al., 1995). Two new items in the tangibles dimension explore physical facilities (Pitt et al., 1998), as reception area and meeting rooms, and the availability of IS applications to users, bringing this construct to a total of six items. One of the researchers established a first face validity, based on his long professional experience in IT services.

The new instrument encompasses 24 items, an open item for respondent opinions, two demographic items regarding the total time working in the division and job profile, and a question about the type of interaction with the ITD in the instrument for clients. This last question aims to filter employees with little or no interaction and to identify the type of interaction. Next, three ITD experts and four clients participated in a pilot test of the new instrument to verify the face validity of the 24 items and the guidelines on how to complete the instrument. Based on the information gained from the pilot test, the revision of the instrument

improved the guidelines for respondents and made some items more understandable, as well as excluded the item "desire of ITD employees to always help", considered redundant with the item "ITD employees resolve all questions and doubts even when they are busy."

The final version of the instrument for data collection had 23 items. The Likert scale used seven points, contrary to the original version of five points. According to Hair et al. (1998, p. 186, 187), "the more points you use, the higher the precision you will obtain with regard to the intensity with which the person agrees or disagrees with the statement." Moreover, the authors of SERVQUAL themselves Parasuraman, Berry, and Zeithaml (1991) affirm that this model provides the basic structure to support service quality and that this structure may receive some adjustments to fit specific needs.

Procedures of Data Collection and Analysis

The standard procedures for this type of survey (Hair et al., 1998) guided the data collection. The data collected are valid for the analysis of the results. In April 2005, 20 ITD employees and 32 client employees participating in internal bank training answered a printed version of the instrument. From April to May 2005, 78 ITD employees and 100 client employees answered the instrument via e-mail. A preanalysis eliminated unanswered instruments. The return rate was 14.0% of a total of 708 service providers and 5.5% of a total of 2,409 clients. Part of the ITD employees does not interact with the clients, and vice versa. Consequently, these rates are slightly higher.

To assess the differences in perceptions of IT service quality and to test the construct validity of the model, this research analyzed the data factor structure using multivariate analysis techniques such as the exploratory and confirmatory factor analysis. Although different researchers tested the SERVQUAL model in several situations, its factor structure is not uniform for IT services, thus justifying new tests. Before the multivariate analysis, this study explored the data dimensionality using graphical examination, missing data (omitted values) and outliers, and tests for statistical assumptions of multivariate analysis. The necessary modifications ensure dimensionality adequacy.

In the qualitative data analysis of the open question answers, the technique of content analysis helped to identify new categories that symbolize aspects of the quality of the services provided.

FINDINGS

This section validates the survey instrument, the analysis of perceived quality levels, and observed gaps. The SPSS® and Amos® 4.0 statistical software packages support the analysis of the quantitative data.

Respondents

ITD employees (44%) and clients (66%) composed the sample of 228 valid respondents. Twenty nine percent of the ITD employees haveworked in the area for 1 to 4 years, 29% for 5 to 10 years, and 42% for more than 11 years. In the category of job position, 32% have management level positions (sector manager or core manager) and 68% have technical level positions (consulting analyst, system analyst, assistant analyst, associate analyst or senior analyst). In client groups, 40% have interacted with the ITD for 1 to 4 years, 35% for 5 to 10 years, and 25% for more than 11 years. In job positions, 2% of the clients have directorial positions (director, general manager or executive manager), 13% have management level positions, and 86% have technical level positions.

Construct Validation

The *exploratory factor analysis* examined the underlying standards of the variables observed

without the influence of the researcher (Hair et al., 1998). Therefore, analysis verified how the scale items grouped themselves, providing a preview for confirmatory factor analysis. Bartlett's sphericity test (3893.5; pb0.000) and the measurement of sampling adequacy (MSA=0.938) represented the statistical probability that the correlation matrix has significant correlations, as well as the adequacy for using the factor analysis (see Figure 2). The results confirm the data adequacy.

The analysis of the results took in consideration the factors with self-value equal to or higher than 1 and used the technique of factor analysis through the extraction of the principal components with VARIMAX rotation. According to the data in Figure 2, two factors encompass the variables of the tangibles construct (TANG). Furthermore, the reliability construct (REL) encompasses the first item of the responsiveness construct (RESP). Finally, one single factor combines the factor loads of the other items of responsiveness and the items of the assurance (ASR) and empathy (EMP)

Figure 2. Exploratory factor analysis

Item	Factor				Cronbach's Alpha
	1	2	3	4	
TANG1				0.88	0.72
TANG2			0.51		
TANG4			0.81		
TANG5			0.86		
TANG6				0.54	
REL1		0.63			0.89
REL2		0.65			
REL3		0.67			
REL4		0.85			
REL5		0.61			
RESP1		0.75			0.87
RESP2	0.64				
RESP3	0.71				
ASR1	0.76				0.92
ASR2	0.70				
ASR3	0.79				
ASR4	0.80				
EMP1	0.65				0.91
EMP2	0.67				
EMP3	0.60				
EMP4	0.70				
EMP5	0.74				

constructs. Since the objective is to assess the underlying structure, this stage of analysis considers all the items. Cronbach's alpha indicates good scale reliability of values above 0.7 (Hair et al., 1998) for the groups of variables in the constructs. Considering the fact that multiple indicators measured a construct, the analysis demonstrates that such indicators justify the construct.

The *confirmatory factor analysis* through structural equation modeling measures the degree in which the survey data responds to the expected model. Upon verifying the factor loads and the respective statistical tests, the analysis considered three groups of model adjustment measures: a) absolute adjustment measures (RMSEA, GFI), which assess the adjustment of models (structural and measurement); b) incremental adjustment measures (NFI, CFI, TLI), which compare the proposed model with another model specified by the researcher; and c) parsimony adjustment measures (chi-square/gl), which make comparisons between models that present different values in the estimated coefficients to determine the adjustment quantity acquired by the estimation coefficient.

For estimation, this study first built measurement models for each construct that show the relationship between the latent variable (nonobservable element) and the scale items (observable elements). When necessary, this study specified the models again after the adjustment evaluation, based on the inclusion of correlations between errors in the same factor. This procedure is possible (Bentler, 2001) since the theory will always be unable to predict exactly all the sources of correlation among the data. This study implemented adjustments by correlating errors of the same factor to improve the model concerning the TANG and ASR constructs. In this stage, the findings confirm the convergent validity of all constructs.

Nonetheless, the findings do not confirm the discriminant validity due to problems identified in the following construct pairs: RESP and REL; RESP and ASR; RESP and EMP; REL and ASR; REL and EMP; and EMP and ASR. The factor loads

present quite reasonable magnitudes (above 0.5) for practically all items, except for the variables TANG1 (0.29) and TANG2 (0.42) in the tangibles dimension.

The last stage of the confirmatory factor analysis was the evaluation of the model adjustment indices (see Figure 3). The chi-square/gl relation of the model is quite satisfactory (2.28), which indicates that the estimated matrix corresponded well to the observed matrix. The other indices are also satisfactory. All have magnitudes close to the values considered good models (above 0.9 for GFI, NFI, TLI and CFI; and below 0.08 for RMSEA). Therefore, the factor structure is valid, although the structure retains reservations concerning the discriminant validity.

The Perceived Service Quality Level and the Resulting Gap

Based on the quantitative data collected from the survey, this study initially assessed the service quality level perceived by clients and ITD employees (supplier) and the gap between these perceptions in each item of the questionnaire. A positive gap means clients' satisfaction with a superior service performance by supplier, whereas a negative gap indicates clients' dissatisfaction with a lower service performance (Jiang et al., 2000). If the gap is zero, the clients' and supplier' perceptions are the same and no superior performance is perceived by clients.

The findings in Figure 4 show that ITD clients are dissatisfied in relation to the services provided (negative gaps), which indicates that client perceptions are lower than those of employees who work in the IT division. Only the item TANG1 has a positive gap, which presents a low factor load in the measurement model and would thus need revision. Moreover, the variable with regard to the operation of applications (TANG5) is the only one with a value close to zero, which indicates that the perceptions between clients and suppliers are similar.

Considering the variables with negative gaps, the largest differences of opinion fall under the category of empathy (EMP3: ITD employees give proper attention to client needs; and EMP4: the ITD gives real importance to essential needs the client presents) and responsiveness (RESP2: ITD employees immediately address urgent needs). The users demonstrate dissatisfaction with the level of importance ITD employees give to their problems, with the amount of attention they give to solving their needs, and with the priority given to their urgent requests.

Content analysis of the answers given to the open question "Make comments you consider pertinent about the quality of services provided by the ITD, covered or not by previous items of the questionnaire" identifies the cause of such dissatisfaction with the services. The content analysis follows recommendations by Silverman (2001) to obtain categories emerging from answer patterns. Five new categories emerged from high frequency answers regarding the potential causes of client dissatisfaction with the quality of IT services provided, all related to the SERVQUAL model dimensions (see Figure 5).

Figure 6 presents some quotes that represent the quality perception by ITD clients, which justify the five new categories identified through the content analysis.

Figure 3. Indices of the measurement model adjustment

Model	Chi-square	P	gl	Chi-square/gl	GFI	NFI	TLI	CFI	RMSEA
Measurement	447.47	0.000	196	2.28	0.85	0.89	0.92	0.93	0.08

Figure 4. Perception of users vs. perception of ITD and resulting gap

Dim.	Items	Averages		
		ITD	Clients	Gap
Tangibles (TANG)	TANG1. The IT equipment (computer, printer, etc.) that you use for Bank activities is modern, that is, it meets the needs of your activities.	3.9	4.4	0.5
	TANG2. ITD presents visually attractive physical facilities (reception area, meeting rooms, and presentation rooms).	5.5	4.9	-0.6
	TANG3. The Application of Information Technology Service Requirement (application that replaced the executive demand) is easy to use and meets your needs. **(ELIMINATED)**	3.4	3.9	0.5
	TANG4. The screens of other applications, as well of reports, have a clear language and are easy to understand.	4.4	4.1	-0.3
	TANG5. The operation of the applications is easy and stimulates their use.	4.3	4.2	-0.1
	TANG6. When you try to access the applications required for your job, they are always available (accessible).	5.0	4.3	-0.7
Reliability (REL)	REL1. When the ITD promises to do something for a period of time (consultancy, participation in group work, lend equipment, meetings, etc.), it actually does it.	4.6	3.6	-1.0
	REL2. When you have a problem or a necessity, the ITD shows a real interest in solving them.	4.3	3.6	-0.7
	REL3. When the ITD service is concluded there is no need of corrections.	3.6	3.2	-0.4
	REL4. The ITD delivers its services at the due date, that is, with no delays.	3.8	2.8	-1.0
	REL5. The ITD is known for generating information without errors.	4.3	3.5	-0.8
Responsiveness (RESP)	RESP1. The ITD employees tell you exactly when the services will be performed, that is, the deadline/finish date.	4.1	3.2	-0.9
	RESP2. If you have an urgent need, ITD employees immediately address it.	4.4	3.1	-1.3
	RESP3. The ITD employees resolve your questions and doubts at the appropriate time, even if they are busy.	4.6	3.6	-1.0
Assurance (ASR)	ASR1. The behavior of ITD employees inspires you with trust.	5.0	4.2	-0.8
	ASR2. You feel safe when relating to the ITD.	4.9	3.9	-1.0
	ASR3. The ITD employees are always assured when responding to your questions.	4.9	4.3	-0.6
	ASR4. The ITD employees have the required knowledge to resolve your questions and doubts.	5.3	4.6	-0.7
Empathy (EMP)	EMP1. The ITD gives you individualized attention.	4.1	3.4	-0.7
	EMP2. The ITD provides services at a convenient schedule for you.	5.1	4.3	-0.8
	EMP3. The ITD has employees who give proper attention to your needs.	4.9	3.7	-1.2
	EMP4. The ITD shows real importance to essential needs you presented.	4.6	3.4	-1.2
	EMP5. The ITD employees understand the specific needs presented by you.	4.7	3.9	-0.8

Figure 5. Emergent categories of IT service quality

Emergent Categories	Elements	Relations with the SERVQUAL Dimensions
Service	Supplier's service to clients, including telephony, schedules and access to qualified people to solve the problem.	Responsiveness, empathy
Competence	Set of knowledge and abilities needed to perform well in the ITD division.	Assurance
Demand	Attributes clients expect from the supplier to fulfill the request for projects or services: (ability of) definition; understanding; flexibility; commitment; fulfillment of deadlines.	Responsiveness, empathy
Solutions	Results of meeting the clients' demand: delivery of products and/or services; credibility of the solutions offered.	Reliability, assurance, tangibles
Communication	Information channels available, including internal communication for ITD employees and external communication for clients of other divisions.	Responsiveness

CONCLUSION

Seth et al. (2005) highlights the importance of customer satisfaction in today competition in a globalization and liberalization context for both developing and developed countries. In this environment, organizations must pay attention not only in the technical performance of its services,

Figure 6. Quotations by respondents of ITD client divisions

Categories	Client's quotations
Service	"The telephone service is not good enough... Sometimes we call and the phone rings... rings… rings and you have to give up because nobody answers it…" "Regarding the fact of resolving questions and doubts it is still difficult to locate the right person to answer exactly what you need to know…"
Competencies	"I understand that the worst problem at ITD is not personnel quality, in my opinion they have a high standard. The worst problem is the lack of personnel or the way they are organized…" "I suggest sharing the knowledge by job turnover and constant training, to manage the ITD knowledge in a way that it is not exclusive of a single employee…"
Demand	"The ITD, through instruments of service requirement, has a bureaucracy that blocks both the requirement and the execution of any alteration requested to a program. Everything is too slow…" "It is complicated to send a demand, which is almost never fulfilled…" "To make technology demands efficiently met, it is necessary to directly follow the demander, searching for periodic information about the project status and timely execution…"
Solutions	"The applications must guide the user, without the need of looking for help or attending a training program to use them…" "The work is always done in a hurry, without assessing the risks…"
Communication	"When there is a problem in the systems, the ideal is to have a messenger informing the manager what is happening, so that the ITD Call Centers may be warned and have conditions to provide information to the Bank's branches. Nowadays this is done by telephone…" "The main problems presented by the ITD are related to the deadlines to meet the requests, which almost never correspond to the client's needs, besides the lack of interaction between the parts in the development of the product/service and the lack of a global vision of the environment in which it is being developed…"

but mostly in the way they deliver them, which is of a functional dimension. SERVQUAL has the capacity to evaluate both technical and functional dimensions of a service, as showed by this research.

This research considers that evaluating the alignment of IT service quality perceptions between ITD employees and IT client employees is a factor of strategic importance between IT division and other divisions. This alignment results when values are close to zero. Positive values indicate that user assessments surpass those of suppliers. Thus the organization can reduce or simply maintain efforts related to the elements of alignment. Conversely, negative values indicate needs that ITD must satisfy. This research provides an overview of how an organization as a whole sees IT activities, a view that may diverge from the ITD perception of itself.

From the client relationship perspective, the findings indicate that the SERVPERF instrument is a valid measurement of the perception of IT service performance due to its emphasis on the functional dimension (process), despite the technical dimension limitation of its original version. Nevertheless, the SERVQUAL model can receive some modification to better adapt the model to specific contexts (Parasuraman et al., 1991). Thus, these findings do not confirm the factorial model structure of SERVQUAL. However, they do indicate the need to continue its validation process in IT services.

From the client perspective, the complexity of IT services may have some influence on the results obtained. However, the model is helpful in narrowing communication with clients and for the IT area to reflect on its client needs. According to Figure 7, quality dissatisfaction occurred in both technical (tangibles) and relationship dimensions (reliability, responsiveness, safety, and empathy).

Figure 7 also contains evaluation categories that emerged from the analysis of the open question, concretely portraying elements that are part of client perceptions. Further studies regarding IT service quality should incorporate them in the measure instrument, testing modifications in order to make them better adapted to the strong relationship oriented context.

Figure 7. Service quality: gap of perceptions and emerging elements

Dimension	*Gap*	Emergent Categories
Tangibles (TANG)	-0.1	Solutions (delivery of products and services)
Reliability (CONF)	-0.8	Solutions (which must be properly communicated)
Responsiveness (RESP)	-1.1	Service, demand
Assurance (ASR)	-0.7	Solutions (delivery of products and services), credibility
Empathy (EMP)	-1.0	Demand (definition capacity, understanding/comprehension, commitment and compliance to deadlines)

The poor evaluation in the solutions category can result from the high expectations clients ascribe to their projects, or the lack of a clearly defined requirements that lead clients to think that new versions of a product or service will require further versions.

Consequently, both service volume, time for service execution, and priority criteria affect credibility. Another observed situation that affects credibility is the outsourcing of certain project phases, judged by some clients as harmful to individual and organizational commitment. Telephone support, perceived as an important client access channel, deserves special attention in the analysis of service quality.

Findings in the demand category indicate a gap between the perceptions of suppliers and clients, predominantly in what refers to the definition of demand, and which leads to an exchange of excuses between them. Lack of clarity on one side and lack of support on the other one harm the subsequent process. Without a clear definition, the meaning of demand remains obscure, incurring complaints from both sides and causing a negative impact on final product delivery.

Still another issue highlighted is supplier flexibility with respect to the project execution process. An excessively bureaucratic process in the ITD, along with the necessary corrections and validations during the development process, may harm service delivery.

Commitment is very important to the image that clients create about suppliers and the work they develop. Any weakness in this perception may cause distrust and consequent project abandonment, with clients moving to the market to buy similar products. However, clients recognize the overload of projects in an understaffed IT division to meet demands. This recognition mitigates the negative perception associated to the lack of deadline compliance. Still, the organization must urgently deal with the issue to prevent the start a vicious circle of demand, deadline non-compliance, demand, and so on.

Among the limitations of this research is the reduced possibility of result generalization, since the survey took place in one single organization and the model validation was partial. The complexity inherent to IT services, which involve tangible dimensions of technical nature and intangible dimensions of relational nature, can explain this partial validation.

Considering the importance of perception alignment to improve service quality management, as well as the importance of ready, reliable, simple, and valid measurement instruments, this study suggests further IT studies. These studies should include the emerging categories to evaluate IT service quality, besides using a representative sample of the banking industry in order to incorporate the conceptual elements that stemmed from the SERVQUAL qualitative analysis (see Figures 5 and 7), which are a theoretical contribution of this study.

From a practical managerial standpoint, the use of SERVQUAL to evaluate the perception

of IT service quality performance provided by an IT division to the business divisions of an organization, as it was in this study, can be considered as a measurement of strategic alignment between them. This has a great managerial impact if the organization adopts *ITIL* (IT Infrastructure Library) model (OGC, 2007), when the results can indicate the effectiveness of the two main areas of this model – service support and service delivery – and suggest improvements in IT service management. The *strategic alignment* between IT and businesses has been considered in the last years a subject of major concern by IT executives in organizations (Luftman et al., 2009).

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Chapter 16
Framework for IT Service Value Engineering:
Managing Value and IT Service Quality

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ABSTRACT

Managing the business value of IT-Services is an important aspect in the context of IT-Service quality management. This chapter introduced a framework for IT-Service value engineering and closes gaps in research and practical management in IT value management. The concept illustrates aspects of IT service value engineering and IT business alignment and the relation to IT service quality management. The Framework for IT service value engineering is made up of different management levels and a value engineering process. It integrates various concepts from IT and business value management in order to evaluate and improve the contribution of IT services towards overall business value.

INTRODUCTION

Today, the management of information technologies (IT) is a highly complex task that requires a broad spectrum of competence. The development of service-oriented architectures, cloud services and the construction of "software as a service" models demand concepts that provide management support regarding the selection, evaluation and implementation of modular IT services within companies. On an operational management level, there is a demand for an alignment concept to support the mapping of IT services to business processes. Additionally, there is a requirement to demonstrate that IT provides a measurable value with regard to business success.

From the perspective of research, many concepts and models have been developed in the past in order to describe the general contribution of IT towards business value. The efficient use of IT within enterprises has also been the focus of a great number of publications in the context of IT business alignment. However, up until now one aspect has not been considered either in research or in practical management, i.e. the efficient integration of these specific models into a general

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systematic value management framework which integrates aspects of IT business alignment, business engineering and IT value management.

With the intention of closing this gap, we have developed the framework of "value engineering," which describes a structured process for identifying value as well as risk propositions of IT services in the context of business processes and IT business alignment. This includes the systematic analysis of IT readiness and IT potentials of business processes. Value engineering combines the idea of IT business alignment and IT service portfolio, thus filling the gap in the effective description of the business value of IT services. To describe the idea of IT service value engineering in detail, this chapter outlines value engineering as a concept which enables operational alignment between business processes and IT services in order to increase the business value of IT. With regard to the practical application of value engineering, we are confident that this framework will help companies to efficiently manage the above-mentioned challenges in the future.

With the help of value engineering, the IT potentials of business processes can be identified and evaluated. In the context of operational alignment between IT services and business processes, this allows a number of IT services to be identified which have the potential to support the necessary target process tasks. The goal of the IT service value engineering concept is to assess each IT service independently according to its ability to support business processes and its contribution towards the overall business value. Based on this evaluation process, an efficient portfolio of IT services can be identified which optimally supports business processes and has the potential to contribute most towards the business value under the given circumstances.

The first parts of this chapter introduce and describe the IT service value engineering framework and also highlight selected concepts and specific research work on which the framework is based. The following section of the chapter gives an overview of the concept of business engineering as well as of the current state of research regarding IT business value, focusing especially on concepts for evaluating the business value of IT. A further part roughly outlines concepts and findings from IT business alignment research. A comprehensive framework for IT service value engineering is described based on these concepts.

BUSINESS ENGINEERING

The idea of "business engineering" is based on the professional and systematic development of innovative business concepts in the context of increased potentials of information technology (IT) and new opportunities in IT developments (Österle & Blessing, 2005).

Business and IT are constantly changing. Over the last few years, a large number of innovative developments in the field of IT management have shown a demand for a more flexible and more efficient use of IT services within enterprises. However, in order to master this situation of change in business and IT and to optimally combine the various concepts, suitable methodologies and tools need to be developed. An example of this was presented by Österle and Winter (2003) who introduced the concept of business engineering. Following their interpretation, business engineering is considered as "the methodological and model-based construction plan for organizations of the information age". Accordingly, it is much more than just a new way of modeling business processes and rather a holistic concept for designing and engineering organizational structures and processes (Österle & Blessing, 2005). The concept of business engineering focuses on the future organizational architecture of companies which is customer-oriented and based on network interactions. As a result, enterprises need to build up competencies in managing a value network in cooperation with their respective partners. To do this efficiently, they need to develop their

internal organizational structures to make them networkable and also update their technological infrastructure. Therefore, the success of companies depends on the way how they are able to satisfy customer demands with regard to efficiency and productivity (Österle & Winter, 2003).

To support the task of transformation, business engineering uses several instruments which can be clustered into four distinct categories: modeling languages, reference models, methodologies and IT tools (Österle & Blessing, 2005).

In consequence, this concept requires new competencies and management roles within enterprises. For instance, orchestrators are the direct interface with the customer. They combine different services and products and adapt them for each customer or customer group individually. The added value for customers is the individually designed solution.

In most cases, service providers offer their services to different customers and service recipients. On the other hand, companies receive services from numerous different providers which also use different services and provide different levels of quality. The combination of these services is a success factor for the providers due to the realization of economies of scale.

A further construct is described as a "business collaboration infrastructure" (BCI) (Österle & Winter, 2003). BCI can be defined as the infrastructural basis for the realization of the service oriented organizational structure of companies. BCI is accompanied by several basic services which are independent from the business areas of branches.

There are several principles which define business engineering:

- The transformation of companies requires an engineering-based, structured and model-based procedure.
- There is an enormous potential for innovative business solutions based on innovations in IT, changed environmental factors and changed customer demands.
- The organizational transformation is characterized by changes in network structures and focuses strictly on customer demands.
- Innovations become efficient if they are implemented with regard to business strategies, processes and infrastructures.

In the case of value engineering, the concept of business engineering provides a useful basis which helps enterprises to develop a structured and systematic model that identifies, develops and increases business value due to the use of modular IT services. Regarding IT service value management, this means that business engineering provides a concept which can be transformed according to the individual situation of IT service value management.

BUSINESS VALUE OF IT

Research of IT business is a complex issue involving many aspects of management. In literature, there has been an intensive discussion about the business value of IT for many years. It deals with economic impacts of IT and its manifestations within firms or networks of firms (Kohli & Grover, 2008). An interesting definition was given by Melville et al. (2004) and Wagner (2006) who interpreted IT business value as the corporate performance of IT which has an impact on the process level as well as on the organizational level, comprising efficiency and competitive effects. Relations between investments in IT and company performance, however, are not specific enough for today's IT infrastructures (Weill & Ross, 2004).

As a rule, research on IT business value examines the influence of information technology on organizational performance. In this context, many research concepts have been developed in order to assess the mechanisms which generate

IT business value and to estimate its specific magnitude (Melville et al., 2004).

Results from previous research have shown that IT may indeed contribute to the improvement of corporate performance (Brynjolfsson & Hitt, 1996; Kohli & Devaraj, 2003). The dimension and extent of IT business value depends on a variety of factors including the type of IT, management practices, organizational structures, competition, and macro environment (Melville et al., 2004). Melville and Kraemer (2004) state that "research also suggests that firms do not appropriate all of the value they generated from IT; business value may be captured by trading partners or competed away and captured by end customers in the form of lower prices and improved quality" (Melville et al., 2004).

This section concludes by focusing on the model development of business value by analyzing how IT business value researchers have conceptualized IT and IT business value and by highlighting general research developments (Melville et al., 2004).

In general, research on IT business value is characterized by a diverse treatment of the IT construct. This inhomogeneity and variance in definition has bounded and shaped our current knowledge. A systematic explication and definition based on a precise theory is still lacking and is therefore a necessary first step towards the advancement of our knowledge and model building. In order to provide a uniform theory regarding IT business value, the following section focuses on this topic specifically.

IT Business Value Research

The term "IT business value" is commonly used in reference to the influence of IT on organizational performance. This includes enhancements in productivity, improvements in profitability, cost reductions, competitive advantages, inventory reductions and other measures of performance (Hitt & Brynjolfsson, 1996; Kohli & Devaraj, 2003; Kriebel & Kauffman, 1988).

Researchers have used the term "performance" to denote both intermediate process-level measures as well as organizational measures. Furthermore, two distinctions are made regarding performance: efficiency and effectiveness (Melville et al., 2004). Efficiency emphasizes the internal perspective, employing such metrics as cost reduction and productivity enhancement for the assessment of a given business process. Generally speaking, it focuses on the concept of "doing the right things" (Drucker, 1966). In contrast, effectiveness focuses on the achievement of organizational objectives with respect to a company's external environment and can be manifested in the achievement of competitive advantages (Barney, 1991).

Melville and Kraemer define IT business value as the effect of information technology on organizational performance at both the intermediate process level and the organizational level, considering the influence of efficiency within and competitive pressure between companies (Melville et al., 2004).

Based on this definition, the analysis of current scientific literature on IT business value research has shown that this topic has been covered by a wide range of studies, for instance, in conceptual, theoretical, analytic and empirical studies.

Several theoretical paradigms were used in these research studies, including microeconomics, industrial organization theory and sociology, and socio-political paradigms (Melville et al., 2004).

Model for IT Business Value

The model created by Melville et. al. (2004) is founded on a resource-based view and covers several domains (focal firm, competitive environment and macro environment). It is used to examine the efficiency and competitive advantages which particular implications could have on specific company resources such as entrepreneurship (Rumelt, 1987), culture and organizational routines. This

model has also shown its usefulness in the context of IT businesses by providing a robust framework for analyzing if and how IT can be associated with advantages in a competitive environment (Melville et al., 2004).

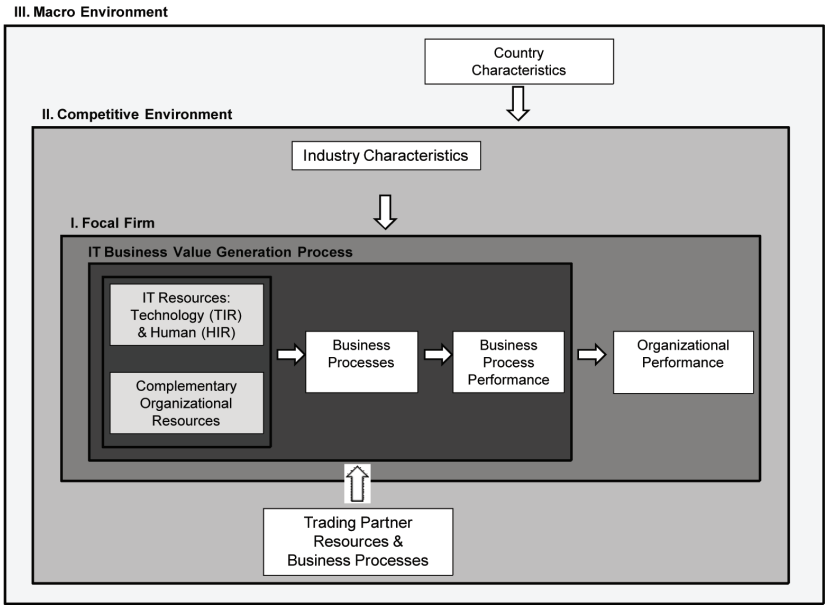
Based on the analysis of the methods other researchers have used to define IT business value, Melville and Kraemer concluded that the foundation of IT business value generation within an enterprise is based on the investment and use of IT resources. In this context, a company that increases its IT potential in the above-mentioned way is defined as a "focal firm" (Melville et al., 2004). In addition to internal resources, external factors also play a role in shaping the extent to which IT business value can be generated and improved. In order to generate business value, especially the competitive environment - which includes industrial characteristics and trading partners - as well as the macro environment need to be taken into account. Hence, Melville and Kraemer (Melville et al., 2004) derived an integrative model of IT business value that comprises three domains: 1. focal firm, 2. competitive environment, and 3. macro environment (see Figure 1).

Tallon et al (2000) identified a list of 30 items to assess the impact of IT on business value. These items are separated in the dimensions process planning and support, supplier relations, procution & operations, product & service enhancement, sales &marketing support s well as customer relations (Tallon et al., 2000).

Conclusions from Current IT Business Value Research

IT, as simply hardware and software components, does not create value in isolation but must be part of a business value creating process with other organizational factors. IT creates value in the form of productivity similar to other forms of capital (Kohli & Grover). IT business value is much more than an improvement of business performance or the improvement of a financial situation. Since the development of the "Balanced Scorecard" by Kaplan and Norton (1992), the limited focus purely on financial results has been replaced by a

Figure 1. Model of business value of IT (Source: Melville et.al. 2004 used with permission)



perspective of multi-dimensional targets. Consequently, with regard to the value management of IT services, this means that business value persists for more than just one component of financial return. IT business value could also manifest itself in the form of process improvements, profitability, or customer surplus (Kohli & Grover, 2008).

This change in perception calls for new values to be defined: sustainability and ecological aspects have become important dimensions in modern IT service management. Therefore, the author suggests the definition of an extended balanced scorecard concept which considers new value dimensions. Suitable indicators need to be defined for each dimension in order to operationalize specifically-defined goals and targets. Additionally, new management concepts and research are necessary to develop these new concepts. As a result of the discussion of changed values in society, the importance of non-financial and imponderable factors will increase in the future.

Apart from the discussion about suitable value dimensions and measures, it is also obvious that the complexity of IT management has increased along with the increased use of IT services. Consequently, it is more difficult to evaluate the contribution of a single service process with respect to overall business value. The value contribution now also depends on organizational structures, business process maturity, frequency of market change and customer perceptions.

It can be summarized that the value of IT services today can be generated at different management levels (strategy, process and infrastructure) and realized by implementing different operational models. One of the main challenges now is to optimize the alignment of overall business targets, business processes and the use of IT services.

The optimization of IT business value, however, is not only achieved using strategic components but also as a result of processes and procedures supported by IT services. The combination and management of relationships between the business site and IT site is the topic of IT business alignment research.

In IT business research, the alignment of all resources plays a key role in the realization of sustainable results. Therefore, IT business alignment has to ensure that all resources are coordinated in the most beneficial way in order to guarantee a maximum outcome for the company. This naturally also includes customer satisfaction regarding the results achieved. By optimizing these processes on a professional level, it can be expected that these customers will also be further interested in investing in these services in order to gain even more benefit from the improvements.

IT BUSINESS ALIGNMENT

In contrast with the other concepts mentioned, the topic of IT business alignment has been on the agenda of researchers for many years and is therefore intensively discussed in information system research. An overview about the numerous studies about effects of IT alignment on firm performance is provided by Oh and Pinsonneault (2007).

Some of the first studies addressed the connection between business plans and IT plans, while others focused on maintaining congruence between business strategies and IT strategies. These perspectives have changed over the years and nowadays research recognizes many different aspects of alignment between business and IT (Chan & Reich, 2007).

IT business alignment considers the importance of the link between IT and business domains to create business value and focuses especially on strategic aspects. In particular, the Strategic Alignment Model (SAM) by Henderson and Venkatraman (1993) has emphasized that IT strategies support business strategies but in turn are also supported by them. This interaction between business and IT highlights the significance of alignment and

thus the importance of optimizing IT business alignment (Wagner, 2006).

Alignment Definitions

Many definitions have been developed over the years in the context of IT business alignment. Sauer and Yetton (1997) discussed the theory that the basic principles of business alignment are based on the management of IT. Given their interpretation, IT should be managed in a way that mirrors business management. Another concept states that alignment is the efficient connection and interaction between business and IT in order to "reach a common goal" (Campbell, 2005). Additionally, Reich and Benbasat (1996) defined alignment as the degree to which the mission, objectives and plans contained in the business strategy are shared and supported by the IT strategy. Henderson and Venkatraman (1993) further state that alignment is the degree of fit and integration among business strategy, IT strategy, business infrastructure and IT infrastructure. To conclude, a good degree of alignment can be characterized as the application of the most appropriate IT services in a given situation for the individual organization und business process. It also means that these services are applied in a timely way and that the actions remain congruent with the business strategy, goals and needs of the organization (Luftman & Brier, 1999).

In literature, the term alignment has also been referred to as "fit" (Chan, 1992; Henderson & Venkatraman, 1993), "linkage" or "integration" (Chan & Reich, 2007). In this context, Chan (1992) defined "fit" as the degree of coherence between the applied business strategy and realized IT strategy. Another interpretation was suggested by Henderson and Venkatraman (1993) where they defined "fit" in terms of the relationship between the external business strategy and the internal infrastructure and processes.

According to the previously mentioned concepts, the variability in definitions clearly shows that alignment between business and IT covers many levels of management. Therefore, ideally IT business alignment should be achieved at all levels of organization, including organizational visions and goals, strategic management, organizational and process levels, the project level and individual cognitive level (Chan & Reich, 2007). The challenge in this field lies in transferring alignment on the higher level of organizations to the lower levels. In order to optimize processes, alignment has to translate business unit goals into personal goals (Campbell, 2005).

However, up until now this has been impeded by the lack of a common "language" between business and IT executives (van der Zee & De Jong, 1999). It soon became clear that there is an urgent need for building bridges between these levels to ensure that both IT and business personnel use the same terms while talking about the same topic. Once attained, this will result in the alignment of thought and action between all levels of the organizations (Chan & Reich, 2007).

The business and IT performance implications of alignment have already been analyzed and empirically demonstrated in the past (Chan *et al.*, 1997; Kearns & Lederer, 2003).

Additionally, over recent years many models and concepts have been developed which support the analysis and management of IT business alignment.

Alignment Models

Although many models for IT business alignment have been developed during the past few years, in this chapter we focus on the most common and cited models.

In the mid 1980s, the "MIT model" was developed as a result of the requirements of IT changing from a mere support tool into a strategic asset perspective. This model stated that revolutionary changes involving IT investment can bring about substantial rewards as long as the key elements of strategy, technology, structure, management processes, individuals and their individual roles

are kept enclosed in the alignment process (Chan & Reich, 2007). The MIT model has strongly influenced the development of subsequent models based on this definition.

One of these later models was the "Strategic Alignment Model" (SAM), created by Henderson and Venkatraman (1993). The SAM model describes four related key domains of management choice, namely business strategy, organizational infrastructure and processes, IT strategy and IT infrastructure and processes. In this model, the process of alignment is distinct from bivariate fit (e.g. linking two domains) and cross-domain alignment (e.g. linking any three domains). To date, the SAM model has become one of the most-cited alignment concepts in literature and has received great empirical support (Chan & Reich, 2007). However, the concept also has some limitations. For instance, depending on how IT intensive an industry is, the usefulness of the model may vary and the assumptions of the SAM model may not hold (Burn & Szeto, 2000).

Maes (1999) and Maes et.al. (2000) extended the SAM model and designed a framework that incorporates additional functional and strategic layers. They separated information providers from the systems providing information. Consequently, an information domain represents the knowledge, communication and coordination of information. They also added a third dimension that contains specific sub-architecture areas (Chan & Reich, 2007).

A further model developed by Baets (1992) was based on the enterprise-wide information model (Parker *et al.*, 1988). This model illustrated in detail the interaction of business strategy, organizational infrastructure and processes, IS infrastructure and processes and IT strategy. The model also included the fact that alignment takes place in a broader organizational context and therefore incorporates factors such as competition, organizational change, human resource issues, the global IT platform and IT implementation processes.

For IT business alignment models and especially their applications, it can be concluded that, when combined, they have the potential to address all relevant aspects of alignment. However, given the number of models, methodologies are required which optimally measure the quality and performance of the alignment process. Therefore, in the next part, we provide a brief overview of concepts and possible solutions for measuring IT business alignment.

Alignment Measures

Apart from the development of models to describe and model IT business alignment, the development of suitable alignment measures is a further important aspect in IT management. Especially for practitioners, it becomes more efficient if alignment can be measured and managed in an easy and standardized way. For academics, reliable and valid measures are important in order to ensure the quality of investigations into alignment. In scientific literature, several different approaches have been used to assess alignment. These include typologies and taxonomies, fit models, survey items, mathematical calculations and qualitative assessments (Chan & Reich, 2007).

Typologies are defined as deductive, intuitive groupings or classifications of phenomena, while taxonomies describe groupings based on inductive, empirical research results (Chan, 1992).

Venkatraman (1989) discussed six different conceptualizations of fit in strategy research: moderation, mediation, matching, gestalts, profile deviation and co-variation. Based on the earlier STROBE model (Strategic Orientation of Business Enterprise), Chan et. al. (1997) developed the STROIS (Strategic Orientation of IS) instrument which improves the earlier model by adding the strategy orientation to the six dimensions of the STROBE model.

Kearns and Lederer (2003) developed a 12-item measure of alignment. This scale is used to measure and compare the alignment of the IT

plan with the business plan (six items) and the alignment of the business plan with the IT plan. An accurate measurement of IT strategy and IT structure can also be obtained by using a questionnaire developed by Bergeron et al. (2004) to evaluate specific parts of these measures. The questionnaire includes measures such as dimensions of IT environment scanning, IT planning and control and IT acquisition and implementation. Another questionnaire-based method is the Organizational Culture Audit (OCA), which considers alignment as an ongoing process and could therefore be used for annual evaluation by different independent managers.

Besides the questionnaire-based measures, a number of quantitative mechanisms have been described to assess the alignment process. For example, Day (1996) favored the three measures of alignment measurement, alignment index and effective acid test.

Apart from the questionnaire-based measures, qualitative work has also been carried out to assess IT business alignment. Several measures of social alignment dimensions, such as the alignment of written business and IT plans, self-reports, a mutual understanding of current objectives, congruence in long-term business and IT visions have been compared and analyzed by Reich and Benbasat (1996). With respect to psychological measures, Tan and Gallupe (2006) defined the shared cognitive ability as a proxy for alignment. Using cognitive maps between business and IT executives, they described that higher cognitive uniformity is related to a higher level of alignment (Chan & Reich, 2007).

Given the previously-mentioned approaches to alignment, it can be concluded that research results clearly indicate the positive relationship between IT business alignment and added value (Sabherwal & Chan, 2001; Sabherwal *et al.*, 2001; Tallon *et al.*, 2000). However, up until now only a small amount of research work has been carried out regarding the operationalization of IT business alignment. This is probably the reason why alignment is still a difficult topic for managers and consequently often carried out in a highly inefficient way.

A solution for the improvement of this situation has been provided by Fraunhofer IAO in the form of a concept for the operationalization and evaluation of operational IT business alignment. The concept results from research work carried out by the innovation forum "Banks & Future". The forum is made up of a group of experts who have developed a solution to operationalize IT business alignment (Praeg *et al.*, 2007) founded on the strategic alignment model by Henderson and Venkatraman (1993). In addition to previous models, however, the Fraunhofer IT business alignment allows for the measurement of strategic as well as operational IT business alignment.

It can be summarized that both IT business alignment and IT service quality support IT business value, but in two different ways. Firstly, alignment helps to reduce potential risks given by the constant need of managing requirements and supports the measurement of business process performance. It also has the potential to manage potentials risks and incidents which may occur through the use of IT services. Secondly, IT business alignment increases the value proposition due to the constant improvement of IT business process and process performance support. Through a close link between corporate strategy and process performance indicators, alignment helps to significantly improve business value.

Given the before-mentioned advantages of the value engineering of IT services, it can be said that existing concepts in the areas of business engineering, IT value management and IT business alignment generally provide useful input regarding the challenges in IT departments and business process owners' face. However, it is also obvious that a general solution covering all relevant aspects of IT value engineering is still lacking. For this reason, a framework has been introduced which has the potential to fill this gap. In the following, specific details of this new con-

cept are described in detail with a special focus on the value engineering of IT services.

CONCEPTUALIZING IT AND IT SERVICES

However, the specification of IT business value depends on the definition of IT and IT services. By understanding how IT has been conceptualized in previous research, a solid foundation is created from which we can derive a systematic and theoretically-based definition of IT and IT services.

According to Melville and Kraemer (2004), five conceptualizations of the IT artifact have been implemented: 1. tool view, 2. proxy view, 3. ensemble view, 4. computational view and 5. nominal view.

- Tool view: IT is a tool intended to generate value, e.g. productivity enhancement, cost reduction, competitive advantage, improved supplier relationships, etc. The specific intention of IT is often unknown. Studies of specific system and implementation contexts enable tool view assumptions to be examined.
- Proxy view: IT is operationalized via proxies such as capital stock denominated in dollars. A wide range of potential proxies exists, but few have been adopted. Adoption of diverse proxies enables triangulation and enhances accumulated knowledge.
- Ensemble view: Assessment of IT business value generation in rich contexts, often using case or field studies. Organizational structure and co-innovations such as workplace practices may be included as moderators or mediators of value.
- Nominal view: IT is not conceptualized and appears in name but not in fact. Abstraction enables model precision at the expense of generality

Besides the conceptualization of IT in the context of value research, a precise and comprehensive definition of IT services is required. The Office of Government Commerce (OGC) provides a set of perspectives for defining IT services.

A first perspective focuses on IT services as components of IT applications. They are embedded in IT systems, IT infrastructure and are, accordingly, an outcome of an IT application. A second perspective addresses IT services as a part of IT organizations with its own set of capabilities and resources. Given this interpretation, IT services are considered as a set of services which support the organizational processes in order to deliver and operate the IT infrastructure within an enterprise. IT services may also have a support function to ensure that all customers of an IT unit can access and use these services, applications and infrastructures in a defined way. Therefore, this perspective of IT services focuses on their application by customers. Seen from a third perspective, IT services are a set of utilities used by business processes. In this context, IT services can be considered as being independent products provided by an internal or external IT company and can be used in independent business processes and functions. The fourth perspective addresses IT services as a category of business assets that provides a stream of business benefits specifically designed for their owners (OGC, 2007a, 2007c).

In this context, the term IT service is defined as a set of utilities which can be used by business processes. IT service covers a set of functionalities which support specific entities of these business processes. They are offered by internal IT service providers (IT departments) or independent external service providers. Accordingly, IT services can be traded on internal or external markets as individual products which are defined by their respective service levels. IT services especially increase business value as a result of support func-

tions and improvements in business processes and consequently generate an increase in performance and quality.

PORTFOLIO MANAGEMENT FOR IT SERVICES

IT portfolio management is not a new topic within most companies. But the definition and practical aspects are not obvious or widely accepted. IT portfolio management provides tools, processes and disciplines needed to translate IT into a common taxonomy that both business and IT executives understand.

In the field of IT portfolio management, many practices and techniques have been developed to measure and maximize the return of individual and aggregate technology investments and to minimize risks (Jeffery & Leliveld, 2004). The term IT portfolio management covers all aspects regarding the coordination of all possible planned and executed IT projects as well as all existing IT assets within a company with the aim of improving overall corporate targets (Zimmermann, 2008).

The overall target of IT portfolio management is to deliver measurable business value (tangible and intangible) while aligning and improving the business and IT strategy (Maizlish & Handler, 2005). Related to the portfolio management framework utilized in the financial service sector, IT portfolio management is a combination of people, processes, and corresponding IT objects that senses and responds to change by

- an effective communication,
- creating and cataloging a detailed, value-based, risk assessment of the IT assets,
- eliminating redundancies while maximizing reuse
- Scheduling personnel and other resources optimally
- Monitoring and measuring IT assets (costs, schedule, scope, timing, yield, risk, benefits etc.) from development through post-implementation (Maizlish & Handler, 2005)

IT portfolio management enables IT projects, applications or other IT assets to be evaluated under the aspects of value and risk.

Regarding to Maizlish and Handler (2005) there are three primary areas of IT portfolio management:

1. Processes and a framework to plan, create, assess, balance, and communicate the execution of the It portfolio.
2. Tools that analyze information and data, such as value, cost, risk, benefits, requirements, architecture, and alignment to business and strategic objectives.
3. A common business taxonomy and governance that communicates and defines the principles, policies, guidelines, criteria, accountability, range of decision-making authority and control mechanisms.

To do this, qualitative and quantitative models are developed and implemented. Qualitative portfolio models evaluate IT assets concerned with the alignment of business and technology strategies. Quantitative models focus on value-based measures (Wehrmann *et al.*, 2006). However, there is not an exclusive choice for qualitative and/or quantitative models. In many cases, it makes sense to use both concepts. Even if an IT asset is based on the most innovative technology, it is ineffective if is not in line with the overall strategy (Wehrmann et al., 2006).

One of the great challenges in portfolio management is to model and evaluate the mutual dependencies of risk and benefit factors of IT assets. As a result, some dimensions and criteria can be derived to evaluate existing concepts. These dimensions include value, risk, dependencies between IT assets, usage of existing concepts and balancing of the value and risk position.

To be able to assess the economic value of IT assets, a basic understanding of the term value is essential because inter-subjective traceability is necessary in order to compare different alternatives. Therefore, the quantification of financial and non-financial indicators is essential in order to assess the value of IT services.

The value of an IT asset is further influenced by different risk indicators. The risk evaluation must perform two tasks. First it must be evaluated for every single IT asset and second it must be evaluated for the whole portfolio. The portfolio risk is determined through the individual risks of each IT asset and the risk positions through the dependencies between IT assets which are in a portfolio. The interdependencies between IT assets must be examined and evaluated within the scope of portfolio management. Interdependencies can be identified for IT investments as well as for innovation and integration management.

From the practical aspect, it can be concluded that the effort involved in gathering and analyzing the necessary data is not too extensive and is lower than the expected benefit.

The value and risk positions of IT assets are manageable in this way, enabling IT assets to be customized in many cases. As a result, the balance between value and risk positions can be influenced. A concept for IT portfolio management should therefore consider this possibility to design different IT assets (Wehrmann et al., 2006). Based on this, indicators existing concepts for quantitative portfolio management can be evaluated.

To optimize the management process for IT portfolio management Jeffery and Lelivedl developed an IT portfolio maturity model (Jeffery & Leliveld, 2004). The model segments the portfolio management into four stages: ad hoc, defined, managed and synchronized. On the ad hoc level companies make decisions about IT investments in an uncoordinated way. On the defined level, companies have identified and documented key components of their portfolios and roughly estimating costs and benefits for each IT asset or project. All necessary data's are logged in a central database. Organizations which are on a managed stage have a standardized portfolio management process that enables objective project selection and has a clear link with business strategy. Portfolio management processes are part of existing management-control processes and financial metrics, such as ROI and net present value (NPV) are calculated and used by decision makers to align IT spending with strategy. Organizations on the synchronized level are able to align investment portfolios with business strategy. These organizations use evolving metrics to measure a project's value through its life cycle. To increase the aggregate value of the IT investments they assess the risks associated with each project and the portfolio risks (Jeffery & Leliveld, 2004).

Research results from Jeffery and Leliveld (2004) shows that the most important benefit of IT portfolio management is the improved business-strategy alignment, followed by a centralized control as well as cost reduction, communication with business executives, improved ROI, improved customer service, professional respect, competitive advantage, IT integration during mergers and acquisitions and improved decision making (Jeffery & Leliveld, 2004).

It can be summarized that IT portfolio management is a suitable concept to evaluate risk and value positions of IT services as well as the interdependencies between the different assets. Therefore efficient portfolios of IT services can be defined in context of several business situations and the business value can be actively managed.

Based on the advantages of value engineering of IT services mentioned before, it can be recapitulate that existing concepts in the areas of business engineering, IT value management and IT business alignment generally provide useful input for the challenges in IT departments and business process owners' face. However, it also became obvious that a general solution which could cover all relevant aspects of IT value engineering was still missing. For this reason, a framework has been

introduced which has the potential to fill this gap. Following, specific details of this new concept will be described in detail with the special focus on value engineering of IT services.

FRAMEWORK FOR IT SERVICE VALUE ENGINEERING

As previously highlighted, IT service value engineering has to consider many different aspects and levels of management in order to achieve business value through the use of IT services. This chapter now illustrates the specific relationship between quality management, value engineering and performance management in the field of IT service management. Although a broad spectrum of research work already exists in the field of IT service management, only parts of this spectrum have been analyzed so far.

There is a particular lack of knowledge about the mechanisms connecting IT assets with corporate performance (Wagner, 2006). Furthermore, there are gaps in the operationalization of business IT alignment as well as in the lifecycle-based administration of IT service quality management.

IT service management frameworks have been developed in order to support research work as well as to provide practical guidelines for IT managers. Accordingly, frameworks for IT service management have been designed in order to organize the management process and thus to ensure the establishment of an expected level of IT service quality. To summarize, most of these frameworks describe different processes which are expected to enable the effective IT service management with the aim of increasing business value.

With regard to the expression of "business engineering," the term "IT service value engineering" defines a framework for the systematic definition, design and value-based management of IT services within companies. The framework described focuses on IT services instead of IT in general. According to the author, IT services are independent objects which provide a defined number of functionalities to support business processes. IT services can be managed as a separate product and are documented in service catalogues. IT services are traded on markets and have an individual price. In our understanding, IT services are offered by internal and/or external service providers.

One aim of the IT service value engineering framework is to integrate different concepts regarding the value management of IT and IT service management. Existing concepts for business value management focus on the identification and evaluation of IT in general. This framework focuses on the identification, evaluation and management of the value of IT services.

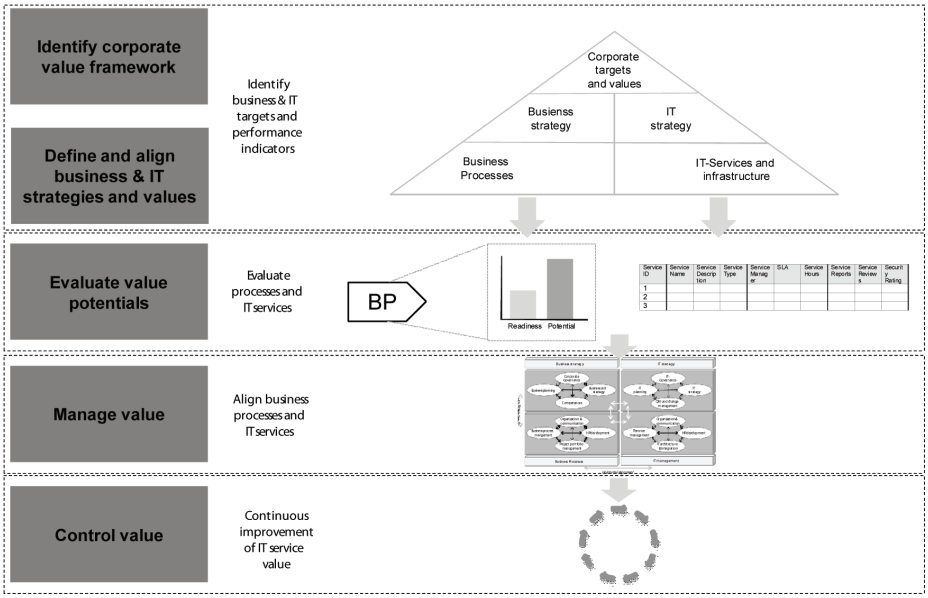
A further goal of the framework is to provide a structured process which supports IT managers in identifying, evaluating and managing the business value of IT service portfolios in the context of implemented business processes. Through the value engineering framework, companies will be able to create efficient IT service portfolios for each existing and implemented process within the enterprise.

In the following sections of this chapter, the framework of IT service value engineering is introduced. The framework shows that value engineering covers different levels of management, from a strategic to an operational level. Besides the different levels of management, IT service value engineering defines a structured process of value definition, identification, evaluation, management and controlling, which is also described in the chapter.

Structure of the IT Service Value Engineering Framework

The structure of the IT service value engineering framework is illustrated in Figure 2. The framework covers five levels of management, from a strategic level to an operational level.

Figure 2. IT value engineering framework



The strategic level covers the definition of a corporate value framework and the identification of business value. Therefore, company-wide goals and values need to be defined which provide the framework conditions where a company wants to develop itself and with which strategies it wants to achieve these goals. Consequently, management processes have to be implemented to define business objectives and derive value dimensions. Strategies for achieving goals are also required and measures defined in order to analyze the success of the implemented processes. Furthermore, company-wide goals have to be detailed and specified for each business unit and derived for each business process. Besides the business perspective, the strategic level also focuses on the IT perspective. Specific strategic objectives for IT need to be derived and defined based on the corporate targets and values. An IT strategy must be defined and specified for IT services as well as for IT processes. Due to the implementation of IT business alignment processes, the fit between business and IT should be ensured.

The operational levels of the framework focus on the relation between business processes and IT services. They cover the evaluation of potential values in business processes and the operational alignment between processes and IT services. The operational level also addresses value management and value controlling. The goals of the operational levels to analyze business processes with regard to their potential and readiness to use IT services and also to evaluate the "fit" between process requirements and IT service functions in order to provide value for corporate value.

From a business process perspective, both the technology readiness level and IT value potential need to be evaluated for each business process as well as the possible effect of the business processes on overall corporate value. Furthermore, the operational IT business alignment between business processes and IT service has to be evaluated.

Based on the results of the value potentials and process analysis, indicators then need to be defined to measure the potential value of IT services. The indicators must also be capable of identifying potential risks associated with the use of each

IT service and the whole IT service portfolio used to support a business process. To select and evaluate suitable IT services, the use of a portfolio management process is recommended. By using a quantitative portfolio evaluation method, efficient IT service portfolios can be identified for each process. Combined with the risk evaluation made by the decision makers, it is possible to define an optimal portfolio for a business process.

Besides the structure of the framework, the process of IT service value engineering is of interest to illustrate how the model can be used to manage IT services within a company.

Process of IT Service Value Engineering

The IT service value engineering framework describes a ten-step process for the value-based management of IT services. The different process phases are described in the following paragraphs.

Identify Corporate Value Framework

At the strategic level, the value engineering model demands the definition of business values and organizational targets.

As in every strategic management concept, it is necessary to define a corporate vision and define corporate targets. The targets should focus on different dimensions of management and not only on financial goals. One widely-used instrument is the balanced scorecard (Kaplan & Norton, 1992) which recommends the use of multi-dimensional targets. Each target has to be operationalized through one or more key performance indicators.

These targets define the overall corporate value basis and define the values which are of importance to a company. They define the framework conditions for IT service value engineering. This makes the IT service value framework individual for each company.

Once the multidimensional corporate targets and key performance indicators have been defined, the top level targets need to be broken down and targets for business units and business processes derived.

Define and Align Strategies and Values for Business and IT

The second process phase involves the definition of business and IT strategies and performance indicators. The balanced scorecard can be specified

Figure 3. From vision and values to operational performance indicators



and detailed for the operational level of business processes. A result of the breakdown of strategic indicators on a business process level is that each process has a multi-dimensional set of targets which is defined and operationalized through key performance indicators. This gives a set of targets and values for each process, showing how the process is linked to corporate targets and how each process contributes towards the overall business value.

In this phase, an IT strategy based on the corporate targets needs to be derived. Consequently, strategic business targets have to be aligned with strategic targets for the IT department. Once business and IT strategies have been defined, it is necessary to operationalize strategies through key performance indicators for business and IT value and performance management. Additionally, the strategic and operational business objectives need to be transferred to strategic and operational IT objectives. This phase results in the definition and alignment of values and objectives on a strategic as well as on an operational level.

The research results from Luftman, Papp and Brier show enablers and inhibitors of strategic alignment (Luftman *et al.*, 1999). They demonstrated that senior executive support, IT involvement in strategy development, IT business partnership, good prioritization of IT projects and an understanding of IT department business are enabling factors of IT business alignment. Therefore, these factors need to be taken into consideration in the alignment process.

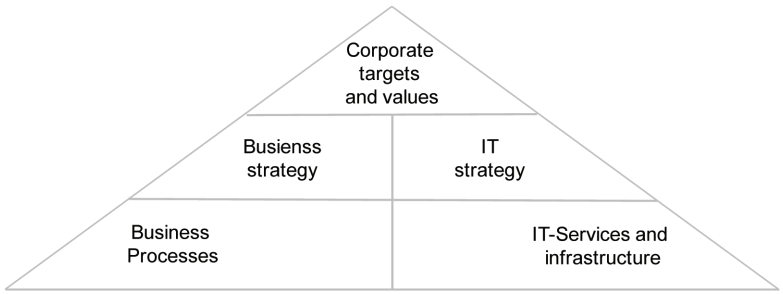
Evaluate Value Potentials

This part in the IT value engineering model assesses the business potential and defines framework conditions for evaluating IT service value. Here, the processes with associated targets are defined and a list of processes generated. The evaluation of value potentials is the first step in the operational level of the value framework. Two perspectives have to be considered in this phase. Firstly, business processes need to be evaluated with regard to their potential and readiness to use IT services. Secondly, a pre-selection of IT services is necessary in order to reduce the number of services requiring evaluation in the next process step.

To evaluate processes, the complexity of business processes needs to be reduced. One option here is to break down complex processes into several sub-processes and process patterns. A process pattern is a module of a business process with a clear structure and predefined output. Each pattern represents part of a business process and provides the business value. The requirements of the process pattern define the IT service value structure.

By breaking down business processes, processes can be evaluated with regard to IT readiness and IT potential. Consequently, the next step of the value engineering model addresses the evaluation of each process as far as IT service readiness and IT potential are concerned.

Figure 4. Identifying of business and IT strategies and performance indicators



Parasuraman (2000) introduced the term "Technology Readiness Index" (TRI) which refers to the "…people's propensity to embrace and use of new technologies for accomplishing goals in home life and at work" (Parasuraman, 2000).

Process readiness indicates the level of process maturity with regard to the use of IT services. IT readiness defines the maturity level of a process regarding the use of IT services in order to accomplish defined tasks and achieve business targets. The readiness analysis considers technical, human resource capabilities and also economic and organizational aspects. The technical analysis evaluates a process to see if the different tasks can be supported by IT services. The resource analysis assesses the capabilities, qualifications and acceptance of employees involved in the process. The economic and organizational analysis focuses on budgeting issues and a cost-benefit analysis of using IT services. In addition to this, the analysis of the organizational process infrastructure evaluates the fulfillment of customer demands and the efficiency of IT service usage (Thonabauer *et al.*, 2005). The overall readiness of a business process is determined by the degree of readiness of each sub-process or process pattern.

Besides IT readiness, IT service process potential is of great interest in the context of IT value engineering. The IT service potential indicates how well a process can be supported by IT services and evaluates the performance potentials from the technological, staff, and organizational perspective. IT use indicates how well a process is actually supported by IT services. Generally, business processes with a high number of structured tasks and predefined outputs imply a higher IT service potential than is the case with unstructured processes and undefined outputs (i.e. an advisory speech in a bank may not necessarily result in a contract).

To analyze readiness and potential, indicators need to be defined for IT service readiness and for the IT potential of a business process. Both the IT potential and the IT readiness index define an important part of the business value of IT services.

From the point of view of IT, it is necessary to define a number of suitable services which can be used to support the business processes. Before evaluating each IT service, the number of services has to be reduced and a pre-selection of possible IT services compiled from a service catalogue. Therefore, the use of a structured IT service catalogue may support the structured documentation of existing IT services.

A service catalogue contains details of all IT services which can be delivered to customers, including information and relationships regarding supporting services, shared services, components and other entities required in order to provide the services (OGC, 2007b). ITIL provides an example of the structure of a service catalogue.

A service catalogue contains details of all IT services which can be delivered to customers, including information and relationships to sup-

Figure 5. Evaluation IT readiness and IT potential of business processes

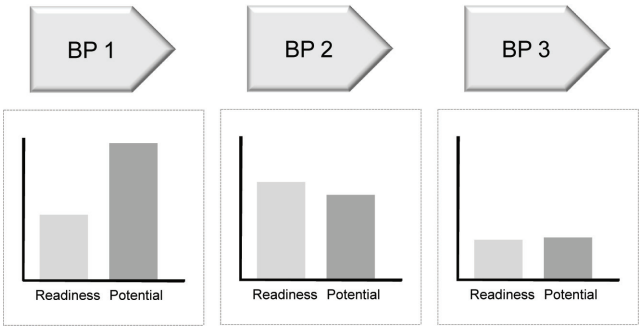


Table 1. Example of a service catalogue structure

Service ID	Service Name	Service Description	Service Type	Service Manager	SLA	Service Hours	Service Reports	Service Reviews	Security Rating
1									
2									
3									

porting services, shared services, components and other entities necessary to provide the services. ITIL provides an example about the structure of a service catalogue.

The breakdown enables the IT requirements of each part of the process to be identified. Based on this requirements analysis, possible IT services can be pre-selected.

At this stage, IT readiness and potentials of relevant business processes are identified and suitable IT services pre-selected. The next step in the value engineering process is to align IT services with business processes and to design an efficient IT service portfolio.

Manage Value

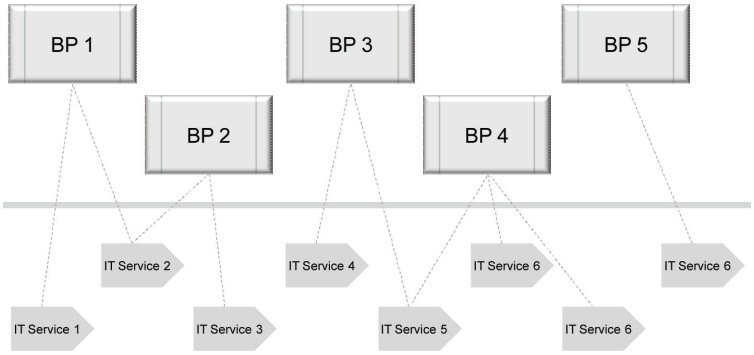
The process phase of managing value focuses on the operational alignment between business processes and IT services with the aim of maximizing IT service value. Consequently, it is necessary to design an efficient IT service portfolio and evaluate the quality of IT business alignment on a process level.

In the context of value engineering, the use of quantitative portfolio techniques is recommended in order to define an efficient portfolio of IT services and thus maximize business value. To define an efficient IT service portfolio, suitable indicators regarding value contribution and risks related to the use of an IT service have to be identified.

IT service benefits are evaluated by assessing the contribution of a service towards the relevant process targets. The key problem here is how to evaluate the contribution of IT services towards the achievement of the defined process targets. A value benefit analysis is one suitable method for evaluating the contribution of the defined targets by scoring. The defined targets and related scores have to weight with regard to their effect on the processes. Subsequently, the fulfillment of the defined target as a result of the specific IT services needs to be evaluated. Based on this, a weighted index can be defined which represents the value contribution of a service.

As well as evaluating benefits, there is also a need to identify and evaluate the risks associated

Figure 6. Operational alignment between business processes and IT services



with the use of IT services. Therefore, possible risk categorizations and impact models have to be defined. To evaluate risks, Maizlish and Handler (2005) provide a risk scoring method to compare risks associated with different IT investments. Their method covers risk categories, risk factors, risk mitigation, residual risk, weights, risk scoring and weighted score. In the case of risk scoring, risk indicators are also defined and evaluated, enabling an overall risk score to be computed.

Based on the evaluation of the benefits and risks of the individual IT services, it is possible to define portfolios for each business process from the pre-defined IT services. In a subsequent step, efficient portfolios then need to be identified. These are portfolios with a high contribution towards the process value and overall business value.

To find the optimal portfolio of IT services, the risk awareness of the decision makers or of the company needs to be defined. The risk awareness is illustrated through a risk function. The optimal portfolio will be achieved when the risk function tangents the efficient line. At this point the maximum of the value contribution of IT services is achieved (see Figure 8).

After defining the optimal portfolio of IT services, it is extremely important to ensure that the operational alignment between IT services and business processes is working properly. The best portfolio is worth nothing if processes and services are not implemented and operated correctly. Therefore, the operational alignment of IT services and business processes has to be assessed. To do this, a model needs to be created which is able to describe the entities of an IT service as well as of a business process and which defines indicators for measuring the level of alignment and identifies gaps. As mentioned in the previous section, there is currently a gap in research and an existing challenge with regard to operational business IT alignment. A solution to this problem is provided by Fraunhofer IAO and the Innovation forum "Banks & Future".

An expert group made up of over 15 members has developed a solution to operationalize IT business alignment (Praeg *et al.*, 2007) derived from the Strategic Alignment model created by Henderson and Venkatraman (1993). The model was developed based on literature reviews, expert interviews and workshops, and a prototype was tested by partner organizations. The IT business alignment assessment uses several indicators in the evaluation and enables strengths and weaknesses to be identified. Figure 9 shows an example of a result chart. The differences between the graphs show a mis-alignment between IT and business and the position of the graphs indicates the degree of alignment.

Figure 7. Examples of IT portfolio

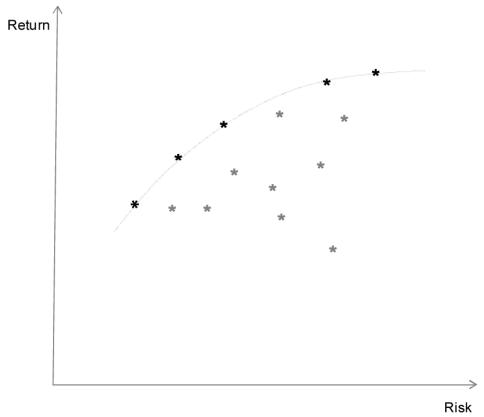


Figure 8. Optimal IT portfolio

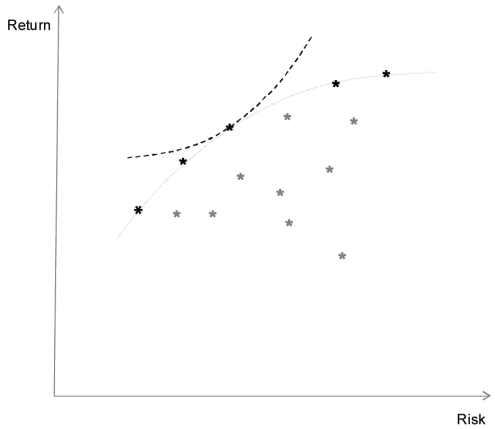
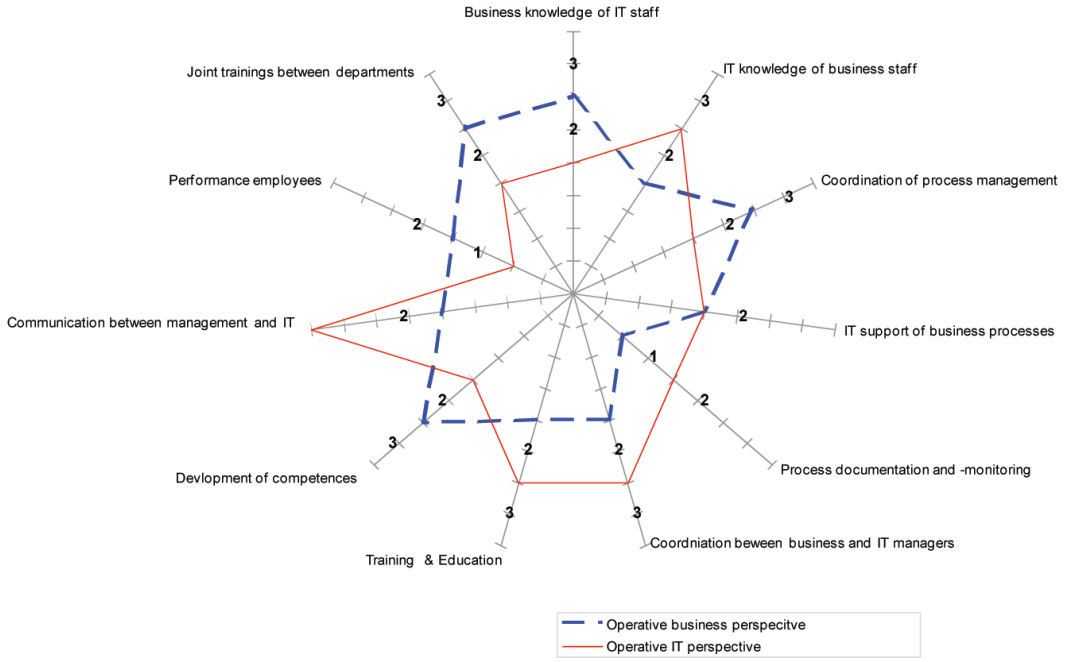


Figure 9. Result chart of the IT business alignment assessment tool (Source: Praeg et al., 2007)



Zimmermann provides a concept which integrates the evaluation of an IT project portfolio with the measurement of strategic fit (Zimmermann, 2008). The two-dimensional portfolio chart becomes a three-dimensional space which illustrates benefit, risk and strategic fit.

This value engineering phase highlights the evaluation of the value contribution of IT services. Not only is the identification and evaluation of business value important but also continuous controlling over time in order to sustain the value contribution of IT services.

Control Value

The final stage of the value engineering process covers a controlling process in which the performance and value contribution of the selected IT service portfolio is evaluated, continuously measured and systematically improved.

The aim of this process is to ensure the business value contribution of IT services. To achieve this, an analysis has to be carried out to assess whether the external factors and framework conditions, e.g. market structures, customer demands etc., have changed and whether a need exists to adjust the IT service portfolio selected.

During the controlling process, strategic corporate targets also have to be checked to ensure that they are up-to-date and, if necessary, adapted to a meet the requirements of a changed environmental situation. An additional task is to assess if there is a demand to reengineer existing processes, if there is a change in the IT business value situation and if changes to the IT service portfolio need to be made.

However, not only passive reactions to changed environmental factors and processes have to be taken into consideration in the controlling phase. Continuous evaluation of the value contribution of the IT service portfolio is also required. During this process, the importance of initiating improvement activities is not to be underestimated.

It can be summarized that the value engineering process with all its associated tasks is a highly complex process which considers all levels of

management within a company. Consequently, the support of top management as well as effective cooperation and intensive communication between business and IT departments is very important. Besides the management of the business value of IT, it is also highly relevant to ensure a predefined level of quality.

RELATION BETWEEN IT SERVICE VALUE AND QUALITY MANAGEMENT

As well as describing the framework, the author also shows the close relation between value engineering and the quality management of IT services.

With regard to quality management, the overall goals are to ensure the effectiveness and efficiency of IT service usage within enterprises. Quality is an important factor in achieving business value through IT. A major target of IT service quality management is to guarantee customer satisfaction and provide a predefined level of service quality. Besides the customer perspective, a further goal of IT service management is to improve IT efficiency and maximize the business value of IT service usage within companies. Consequently, the management of quality supports an increase in the business value of IT.

Apart from the direct influence of quality on business value, there are also indirect relationships between value and quality. One of these addresses the effect of quality on strategic and operational business IT alignment. Through quality management, the fit between business requirements and IT potentials can be improved. Progress in business IT alignment will result in an improvement in the value contribution of IT towards business targets. Furthermore, IT service quality management supports the efficiency and effectiveness of the use of IT services. Effectiveness means that all activities and usage of IT services are clearly linked with business processes and corporate targets and values. Efficiency addresses the optimal design of IT service portfolios in order to support business processes and maximize the value contribution of IT services towards process targets.

It can be summarized that IT service value engineering and quality management are closely linked with one other. Therefore, a well-established IT service value management not only helps to increase the quality of services but also supports the business value of IT service usage.

SUMMARY AND OUTLOOK

Due to the increasing use of modular IT services, a concept is required which supports the management of IT services. Existing models and concepts in the field of IT service management provide neither integrated management processes nor value indicators for a value-based management. This chapter demonstrates the connection between aspects of IT service value engineering and IT business alignment and the relation to IT service quality management. The aim of this chapter is to illustrate a management concept which shows the relationship between different aspects of value engineering and results in a more effective and efficient IT service management in practice.

The author therefore presented a framework for IT service value engineering that is made up of different management levels and a value engineering process. With this IT service value engineering framework, a concept is introduced which is capable of closing the gap in IT value research. It integrates various concepts from IT and business value management in order to evaluate and improve the contribution of IT services towards overall business value. However, there are also some limitations to the framework. With regard to the requirement of a holistic model for IT service value management, the existing concept needs to be extended by additional perspectives, such as the human aspect, organizational structures, market developments, etc. This will generate a

complex model which will be a great challenge to describe, evaluate and implement.

The framework demonstrates the complexity of IT business value management in general and especially with regard to IT services. However, there are still many aspects which require analysis in further research projects. Due to developments in the field of IT and increasing cost pressure, there is a great demand for an integrated framework for the value engineering of IT services.

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KEY TERMS AND DEFINITONS

Business Engineering: Business engineering is a structured and holistic concept for the development of socio-technological solutions in the context of enterprise transformation. In most cases business engineering focuses on business processes as interfaces between IT and technology as well as business strategy and management.

IT Business Alignment: IT business alignment describes the degree to which mission, objectives and processes contained in business are shared and supported by IT. Alignment describes a status as well as a process perspective.

IT Business Value: The IT business value is characterized as the benefit of an IT service to process or corporate targets and strategy

IT Service: IT service is defined as a set of utilities which can be used by business processes. IT service covers a set of functionalities which support specific entities of business processes and provide value to business.

IT Service Portfolio: IT service portfolio management covers all aspects regarding the coordination of all IT assets within a company with the aim of improving overall corporate targets and maximizing IT service business value

IT Service Quality Management: IT service management is a structured process for plan, execute, evaluate and improve quality of IT services.

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