

Specification of Service Level Agreements, clarifying concepts on the basis of practical research

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Kwintes stands for Quantifying Information Technology Services, and is directed at the development of methods and tools that will help suppliers of information technology services to improve their service delivery.

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ABSTRACT

Over the last ten years the primary business processes of many organisations have become strongly dependent on IT systems. As a consequence the integration of IT systems into organisations, and in particular the subsequent exploitation and operation support activities, have become of utmost importance. The area of IT exploitation and operation is known as Service Management and covers activities such as performance and availability support, end-user and help desk support, education, and technical operation.

One of the main concepts of Service Management is the Service Level Agreement (SLA). The purpose of a SLA has recently shifted from being a financial contract towards an instrument for the management of the customer's expectations. Managing customer's expectations is based on the definition of services, the specification of service levels agreements and the design and implementation of service processes.

This paper presents the underlying concepts for the identification and specification of Service Level Agreements. Based on lessons learned from empirical research a description and clarification is given of these SLA concepts.

KEYWORDS

Service Level Agreements
Information Technology Services
Customer Needs
Quality
Case study research

ISRL CATEGORIES

GB05 (USER REQUIREMENTS) or GB07 (USER EXPECTATIONS)

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1 INTRODUCTION

Information technology (IT) increasingly influences the ability of enterprises to be competitive in continuously changing market situations. Over the last ten years the primary processes of many organisations have become strongly dependent on IT systems. As a consequence the integration of IT systems into organisations, and in particular the subsequent exploitation and operation support activities, have become of utmost importance. Unfortunately the area of IT exploitation and operation, also known as IT Service Management, is still rather immature in comparison with other IT areas, such as for instance IT systems analysis and design. Although many structured methods and techniques exist for the identification and the specification of IT systems there are hardly any approaches and instruments for the structured specification of IT services.

Regarding IT integration and exploitation the relatively new domain Service Management has emerged rapidly. This is amongst others reflected by the amount of effort and resources that are spend on Service Management. It is estimated that large companies spend up to 50% of their investment portfolio on IT related investments (Renkema 1995). Generally it is assumed that only 20% from these investments are directly covered by the costs of IT development. The remaining 80% consist of the costs of integration, operation and exploitation of IT systems. These costs are referred to as IT service costs. IT Services Management covers services such as performance and availability support, end-user and help desk support, education, technical operation. Organisations often need various kinds of specialised support during the operation and the exploitation of their IT systems.

In the UK important work has been carried out by CCTA. A collection of Best Practices that is called ITIL (CCTA, 1987) focuses in particular on the various aspects of IT Service Management and introduces as one of the main concepts for Service Management the Service Level Agreement (SLA). Recently more and more publications on SLAs can be found in various journals and magazines (Metzler 1997; Radosevich, 1997; Steinke, 1997;). One of the most important trends is the shift of the goal of a SLA from being a financial contract towards an instrument for the management of the customer's expectations. However, there still exist many unsolved questions in the IT Service Management area, e.g. regarding the definition of services and the specification of SLAs.

This paper will address these questions by summarising lessons learned from empirical research and by clarifying the underlying concepts for the specification of SLAs. The main Why, What and How concepts of SLAs will be presented. Section 2 addresses the problems that were found in practice, some suggested answers from literature and also some important remaining questions. In section 3 we will describe our empirical research approach, in particular the scope that we defined and the methodology that we followed. Section 4 addresses pre-understandings that formed the reference basis for the research carried out. In Section 5 a case study is presented. Based on the case study results, we introduce in section 6 the developed SLA specification concepts. Section 7 finalises the paper with conclusions and recommendations for future research.

2 WHY IS SPECIFYING SLAS IMPORTANT?

IT Service Management is a relatively new domain in IT management. IT Service Management focuses on the planning, monitoring and control of IT services. Currently the IT Service domain shows a rather scattered picture of various types of defined and undefined services. As a consequence it is difficult to manage IT services in a formal and efficient way. This counts for all IT services, such as recoverability services, performance planning

services, help desk services, maintenance, educational services, etc. To manage IT services in a proper way it is necessary that there is consensus about the services between an IT provider and a customer, both external and internal to an organisation. Although the concept of customer orientation is often addressed in the Information System development area (e.g. Trienekens and Kusters 1992) there is still a lack of formal and structured customer orientation in IT Service Management.

2.1 SLA problems

Although there is much evidence about the role and importance of SLAs in the context of Service Management, SLAs show many shortcomings in practice. From empirical research some major problems have been identified, see for example (Trienekens et al, 1997). Hereafter we will address these problems briefly.

Specification of effort versus specification of results

Most SLAs focus on agreements regarding the effort that will be spent by an IT provider in case a problem occurs. However, often no commitments are specified regarding the effectiveness of a service for a customer's business processes and his business objectives. Instead of "the IT service X will provide your company with result Y", a SLA usually states "we will be at the site within a certain amount of time in case your IT systems break down".

Unclear service specifications

Agreements on for instance "the availability of a network" are usually specified by a figure called the availability percentage. It is often hard to determine what the precise meaning of such a figure is. What is for instance the difference between an availability percentage of 98% and 99%? And does 98% mean that the network can be "down" for a whole week, after being "up" for the last 51 weeks? Often it is unclear in what way availability, or another aspect of a service, can be measured.

Incomplete service specifications

It is difficult to make complete agreements on IT services, for instance on services such as security control and disaster prevention. Regarding the latter a key problem is that there is not yet a good classification and there are not yet good definitions of disasters. In general a full description of a disaster and the requirements regarding IT services can only be given afterwards. Confusion and misunderstandings about responsibilities, leading to serious legal actions, are often the consequences.

Insufficient cost management

Cost management is often interpreted as a "fixed price each year for a particular set of IT services". In what way these costs can be differentiated and can be related to specific IT services, and in particular to the needs and the wishes of a customer, is often unclear. As a consequence it is very difficult to determine a price/performance optimum for a customer. From the perspective of a provider it is difficult to aim at efficiency in the service processes, because of the lack of insight in the costs of individual IT services.

"Dead-end" SLA documents

As a consequence of the problems that have been described in the foregoing a Service Level Agreement is often a technical document that can only be understood by a small group of technical oriented people. Such a document has a very restricted meaning for end-users and their management. They are not able to interpret the 'agreed' service specifications in the right way. For them the development of a SLA becomes just an unsatisfying tradition.

As stated before none of the available structured IT systems development methods focus on the needs of users or customers after the integration of an IT system into an organisation. Developing IT systems is still rather separated from the operation and exploitation of these systems in their business environments. During IT systems development the characteristics of the various services that are needed after integration are not recognised. Therefore it is not possible to identify the needed Help Desk support already during development of an IT

system. It is also not possible to specify the services for the establishment of a needed availability level of a system or to identify and describe in an early phase the needed training facilities.

2.2 Towards structured SLA specification

Identifying the needs for IT services is important, if not already during the analysis and design of an IT system, then at least before the integration of a system. IT services have to be defined, have to be specified and have to be agreed upon. Until now in practice only little attention has been given to the structured and formal specification of IT services. In some articles this has been noticed and some authors have suggested approaches to identify service needs and to plan and control service processes. We will address briefly some opinions and approaches for the specification of SLAs. We will focus in particular on the objectives of the current approaches, their stepwise procedures, but also on their restrictions.

Objectives of current SLA specification approaches

Better management of financial resources and increased confidence in the budgeting process are important objectives of a SLA, see (McBride, 1998). In other references (e.g. Karten, 1998) the primary objective of a SLA is to serve as a communication aid and a conflict preventing instrument. Further objectives that are mentioned are respectively: an objective basis for agreements, a clear description of the elements of a good service, and executable service processes. Also human aspects are considered to be key elements for SLA development, in particular such aspects as problem solving, consensus building etc. In other references the technical aspects of services are addressed, for example various service metrics in (Passmore, 1996).

Stepwise approaches in current SLA specification approaches

In current SLA specification approaches (e.g. Karten, 1998; McBride, 1998) SLAs are considered as formal written agreements between end-users and IT providers. SLA specification follows in general a stepwise approach. In (McBride, 1998) there is a strong emphasis on the determination of available resources, the current resources in use and the existing levels of the services. However, the process of SLA making itself is only described in global terms. In (Karten, 1998) a stepwise procedure is described for the development of SLAs. Respectively are mentioned:

- an investigation of the background information of a customer and the identification of his needs;
- the determination of service levels by a provider;
- the obligation of a provider to come to an agreement with a customer;
- the development of basic rules for the collaboration between a customer and a service provider.

Restrictions in existing SLA approaches

In some articles the focus of SLA specification is restricted to the tasks and the role that IT providers have in IT Service Management (McBride, 1998). SLA specification is only described in (global) terms of important attention points for an IT provider. The identification of service needs and the analysis of service requirements is hardly addressed. However an unanswered question is in what way a customer should be involved in the SLA specification process.

In (Karten, 1998) no clear distinction is made between the various SLA components, there are no operational stepwise procedures, and hardly practical support for the identification of SLA needs. (Passmore, 1996) restricts itself to network management, topics of services in this domain are discussed, there is no stepwise formal procedure described.

3 SPECIFICATION OF SLAS: SCOPE AND METHODOLOGY

This paper will address the specification of Service Level Agreements. In particular the underlying concepts of SLAs and the specification process of SLAs will be discussed. Based

on practical research SLA specification concepts will be presented for the structured development of SLAs. In this section we will address briefly the major scope issues for the research presented in this paper and the main methodology issues regarding the approach of our research.

3.1 Scope issues

The scope of the research in this paper is based on three dimensions, respectively the business situation in that a SLA is specified, the consensus aspect of a SLA, and the focus on existing IT systems.

The business situation regarding SLA specification

Various business situations can be recognised in which companies feel the need for specifying SLAs. Sometimes SLAs are needed for services that are already being delivered for years, but in other situations SLAs have to be specified for IT systems that have not yet been designed. In particular the latter situation is a very immature domain of service level management. Therefore we will restrict ourselves in this paper to these business situations where several business characteristics are already clear and determined, respectively the business objectives are reasonably clear, the business processes can be described formally and the IT systems have been well defined.

The consensus aspect of a SLA

Consensus building is one of the major aspects of SLA specification. A SLA can not and should not be considered as just a formal contract between financial and legal representatives from a customer and a service provider. This restricts the practical and operational value of a SLA very strongly. The consensus aspect covers:

- content agreement (both services and service levels);
- conflict prevention (provider promises versus customer expectations);
- distinction between service processes (of a provider) and business processes (in a company);
- expectation management (expectations are not stable, expectations change).

A stable relationship between customer and provider

We consider IT services as dedicated processes, i.e. there should be no confusion about the client, the service provider and the IT system. Short-term relations between customers and providers are often ad-hoc and chaotic regarding service management. Therefore we will focus in this paper in particular on more stable mid term and long-term relations between service providers and customers.

3.2 Methodological issues

To structure the research we adopted the concept of 'pre-understandings'. Pre-understandings refer to knowledge, insights and experience that researchers have before they plan and execute a research project. (Gummesson, 1991). Based on explicit pre-understandings a research project is carried out and new understandings can emerge. Consequently, based on lessons learned, the understandings can be elaborated towards new theoretical constructs.

Before carrying out our research project, we investigated the knowledge and experience with SLAs in our research group. To structure the ideas that we had about the specification of SLAs, the concept of pre-understandings has been adopted. The ideas have been formulated in terms of pre-understandings and these pre-understandings

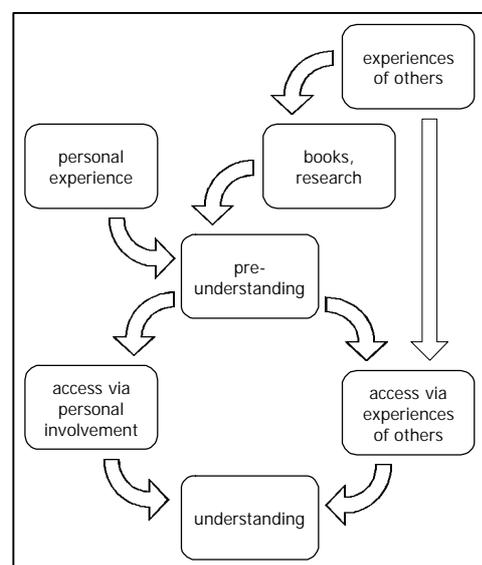


Figure 1 Research methodology 7

formed a reference basis for our case studies. Based on lessons learned during the case studies we came to (new) understandings regarding SLA specification and the foundation of SLAs, in particular the underlying concepts. These SLA concepts will be presented and discussed in section 6 of this paper.

4 PRE-UNDERSTANDINGS

The eighth pre-understandings, that form the reference basis for our research, are described hereafter. First we address a general pre-understanding which covers the main principle of SLAs and SLA development. Consequently we address pre-understandings regarding the structure and the format of SLAs. Then we address our pre-understanding regarding the influences of situational factors in business for the composition of a SLA, e.g. strategy, market, and organisational structure. Finally the pre-understandings are described that reflect the approach that should be followed to specify a SLA.

The general pre-understanding

- I. *A SLA is more effective when it reflects the needs of a customer in understandable terms.*

A SLA is of equal importance to a service provider and a customer. Both parties are involved and should be able to understand the content of a SLA completely. In that perspective it is often better that a service provider strives at using the terminology of a customer than the other way around.

Pre-understandings regarding the content of Service Level Agreements

- II. *A SLA should be specified in terms of business effectiveness.*

A main problem of current SLAs is the limited clarity about the effectiveness of a SLA for a business system. SLAs often don't address the results of services regarding particular business processes but are restricted to only a description of the efforts that a provider will spend.

- III. *A SLA that is specified in measurable terms will increase its understanding and the consensus building process of the various involved parties.*

Subjective and qualitative aspects in the service specifications cause many misunderstandings and conflicts in SLA development and SLA usage. Metrics and quantitative measurement should avoid these problems.

- IV. *A SLA should be based on well-defined SLA components*

Based on literature study and case study research a number of SLA components could be identified, examples are Availability, Integrity, Security, Performance, Calamity, User support, Education and Change Management.

Pre-understandings regarding the development of Service Level Agreements

- V. *Different user groups have different service needs.*

Differentiation of services will lead to more effective and efficient service processes. In business situations with many users it can be difficult or impossible to determine all the various needs and wishes. In these situations we suggest to cluster users in user groups or to develop a typology, e.g. on the basis of the specific functional characteristics regarding the usage of an IT system for each user group.

VI. Structured design of a SLA will increase its quality and will limit the time that is needed for its development.

Developing SLAs following a well-founded and formal approach will avoid that involved parties take decisions in an ad-hoc way and end up with poorly motivated and incomplete SLAs.

Pre-understandings regarding the importance of specific Business Characteristics

VII. The relative importance of the various SLA components can be derived from business characteristics.

SLAs have to fit with the needs of the business processes of customers. Knowledge of these business processes is a prerequisite for the specification of SLAs. Specific business characteristics should be used to identify pointers to priorities regarding the various SLA components.

VIII. The relative height of the Service Levels of agreements can be derived from business characteristics.

An equal rationale as under VII, can be given regarding the reformulation of the relative height of the importance of the prioritised service components.

5 SERVICE LEVEL AGREEMENT ON NOTEBOOKS

As can be concluded from Figure 1 the pre-understandings form the reference basis in the case study that will be presented in this section. By means of this field research, or personal involvement as Gummesson calls it, the pre-understandings have lead to well-motivated lessons learned regarding SLAs and the SLA development process. In section 6 the lessons learned will be elaborated towards main theoretical concepts for SLAs and SLA development.

5.1 Case description

As part of its education renewal program the Eindhoven University of Technology (TUE) offers every first year student a notebook computer. The first notebooks were offered to the 1997/1998 generation. Within five years every student at the TUE will have a notebook, which will be used in lectures, during tutorials, in study groups, at home, etc. In the year 2002 more than 5000 notebooks will be in use.

The existing ICT Service centre of the TUE (ICTS) is not used nor suited for providing services to many end-users. Therefor a dedicated, new service centre is needed to service this large number of notebooks. Typical tasks of this Notebook Service Centre (or NSC) will be solving hardware and software problems, installing new software and helping students to use their computer more effectively and more efficiently. The NSC should be a flexible organisation with a close and direct contact with its customers, capable of dealing with the expected large variety of demands and able to anticipate new or changing service demands. To know what can be expected and should be provided, students and NSC need a clear and unambiguous agreement.

For parts of its services the NSC has to rely on services provided by the TUE service centre with its thorough but somewhat bureaucratic business culture. Because of the different services, different cultures of the service providing parties and their dependencies, it is obvious that, also from this viewpoint explicit agreements have to be made.

5.2 The work done

The SLA process has been divided into two parts. First the needed services have been examined and translated into service levels. These service levels have been the input for the service level agreement, which has been written in the second part of the SLA process.

As said, we started the SLA process by examining the service levels needed. The second pre-understanding states that different users ask for different service levels, so we identified different user groups, in conformance with the different faculties of the university. We assumed that different faculties, such as computer science, architecture and chemical engineering needed different service levels. Interviews were used to characterise these faculties in order to determine the needed service levels and the relative importance of the different components of the SLA (pre-understandings VI, VII and VIII).

During the interviews differences between the faculties were found but the similarities were much more obvious and demanding. Furthermore, students would go 'shopping' for the best service, if service at the architecture faculty would be better than at the mathematics department. So, although there were some differences in for instance the needed user support, the service levels should be the same, campus wide.

The interviews indicated the main components of the SLA. Although the TUE as a university does not depend on the new ICT, its renewal program does. Therefore availability of the ICT and service was marked as one of the major factors of success. The second major component was user support. Services like answering questions and solving hardware problems should be done as quickly and competent as possible. The third and last major component was flexibility of both the service and agreement. Flexibility was needed because the service was new to all involved stakeholders, which makes it impossible to predict the use of both ICT and service. After the first initial steps the NSC will need to listen to their customers and improve where needed. Summarising we may say that availability, user support and flexibility were seen as the most important components of the agreement to be made.

The second part of the work was the actual specification of the Service Level Agreement document. First the different components of the SLA had to be made measurable (pre-understanding V). For instance the widely spread but vague term availability was made explicit and measurable by defining problem solution times. These times were set according to priorities, which are identified based upon the different periods of use (lectures and tutorials, study and exams) and the severity of possible problems. So a student with a broken notebook will get a solution within one hour, during his or her exams. During the normal lecture period, a student with a small problem will be helped within 16 hours. Of course the possible severity was described, limits were set to repetition of problems, etc. See appendix 1 for more details.

Because of the project organisation being responsible for both the initial services as the transfer to the existing university organisation, current project participants and new (unknown) parties within and outside the TUE should understand the document. Therefore the conclusions and decisions made during this service definition phase had to be mentioned in the SLA. This made the document more transparent. Figure 2 in appendix 1 gives a small example on this subject. Furthermore the service (and the document) has been divided into clear-cut end-user oriented sections that can be simply changed, without having to change the whole document. See appendix 1 that shows part of the table of content of the SLA. This made the third important SLA component flexibility explicit.

All accountable parties were involved from the start in reviewing the SLA document: SLA content experts, TUE service experts, jurists, the NSC service manager and the overall notebook manager of the TUE. By the fifth review the final SLA was ready to be signed and that is where this description of the SLA creating process stops.

5.3 Encountered problems and lessons learned

Several questions and problems surfaced during the development of the Service Level Agreement on notebooks. Being a practical case study, these questions mainly focussed on the 'how' and 'what' of the SLA process. The answers that were found are described here as the lessons learned. In total seven lessons will be presented that are direct applicable in any SLA process.

One of the seven lessons was learned during the transition from the examining phase to the actual writing of the SLA. During the first phase (identifying and examining needs) a global structure for the SLA document emerged, based on the usual SLA components like availability and user support. This document structure proved to be inadequate because reviewers were lost. They looked at service as the complementary part of the ICT products that would be used and they were not able to distinguish these 'serviced objects'. The structure of the SLA had to be reshuffled and the new structure was based on the actual use of the different (parts of the) ICT products, the serviced objects, in order to let the SLA represent the world of the client. For each of these objects the components (availability, etc.) were described. A positive side effect was that this structure provided a clear basis for the Service Level Report document. If the structure of the SLR coincides with the SLA structure, it is easy to see, for instance for the legal department, if the agreed levels are reached and which services need extra attention. Therefore the first lesson is:

Lesson 1 Decide at an early stage what the serviced objects are, seen from the eyes of the user, and determine how this will be reflected in the document structure of the SLA.

The second lesson is about the possibility to discriminate between the different SLA components and determine the level of service based on the user group characteristics, pre-understandings VI, VII and VIII. After the mentioned interviews it was clear that some aspects of the service needed more attention than others did. From the situation it was clear that for instance performance would be inferior to availability and user support. Unravelling these components of the total service made it possible to determine the relative importance for each of those components by looking at the business situation at hand. The lesson here is:

Lesson 2 Try to untangle components of the needed service(s) and focus on these parts, rather than on the whole service at once.

A third problem was formed by the project itself, just by being a project. This situation stressed the fact that some members of the involved organisations would have to work with a SLA that would be new to them. They were not involved in determining the needs nor in writing the document. As already mentioned in former paragraph on the work done, this emphasises the need for a readable and transparent document, based on measurable results. A document that can be understood and easily adapted, even by people who not have been involved in the earlier steps or without any content related knowledge (i.e. the mentioned legal departments).

Lesson 3 Create a readable and easy to adapt document, by including descriptions of taken decisions on both document structure and services.

Being a project (with temporary members) the role of client and customer wasn't always clear to the provider. Decisions on whether the agreed service levels were contractual requirements or norms without direct financial penalties were postponed. A final reporting format was also delayed. This made it difficult to finalise the agreement, which leads to the next lesson:

Lesson 4 Appoint at the start of the SLA process the responsible and accountable managers from all stakeholders.

These first four lessons point out that a review board (i.e. the responsible and accountable managers and the legal departments of all involved parties) is needed to assure the

coherence between all involved parties. The (lack of) cohesion first becomes apparent in the structure of the SLA document. The fifth lesson is:

Lesson 5 The review board is essential during the writing of the SLA and should be involved when the draft version of the SLA document structure is ready.

One more fundamental question addresses pre-understanding II on different user groups and their need for different service levels. As said, the similarities between the faculties were much greater than the identified differences and the organisation asked for the same service levels at the whole campus. So the stated pre-understanding II could not be proven nor disproved. The question that remains is, how the lack of difference between the needed service levels can be declared?

The answer could be that each student uses the same standard office applications and that this is perhaps more determinative than we thought starting this case. The case also made clear that organisational characteristics could be very demanding on this point. Accordingly the first lesson is a refinement of the second pre-understanding and reads:

Lesson 6 The possibility to discriminate between user groups depends on the technical and organisational possibility and desirability of the situation.

According to this lesson mainly the characteristics of the faculties that directly relate to (the use of) the ICT product(s) are of interest. This means that all faculties are part of the same user group, seen from the office products. At the time this article was written, no data was available on the actual use to see if the provided services are similar for all students, but the first impressions of the NSC seems to confirm this explanation.

One prominent problem was the interface between the service already provided by the TUEs' ICTS and the service that had to be provided by the new NSC. To be able to reach the needed service levels both parties had to know how some parts of the services were or should be done. The already mentioned difference between the two organisations also asked for the description of parts of the underlying services processes, next to the results descriptions. After all, responsibilities and information transfer had to be made explicit, to be sure that the users would get the services that were defined. This is in contradiction with the stated pre-assumptions on SLAs which focus on results and which pay no attention at all to the processes. Here knowledge of the underlying service processes was essential for mutual trust and understanding by all involved stakeholders, including the ultimately responsible TUE notebook manager.

The need for (some) process descriptions is evident if we think about what the term agreement implies. It refers to a shared goal, which in turn asks for co-operative processes by both client and provider. An agreement therefor should not be seen as a solid contract that can not be adapted and should only be used in case of a conflict. Instead it is a document that tries to bring two or more parties into conformity. Therefor commitments on the results of the service processes will not always be enough. The lesson learned here is:

Lesson 7 In each situation the balance between commitments on results and efforts should be determined between both provider and client in order to be sure of the needed co-operation.

For the defined service processes (incident handling, user support, change management, configuration management and service management) the serviced objects like standard software, faculty software, etc. were described (see figure 1 in appendix). This resulted in explicit norms with which the service processes should comply.

Together these lessons show that the user focus and structured approach of the SLA process are very important. By focussing on the client and by developing the SLA step by step the client was able to discuss and contribute to the SLA making process and the final agreement. Both aspects lead to a well-structured and understandable document, which is the basis for successful service delivery.

6 CONCEPTS FOR SPECIFYING SERVICE LEVEL AGREEMENTS

This section presents concepts for SLAs and the SLA development process. Concepts are being considered as theoretical constructs or well-founded principles. The concepts that will be addressed hereafter represent understandings that have evolved from the pre-understandings that have been used as a reference basis during the case studies. The concepts for SLAs and SLA development that have emerged from the lessons learned cover the following subjects:

- the key underlying principle of Service Management (why);
- the content of a SLA (what);
- the development of a SLA (how).

6.1 The main underlying principle: Service Management is a continuous process

General service management literature often proposes that quality should be defined as “meeting and/or exceeding customers’ expectations”. However, in many cases there exists a gap between what a customer needs and what a service provider is able or is willing to provide. Based on the case studies and in particular the lessons learned, the identification of the needs of a customer, the design and implementation of a service process, and the learning about and the improvement of the service should be considered as a continuous process. For this continuous process a model has been developed that is called the Service Management Lemniscate, see Figure 2.

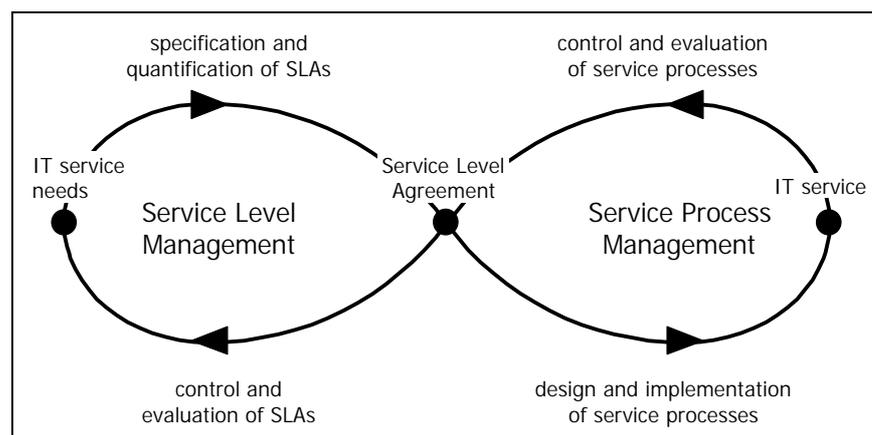
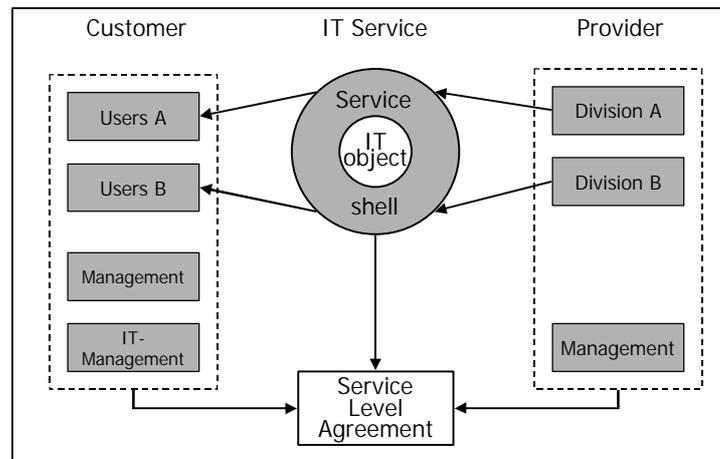


Figure 2 The Service Management Lemniscate

This model has to be interpreted as follows. The service needs of a customer have to be covered by the IT service of a particular service provider. Therefore the IT needs have to be identified and specified in Service Level Agreements. The SLA is the central point in the Service Management Lemniscate. In a specified SLA the two (opposite) parties have to reach an agreement, both on the IT services to be provided and the level or the quality of the services. The Service Management Lemniscate shows the role and the importance of a SLA as a means for bridging the gap between a user and a service provider. A SLA supports the communication about services and forms a basis for the implementation of the service processes. The Service Management lemniscate also stresses the importance of evaluation, learning and improving, both of the service processes and the SLA.

6.2 The content of a SLA: pit, shell, components and levels

Figure 2 presents a SLA and its context, i.e. the various parties that play a role, the IT service itself and the interrelations with a SLA. Where Figure 2 presented a main principle of SLA development in an abstract way, Figure 3 addresses more in detail the meaning of some of the key concepts in the Service Management Lemniscate.



Hereafter the concepts in will be clarified. The following paragraph discusses the content of a SLA, respectively the IT service itself, the levels of IT services and the hierarchical structure of a SLA.

Hereafter the concepts in will be clarified. The following paragraph discusses the content of a SLA, respectively the IT service itself, the levels of IT services and the hierarchical structure of a SLA.

Figure 3 Key concepts of a SLA

Service pit and service shell

From the case studies we learned, see for instance Lesson 1 Paragraph 5.3, that every user need regarding IT services can be traced back to tangible IT objects. This shows that an IT service should be considered as consisting of a so called kernel or pit (i.e. an IT object) and a shell that surrounds the pit. Examples of this pit are respectively an information system, a network application, or a component of an IT infrastructure. The shell consists of a set of service processes that are carried out by a service provider to establish or to improve the agreed quality of the serviced IT objects. This notion of a pit is in conformance with general service management literature (e.g. Sasser, 1978) in that services are often considered to be combined product/process entities.

The initial requirements regarding the function and the performance of IT objects are derived from the role and position of IT objects in business processes. The objective of IT objects is that they ultimately cover the information needs of the users. IT services are needed for the management and exploitation of IT objects in business processes. Therefore the specification of IT services will always refer to (an) IT object(s) and its surrounding business processes. The structure and content of the shell reflect, in the ideal situation, the needs of a customer's business system regarding the service to be delivered.

Practice shows us that one IT service can contains any number of IT objects. Two different situations can be identified: an IT service such as 'office automation' covers a variety of IT objects, e.g. a desktop computer, a notebook, a printer, etc, or, as in the Notebook case in section 5, an IT service contains a large number of the same IT objects. In both situations the basic 'pit and shell' concept is still applicable. For the latter situation the service for these 'multiple pits' must be divided into instances of the pit; one instance for each IT object. For all 5000 notebooks the same IT service has been described in the determined SLA. In the first situation the different IT objects are part of a larger IT system. This system is the pit of the IT service 'office automation'. The 'pit and shell' concept is therefore also applicable in this situation. Figure 3 explain this coherence between IT object, IT component, IT system and IT infrastructure. It represents the two types of IT objects that are distinguished in this paper, namely the IT system and the IT infrastructure. They are defined as follows:

- IT component:
An entity that supports the processing, the storage, the distribution, the input and the output of data.
- IT system:
A coherent collection of IT components that is intended to perform a collection of functions to support particular groups of end-users in a particular business processes.

- IT infrastructure:
A collection of IT components that is used by multiple (more than one) IT systems.

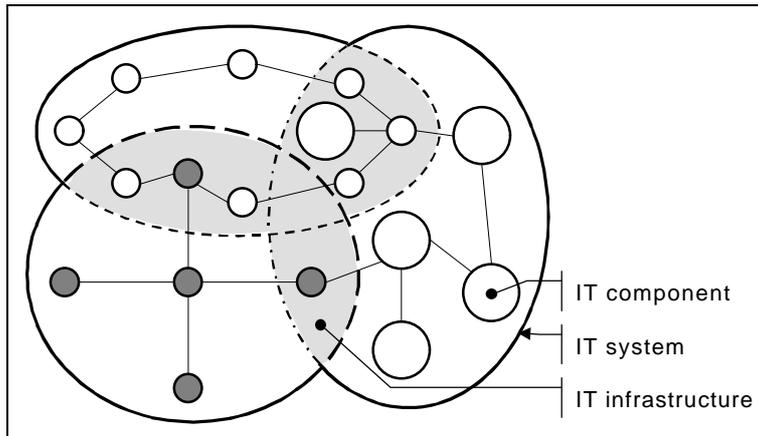


Figure 4 Three types of IT objects and their interrelations

Service components and service levels

The service components that we addressed in pre-understanding VI are a collection of service topics that have been recognised in practice in a large number of SLAs. Considering an IT service as consisting of a pit and a shell, service components can respectively address the quality of an IT service process and the quality of an IT object. The first type of service components is 'effort related'. The second type of service components is 'result related'.

In Lesson 7 (see Paragraph 5.3) we learned that collaboration between a provider and a customer regarding the determination of SLA components is of utmost importance. Each service component, both service processes and IT objects, have to be understandable for both customers and service providers. With respect to the main underlying principle of service management, i.e. the bridging of the gap between customers and service providers, service processes should be directly visible for a customer, such as User Support (or Helpdesk management). This means that service processes such as Problem Management should not be specified in SLAs. Customers want and need to leave this to the provider who has to implement these types of provider processes. If these processes are not properly implemented and carried out by a service provider this will be reflected by the quality measurement, e.g. the performance or the availability, of the IT objects or the delivered IT services

Table 1 combines the object and process oriented quality aspects. The vertical dimension contains the IT object and the IT service processes that form the shell around it. In fact these are the components of the IT services. For each of these IT service components agreements have to be made regarding the quality or the level of the service. The processes, which are listed in the vertical axis, are the results of literature study and empirical research. On the horizontal axis the quality aspects (or characteristics) of both the IT object and its surrounding IT service processes are listed.

For each IT object its product related quality has to be described. The IT object has to perform certain functions (functionality), within a certain time (performance). The product must be reliable (and thereby available) to a certain degree and it will be able to handle a certain amount of users, commands, etc. (capacity). These four quality related characteristics are also applicable to the service processes or service components that form the shell around the pit. For instance an agreement on user support should include the kind of questions that can be handled, the reaction times on these questions and the number of questions that can be handled without capacity problems. It also has to state when and where user support is available.

The combination of the horizontal and vertical axis describes the quality that must be quantified in the service level agreement.

Object and Process Components		Quality Characteristics			
		Availability	Performance	Functionality	Capacity
Service Subjects	IT Object				
	Security				
	Calamity				
	User Support				
	Education				
	Change Management				
	Reporting & Evaluation				
				

Table 1 The SLA Object and Process Components

A set of agreements on the quality of service components (both service processes and IT objects) forms a Service Level Agreement. At the horizontal dimension the quality attributes are positioned. In accordance with pre-understanding I and V for each of the attributes a service level should be specified, reflecting the quantified performance of a service process/IT object/attribute combination.

6.3 The development of SLAs: knowing the actors and following a structured approach

Knowing the actors

In practice often a large number of different parties (or actors) are involved in the life cycle of an IT service. Each of these parties should play a role in the SLA specification process to assure the acceptance and the effectiveness of a SLA. The case studies left us with some unsolved questions regarding this participation. Lesson 4 of the first case study says that the managers of the stakeholders should be involved right from the start of the SLA specification process. In another case study the situation was so complicated regarding the number of parties involved that these actors and their interrelations could not be determined at the beginning of the SLA specification processes.

Following a structured approach: linear or iterative

A number of lessons learned emphasise a structured approach for SLA development. Lesson 2 showed us that it is better to untangle first the different components of an IT service and Lesson 1, 4 and 5 tell us something about the way the SLA specification process should be started. Of course these lessons, or guidelines, only address a small part of the total SLA specification process. However it has become clear during both the case studies, that the explicit and formal structuring of the SLA specification processes is of utmost importance. Both a linear and an iterative process can be necessary. For example in another case that we studied it became clear that the SLA was not specified in the context of a pure service provider/external customer relation. In fact it was an internal business situation in that it was needed to follow an iterative approach. The first steps in the provision of IT services started even without a clear SLA specification and only a vague notion of what the customer needed. Consequently this vague notion has been transformed stepwise, on the basis of experiences, in an effective and suitable service.

7 CONCLUSIONS

Based on explicitly defined pre-understandings, empirical research has been carried out on the identification and the specification of Service Level Agreements (SLAs). Lessons learned from case studies provided us with a basis of reference for the development of an underlying foundation for the specification of SLAs. This underlying foundation provides practitioners with a set of operational SLA concepts. Future empirical research will focus on the refinement and the enrichment of the SLA concepts and the development of a coherent set of tools for the specification of SLAs.

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APPENDIX 2 PART OF THE SLA ON NOTEBOOKS

The following parts belong to the concept service level agreement on notebooks for the Eindhoven Technical University.

SLA Structure

The document consists of four parts. It starts with the introduction part, which contains an overall view of the service situation and the goal of the agreement, followed by the 'organisation and communication' section.

Section three describes and defines the service and service levels based on the different serviced objects. Section four describes for each service process the interaction between the involved parties, again based on the serviced objects. This results in the following table of content.

[...]	
Section 3.	Service Provision
3.1.	Introduction
3.2.	The serviced objects (of the notebooks)
3.3.	Service Levels
3.3.1.	Opening hours NSC
3.3.2.	Availability
3.3.3.	User Support
3.4.	Definitions
Section 4.	Service provision processes
4.1.	Priorities and norms
4.2.	Incident Management
4.2.1.	Parties and responsibilities
4.2.2.	Diagnose process (overview)
4.2.3.	Activities for serviced object A (Basic Hardware)
4.2.4.	Activities for serviced object B (Additional Hardware)
4.2.5.	Activities for serviced object P (Basic Software)
4.2.6.	Activities for serviced object Q (Faculty Software)
4.2.7.	Activities for serviced object R (Additional Software)
4.3.	Change Management
4.3.1.	Parties and responsibilities
4.3.2.	Activities for serviced object A (Basic Hardware)
4.3.3.	Activities for serviced object B (Additional Hardware)
4.3.4.	Activities for serviced object P (Basic Software)
4.3.5.	Activities for serviced object Q (Faculty Software)
4.3.6.	Activities for serviced object R (Additional Software)
4.4.	User Support
[...]	

Figure 5 Part of SLA table of content

This partial table is provided to give some insight in the way the document is structured. On the next page the SLA component availability is described in a detailed manner.

SLA component availability

Following paragraphs contain pieces of the original SLA document. Goal is not to describe the component availability to its full content, but to give some directions in unravelling an unclear or vague component like availability.

In three figures the description of availability, the definition and part of the actual figures are given.

One component of the provided service is to make and keep the notebooks available. By solving Incidents as quickly as possible the Notebook Service Centre strives for a high availability rate. [...] In calculating the availability rate the severity of Incidents is represented: the more severe an Incident is, the more it negatively influences the availability rate.

Figure 6 Part of the description

Availability The degree to which a notebook functions in accordance with the set specifications, during opening hours of the Notebook Service Centre.

Availability rate The availability rate a an individual notebook per month is calculated using the following formula:

$$A_n = \frac{(st - \sum_{i=1}^{I_n} D_i \times W_i)}{st} \times 100\%$$

where;

- A_n : Availability rate of notebook n
- st : Service time
- I_n : Number of Incidents per month of notebook n
- D_i : Downtime of Incident i
- W_i : weight of Incident i ;
 $W_i = 1$ for Incident type 1,
 $W_i = 0,6$ for Incident type 2,
 $W_i = 0,1$ for Incident type 3.

Service time The agreed period of time, during which the availability rate is calculated. This is the number of working days per calendar month times the opening hours of the Notebook Service Centre.

Figure 7 Part of the definitions

In order to organise reported incidents each incident is prioritised. The ascribed priority depends on both the period during which the incident is reported and the type of incident.

[...]

This table presents the priorities and subsequent problem solving times.

Problemsolving times for Incidenten		
Priority	Problem solving time, goal A	Problem solving time, goal B
1	1 hour	4 hour
2	2 hour	8 hour
3	4 hour	16 hour
4	8 hour	16 hour
5	16 hour	24 hour

- 95% of all reported incidents will be solved according to goal A.
- 99.9% of all reported incidents will be solved according to goal B.

These percentages are calculated per calendar month.

Incidents that are not solved within the 'goal B' times shall be reported individually in the monthly service level report.

Figure 8 Part of availability service level