Fachhochschule Wiener Neustadt
> Technische Studiengänge

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Research Paper

Realization of the Availability and Capacity Management processes in compliance with ITIL® using the example of the University of Applied Sciences Wiener Neustadt by determining knowledge of experts from Austria and the USA

Master degree program
Computer sciences

Specialization: IT management

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Author

Mai 2012
Date

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I assure you,

I have independently written this research paper and neither other than the specified sources and tools nor any unauthorized assistance used.

15.05.2012

Date

Signature

Kurzzusammenfassung:

IT Service Management ist ein Ansatz, der IT-Organisationen nachhaltig befähigen soll, den Kunden Nutzen in Form von Services zu stiften. ITIL stellt ein Referenzmodell zur möglichen Umsetzung von IT Service Management in IT-Organisationen dar.

Bei der praktischen Umsetzung der ITIL-Empfehlungen sehen sich viele IT-Organisationen mit einem Problem konfrontiert. Notwendige Funktionen und Prozesse werden durch ITIL zwar detailliert spezifiziert, allerdings erfahren IT-Organisationen eine nur unzureichende Unterstützung im Wandel von der Technikzentrierung hin zur Serviceorientierung.

Die vorliegende Master Thesis veranschaulicht die praktische Umsetzung der Availability- und Capacity Management-Prozesse nach ITIL am Beispiel der Fachhochschule Wiener Neustadt. Dabei fließen die praktischen Erfahrungen ausgewählter Experten in die vorliegende Arbeit ein.

Schlagwörter:
IT Service Management, ITIL, Availability Management, Capacity Management
Verfügbarkeit, Kapazität

Abstract:

IT Service Management is an approach which empowers IT organizations to provide value to their customers in the form of services. ITIL is a framework which specifies a possible implementation of IT Service Management within IT organizations.

The realization of the recommendations concerning ITIL is a problem for many IT organizations, because ITIL specifies the essential functions and processes in detail, but does not really provide assistance to IT organizations regarding the change from the technological to the service orientation.

This master's thesis shows the realization of the Availability and Capacity Management processes in compliance with ITIL using the example of the University of Applied Sciences Wiener Neustadt. In doing so the practical experience of chosen experts is integrated.

Keywords:
IT Service Management, ITIL, Availability Management, Capacity Management
Availability, Capacity

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1 Introduction

1.1 Intention and method of this paper

The realization of the recommendations concerning ITIL is a problem for many IT organizations, because ITIL specifies the essential functions and processes in detail, but does not really provide assistance to IT organizations regarding the change from the technological to the service orientation. Although ITIL answers to the question what to do in order to accommodate IT Service Management (ITSM) ITIL does not provide assistance regarding its implementation. For this reason many IT organizations have troubles with the realization of the recommendations concerning ITIL since they do not really know how to implement the specified functions and processes.

ITIL is built up of four functions and 26 processes which are closely entwined with each other. ITIL processes are constrained of each other because they are mutual input and output sources. This fact raises the question how to implement a process which needs input from another not (yet) existing process.

The knowledge regarding the implementation of ITIL functions and processes exists in the practical experience of experts (who mostly work in business consultancies). The ambition of this paper is to determine the intrinsic knowledge from appropriate experts. Thereby this paper provides assistance to IT organizations which face the implementation of Availability Management (AM) and Capacity Management (CM) as well as related processes concerning ITIL. In doing so the realization of the AM and CM processes is demonstrated using the example of the IT organization of the University of Applied Sciences Wiener Neustadt (UASWN).

1.2 Research question

This paper concerns with the superior research question how AM and CM processes following ITIL can be realized within IT organizations considering effectiveness as well as efficiency. For that purpose the superior research question is divided into following subordinated research questions:

1) Does the definition of the term “service interruption” in compliance with ITIL accord with the service-oriented approach?
2) Are the recommendations of ITIL regarding Service Failure Analysis (SFA) effective as well as efficient and how are they handled in practice?
3) Which relevance have requirements analysis in practice when planning and designing of new and changed services?
4) How do organizations deal with costs and risks of service’s availability and unavailability in practice?
5) What are the lessons learned when introducing the AM and CM processes in compliance with ITIL and how could a possible approach to introduce these processes look like?

1.3 Structure of this paper

Chapter 1 introduces the interested reader of this paper to its intention and method as well as the superior research question divided into five subordinated research questions.

Chapter 2 addresses ITSM and ITIL from a general perspective. Both are essential for a further understanding of this paper's sequel. The relevance of ITSM for business as well as IT is demonstrated, the "service" term is explicated, and finally ITIL is shortly dealt as possible approach to implement ITSM.

Chapter 3 presents the UASWN with its status quo and target condition from the ITIL perspective.

Chapter 4 treats the determination of practical experience of appropriate experts by qualitative interviews which represent a significant part of this paper. The decision to use qualitative interviews as preferred research method and their prerequisites are highlighted. All questions and answers of the qualitative interviews are finally contrasted with each other.

Chapter 5 and 6 address the AM and CM processes from a theoretical perspective. The focus and objectives of these processes as well as their value contribution to the business are explicated. The core principle of each process is demonstrated including their interfaces to other ITIL processes, Critical Success Factors (CSF), and Key Performance Indicators (KPI).

Chapter 7 deals with the realization of the AM and CM processes in consideration of the service scope and the Service Asset and Configuration Management (SACM) process as prerequisite.

Chapter 8 finally handles all key findings in a conclusion.

2 IT Service Management and ITIL

2.1 Relevance of IT Service Management for business and IT

Business processes are indispensable for the creation of operational performance [Ros06]. Organizations devote a special attention to their IT when they realize their business processes.

In the past IT was noticed only as a business supporting role. However in presence IT generally represents a strategic asset that organizations can gain a sustainable competitive advantage.

Business processes supported by IT represent a limited value at best; maximum value is accessible only through continuous interaction between business and IT. Therefore IT has to align with the business; it must elicit the requirements and needs of the business regarding quality and quantity and appropriately react to them.[1] The alignment of IT on business is often referred to in the literature as a business-IT-alignment.

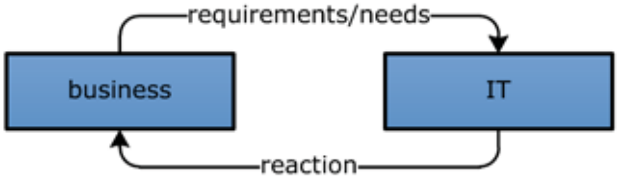

Figure 1: Business-IT-alignment cycle

IT organizations generally act as an IT Service Provider (ITSP) of an organization or any of its organizational units and their task is to completely support them. Therefore IT organizations have to pay attention on business-IT-alignment because it "aims to ensure that IT assets are being used efficiently to assist the entire organization [Buc08, p. 3]." But holistic assistance implies more than the supply of an organization with hardware and software; in fact IT organizations have to understand the business of their customers and accordingly align themselves.

Business-IT-alignment is not only an issue of an IT organization; rather it includes all management levels and so it is an integral part of IT governance. "IT governance is the organizational capacity exercised by the board [of directors], executive management, and IT [and business] management to control the formulation and

[1] Cp. figure 1 (Business-IT-alignment cycle).

implementation of IT strategy and in this way ensure the fusion of business and IT [Van08, p. 5].”

For the sake of completeness it must be said that IT governance is also an integral part of enterprise governance.

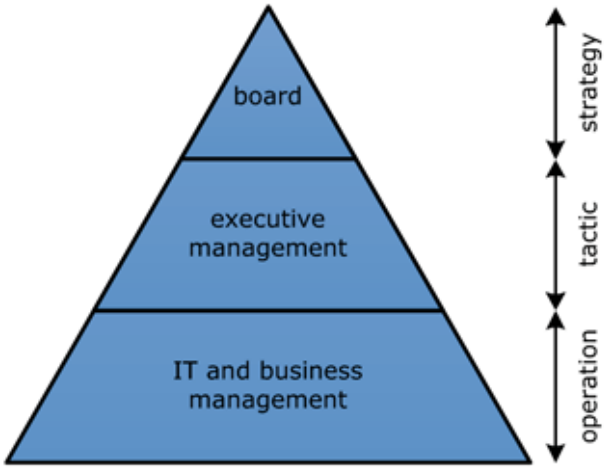

Figure 2: Three levels of IT governance responsibility [Van08, p. 6]

The “IT governance” and “ITSM” terms can cause confusion because they are on everyone’s lips and often used differently by different groups of people in different IT organizations. PETERSON provides an insight into the differences between these terms; “whereas the domain of IT [Service] Management focuses on the efficient and effective supply of IT services and products, and the management of IT operations, IT governance faces the dual demand of contributing to present business operations and performance, and transforming and positioning IT for meeting future business challenges [Pet04, p. 44].”

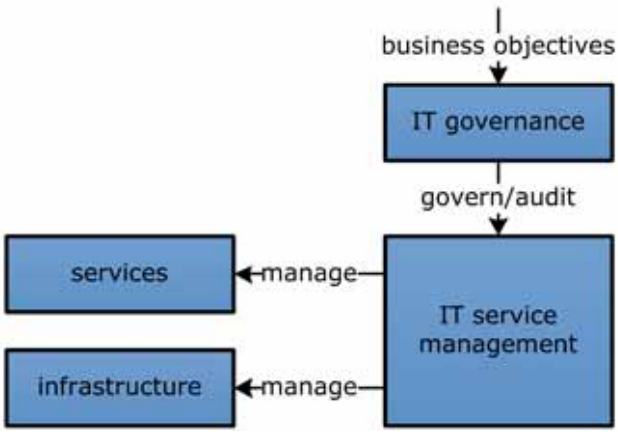

Figure 3: Relational model between IT governance, ITSM, services, and infrastructure [Sal04, p. 3]

For the purposes of this paper the ITSM term is defined as "a set of specialized organizational capabilities for providing value to customers in the form of services [Cab11a, p. 15]."

This means ITSM should sustainably enable IT organizations to provide value to their customers or the business in the form of services; the tactical and operative management layers are most responsible to it.[2]

2.2 Services: The intangible phenomena

2.2.1 Services in general

There are numberless definitions of the "service" term in the literature. This term is also used in different contexts of the everyday life. For this reason it is necessary to define this term at first.

Within the meaning of CLERC & NIESSINK a service is "a set of benefits that is created by activities and delivered by one party to another [Cle05, p. 19]." According to ITIL 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 [Cab11a, p. 13]."

For this purposes of this paper both terms are correct. Unfortunately the characteristics of services are not sufficiently defined by the ITIL core literature. For a holistic understanding of what a service is a further determination of its characteristics is necessary. CLERC & NIESSINK have identified the following characteristics of services [Cle05, p. 19]:

1) Intangibility: Intangibility means a service is not touchable. Therefore it is not possible to assess a service's quality before consumption.
2) Heterogeneity: Services are created by processes. These processes do not have homogenous input factors such as material but heterogeneous input factors such as capability, knowledge, material, and people.
3) Simultaneous production and consumption as well as perishability: The consumer of a service is always involved to its production. If a service is not consumed immediately after its production it will vanish what means it is not possible to keep a service in stock.

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[2] Cp. figure 2 (Three levels of IT governance responsibility); p. 10.

2.2.2 IT services

According to ITIL is an IT service "a service provided by an IT service provider […] [which] is made up of a combination of information technology, people and processes [Cab11a, p. 13]".

However HUPPERTZ ET AL. define an IT service as a bundle of benefits, which is

1) provided by a service provider's activities,
2) generated by IT and non-IT equipment,
3) sold by the service provider to the service customer,
4) provided to the staff of the service customer and other eligible persons, and
5) used by the service users to do their business tasks and to support them respectively [Hup06, p. 17].

Referring to the business-IT-alignment cycle[3] it is essential to an ITSP to know the requirements and needs of its service customer; otherwise business is unsuccessfully done.

All integral parts of an IT service lifecycle are demonstrated with the help of the following figure. Thereby the question why an IT service is more than a bare mix of IT products should also be clarified finally. It is explicitly stated that the following IT service lifecycle[4] demonstrates the service-oriented approach and should not be confounded with ITIL.

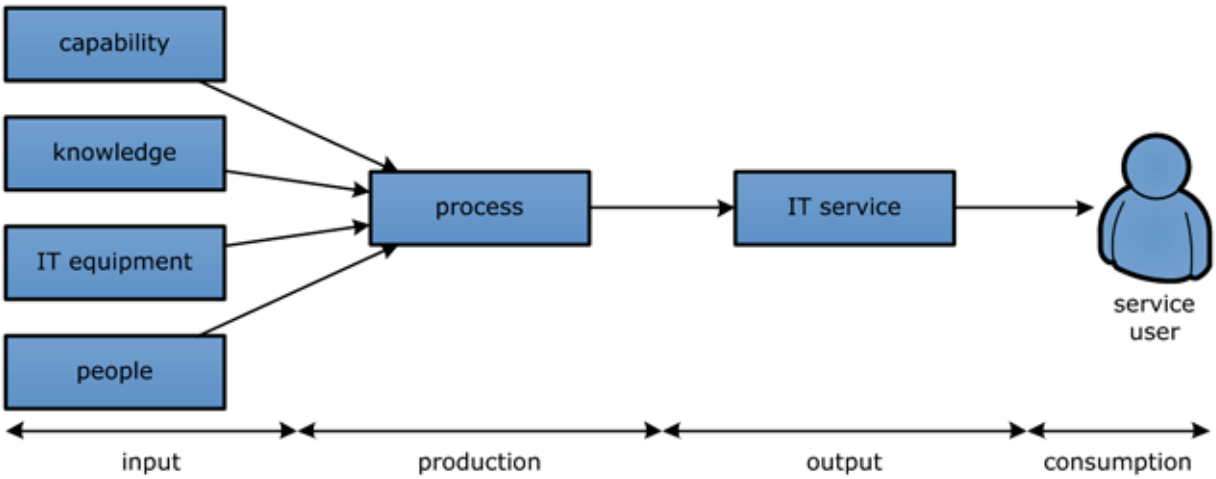

Figure 4: IT service lifecycle

[3] Cp. figure 1 (business-IT alignment cycle); p. 9.
[4] Cp. figure 4 (IT service lifecycle).

The production process of an IT service is triggered by the demand of its user. Of course the production process of IT services need input factors which flow into this process; these input factors are capability, knowledge, IT equipment, and people:

1) Capability: An IT organization must have a structural organization as well as a process-oriented organization. The structural organization grants stability and expertise whereas the process-oriented organization cares the focus to the customer. It is also very important to fix a service-oriented mindset within an IT organization to fulfill the requirements and needs of the customer. A continual improvement of an IT organization's capability is highly recommended.[5]
2) Knowledge: Knowledge implies not only expertise but also knowledge about the customers to ensure fulfillment of the specific requirements and needs.
3) IT equipment: Of course IT equipment (hardware and software in general) is also necessary for an IT service's production process. The following table provides an additional insight into the difference between an IT product and an IT service.[6]
4) People: People are a serious part of an IT service's production process. In addition to their expertise and service-oriented alignment methodological skills such as project management and social skills are vital too.

The listed input factors make the production process of an IT service possible which outputs a specific IT service. Finally an IT service is simultaneously consumed by the service user to its production.

Criteria	IT products	IT services
Tangibility	Tangible	Intangible
Identity	Identic production	Individual production (therefore variation is possible)
Divisibility	Divisible	Indivisible
Verifiability	Verifiable (at original)	Unverifiable (until production and simultaneous consumption)
Production period	(Maybe) different to consumption	Identic to consumption
Production process	Without user participation; production can be interrupted without any handicap for the product or user; failures can be corrected without impact to the user	Requires user participation; production must not be interrupted because any interruption impinges the service and/or user

Table 1: Differences between IT products and IT services (1/2) [Hup06, p. 23]

[5] Cp. e.g. Capability Maturity Model (CMM) of the Carnegie Mellon University.
[6] Cp. table 1 (differences between IT products and IT services (1/2)) and table 2 (differences between IT products (2/2)); pp. 13-14.

Criteria	IT products	IT services
Consumption period	Different to production period	Identic to production period
User participation	Uninvolved in production process	Completely involved in production process
Usability	Repeatedly applicable	Only once applicable (then vanished)
Measurability	Measureable	Not measureable (because of its intangibility)
Ability to rework	Possible	Impossible (because of its simultaneous production and consumption)
Transportability	Transportable	Not transportable (because of its intangibility)
Time-dependence	Independent	Dependent (because of it simultaneous production and consumption)
Suitability for storage	Suitable for storage	Not suitable for storage (because of its intangibility)
Ability to produce on reserve	Able to produce on reserve	Not able to produce on reserve
Consistency	Consistent (waste possible)	Vanish immediately after its production (waste impossible)
Ownership	Able to own	Not able to own

Table 2: Differences between IT products and IT services (2/2) [Hup06, p. 23]

An IT service delivers value to its customer if it meets the customer's expectations regarding utility and warranty. "Utility is the functionality offered by a […] service. Warranty is an assurance that a […] service will meet its agreed requirements [Cab11a, pp. 17-18]." The following figure demonstrates value creation of an IT service through utility and warranty.[7]

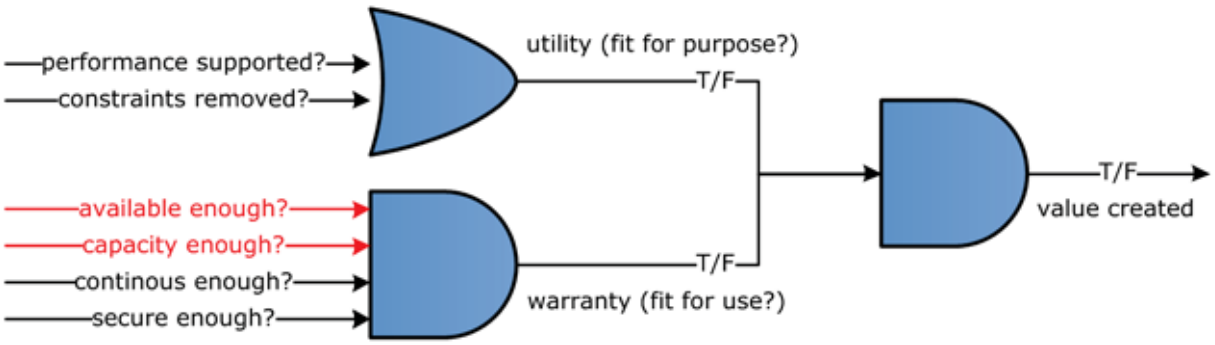

Figure 5: Value creation of an IT service through utility and warranty [Cab11a, p. 18]

This paper has its focus on availability and capacity which are both (red marked and) included in the warranty of an IT service.

[7] Cp. figure 5 (Value creation of an IT service through utility and warranty).

2.3 ITIL as an approach to implement IT Service Management

ITIL was named several times in former chapters why this term is enlarged in this subchapter. The purpose of this subchapter is to convey a basic knowledge of ITIL which is required for a further understanding of this paper.

After its authors ITIL represents a “part of best-practice publications for IT Service Management [Cab11a, p. 3].” It was developed in the late 1980’s by the Central Computing and Telecommunications Agency (CCTA) which was a former agency of the government of the United Kingdom. “The reason for commissioning the CCTA was lack of quality of the IT services procured by the British government, so that a method had to be found to achieve better quality and simultaneously decrease their costs. The objective was to develop effective and efficient methods for the provision of IT services […] which is today known as ITIL [Kem11a].”

In its relevant version of July 29, 2011 ITIL is built up of four functions and 26 processes, which are closely entwined with each other. ITIL is a complex framework for a best-practice realization of ITSM and can be applied in all IT organizations. ITIL orientates oneself to the IT service lifecycle and is divided into five books which represent the ITIL core literature:

ITIL Service Strategy

“ITIL Service Strategy […] provides guidance on how to view service management not only as an organizational capability but as a strategic asset. Topics covered in ITIL Service Strategy include the development of market spaces, characteristics of internal and external provider types, service assets, the service portfolio and implementation of strategy through the service lifecycle [Cab11a, p. 5].”

ITIL Service Strategy includes the following processes:

1) Strategy Management for IT Services
2) Service Portfolio Management
3) Financial Management for IT Services
4) Demand Management
5) Business Relationship Management

ITIL Service Design

“ITIL Service Design provides guidance for the design and development of services and service management practices. It includes the changes and improvements necessary to increase or maintain value to customers over the lifecycle of services, the continuity of services, achievement of service levels, and conformance to standards and regulations [Cab11a, p. 6].”

ITIL Service Design includes the following processes:

1) Design Coordination
2) Service Catalogue Management
3) Service Level Management
4) Availability Management
5) Capacity Management
6) IT Service Continuity Management
7) Information Security Management
8) Supplier Management

ITIL Service Transition

“ITIL Service Transition provides guidance for the development and improvement of capabilities for introducing new and changed services into supported environments. IT describes how to transition an organization from one state to another while controlling risks and supporting knowledge for decision support [Cab11a, p. 6].”

ITIL Service Transition includes the following processes:

1) Transition Planning and Support
2) Change Management
3) Service Asset and Configuration Management
4) Release and Deployment Management
5) Service Validation and Testing
6) Change Evaluation
7) Knowledge Management

ITIL Service Operation

“ITIL Service Operation describes best practice for managing services in supported environments. In includes guidance on achieving effectiveness and efficiency in the delivery and support of services to ensure value for the customer, the users and the service provider [Cab11a, p. 6].”

ITIL Service Operations includes the following processes and functions:

1) Processes:
    a. Event Management
    b. Incident Management
    c. Request Fulfillment
    d. Problem Management
    e. Access Management
2) Functions:
    a. Service Desk
    b. Technical management
    c. IT Operations Management
    d. Application Management

ITIL Continual Service Improvement

“ITIL Continual Service Improvement provides guidance on creating and maintaining value for customers through better strategy, design, transition and operation of services. It combines principles, practices and methods from quality management, change management and capability improvement [Cab11a, p. 7].”

ITIL Continual Service Improvement includes only one process, the Seven-Step Improvement Process.

3 Initial situation and task

3.1 The University of Applied Sciences Wiener Neustadt

Founded in 1994 the UASWN is the first University of Applied Sciences in Austria. The UASWN offers a variety of study programs in business, engineering, health studies, security and sport.

Approximately 3,200 students are currently enrolled in these study programs which are offered at the headquarters in Wiener Neustadt and the branch offices in Tulln and Wieselburg.

The UASWN is supported by its own IT organization (UASIT) which represents an IT shared service provider. This type of ITSP means this IT department provides IT services to the entire organization which consists of management, administration, and faculties including their staff as well as students.

3.2 Status quo and target condition from the ITIL perspective

The motivation of the UASWN in 2008 to introduce ITSM in its organization was primarily triggered by two events:

1) A Service Level Agreement (SLA) was initiated by the UASIT and another department of the UASWN which describes the offered services in detail. Thereby misunderstandings could be avoided because the SLA lists in detail which services are provided or not by the UASIT to the other department. Beside the list of offered services this SLA included also further information such as response time or service time.
2) The second trigger was a meeting of the IT managers of all Universities of Applied Sciences in Austria. The IT manager of the UASWN was asked there by a colleague to what extent ITIL is known and if an introduction of ITIL is planned. This question inspired the UASIT to develop a Service Catalogue.

In addition to the Service Catalogue development the UASIT has begun to introduce the Incident Management process by implementing the ITIL Service Desk function and the use of process-supporting software. After this implementation the Event Management process was realized.

To date some ITIL processes are already implemented in different maturity levels. There are ITIL processes which are written down as well as ITIL processes which are lived but not written down:

1) Written down:
    a. Access Management
    b. Event Management
    c. Incident Management
2) Lived but not written down:
    a. Service Catalogue Management
    b. Service Level Management
    c. Supplier Management
    d. Problem Management

The UASIT currently implements the Information Security Management process as well as the AM and CM processes which have the focus of this paper. The decision to introduce the AM and CM processes was triggered by lack of know-how regarding availability and capacity of the offered services. Both availability and capacity are a significant character of a service; therefore it is vital to manage them. The target condition from the ITIL perspective is to implement the AM and CM processes. After this implementation the ITIL process portfolio of the UASWN will consist of ten ITIL processes which is a base for a future maturity level measurement.

4 Determination of expert knowledge by qualitative interviews

4.1 Qualitative interviews as preferred research method

There exists a variety of different methods to determine expert knowledge but not each method is suitable for determining reliable and useful expert knowledge. As aforementioned ITSM and especially ITIL are currently on everyone's lips but only few organizations had already the heart to change to the service-oriented approach and to implement the recommendations concerning ITIL.

Though a lot of experts hold ITIL certifications they do not have enough practical experience in the realization of ITSM with the recommendations concerning ITIL. There are only few experts who have theoretical as well as practical experience. An expert is a person who has a reliable and useful knowledge because of its particular education and job as well as long-term experience.

For this reason only qualitative interviews are suitable to determine the knowledge of the experts to get reliable and useful statements regarding the realization of ITSM with the recommendations concerning ITIL.

The further part of this chapter describes the choice of experts and the approach of execution as well as asked questions and a comparison of the answers. At last an interim conclusion is made.

It is vital for the success of a qualitative interview that the interviewer has at least a basic ITSM/ITIL knowledge because of the development of the research question. An interviewer must have the ability to ask questions on the knowledge level of the chosen experts. I hold an ITIL V3 Foundation certificate and have some practical experience with the Change Management process concerning ITIL.

4.2 Choice of experts

As aforementioned it is absolutely necessary that all interviewed persons have a particular education and job as well as long-term experience. All six chosen experts are certified ITIL experts. Three of them hold an ITIL V3 Foundation certificate and the others hold an ITIL V3 Expert certificate.

The chosen experts are either employees or self-employed persons. All of them act in the business consultancy industry and were involved at least in one ITIL project. Hence the chosen experts were predestined for a qualitative interview.

The original intention of this paper was not only to interview experts from Europe but also from the United States. Unfortunately I could not find any suitable experts who match the aforementioned criteria. The professors as well as the staff of the IT department of my host university were not familiar with ITSM/ITIL although some services like e-mail or Moodle are sourced and operated by external ITSP. Further persons of other universities in the United Stated confirmed my impression that at least in the academic environment ITSM/ITIL do not have the degree of popularity in the United States such as Austria.

4.3 Approach of execution

At the beginning the chosen experts were asked if they would provide themselves for a qualitative interview. The asked questions were sent to them prior to the interview.[8] After their commitment to the asked questions an individual appointment was scheduled and the experts were interviewed either personally or by telephone.

The particular interview journals included data regarding the interviewed experts as well as place, date, and time of the qualitative interview. Their statements were explicitly not captured by an audiotape but their key statements were written down. All experts were asked for permission to cite them by name. The possibility was given to all experts to review their cited key statements prior to the publication of this paper.

[8] Cp. subchapter 4.4 (Asked questions); p. 22-24.

4.4 Asked questions

Question 1:

The AM process in compliance with ITIL defines the term "service interruption" as planned or unplanned downtime of a service. Services are either available or not. So it is not a service interruption in the narrower sense if a service is available but does not meet the agreed service level. It could be a service interruption in the broader sense if the term “service interruption” is extended to the fulfillment of the agreed service level. The hypothesis results that service interruptions do not solely follow by the unavailability of a service, but also exist, if the agreed service level is not fulfilled.

What is your attitude to this hypothesis?

Question 2:

The AM process in compliance with ITIL recommends the execution of an agreed number of SFA per year.

Is the execution of an agreed number of SFA per year realistic and the handle in practice?

Question 3:

Which area of expertise determines the number of SFA per year? Do solely the business and/or the ITSP define this? Would you consider more divisions?

Question 4:

Can you make a statement about the cost-benefit ratio by SFA? Is your experience that SFA significantly increase the service quality?

Question 5:

Which focus do you recommend for the implementation of SFA? Should SFA cover the full service landscape or only certain services?

Question 6:

The requirements analysis is essential in the planning and design stage of new or changing services and captures both functional and nonfunctional requirements. The accuracy and completeness of the requirements analysis correlates with the value creation of the services.

In practice do the business and/or the ITSP pay the same attention to nonfunctional requirements (e.g., availability or capacity) as to functional requirements or do they neglect them?

Question 7:

In your experience what are the causes of poor requirements analysis? Does the ITSP sloppily execute requirements analysis and/or does the business inadequately specify its nonfunctional demands on services?

Question 8:

Do you have practical tips on how to deal with the requirements analysis? Do you prefer certain standards?

Question 9:

ITIL distinguishes between cost, which due to the realization of a service's availability and cost, which due by a service's unavailability.

Are companies aware of the impact which may result of a service's unavailability? Which practical experience have you made?

Question 10:

In your experience how do organizations deal with this risk? Do they take the risk knowingly or unknowingly or do they take actions to avoid respectively reduce the risk? Are such decisions solely made on the base of available budgets or are other factors considered as well?

Question 11:

In your experience do ITSP provide services in a cost-effective manner or do they undersize critical services and/or oversize uncritical services regarding availability and/or capacity?

Question 12:

In your experience what are the most common mistakes when introducing the AM and CM processes in compliance with ITIL and how can they be avoided?

Question 13:

How would you introduce the AM and CM processes in compliance with ITIL if some related processes have not yet been introduced or written down?

4.5 Comparison of the answers

Answers to question 1:

1) Answer of BIRKE [Bir11]: It is only a service interruption if the interruption exceeds the tolerance threshold which is defined in the SLA.
2) Answer of KRIPPEL [Kri11]: This hypothesis has to be rejected or re-written as follows: “The hypothesis results that a service interruption does not solely follow by the unavailability of a service, but also exists, if its service level does not fulfill the quality as explicitly agreed with the customer.” All SLA have to be placed within the organization in a manner so that they can be fulfilled. The Service Level Management (SLM) process is responsible for an optimal realization of the customer needs within the organization. Both the AM and CM processes are triggered by the SLM process; AM has to ensure availability whereas CM has to ensure capacity. A pure binary measurement (available or unavailable) of a service’s availability is a wrong approach because the agreed quality plays a role too. The AM and CM processes cannot exist without specified requirements of the SLM process. Are requirements given by customers or which other motives favor the introduction of the AM and CM processes? Internal ITSP or IT shared service providers are often hostile toward the introduction of the AM and CM processes and try to avoid them at all costs because their introduction leads to liabilities of internal ITSP and IT shared service providers. In contrast external ITSP are more open-minded to the introduction of the AM and CM processes because they are customer-oriented and have their customers in a strong focus. The AM process on the tactical level can reduce incidents on the operational level in any case.

3) Answer of MANN [Man11]: MANN completely agrees with the statement of KRIPPEL but in his opinion the AM process must be expanded to confidentiality and integrity.
4) Answer of RIEGLER [Rie11]: According to RIEGLER it is only a service interruption if the SLA is violated. The promised availability and capacity must be guaranteed. The SLA is specific and individual. There are no templates for this purpose. Measures must be taken to hold the SLA. The costs (e.g., high availability) are significant. In the event that the service level is violated ITSP often satisfy their customers with refunds (e.g., voluntary penalty) in months with service violations.
5) Answer of RÖMER [Röm11]: This hypothesis has to be rejected. It is indeed meaningful but the terms are incorrectly defined. There must be a clear distinction between a service interruption and a violation of the service level. A service interruption does not necessarily lead to a violation of the service level. For example, when a service was available to 98% in a given period, however, availability is defined by 95% the service level was not violated.

Answers to question 2:

1) Answer of BIRKE [Bir11]: It is realistic to define a certain number of SFA. This number must, however, be adapted to the actual needs and risks. The continuous adaption is triggered by the SLM process in the case of changes of SLA. Note: BIRKE has seen the execution of SFA only once in practice. So he believes that SFA are rarely executed.
2) Answer of KRIPPEL [Kri11]: SFA should be executed parallel to the service's Availability Reports especially if there are frequent service level violations within the observation period (cp. SLA Monitoring Chart). The execution of SFA once a year is sufficient for stable services.
3) Answer of MANN [Man11]: The execution of an agreed number of SFA per year is realistic. Note: MANN refers to the Business Impact Analysis (BIA) which ultimately triggers SFA.
4) Answer of RIEGLER [Rie11]: In the opinion of RIEGLER SFA need to be settled in the area of risk management. Risk management is insofar essential as an IT organization needs to have knowledge about which data are available on which systems to restore them in the case of an emergency. In general an

annual revision of the SFA is executed. The annual revisions usually are not reduced to single services but on the overall concept of an organization. The services are categorized according to protected objects. In the opinion of RIEGLER SFA have a hybrid position between ITSM and risk management.

5) Answer of RÖMER [Röm11]: There are few organizations which have linked their services with the underlying resources. At least RÖMER does not know organizations which do so. The common approach is the Component Impact Failure Analysis (CFIA) which is associated with the services.

Answers to question 3:

1) Answer of BIRKE [Bir11]: The competence to determine the number of SFA falls clearly to the ITSP which must ensure that the offered services can be provided in the agreed manner (cp. SLA). In case of violations or threats of a SLA the ITSP has to decide which services are considered as part of a SFA. If this decision would fall to the business it is too late for the ITSP to intervene.
2) Answer of KRIPPEL [Kri11]: The competence to determine the number of SFA falls clearly to the ITSP. As a general rule the ITSP has lack of arguments in justification to the customer in the case of service level violations. The SFA is a tool for early detection which can help an ITSP to move from reactive to proactive behavior.
3) Answer of MANN [Man11]: The competence to determine the number of SFA falls clearly to the ITSP. MANN believes, however, that the measurement of availability may not solely happen on the part of the ITSP but also on the part of the business. In general the monitoring is only done by the ITSP what is not correct in the opinion of MANN. However there are organizations which outsource their entire IT infrastructure and thus measure themselves. MANN considers this approach to be wise.
4) Answer of RIEGLER [Rie11]: The competence to determine the number of SFA falls clearly to the ITSP.
5) Answer of RÖMER [Röm11]: The competence to determine the number of SFA falls clearly to the ITSP. The ITSP must ensure that the offered services can be provided in the agreed manner (cp. SLA). In case of violations or threats of the SLA the ITSP has to decide which services are considered as

part of a SFA. If this decision would fall to the business it is too late for the ITSP to intervene.

Answers to question 4:

1) Answer of BIRKE [Bir11]: BIRKE has no practical experience with the execution of SFA. Therefore he cannot make a statement about the cost-benefit ratio by SFA. BIRKE believes that increases in quality by SFA are difficult to measure but in his judgment quality is increased by SFA.
2) Answer of KRIPPEL [Kri11]: KRIPPEL is of the opinion that it is not possible to initiate and measure improvements without SFA. An ITSP must be prepared to commit to and implement SFA which is dependent on the maturity level. If there is willingness SFA must be implemented adequately. Improvements can be initiated only by measurements and the SFA is a prerequisite for these measurements.
3) Answer of MANN [Man11]: From the perspective of MANN the SFA is a structured risk analysis. Anything that is not measured cannot be controlled. In the project experience of MANN the quality could be sustainably increased in all projects for which SFA or similar methods were used.
4) Answer of RIEGLER [Rie11]: The more SFA and other tests are executed the higher the quality. From a cost perspective SFA should be applied only to the critical services. If the execution of SFA requires additional costs the budget must be approved by the business. It is here the fate of the IT manager to make the benefit of SFA tangible for the business.
5) Answer of RÖMER [Röm11]: The cost-benefit ratio of SFA is dependent on the degree of analysis. The shorter the time intervals between SFA the higher are the resulting costs. The more stable a service is the worse a high sampling rate, for example, due to performance loss or license fees. RÖMER has seen too few SFA in practice to represent a general trend regarding the increase of quality of services. An approach at the service level is only followed by organizations if they feel no pain at the resource level because pain will be discussed at the resource level. An important critical success factor (CSF) for SFA is the open culture within an organization or within an ITSP. The technically responsible person of an (partially) unstable service

will be reluctant to let the service being measured or will likely distort the results. The human factor must not be neglected in any case.

Answers to question 5:

1) Answer of BIRKE [Bir11]: Following the Pareto principle the most critical services should be considered at first as part of a SFA. The rest should be checked at random.
2) Answer of KRIPPEL [Kri11]: The services which are covered by SFA have to be narrowed down by scoping. The scope depends on the requirements of the business. All demands regarding service quality must always be higher than the current performance level in order to avoid a standstill which is a backspace. The priority is to implement effectiveness followed by efficiency.
3) Answer of MANN [Man11]: Following the Pareto principle the most critical services should be considered at first as part of a SFA.
4) Answer of RIEGLER [Rie11]: The most critical services should be considered as part of a SFA.
5) Answer of RÖMER [Röm11]: The SFA definitely needs to be executed on the critical services. Following the rooms for improvement needs to be identified in the other services which can be triggered by the business and/or ITSP. The implementation of SFA on the entire service landscape is a desire which is rarely encountered in practice. Note: In the personal opinion of RÖMER the implementation of SFA on the entire service landscape is cost-ineffective in any case.

Answers to question 6:

1) Answer of BIRKE [Bir11]: According to the experience of BIRKE both types of requirements are considered equally.
2) Answer of KRIPPEL [Kri11]: In general functional requirements are usually in the foreground and nonfunctional requirements make them perfect. There is a high emphasis on utility followed by warranty. When using individual software the primary focus is on functional requirements. This means a compromise for nonfunctional requirements in favor of functional requirements. When using standard software warranty against utility is considered.

3) Answer of MANN [Man11]: There is a high emphasis on the functional requirements but the nonfunctional requirements are not neglected. “If the functional requirements are not fulfilled nobody must take care about the nonfunctional requirements.”
4) Answer of RIEGLER [Rie11]: According to the experience of RIEGLER both types of requirements are equally considered. An ITSP is responsible to elicit both the functional and nonfunctional requirements of the business. In planning and dimensioning of a service the business is asked how it intends to use the service. The statement of the business results in the functional and nonfunctional requirements. The underlying resources are then elicited by the ITSP.
5) Answer of RÖMER [Röm11]: Usually less attention has been paid to functional requirements than nonfunctional requirements. Warranty comes before utility. Römer justified this by saying that unlike functional requirements nonfunctional requirements can be measured “hard”. Utility is requested by the business but not measured as opposed to warranty.
6) Answer of SCHROERS [Sch11]: Nonfunctional requirements are clearly neglected whereas functional requirements are usually met.

Answers to question 7:

1) Answer of BIRKE [Bir11]: BIRKE believes that the poor requirements analysis is usually associated with communication problems between the business and ITSP.
2) Answer of KRIPPEL [Kri11]: It is important to distinct between internal and external ITSP. Internal ITSP usually have no need to show binding. Lack of readiness and training as well as the often fact that an internal ITSP has no pressure to act are further reasons. Many IT managers have no relation to the modern ITSM coupled with a weak to non-existent readiness for further development. Lack of common understanding between the business and ITSP as well as lack of a common language are other factors which lead to a poor requirements analysis.
3) Answer of MANN [Man11]: The requirements specification is often sloppily captured. The reasons are the high time pressure and the temptation to work on the operating system without the use of test systems. It must also

be noted that the ITSP is afraid of the business. ITSP often do not bear a reference to the service-oriented approach and this circumstance causes fear of a constructive dialog with the business. In his role as a consultant MANN tries to initiate the flow of words between the business and ITSP. MANN tends to systemic counseling beside specialist counseling which means that he primarily gives no opinion but tries to lead the business and ITSP to their own opinion.

4) Answer of RIEGLER [Rie11]: RIEGLER disclaims strongly that an ITSP sloppily execute requirements analysis. He believes that lack of experience of the IT staff as well as lack of communication between the business and ITSP and lack of internal communication within an ITSP are the most frequently reasons for lack of requirements analysis.
5) Answer of RÖMER [Röm11]: There are three reasons for lack of requirements analysis. Lack of economic and/or technical understanding exists between the business and ITSP which RÖMER traces back to a structural problem. People in organization cannot correctly analyze requirements because they lack the methodology to do so. There is also a missing of the consequences of learning from the past: What really happened? What are the lessons learned? How we make it better in the future? Here the Continual Service Improvement (CSI) approach is recommended.
6) Answer of SCHROERS [Sch11]: The mandatory specifications are often made prior to the requested specifications. This is the wrong approach because it is often the case that the business does not know its requirements. The higher the hierarchy of an organization the lower its know-how regarding requirements.

Answers to question 8:

1) Answer of BIRKE [Bir11]: All relevant decision makers from the departments must be involved in the process of requirement analysis. Standards cannot be determined in general because they are company-specific to an essential part. Note: BIRKE prefers the V-Model.
2) Answer of KRIPPEL [Kri11]: KRIPPEL suggests the creation of standardized contracts and procedures which cover the discussed topics in an adequate and target group-oriented manner. Target group-orientation means that a

standard is not generally applied to all topics. ITSP must face the question of what is important. Based on this question procedures and processes must be created and established in order to allow a standardized approach.

3) Answer of MANN [Man11]: MANN prefers the usage of the BIA.
4) Answer of RIEGLER [Rie11]: RIEGLER prefers standardized requirements analyzes by check lists because this is as simple and complete as possible.
5) Answer of RÖMER [Röm11]: RÖMER suggests either Demand Management (DM) or requirements management. DM is a very young discipline and was not really used until 2000. It is also heavily oriented on the business-IT-alignment approach. RÖMER personally act as follows: He tries to understand the business process to support this afterwards. This raises the question how the business process can be supported by the use of IT. If an answer to this question was found the requirements regarding IT are analyzed. With this approach the business-IT-alignment approach is softened and allows an additional optimization of business processes. This approach bases on very strong interactions between the business and ITSP. The pure business-IT-alignment approach leads to the consequence that the business process is not properly supported because it has not properly been understood by the ITSP or the business process “simply does not work” or cannot be realized. For this reason this approach allows an interdisciplinary perspective.
6) Answer of SCHROERS [Sch11]: It is needed to adapt to the customer. There are customers who are unfamiliar or even suspect structured approaches. This question cannot be answered in general but only in accordance to the customer. It is essential to know what is important for the customer which is a very sensitive issue. A consultant often knows the right way but cannot go this way because the customer does not want to go along. There exist many standards. One of the most common used standards is the Capability Maturity Model Integration (CMMI) SCHROERS is also working with. However requirements management is also possible.

Answers to question 9:

1) Answer of BIRKE [Bir11]: Most organizations are not aware of the costs which due to service's unavailability. Failures are not recognized in most cases and generally accepted as internal costs.
2) Answer of KRIPPEL [Kri11]: Most organizations are not aware of the consequences. If they are aware their awareness is often rudimentary (especially in small and medium-sized enterprises). As a rule the awareness in large organizations is very high. The fact that an ITSP cannot explain correlations to the business is a major reason for the poor to not-existent awareness. This results in the non-approval of budgets.
3) Answer of MANN [Man11]: According to the experience of MANN organizations are not aware of the impacts which due by a service's unavailability. Organizations come down on it more and more that it would be better to have awareness. For this reason risk analyzes are increasingly demanded in the market.
4) Answer of RIEGLER [Rie11]: Initially awareness for the impact of service's unavailability does not exist. Awareness is characterized by the occurrence of service's unavailability events. According to RIEGLER this observation can be made within organizations of all sizes. The attacks of Anonymous as an example have briefly raised awareness but the half-life of awareness is generally short. IT staff attend events and workshops and are faced with risk issues which they relatively quickly forget again.
5) Answer of RÖMER [Röm11]: The cost awareness of ITSP is very strong.
6) Answer of SCHROERS [Sch11]: There is no real answer to this question. Awareness depends on the industry and the customer category (cp. ABC analysis). Category A customers are aware of the impacts and understand the definitions in detail. The higher the customer category the higher its awareness.

Answers to question 10:

1) Answer of BIRKE [Bir11]: In the case that organizations are aware they take actions to reduce risks in form of risk plans. Drivers for it are the Business Continuity Management (BCM) as well as quality management initiatives (e.g., certifications) if these are desired or required by an organization's stakeholders (especially customers and suppliers).
2) Answer of KRIPPEL [Kri11]: Many organizations unknowingly take the risk because the ITSP cannot explain correlations to the business. If the risk is knowingly taken the company has made thoughts at least and accepted the risk in the form of a residual risk.
3) Answer of MANN [Man11]: A knowingly acceptance of risk does not exist. This only unknowingly happens. Risk analysis and risk management are a trend in the market and definitely represent a measure for risk reduction.
4) Answer of RIEGLER [Rie11]: RIEGLER means that ignorance certainly plays a role but he cannot estimate if risks are knowingly or not taken into account. However companies which knowingly accept risks but do not protect themselves have to expect legal consequences since it is a grossly negligent act. In Austria for example information has to be provided to customers when customer data has been stolen. In such cases experts from the court review the proper handling of the data and often determine a grossly negligent handling of the data.
5) Answer of SCHROERS [Sch11]: This question depends on the industry as well as the customer category. "If you are not aware of the risks you cannot act against them." Potential threats must be documented and handled in an economic reasonable manner.

Answers to question 11:

1) Answer of BIRKE [Bir11]: In the experience of BIRKE noncritical services are oversized while critical services are often undersized.
2) Answer of KRIPPEL [Kri11]: The cost-inefficient provision of services occurs insofar as the offered services do not meet the actual needs of the business because they do not often know their needs. Another fact is that many ITSP do not yet think in services, but in hardware, software, etc.

3) Answer of MANN [Man11]: MANN agrees to BIRKE that noncritical services are oversized while critical services are often undersized. The reason for this is redundancy associated with higher costs. A seller of IT infrastructure is interested to sell as much IT equipment as possible. For this reason ITSP need good IT managers who know what is really needed and who can block such sales pitches.
4) Answer of RIEGLER [Rie11]: According to RIEGLER servers are not optimally dimensioned according to the textbook. The budget plays a big role so an oversizing of services is rarely found.
5) Answer of RÖMER [Röm11]: The sizing is usually kept very simple by the rule of thumb. The service-oriented approach has not yet been established in organizations. For this reason the focus is still the resource and not the service. Availability and capacity are both usually oversized for critical as well as noncritical services.
6) Answer of SCHROERS [Sch11]: Ideally the right service is provided to right customer at the right time in the right amount. This depends on who is planning the service. In the case that ITSP plan services are often oversized. An internal ITSP or IT shared service provider still executes a certain might within an organization. Because of lack of intermediation between business and IT services are not adequately sized.

Answers to question 12:

1) Answer of BIRKE [Bir11]: The three most common mistakes are the unclear definition of objectives as well as the omission of certain business areas and last but not least the poor anchoring of procedures and rules in an organization. The omission of certain business areas means that ITIL processes are first implemented in certain business areas but afterwards the scope is not extended to the entire enterprise. The poor anchoring of procedures and rules in an organization means that they are in place but not lived.
2) Answer of KRIPPEL [Kri11]: An ITSP often does not know the needs of the customers because the functional and nonfunctional requirements are not adequately specified. Services can therefore often not or only insufficiently be defined because of lack of understanding the business processes. Lack of mapping between services and business processes can often be traced to

lack of knowledge about the business (What does the business and what does it need?).

3) Answer of MANN [Man11]: The most common mistake of ITSP is not to think in processes. An approach of thinking in processes needs to be introduced and gradually increased. ITIL must be seen and lived as best practice by an ITSP but not at any price. A common vocabulary is necessary for a common understanding.
4) Answer of RÖMER [Röm11]: A missing Configuration Management Database (CMDB) is the most common problem when introducing ITIL processes. A special attention must be paid to the maturity of a CMDB. The maturity of a CMDB determines how effectively and efficiently the components support the strategic goals of the business. The granularity needs to be individually determined. The better the relationship can be understood between the product level and the component level the higher the level of maturity of the CMDB. It is important to demonstrate the relationships between product and service.
5) Answer of SCHROERS [Sch11]: Too much focus on technology and too less focus on the business are the biggest mistakes. The AM and CM processes should always be closely linked. Actually these two ITIL processes should be always established together.

Answers to question 13:

1) Answer of BIRKE [Bir11]: BIRKE suggests a light implementation of ITIL at first which means the implementation of processes whichever currently are possible. Afterwards the maturity of these ITIL processes has to be successively increased by an iterative and incremental approach.
2) Answer of KRIPPEL [Kri11]: The IT infrastructure needs to be documented (cp. CMDB) at first. Apparently missing ITIL processes are running but they are not documented in the wished manner. Interfaces to other not or not fully implemented ITIL processes must be generically described; what is the input and output of these ITIL processes?
3) Answer of MANN [Man11]: MANN would not introduce the AM and CM processes if other ITIL processes are not yet established. When introduced to the situation of the UASWN MANN agrees with the statement of KRIPPEL that

the lack of ITIL processes need to be introduced to selected services. The reason why there is no CMDB in various IT organizations is explained by MANN as follows: “It is the nature of man to reject any documentation so as to protect the job as well as block the career.” This means that IT staff tends to implicit knowledge which they do not want to make accessible to others. In this way they hope to protect the job but will not be promoted because they are needed at their current position due to their implicit knowledge. MANN emphasizes the importance of having a top-down overview. It is important to start with the Service Catalogue which must ever be broken down step-by-step.

4) Answer of RIEGLER [Rie11]: RIEGLER would generally begin with the introduction of the CM process because capacity is a prerequisite for availability. If capacity is insufficient the availability suffers. Following it is to investigate by what measures availability can be managed and increased.
5) Answer of RÖMER [Röm11]: At first the requirements of the business must be specified following by an analysis of the current availability and capacity which has to be conducted on the service and component level. If these requirements are not fulfilled an action plan has to be developed which must include data about the measures and period. As a rule this leads to an IT improvement project. If the result of the analysis shows a considerable oversizing, the ITSP can decide to reduce the current investment, if the business does not show any intentions to grow its business processes to this level in the near future.
6) Answer of SCHROERS [Sch11]: SCHROERS recommends a concurrent implementation of the AM and CM processes. An interface matrix at the process level is necessary. In the case of the UASWN these ITIL processes should be established in a rudimentary manner.

4.6 Interim conclusion

A service's availability strictly depends on its SLA which means that an occurrence of a service's unavailability does not result in a service interruption in either case. In fact it is only a service interruption if the service's unavailability exceeds the thresholds which are in the SLA. All requirements of services are determined by the SLM process and written down in SLA. The AM and CM processes can therefore not exist without the SLM process. The introduction of the SLM process and the creation of SLA are usually triggered by the business and/or external ITSP according to the holistic fulfillment of the business needs. In contrast to internal ITSP or IT shared service providers, who are often hostile toward the introduction of the AM and CM processes, external ITSP embrace this because they act customer-oriented and have their customers in a strong focus. The business is best supported by an open-minded ITSP who is willed to make a commitment and transparently acts with an intention for improvement.

The AM process in compliance with ITIL recommends the execution of an agreed number of SFA per year. All interviewed experts agree to this recommendation but this number has to be adapted to the actual needs of each service which depends in the main on its reliability and risk. The competence to determine the number of SFA falls clearly to the ITSP. Unfortunately it was not possible to gain a really reliable statement regarding the cost-benefit ratio of SFA because the most experts either do not have seen so much SFA in practice to assess a general trend or have used SFA in a modified manner but all experts believe that the use of SFA increases a service's quality. SFA are very cost- and resource-intensive and from an economic perspective they are best applied to the most critical services following the Pareto principle which promises the best cost-benefit ratio. The Pareto principle means an improvement of 80% with an effort of only 20%. From an economic perspective it is usually meaningless to subject uncritical services to SFA.

It was very difficult to gain a really reliable statement regarding the assessment of functional and nonfunctional requirements. The interviewed experts made different experiences. It seemingly depends on the used software; when using individual software the primary focus is on functional requirements in contrast to standard software where the primary focus usually is on nonfunctional requirements. Both types of requirements must be regarded in an adequately manner. A service with a high utility does not provide any benefit to the business with a low warranty and

vice versa. According to the experiences of the experts poor requirements analysis can have many different causes. Lack of communication between the business and ITSP which usually occurs by a lack of common understanding is a frequent reason. The business often does not really know its requirements and ITSP often struggle with lack of methodology in requirements analysis which can be traced back to a low experience in requirements analysis. The consultation by a system counselor can be helpful to initiate the flow of words between the business and ITSP. People who are responsible for requirements analysis have to listen to the business to get a holistic understanding of its needs. This approach can represent a possibility to discover additional opportunities for improvements. Another frequent cause for a poor requirements analysis is a missing of consequences of learning from the past. Past projects are either not reviewed or not in the right manner. It is very important to learn from the past to avoid already done mistakes in the future. This approach needs a broad mind from both the business and ITSP to analyze prior projects together and to take appropriate actions for future projects. The creation of standardized documents like check lists or procedures definitely seems to be a meaningful general approach. All consequences from the past have to flow into the documentation to guarantee a steady improvement on future projects. There are several other approaches and frameworks to deal with the requirements analysis. It is not meaningful to recommend a certain approach or framework because its success depends on different terms and conditions like the size of the organization and the knowledge of its employees regarding structured approaches and frameworks. Formal approaches and frameworks can help to analyze requirements but are not an alternative for pragmatic thinking.

ITIL distinguishes between costs, which due to the realization of a service's availability and costs, which due to a service's unavailability. Most organizations are not aware of the costs which due to a service's unavailability. Following the experience of the interviewed experts it primarily depends on the size of an organization if there is an awareness of the costs which due to a service's unavailability. In general it can be said that big organizations usually have a strong awareness in contrast to small and medium ones. A possible reason for this could be the employment of dedicated experts in big organizations instead of generalists in small and medium organizations who often have to pay attention to many different things. Another interesting fact is the high awareness of ITSP in contrast to the low to non-existent

awareness of the business. ITSP are often not able to demonstrate the impact of a service's unavailability to the business. The result is the non-approval of budgets to avoid these risks. This clarifies the so-called vicious circle which can be broken only by the capability of an ITSP to demonstrate the impact of a service's unavailability to the business. However it is essential to have a continuous focus on this issue which means it is not purposeful to occupy oneself only once but continuously. If the risks and its impacts are explained by the ITSP to the business the business usually takes actions to reduce these risks. A knowingly acceptance of risk does not exist. In the opinions of the interviewed experts there are several mistakes when introducing the AM and CM processes in compliance with ITIL. The most common mistakes are:

1) Wrong mindset: The focus is on technology instead on the business which results in lack of knowledge about the business and its needs which leads to the fact that services are not adequately specified regarding their functional and nonfunctional requirements meaning an ITSP often cannot provide the needed services to the business.
2) Unclear objectives paired with an omission of certain business areas.
3) Poor anchoring of procedures and rules.
4) Missing CMDB.

ITIL is built up of many processes which are closely entwined with each other. For this reason the introduction of the AM and CM processes is a challenge if related processes have not yet been introduced or are not documented. Therefore it is very important to implement only these processes whichever currently are possible. The introduction of the AM and CM processes needs a documented IT infrastructure as a CMDB. The missing CMDB is a frequent reason for a poor implementation of ITIL processes. How shall availability and capacity be managed without any knowledge about the needed components and their mutual relations? Therefore it is vital to write down the implicit knowledge and make it accessible to others. Another pre-requisite for a successful implementation of the AM and CM processes is to know the needs and expectations of the business which have to be written down in a so-called SLA. The current availability and capacity must be analyzed on the service level as well as the component level and contrasted to the SLA. If there are any differences an action plan has to be developed which must include data about the measures and periods.

The determination of expert knowledge by qualitative interviews in this chapter gave a deep insight into the availability- and capacity-related issues which are summarized below:

1) AM and CM processes cannot exist without the SLM process: SLA are absolutely necessary because they represent an agreement between the ITSP and another party regarding the conditions of a certain service. SLA are contracts and therefore legally binding. The AM and CM processes are used to meet the availability- and capacity-related objectives of all SLA.
2) Cost-benefit ratios of SFA cannot be determined: SFA are rarely executed in practice what confuses the issue to gain a really reliable statement about it. All experts were in the same opinion that services can be significantly improved by the use of SFA.
3) Poor requirements analysis lead to poor services: If new services shall be introduced or yet existing services are modified it is urgently recommended to pay attention to their functional as well as nonfunctional requirements.
4) Learn from past projects: Missing consequences are a further reason why already done mistakes occur again in future projects. A recommendation is to review past projects and to draw a conclusion which flows into future projects to avoid the reoccurrence of already done mistakes.
5) Development of standardized documents: The development of standardized documents by check lists or procedures can help to avoid potential mistakes in complex projects or routine jobs.
6) Awareness of hidden costs: An awareness of hidden costs is necessary for an appropriate design of services. Possible risks have to be analyzed which must be avoided to a certain degree by adequate countermeasures. It is important to raise the question which impact is connected to the occurrence probability of a certain event.
7) Demonstration of potential risks: The business is often not aware of the hidden costs which result of risks because ITSP frequently are not able to demonstrate the impact of a certain risk to the business. A missing understanding leads to a non-approval of additional budgets which is necessary to implement appropriate countermeasures.

5 Availability Management

5.1 Focus and objectives

“The purpose of the Availability Management process is to ensure that the level of availability delivered in all IT services meets the agreed availability needs and/or service level targets in a cost-effective and timely manner. Availability Management is concerned with meeting both the current and future availability needs of the business [Cab11b, p. 125].” ITIL defines the following objectives of the AM process [Cab11b, p. 125]:

1) Production and maintenance of an appropriate and up-to-date availability plan that reflects the current and future needs of the business.
2) Provision of advice and guidance to all other areas of the business and IT on all availability-related issues.
3) Guarantee that service availability achievements meet all their agreed targets by managing services- and resources-related availability.
4) Provision of assistance with the diagnosis and resolution of availability-related incidents and problems.
5) Assessment of the impact of all changes on the availability plan and the availability of all services and components.
6) Guarantee that proactive measures to improve the availability of services are implemented wherever it is cost-justifiable to do so.

“The scope of the Availability Management process covers the design, implementation, measurement, management and improvement of IT service and component availability. Availability Management commences as soon as the availability requirements for an IT service are clear enough to be articulated. It is an ongoing process, [which is] finished only when the IT service is decommissioned or retired [Cab11b, p. 126].”

5.2 Value creation

The AM process includes reactive activities as well as proactive activities to create value for the business. In general proactivity means anticipating and taking charge of situations [NU12a] whereas reaction means a response to an event [NU12b]. In accordance with ITIL proactive activities of the AM process include planning, design, and improvement of availability while reactive activities include monitoring, measuring, analysis, and management of all events, incidents, and problems regarding unavailability. [Cab11b, p. 126].

Proactive activities target the avoidance of unavailability whereas reactive activities target the quickest possible restore of services in any case of unavailability. In this way AM provides significant value to the business.

5.3 Measures and methods

The AM process relies on the monitoring, measurement, analysis, and reporting of the following aspects [Cab11b, p. 128]:

1) Availability is the ability of a service or component to perform its agreed function when required. It is mostly measured and reported as a percentage as well as calculated as follows:

$$\textbf{Availability (\%)} = \frac{\textbf{agreed service time - downtime}}{\textbf{agreed service time}} \times 100$$

2) Reliability is an indicator of how long a service or component can perform its agreed function without interruption. It is mostly measured and reported in absolute numbers as well as calculated as follows:

$$\textbf{Reliability (mean time between service incidents (MTBSI))} = \frac{\textbf{available time}}{\textbf{number of breaks}}$$

$$\textbf{Reliability (mean time between failures (MTBF))} = \frac{\textbf{available time - total downtime}}{\textbf{number of breaks}}$$

3) Maintainability is an indicator of how quickly a service or component can be restored to normal working after a failure. It is mostly measured and reported in absolute numbers as well as calculated as follows:

$$\textbf{Maintainability (mean time to restore service (MTRS))} = \frac{\textbf{total downtime}}{\textbf{number of breaks}}$$

There is a direct correlation between availability, reliability, and maintainability of a service and its components. Both reliability as well as maintainability of a service and its components are subjacent indicators to the availability.[9] This means a dependence of availability on reliability and maintainability.

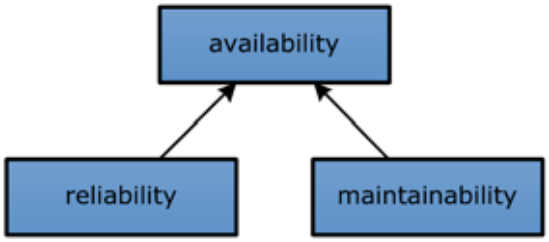

Figure 6: Correlation between availability, reliability, and maintainability

The correlation between availability, reliability, and maintainability is demonstrated using the following example. Imagine an ITSP which holds many servers in its datacenter. Each server must be high reliable which means the hardware of the server must be designed for permanent operation. For this reason its devices (e.g., power supplies or hard disk drives) are designed for higher reliability than devices of a conventional personal computer. But reliability is not only an issue of hardware but also software. An ITSP will also run critical applications for the business on the mentioned hardware. Therefore it is very important these applications run stable without any exceptions. In the case of a failure it is essential for the business to restore the affected service or component to normal working in a very short period. Hence high availability follows high reliability as well as high maintainability.

A well-known concept to address these issues is clustering. A cluster bases on two or more identical components which are used for the same task. A cluster can be built up on the hardware layer as well as on the software layer. In the case of a failure the workload is balanced to the not affected component which means that the business recognizes either no or only a very short downtime. Virtualization is a well-known concept to realize such clusters on the hardware layer whereas clusters on the software layer are often realized by proprietary solutions.

As aforementioned availability is the ability of a service or component to perform its agreed function when required. But what does a service availability of 99% as an example really mean? For a critical service which is permanently used by the business it maybe means that the downtime of this service must not exceed 87.6 hours within a year. Availability is a very abstract indicator because it can be differently

[9] Cp. figure 6 (Correlation between availability, reliability and maintainability).

interpreted by the business and ITSP. If the business needs to use a service daily from 9:00 a.m. to 5 p.m. a maximum downtime of 29.2 hours per year is accepted in this period whereas unavailability outside of this period does not matter.
This raises the question if the business can absorb a permanent downtime of 29.2 hours. In the worst case a permanent downtime of 29.2 hours would mean almost two days of service unavailability. In the case that the business cannot absorb a downtime of almost two days a single definition of the availability indicator does not suffice. It could also be necessary to define further indicators such as reliability as well as maintenance of a service. For this reason an ITSP has to in-depth determine all requirements of the business regarding the availability of a certain service. This determination has to be done for each offered service. If the ITSP is able to fulfill these expectations and the business is willing to pay for the offered service this agreement has to be written down in a SLA which is usually part of the contract.
The purpose of the AM process is to ensure the agreed service level regarding its availability. Therefore the AM process is equipped with many different proactive as well as reactive activities and their underlying methods. It is not the intention of this paper to address all methods because this would go beyond its scope. Instead this paper focus on all currently applied methods within the UASIT. The reason why not all methods will be implemented is that the usage of some methods does not make sense at this particular time. It is explicitly stated that the scope of methods in this paper is not a general recommendation. Rather each ITSP has to individually evaluate its methods. The following list gives an overview of the applied activities and methods to which this paper is responsive in theory and practice at its end:[10]

1) Proactive activities
    a. Component Failure Impact Analysis (CFIA)
    b. Single Point of Failure Analysis (SPoFA)
    c. Fault Tree Analysis (FTA)
    d. Risk Assessment and Management
2) Reactive activities
    a. Unavailability Analysis
    b. Service Failure Analysis (SFA)

[10] Cp. subchapter 7.3 (Realization of the Availability Management process); pp. 61-66.

All proactive and reactive activities of the AM process are interconnected with the Availability Management Information System (AMIS). The AMIS is the central data store of the AM process which means that the results of all availability-related activities are stored in the AMIS and used for further availability-related decisions.

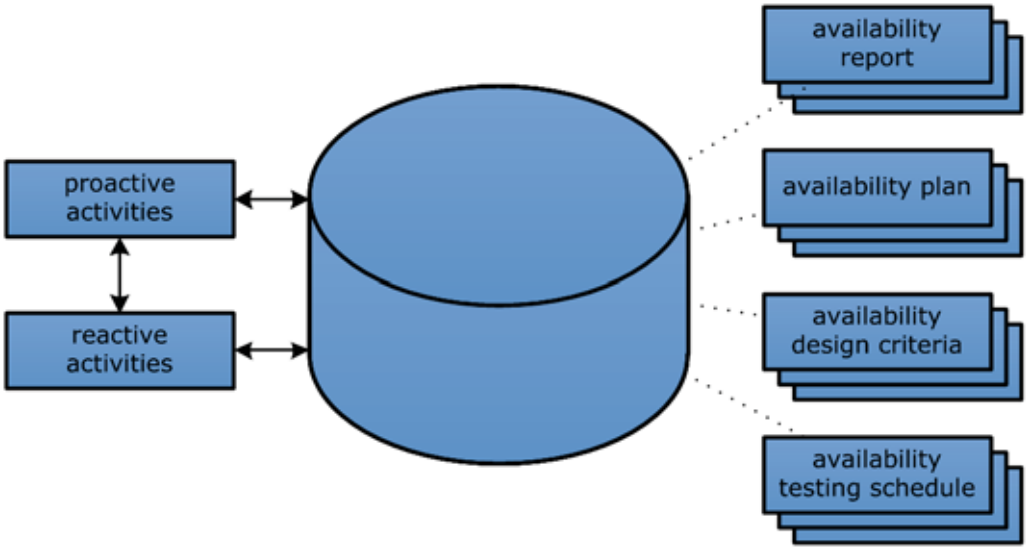

Figure 7: Availability Management Information System [Cab11b, p. 131]

This paper has its focus on the availability plan and reports regarding the AMIS. For this reason the other contents of the AMIS are not covered by this paper at its end.

5.4 Interdependences to other ITIL processes

As aforementioned ITIL is built up of four functions and 26 processes which are closely entwined with each other. The ITIL processes are constrained of each other because they are mutual input and output sources. The AM process is also entwined with several other ITIL processes which are characterized in the following table [Cab11b, pp. 154-155].[11]

Process	Interdependence
Access Management	The AM process provides the methods for appropriate granting and revoking access to services as needed.
Capacity Management	The CM process provides appropriate capacity to support resilience and overall service availability. The CM process also uses information from the DM process about patterns of business activity as well as user profiles to understand business demand for IT services and provides this information to the AM process for business-aligned availability planning.
Change Management	The Change Management process leads to the creation of the projected service outage with contribution from the AM process. When changes are proposed to a service the AM process must assess the change for availability-related issues including any potential impact on achievement of service levels regarding availability.
Incident Management and Problem Management	The Incident Management and Problem Management processes are assisted by the AM process in the resolution and subsequent justification and correction of availability-related incidents and problems.
Information Security Management	The Information Security Management process defines the security measures and policies that must be included in the service design for availability and design for recovery.
IT Service Continuity Management	The AM process works collaboratively with the IT Service Continuity Management process on the assessment of business impact and risk as well as the provision of resilience and recovery mechanisms. The AM process focuses on normal business operation whereas the IT Service Continuity Management process focuses on the extraordinary interruption of services.
Service Level Management	The SLM process relies on the AM process to determine and validate targets regarding availability and to investigate and resolve service and component breaches.

Table 3: Interdependences between the AM and other ITIL processes

[11] Cp. table 3 (Interdependences between the AM and other ITIL processes).

5.5 Critical Success Factors and their Key Performance Indicators

Before this paper goes into detail of the availability-related CSF and their KPI it is necessary to provide an insight into the IT performance measurement systems at first.

Processes are predestined for performance measurement due to their defined input and output. At the beginning of IT performance measurement lone IT performance indicators existed which had a one-sided force of expression and predominantly covered financial and technical aspects. This one-sided force of expression leaded to the development of IT performance measurement systems [Gad06, p. 114]. In the early 1990 Kaplan and Norton developed a performance measurement system called Balanced Scorecard (BSC) which is a common controlling concept. The BSC has rapidly found its way into the controlling of many organizations and because of its success the BSC was adapted to the IT controlling concept [Gad06, p. 114].

The BSC bases on the idea not to follow only one perspective but multiple different perspectives. As aforementioned conventional performance measurement covered the financial and technical aspect of the activities within an organization. The BSC extends this single view to further perspectives as shown in the following figure.[12]

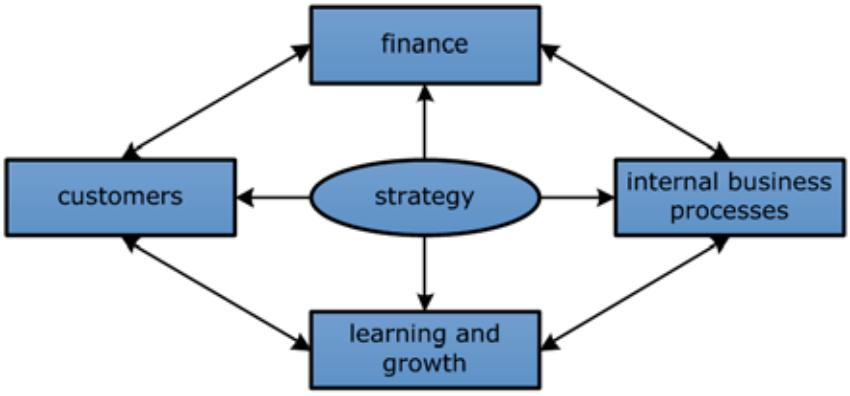

Figure 8: The Balanced Scorecard [Niv08, p. 12]

[12] Cp. figure 8 (The Balanced Scorecard).

Based on the strategy an organization has to raise questions regarding the four perspectives of its BSC [Niv08, p. 12]:

1) Finance: What do our financial stakeholders demand or expect?
2) Internal business processes: At which internal business processes must we excel to drive value for customers?
3) Learning and growth: How do we align our intangible assets to improve our ability to support our strategy?
4) Customers: Who are our target customers, what are their expectations, and what is our value proposition in serving them?

The benefit of the BSC is not only to address the financial perspective. A broader understanding of the consequences of the activities within an organization is vital for its success. For example if an organization would only focus on financial aspects it would know if a certain activity has increased or decreased the financial success but it does not know the consequences regarding the satisfaction of its customers. With this limited perception an organization can only gain a short-term but not a sustainable success. If an organization would fire some employees it will certainly gain a short-term financial benefit but will also recognize that the satisfaction of its customers maybe decreases by this measure. If this scenario would become true a job reduction would not be sustainable because the satisfaction of its customers decreases and will certainly lead to a loss of market share.

An ITSP must also have an effective and efficient controlling concept because it is faced with similar conditions. There will be financial stakeholders with demands and expectations as well as customers who want to be satisfied. For these reasons an ITSP should provide value to the business to survive at the lowest cost as possible; otherwise it is noncompetitive.

The following list demonstrates examples of an IT-BSC [Gad06, p. 120]:

1) Finance
   a. Possible questions
      i. Which benefit does the usage of IT provide to an organization?
      ii. How can the Total Cost of Ownership (TCO) be reduced?
   b. Possible performance indicators
      i. Share of IT costs to revenues or sales
      ii. TCO per employee
2) Internal business processes
   a. Possible questions
      i. How does the usage of IT improve the business process quality?
      ii. How can IT processes be accelerated?
   b. Possible performance indicators
      i. Number of customer's complaints
      ii. Metering rate of an IT process from its input to output
3) Learning and growth
   a. Possible questions
      i. How can the expertise and soft skills of IT employees be increased?
      ii. At which degree is the satisfaction of IT employees?
   b. Possible performance indicators
      i. Number of participants in education and training
      ii. Labor turnover rate or incidence rate
4) Customers
   a. Possible questions
      i. How can the customer's satisfaction be increased by the usage of SLA?
      ii. How do the customers assess the services in comparison to other ITSP (benchmarking)?
   b. Possible performance indicators
      i. Number of service level breaches
      ii. Share of new customers to total customers

As aforementioned the four core perspectives of the BSC depend on the strategy of an ITSP. The following figure demonstrates the derivation of measures from the vision:[13]

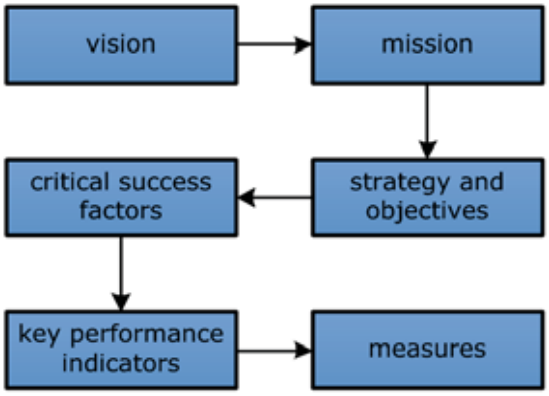

Figure 9: Derivation of measures from the vision [Nai04, pp. 41-42]

CSF are derived from the strategy and objectives of an organization and contribute to them as well as the superior vision and mission. The single CSF for each BSC perspective are subdivided into KPI followed by measures. For the sake of completeness it must be said that KPI can often be subdivided into single performance indicators what depends on the purpose if KPI are subdivided or not. There are many examples for CSF and KPI in the literature but an IT organization must not just implement them but should wonder which CSF and KPI are wise to implement. It can also be a good approach to define own CSF and KPI.

[13] Cp. figure 9 (Derivation of measures from the vision).

Following this introduction to the BSC and IT-BSC important CSF and KPI of the AM process are characterized in the following table [Cab11b, pp. 156-157]:

Critical Success Factors	Key Performance Indicators
Manage availability and reliability of IT service	Percentage reduction in the unavailability of services and components
	Percentage increase in the reliability of services and components
	Effective review and follow-up of all SLA or Operational Level Agreement (OLA) as well as underpinning contract breaches relating to availability and reliability
	Percentage improvement in overall end-to-end availability of service
	Percentage reduction in the number of impact of service interruptions
	Improvements in the MTBF
	Improvements in the MTBSI
	Improvements in the MTRS
Satisfy business needs for access to IT services	Percentage reduction in the unavailability of services and components
	Percentage reduction of the cost of business overtime due to unavailability of services and components
	Percentage reduction in critical time failures (if a service does not respond in the agreed time)
	Percentage improvements in business and users satisfied with services
Availability of IT services, as documented in SLA, provided at optimum costs	Percentage reduction in the cost of unavailability of services and components
	Percentage improvement in the service delivery costs
	Timely completion of regular risk assessments and system reviews
	Timely completion of regular cost-benefit analyzes established for CFIA analyzes
	Percentage reduction in failures of third-party performance on MTRS or MTBF against contract targets
	Reduced time take to complete or update a risk assessment
	Reduced time taken to review system resilience
	Reduced time taken to complete an availability plan
	Timely production of management reports
	Percentage reduction in the incidence of operational reviews uncovering security and reliability exposures in application designs.

Table 4: Important CSF and KPI of the AM process

5.6 Interim conclusion

Availability is a warranty aspect of a service which is addressed by the AM process. The objectives of the AM process are to assist the SLM process in the definition of availability-related Service Levels and the cost-effective realization of adequate availability. The availability of each service is continuously observed and improved by the AM process which equally assists other ITIL processes in availability-related issues such as Incident or Problem Management to give a couple.

The AM process consists of different proactive and reactive methods to ensure availability but each organization with the intention to implement this process has to critically consider their choice of methods. Probably it will not be meaningful to realize all different methods because of economic reasons. The selected methods of the ITIL core literature should not be taken on a certain organization without a proving of any specific adaptions. A pragmatic approach can help an organization to gain maximum effectiveness as well as efficiency in the implementation of the AM process.

6 Capacity Management

6.1 Focus and objectives

“The purpose of the Capacity Management process is to ensure that the capacity of IT services and the IT infrastructure meets the agreed capacity- and performance-related requirements in a cost-effective and timely manner. Capacity Management is concerned with meeting both the current and future capacity and performance needs of the business [Cab11b, p. 158].” ITIL defines the following objectives of the CM process [Cab11b, p. 158]:

1) Production and maintenance of an appropriate and up-to-date capacity plan which reflects the current and future needs of the business.
2) Provision of advice and guidance to all other areas of the business and IT on all capacity- and performance-related issues.
3) Guarantee that service capacity and performance achievements meet all their agreed targets by managing service- and component-related capacity and performance.
4) Provision of assistance with the diagnosis and resolution of capacity- and performance-related incidents and problems.
5) Assessment of the impact of all changes on the capacity plan as well as the capacity and performance of all services and components.
6) Guarantee that proactive measures are implemented wherever it is cost-justifiable to do so to improve the capacity and performance of services.

“The Capacity Management process should be the focal point of all IT performance and capacity issues. The [CM] process should encompass all areas of technology, both hardware and software, for all IT technology components and environments. Capacity Management should also consider space planning and environmental systems capacity [Cab11b, p. 158].”

6.2 Value creation

The CM process primarily bases on two balancing activities. On the one side costs must be balanced against the needed resources and on the other side supply must be balanced against demand [Cab11b, p. 159].

The balancing activity of costs against the needed resources means that the ITSP of an organization is responsible for a cost-efficient provision of the needed resources. There are often more options than only one to provide a service to the business. For this reason an ITSP has to evaluate all possible alternatives and to choose the most cost-efficient option from a strategic as well as an operative perspective.

The balancing activity of supply against demand is another aspect of cost-efficiency and means the avoidance of unused resources. This activity is so important because a bad alignment of an IT service with its business demand results either in higher costs than necessary or in unsatisfied customers. A so-called oversized IT service is equipped with more resources than necessary whereas a so-called undersized IT service cannot satisfying meet the business demand due to lack of resources. Like the CM process the CM process and its sub-processes also consist of proactive and reactive activities. Proactive activities focus on avoidance of lack of capacity whereas reactive activities focus on quickest possible remedial actions of capacity-related incidents and problems. In this way CM provides significant value to the business.

6.3 Measures and methods

The CM is a very complex process which is subdivided into three sub-processes. These sub-processes are the Business Capacity Management process on the strategic level, the Service Capacity Management process on the tactical level, and the Component Capacity Management on the operational level.[14]

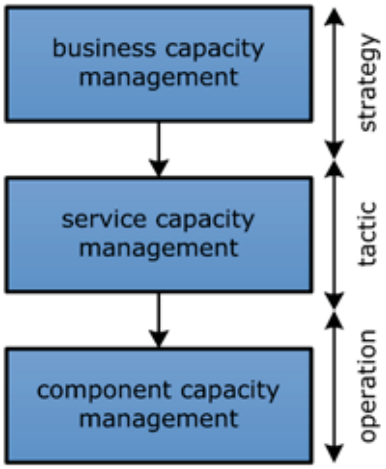

Figure 10: The sub-processes of the CM process

"The Business Capacity Management sub-process translates business needs and plans into requirements for services […] ensuring that the future business requirements for IT services are quantified, designed, planned and implemented in a timely fashion. These future requirements come from the Service Strategy and Service Portfolio [Management process] detailing new processes and service requirements […] [Cab11b, p. 161]."

The Service Capacity Management sub-process is for understanding the required capacity and performance by the Business Capacity Management sub-process. For this reason the Service Capacity Management sub-process creates wide information on the Pattern of Business Activity (PBA) and its impacts on subjacent components.

The Component Capacity Management sub-process has its focus on the components which together represent the IT services. The focal points of this sub-process are technological data like the performance of components and its utilization over past periods to identify possible bottlenecks of performance in present and future. The CM process is strongly entwined with the DM process in Service Strategy because it helps the CM process to understand and (maybe) influence the PBA of IT services.[15]

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[14] Cp. figure 10 (The sub-processes of the CM process).
[15] Cp. figure 11 (The influence of the DM process to PBA); p. 56.

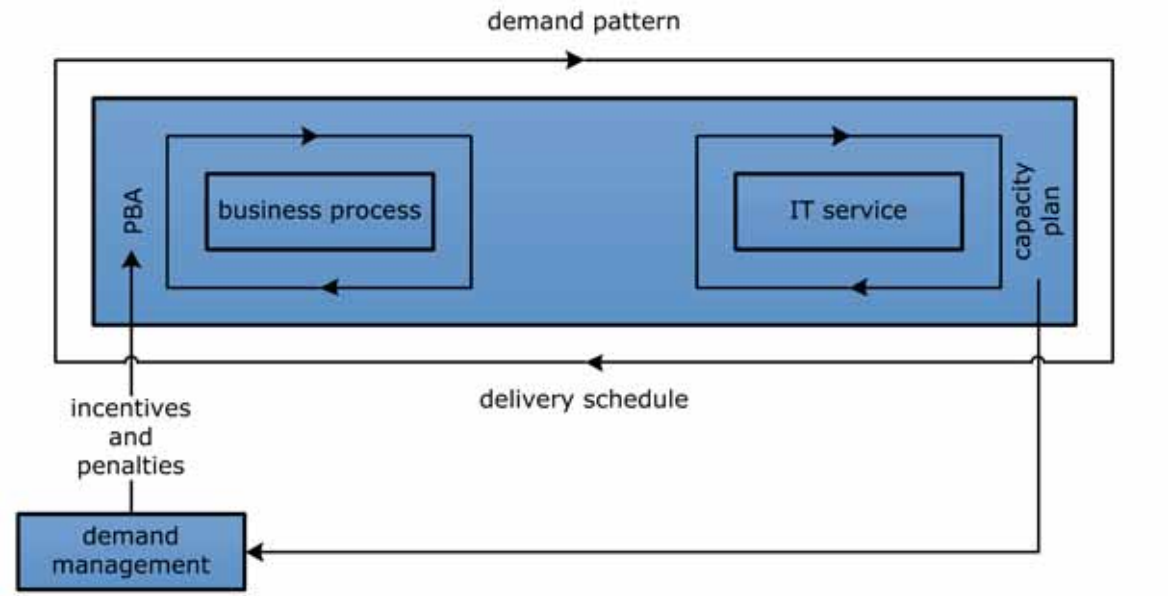

Figure 11: The influence of the DM process to the PBA [Cab11b, p. 164]

Any business process is supported by one or more IT services. The PBA on the one side describes how the business process is used by the business helping the ITSP to understand and prepare for its provision according to the SLA. The capacity plan on the other side is used to manage the resources which are required to deliver the IT services [Kem11b]. If the capacity plan is not appropriately aligned to the PBA the DM process can maybe influence the usage of the offered IT services by incentives and penalties. The workload of IT services usually varies which makes it difficult for an ITSP to deliver IT services at its best cost-efficiency. Imagine a time-registration service which is used by all employees in an organization. Let us assume that the capacity of this service is designed for 1.000 transactions per hour but there are 3.000 employees who all work in one shift. This scenario would mean that all 3.000 employees use this time-registration service at the same time but the IT service is designed to support only 1.000 transactions per hour. This would result in an exceeding of the capacity-related limit. In this case the ITSP has two possibilities to intervene. The first possibility is to procure additional capacity to serve the business in an expected manner which involves additional costs. The second possibility is to allocate the workload of the IT service to a broader time-range which concretely means a change to three shifts. In this case the time-registration could be offered in an appropriate manner at no additional costs from IT perspective. This would be a so-called incentive of the DM process whereas the procurement of yet another capacity including its additional cost represents a penalty.

The purpose of the CM process is to ensure the agreed service level regarding its capacity and performance. Therefore the CM process is equipped with a multiplicity of different measures and methods. It is not the intention of this paper to address all methods because this would go beyond its scope. Instead this paper focus on all currently applied methods within the UASIT. The reason why not all methods will be implemented is that the usage of some methods does not make sense at this time. It is explicitly stated that this scope is not a general recommendation. Rather each ITSP has to individually evaluate its methods. The following list gives an overview of the applied activities and methods to which this paper is responsive in theory and practice at its end:[16]

1) Baselining
2) Trend analysis

Baselining as well as trend analysis belong to the implementation category of the CM process and are all interconnected with the Capacity Management Information System (CMIS). The CMIS is the central data store of the CM process which means that the results of all capacity-related activities are stored in the CMIS and used for further capacity-related decisions.

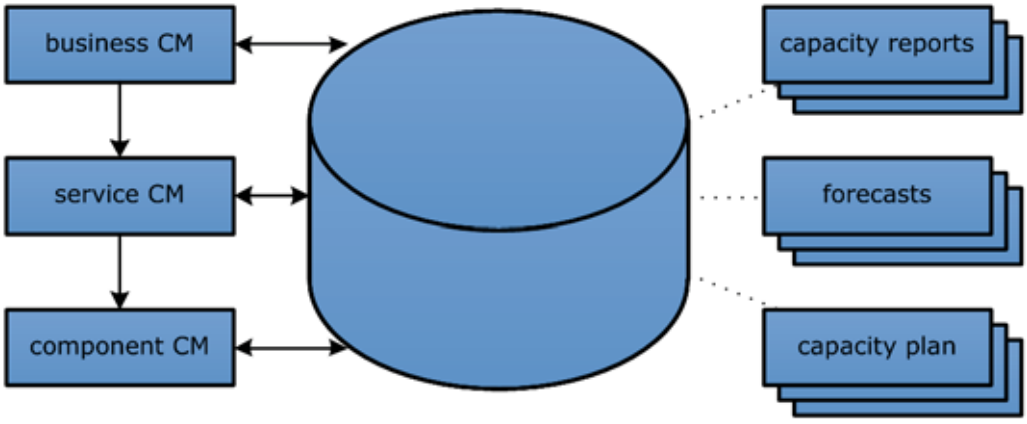

Figure 12: Capacity Management Information System [Cab11b, p. 163]

[16] Cp. subchapter 7.4 (Realization of the Capacity Management process); p. 70-74.

6.4 Interdependences to other ITIL processes

Like the AM process the CM process is also entwined with several other ITIL processes which are characterized in the following table [Cab11b, p. 176].[17]

Critical Success Factors	Interdependence
Availability Management	The AM process determines the resources needed to ensure the required availability of services and components.
Demand Management	By anticipating the demand for services based on user profiles and patterns of business activity, and identifying the means to influence that demand, the DM process provides strategic decision-making and critical data on which the CM process can act.
Incident Management and Problem Management	The Incident Management and Problem Management processes are assisted by the CM process in the resolution and subsequent justification and correction of capacity-related incidents and problems.
IT Service Continuity Management	The CM process assists the IT Service Continuity Management process with the assessment of business impact and risk and determining the capacity needed to support risk reduction measures and recovery options.
Service Level Management	The SLM process provides assistance with the determining capacity targets and the investigation and resolution of service and component capacity-related breaches.

Table 5: Interdependences between the CM and other ITIL processes

[17] Cp. table 5 (Interdependences between the CM and other ITIL processes).

6.5 Critical Success Factors and their Key Performance Indicators

Just as the AM process the CM process has also CSF with subjacent KPI which are characterized in the following table [Cab11b, p. 178].

Critical Success Factors	Key Performance Indicators
Create accurate business forecasts	Production of workload forecasts on time
	Percentage accuracy of forecast of business trends
	Timely incorporation of business plans into the capacity plan
	Reduction in the number of variances from the business plan and capacity plan
Create knowledge of current and future technologies	Percentage of increased ability to monitor performance and throughput of all services and components
	Percentage of timely justification and implementation of technology in line with the business' requirements
	Reduction in the number of old technology which cause breach of SLA due to problems due to problems with performance or vendor's support
Cost-efficiency	Reduction in last-minute buying to address urgent performance issues
	Reduction in the oversizing of IT services and its components
	Percentage accuracy of forecasts of planned expenditures
	Reduction in the business disruption caused by a lack of adequate capacity
	Relative reduction in the cost of production of the capacity plan
Planning and implementation of appropriate capacity to match business' requirements	Percentage reduction in the number of incidents due to poor performance
	Percentage reduction in lost business due to inadequate capacity
	Percentage of new services which match their Service Level Requirements (SLR)
	Percentage of implemented recommendations which were made by the CM process
	Reduction in the number of SLA breaches due to either poor service performance or poor component performance

Table 6: Important CSF and KPI of the CM process

6.6 Interim conclusion

Like availability capacity is also a warranty aspect of a service which is addressed by the CM process. The objectives of the CM process are to assist the SLM process in the definition of capacity-related Service Levels and the cost-effective realization of adequate capacity. The capacity of each service is continuously observed and improved by the CM process which equally assists other ITIL processes in capacity-related issues such as Incident or Problem Management to give a couple. To realize the CM process can be challenging at a high level because of its complexity. In fact it is a real challenge to translate the capacity-related demands from the business across the service level to the component level. The CM process consists of many different proactive and reactive methods to ensure capacity but each organization with the intention to implement this process has to critically consider their choice of methods. Probably it will not be meaningful to realize all different methods because of economic reasons. The selected methods of the ITIL core literature should not be taken on a certain organization without a proving of any specific adaptions. A pragmatic approach can help an organization to gain maximum effectiveness as well as efficiency in the implementation of the CM process.

7 Realization of the Availability and Capacity Management processes

7.1 Service scope

When initiating an IT project like the implementation of certain ITIL processes it is recommended to define a scope to prevent the IT project getting out of control. With the implementation of the AM and CM processes a scope was defined which includes only certain services instead of the whole service landscape. This was a very urgent recommendation of some interviewed experts which helped to keep the focus during the implementation. Four already existing services were chosen but with a different scope from the AM and CM process perspective:[18]

Service	Scope by Process	
	Availability Management	Capacity Management
E-library service	X	
E-mail service	X	X
Time registration service	X	
Web presence service	X	

Table 7: Service scope from the AM and CM process perspective

The e-library service represents a very important information system of the UASWN because it contains metadata about all assets of the library including textbooks as well as different papers and so on. The e-library service is accessible to the entire UASWN which consist of management, administration, and faculties including their staff as well as students. Needless to say that the e-library service represents a core for the lecture. For this reason it is essential to pay a special attention to the availability of this service. The e-library service is not included in the scope of the CM process because its increase in data is dispensable.

For most people e-mail has become an indispensable way to communicate. The UASIT provides a so-called e-mail service to the entire organization which does not only consist of the capability to send electronic documents but provides many more very important functions to realize collaboration. As aforesaid the e-mail service is used by the entire organization but the focus regarding the CM process is only on the stakeholder group of students because its increase in data by other stakeholders is dispensable.

[18] Cp. table 7 (Service scope from the AM and CM process perspective).

The time registration service was designed to gather the working time of the staff of the UASWN. For this reason it is only used by the employees. The focus of this service is only on the AM process.
The web presence service is like the e-library service a very important information system of the UASWN. In contrast to the e-library service it addresses not only the entire organization but also external stakeholders like potential future students who are the customers of the UASWN. This service represents the UASWN outwards and what impression would an unavailable or slow website give to others? Because of this it is also important to provide a high available web presence service.

7.2 Service Asset and Configuration Management as prerequisite

Due to the recommendations of the interviewed experts a rudimentary CMDB was created. A CMDB is an output of the SACM process and is essential for further ITIL process implementations like the AM or CM process. In general it contains data about the relations and interdependences of so-called Configuration Items (CI). Thereby it depends on the particular organization to define the depth of details regarding CI. It is absolutely necessary to be worried about the CMDB: Which depth of details regarding CI is adequate? Which data shall be gathered?
In general a CMDB is a virtual database which does not mean at all costs it is one physical database containing all data about the offered services and their required components with all their specifications. In fact a CMDB can definitely consist of more data sources than one physical database.
In the case of the UASIT there already exist some data sources which cover both configuration and procurement aspects. All information about the configuration of each CI is stored in a web-based information system (so-called Wiki) whereas the procurement information of each CI is provided by a self-made database. The configuration data of client- and server-related CI is supplemented by an additional tool which automatically determines the hard- and software inventory of each client and server. A monitoring system is used to observe all CI regarding availability. The main problem regarding the implementation of the AM and CM processes was the missing aspect about the relations and interdependences of all needed CI because the knowledge about these relations and interdependences has implicitly existed but was not explicitly documented. For the implementation of the AM and CM processes a documentation of this aspect was absolutely essential. For this reason all

interdependences of the components of a service were determined at first and graphically demonstrated afterwards. This information flowed into the monitoring system and made an availability-related monitoring on service level possible.
Prior to the creation of a CMDB it is important to give thought to its concept. As aforementioned an organization has to determine the depth of details as well as the data which shall be gathered. In the case of the UASIT it was meanwhile ample to have a rather obvious focus on components like clients, hypervisors, networks, and servers with a scope only on the affected services.[19] The previous determination of focus and scope helped to prevent the IT project to get out of control and to gain quick results.

7.3 Realization of the Availability Management process

During the implementation of the AM process not all recommended activities and methods according to ITIL were applied because it was not yet meaningful in the case of the UASIT to implement all activities and methods. Instead the UASIT turned its attention to the following activities and methods which were finally applied:

1) Proactive activities
    a. Component Failure Impact Analysis (CFIA)
    b. Single Point of Failure Analysis (SPoFA)
    c. Failure Tree Analysis (FTA)
    d. Risk Assessment and Management
2) Reactive activities
    a. Unavailability Analysis
    b. Service Failure Analysis (SFA)

CFIA “can be used to predict and evaluate the impact on IT services arising from component failures within the technology. The output from a CFIA can be used to identify where additional resilience should be considered to prevent or minimize the impact of component failure to the business operation and users [Cab11b, p. 145].” A Single Point of Failure (SPoF) is any “part of a system that, if it fails, will stop the entire system from working. They are undesirable in any system with a goal of high availability or reliability […] [NU12c].” A SPoFA helps to identify SPoF and to handle

[19] Cp. figure 22 (Component interdependences); p. 91.

them appropriately. Both the CFIA as well as the SPoFA are usually illustrated by a matrix. In reality the SPoFA can be considered as a subset of the CFIA because it is already integrated in the CFIA. This is demonstrated as follows using the concrete example of the UASIT:

Components		Service			
Component group	Component	E-library	E-Mail	Time registration	Web presence
Clients	terminal1			X	
	terminal2			X	
Hypervisors	xen1	M	M	M	M
	xen10	M	M	M	M
	xen2	M	M	M	M
	xen4	M	M	M	M
	xen6	M	M	M	M
Networks	bt1-2	M	M	M	M
	bt2-1			X	
	bt3-8			X	
	fire1	A	A	A	A
	fire2	A	A	A	A
	giga2			X	
	giga3	M	M	M	M
	giga4	M	M	M	M
	MCS	M	M	M	M
Servers	cmsdb				X
	euleneu	X			
	han	X			
	hpux	A	A	A	A
	isgus			X	
	johanna	A	A	A	A
	manu	A	A	A	A
	operator	A	A	A	A
	philipp				X
	reverse	X		X	
	sebastian	A	A	A	A
	steffi				X
	verena2		A		
	verena3		A		
	verena7		X		
	verena8		X		
	webopac	X			
Single Points of Failure		**6**	**2**	**8**	**3**

Table 8: Component Failure Impact Analysis

All relevant components (2nd column) are grouped (1st column) within the matrix; the following columns represent all services which are covered by the CFIA. A CFIA can be read horizontal from the component perspective as well as vertical from the service perspective. The question “By what services is a certain component used?” is answered by the component perspective whereas the service perspective gives an answer to the question “Which components are used by a certain service?”. In a sense the CFIA represents a very rudimentary CMDB. The relations of components and services are demonstrated using the following distinctions:

1) No impact: This means a component has no impacts to a service respectively a service is not affected by a component failure.
2) Single Point of Failure (X): This means a component represents a SPoF to a service. This is a critical constellation and therefore additionally marked with red background.
3) Manual failover (M): This means a component failure affects a service which can be restored by a manual intervention of the IT staff. For this reason manual failovers are marked with yellow background.
4) Automatic failover (A): This means a component failure affects a service which can be restored automatically. The business and users may percept a short interruption. Automatic failover constellations are marked with green background.

SPoF should be avoided at all costs because its MTRS usually are high. A manual failover constellation needs to be critically assessed from the MTRS perspective: What downtime is expected of a component failure? If the downtime is acceptable manual failover maybe are an adequate solution, but if not, the service has to be redesigned using automatic failover configurations.

The FTA “is a technique that can be used to determine a chain of events that has caused an incident or may cause an incident in the future [Cab11b, p. 148].” FTA can be derived from the CFIA and demonstrate the interdependences of services and their subordinated components using Boolean notation.[20] The event on top is an unavailability of a certain service which only compromises the business in the case that a predefined conditional event is not met. All possible causes for a service interruption can be traced by a look at the subjacent grouped CI whose chain of

[20] Cp. figure 17 (E-library service FTA) – figure 21 (Web presence service FTA); pp. 86-90.

events is logically demonstrated. The FTA does not contain all CI of the relevant service but only CI which represent a SPoF (red marked) or require a manual intervention (yellow marked) in the case of a failure.

Risk Assessment and Management is an essential activity within the AM process to analyze potential threats. Risks in general contain of the likelihood of a certain event as well as its impact and are mathematically expressed using the following formula:

$$\textbf{Risk} = f(\textbf{likelihood}, \textbf{impact})$$

Using a coordinate system risks can be graphically demonstrated as follows whereat the x-axis shows the likelihood and the y-axis the impact of a certain event.[21]

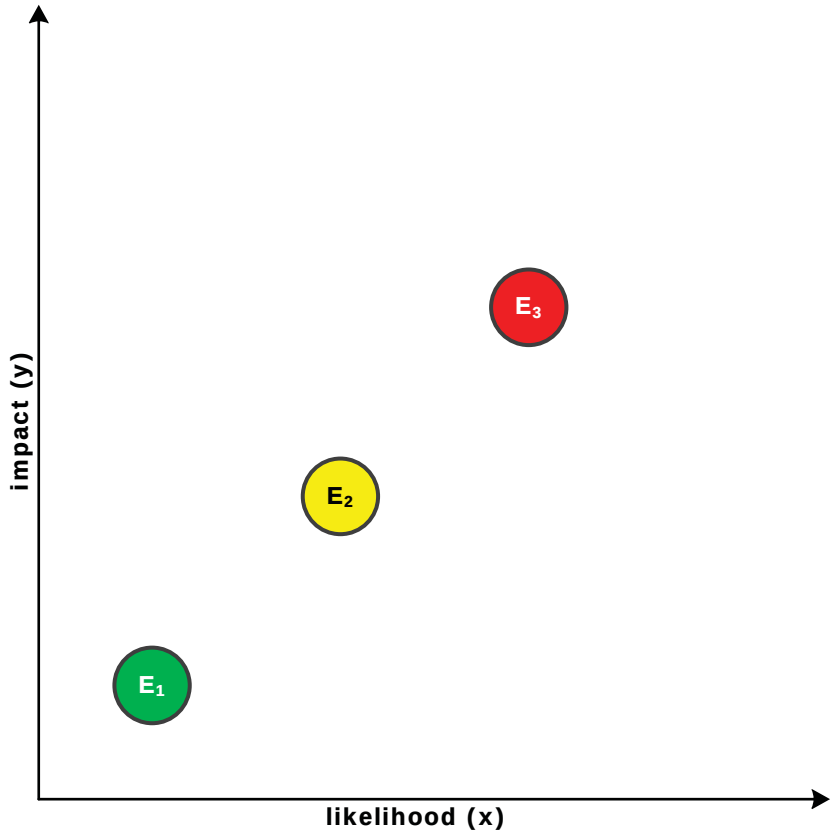

Figure 13: Example of a risk matrix

This risk matrix consists of three events (E_1, E_2, E_3). Depending on their risks the events are demonstrated using different colors. Event E_1 represents a very low risk because its likelihood and impact are very low. In contrast event E_3 is very risky because on the one hand its occurrence is very likely with a high impact on the other hand. The definition of categories regarding likelihood and impact need to be

[21] Cp. figure 13 (Example of a risk matrix).

done at first which varies in dependence of its intended use. Using the concrete example of the UASIT the categories were defined as follows:

1) Likelihood (MTBF)
   a. Very high: once daily
   b. High: once weekly
   c. Average: once monthly
   d. Low: once quarterly
   e. Very low: once yearly
2) Impact (MTRS)
   a. Very high: one week
   b. High: three days
   c. Average: one day
   d. Low: one hour
   e. Very low: less than one hour

The definition of the likelihood and impact categories result in a concrete risk matrix as demonstrated below.

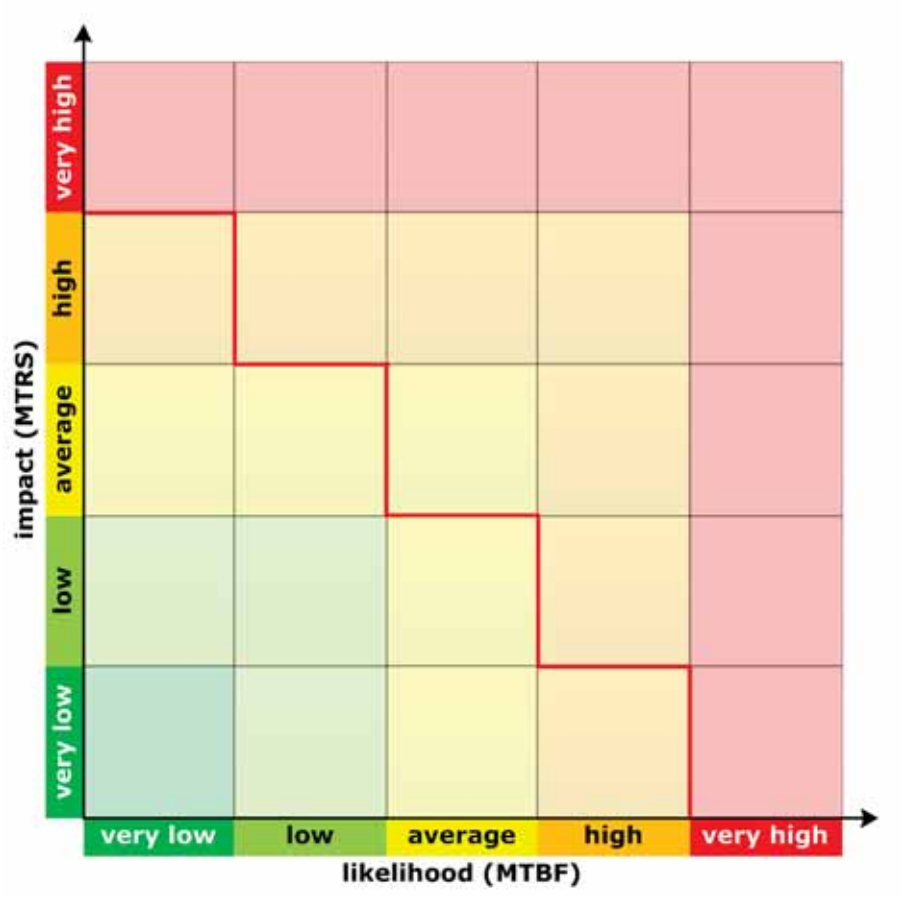

Figure 14: Example of a risk matrix with risk acceptance line

The red so-called risk acceptance line defines the border between acceptable and unacceptable risks. Acceptable risks are risks below this line whereas unacceptable risks are above. A risk acceptance line should be immediately defined after the likelihood and impact categories as well as prior to the risk assessment. This approach prevents any later interference and ensures a diligent and truthful risk assessment. The risk matrix is finally filled with data from the extended CFIA which includes risk assessment on CI level.[22] A risk matrix on CI level is usually overloaded with data which proves to be difficult for interpretation. For this reason all single risks on CI level are aggregated on service level which finally is meaningful.[23] To aggregate these risks on CI level up to the service level the worst case scenario for each service must be assumed. It is important to take the FTA of each service into account to include its CI interdependences. If there are services fraught with unacceptable risks an ITSP has to initiate appropriate countermeasures to reduce these risks to an acceptable level. It is explicitly stated that an entire avoidance of risks is either impossible or not cost-effective; in fact risks must be at a manageable level.

The purpose of the Unavailability Analysis is to investigate all events and incidents causing unavailability of services and components followed by an implementation of remedial actions within the availability plan or the overall service improvement plan (SIP) [Cab11b, p. 134]. “Trends should be produced from this analysis to direct and focus activities such as SFA to those areas causing the most impact or disruption to the business and the users [Cab11b, p. 134].”

Unavailability is the opposite of availability which is continuously determined by dedicated monitoring software within the network of the UASWN. The results are reported on a monthly basis per service and displayed in the so-called AM dashboard which is a part of the Availability Plan/Report.[24] The reporting period depends on the needs of an organization and should be adapted to its specific needs. To grant a good overview the displayed results of the AM dashboard have different background colors; green results mean the target was reached in contrast to red results which mean the target was failed. Targets which are in a short fulfillment and therefore threatened are displayed with a yellow background. The AM dashboard, enriched with availability data of the past year, represents the data base

[22] Cp. table 9 (Extended Component Failure Impact Analysis with Risk Assessment on Configuration Item level); p. 85.
[23] Cp. figure 23 (Risk matrix); p. 92.
[24] Cp. figure 24 (Availability Management dashboard); p. 92.

from which further trend analysis can derived.[25] Because availability was not monitored before January 2012 the data base contains availability data from January up to and including April.

The SFA got a strong focus within the qualitative interviews. It is “a technique to provide a structured approach to identifying the underlying causes of service interruptions to the users. SFA utilizes a range of data sources to assess where and why shortfalls in availability are occurring [and] […] enables a holistic view to be taken to drive not just technology improvements, but also improvements to the IT support organization processes, procedures, and tools [Cab11b, p. 138].” In contrast to the aforementioned measures and methods SFA are usually very voluminous and therefore built up as a project. According to ITIL a SFA consists of ten stages which are sequentially completed [Cab11b, pp. 138-140]. It is not the intention of this paper to reproduce these stages in detail; instead a short overview is given. Because of its complexity SFA are usually built up as a project. At first it is absolutely necessary to select the scope of a certain SFA project. The scope defines the areas of services and/or components which are covered or not. According to recommendations of the interviewed experts the most critical services and/or components should be preferred within the scope. After the scope is defined a project plan must be developed which contains all tasks that have to be done as well as milestones that have to be reached. For a best possible implementation of the SFA it is necessary to involve all concerned departments including their experts. The main goal of a SFA is to find any ideas for improvement. If there are many different experts from different departments involved the opportunity to find any ideas for improvement is higher and can be simultaneously assessed by different perspectives. The desired outputs of a SFA are recommendations for further actions which should be implemented either immediately in the current SFA project or in another further project.

[25] Cp. figure 25 (E-library service trend analysis) – figure 28 (Web presence service trend analysis); pp. 93-95.

7.4 Realization of the Capacity Management process

During the implementation of the AM process not all recommended activities and methods according to ITIL were applied because it was not yet meaningful in the case of the UASIT to implement all activities and methods. Instead the UASIT turned its attention to the following activities and methods which were finally applied:

1) Baselining
2) Trend analysis

As aforementioned the CM process has its focus on the e-mail service. The e-mail service falls back on a set of certain CI like any service but not each CI is critical in a similar manner. For this reason it is recommended to analyze the CI which are most critical due to a lack of capacity. The e-mail service at the UASWN consists in essence of two Client Access Servers (CAS) as well as two Mailbox Servers (MS) which are both connected with each other and the internet. The CAS are used to receive the e-mail-related requests whereas the MS provide the needed storage capacity for the databases which is the actual bottleneck.

Baselining means “to create a baseline model that reflects accurately the [capacity and] performance that is currently being achieved [Cab11b, p. 173].” This baseline model is used for further activities such as predictive modeling.

As aforementioned the most critical factor of the e-mail service is storage capacity why only the two MS are relevant for the following baseline model. Each MS provide a net storage capacity of 1 TB (component capacity) what are 2 TB in total (service capacity). The SLA of the e-mail service is to provide mailboxes for students as well as external lecturers with a storage capacity up to 250 MB and up to 2 GB for the staff. This means a possible provision of 8,000 student mailboxes or 1,000 staff mailboxes (business capacity) respectively an appropriate mix of both. The following figure demonstrates the bottom-up approach of an adequate baseline model as well as the top-down approach for further predictive modeling activities.

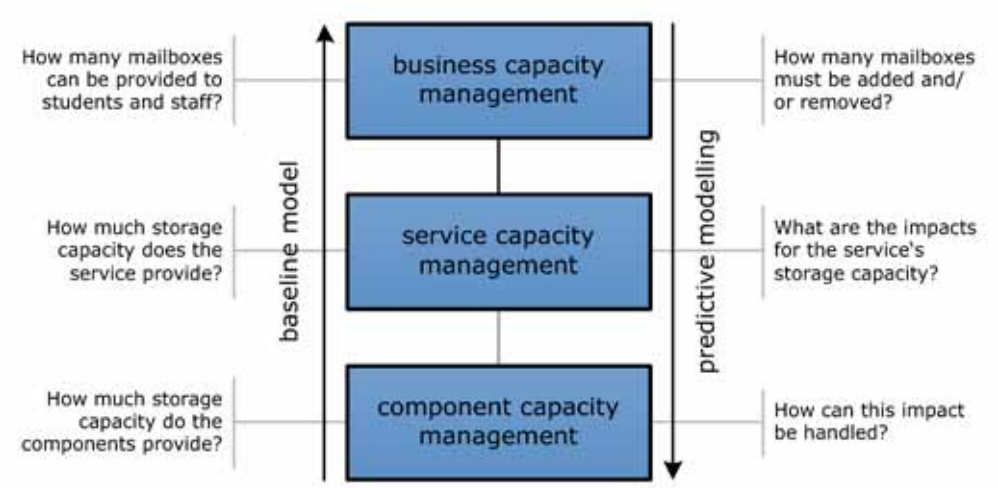

Figure 15: Baseline model and predictive modeling approach of the e-mail service

The baseline model is once created at the beginning and used as base for further predictive modeling activities which are triggered by the business CM sub-process. At the moment the UASWN employs 263 salaried individuals as well as 820 external lecturers who use the e-mail service.[26] This means a need of one mailbox per person or a total storage capacity of 731 GB. As the number of employees is stable hires and layoffs are not considered. The 2,520 students at the campus in Wiener Neustadt represent the biggest part of users.[27] Students at other campuses are not considered because they are out of the e-mail service's scope. Each academic year begins in autumn and ends at the beginning of summer what makes it very easy to define suitable events which trigger any changes in the e-mail service's demand. A certain number of students begin and end their academic studies in September or in June. At the moment approximately 1,500 students begin their academic studies in September and leave UASWN in June each year.[28] This continuous interval is perfect for the UASIT to be prepared for any changes in the e-mail service's demand.

[26] Current number of salaried individuals and external referees by April 24, 2012.
[27] Current number of students at the campus in Wiener Neustadt by April 24, 2012.
[28] Current number of yearly freshmen and graduates by April 24, 2012.

To prepare the initial baseline model the abovementioned statements are subdivided into the appropriate CM sub-processes:

1) Business Capacity Management
   a. 263 mailboxes each with 2 GB for salaried individuals
   b. 820 mailboxes each with 250 MB for external lecturers
   c. 2,520 mailboxes each with 250 MB for students at the campus in Wiener Neustadt
2) Service Capacity Management: A total storage capacity of at least 1,361 GB is required to fulfill the demand which is specified by the Business Capacity Management sub-process.
3) Component Capacity Management: Each MS provides a storage capacity of approximately 1 TB what are 2 TB in total. The current utilization of storage capacity is at approximately 20% due to data de-duplication.

The initial baseline model is necessary to demonstrate the demand of the Business Capacity Management sub-process and its impact to the Service Capacity Management and Component Capacity Management sub-processes. This gives an answer to the question how a service including subjacent CI must be sized from its capacity perspective to fulfill the demand from the business.

All relevant indicators of the CM sub-processes including their relations are tabular demonstrated by the CM dashboard.[29]

Sub-process/ indicator	Capacity (e-mail service)												
	Type	January	February	March	April	May	June	July	August	September	October	November	December
Business CM													
Mailboxes of salaried individuals	Demand	263	263	263	263								
Mailboxes of external referees	Demand	820	820	820	820								
Mailboxes of students	Demand	2.520	2.520	2.520	2.520								
Service SM													
Storage capacity (TB)	Demand	1,37	1,37	1,37	1,37								
	Target	2,00	2,00	2,00	2,00								
	As-is	0,30	0,40	0,40	0,50								
Component CM													
Storage capacity (TB) on verena7	Target	1,00	1,00	1,00	1,00								
	As-is	1,00	1,00	1,00	1,00								
Storage capacity (TB) on verena8	Target	1,00	1,00	1,00	1,00								
	As-is	1,00	1,00	1,00	1,00								

Demand/target reached
Demand/target threatened
Demand/target failed

Figure 16: Capacity Management dashboard

The purpose of the e-mail service is to provide the ability for collaboration to the different user groups. Business demand of this service is expressed by mailboxes whereat the configuration differs regarding the provided storage capacity in dependence of the user groups. In this case the Business Capacity Management sub-process is responsible for a proper determination of the demanded mailboxes by the different user groups. The result of this sub-process is an input for the following Service Capacity Management sub-process which has to elicit the needed storage capacity to fulfill this demand. A further forecast of future demands by the Business Capacity Management sub-process is insofar necessary as the Service Capacity Management sub-process can promptly react to changes and provide additional storage capacity if required. The target and as-is indicators in the CM dashboard represent the sum of the appropriate indicators of the subjacent CI. The target indicator means the storage capacity which is planned for provision whereas the as-is

[29] Cp. figure 18 (Capacity Management dashboard).

indicator shows the real storage capacity utilization. There is a difference between the theoretical and the factual storage capacity utilization due to data de-duplication. Data de-duplication is a technology which prevents a redundant storage of data and can therefore help to save costs. The implementation of appropriate technologies to provide economic capacity and performance is another purpose of the CM process.

The baseline model shows a storage capacity of 1 TB for each CI which results in a total storage capacity of 2 TB. If the required storage capacity would increase the currently provided storage capacity adequate measures have to be undertaken to resolve this issue.

Two trend analyses are used to demonstrate the past as well as current progress of business demand and storage capacity. The first trend analysis shows the timely progress of the demand for mailboxes and its impact regarding storage capacity as well as their future trends.[30] The second trend analysis focuses the target and as-is indicators of storage capacity.[31]

7.5 Continuous planning and reporting

All activities of the AM and CM processes are captured in monthly updated documents; the so-called Availability Plan/Report and Capacity Plan/Report.[32] Both papers consist of a reporting part and a planning part. The dashboard and relevant trend analyses are included in the reporting part which is clearly represented by the use of graphics as well as the avoidance of text. This makes it easy for the recipient to recognize the status quo as well as future trends. The planning part includes all past and future threats as well as the related countermeasures to handle them.

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[30] Cp. figure 29 (E-mail service demand trend analysis); p. 95.
[31] Cp. figure 30 (E-mail service storage capacity trend analysis); p. 95.
[32] Cp. figure 31 (Availability Plan/Report, p. 1) – figure 43 (Capacity Plan/Report, p. 6); pp. 96-108.

7.6 Interim conclusion

This chapter demonstrated the realization of the AM and CM processes using the example of the UASWN. Prior to the implementation it is absolutely necessary to define an appropriate scope which should address the most critical services at first. Afterwards it is important to make sure the existence of the relevant prerequisites like adequately implemented SLM as well as a SACM processes which deliver input to the AM and CM processes. ITIL suggests many different measures and methods which can be implemented in the AM and CM processes but scrutinizing the contribution to a certain goal is urgently recommended. After the selection of appropriate measures and methods the AM and CM processes can be realized; the output of these processes is a plan/report which shows up the past and current progress as well as future trends from which recommended actions are derived for a sustainable service improvement.

8 Conclusion

The intention of this paper was to demonstrate how AM and CM processes following ITIL can be realized within IT organizations considering effectiveness as well as efficiency. The answer of the following questions including the consideration of theirs results was therefore necessary:

1) Does the definition of the term “service interruption” in compliance with ITIL accord with the service-oriented approach?
2) Are the recommendations of ITIL regarding SFA effective as well as efficient and how are they handled in practice?
3) Which relevance have requirements analysis in practice when planning and designing new and changed services?
4) How do organizations deal with costs and risks of service’s availability and unavailability in practice?
5) What are the lessons learned when introducing the AM and CM processes in compliance with ITIL and how could a possible approach to introduce these processes look like?

Ad 1)

A service’s availability strictly depends on its SLA which means that an occurrence of a service’s unavailability does not result in a service interruption in either case. In fact it is only a service interruption if the service’s unavailability exceeds the thresholds which are in the SLA. For this reason the term “service interruption” in compliance with ITIL is not in accordance with the service-oriented approach. ITIL defines any service’s unavailability as a service interruption whereas service interruption following the service-oriented approach is given if the SLA was violated.

Ad 2)

The execution of an agreed number of SFA is recommended by the AM process in compliance with ITIL. This recommendation is insofar effective because the quality of services can be increased by SFA. From the perspective of efficiency it is very clever to address the most critical services with SFA at first; following the Pareto principle means a significant increase of the overall service quality with comparable less effort.

Ad 3)

The holistic requirements analysis of new and changed services is indispensable to lead them to success. Both functional as well as nonfunctional requirements have to be determined in an appropriate degree with equal respect. In practice either functional or nonfunctional requirements are often neglected. Lack of communication between the business and ITSP which usually occurs by a lack of common understanding is a frequent reason for insufficient requirements analysis. Both business and ITSP must have a strict awareness of the priority of requirements analysis to successfully create or change services.

Ad 4)

The awareness regarding costs which result to service's unavailability is often low. In general it can be said that the bigger a company is the higher is the awareness for these costs. There are also up- and downturns of awareness which depends on frequency as well as previous time periods of a service's unavailability. This means that the awareness is higher if services were recently unavailable in contrast to a low awareness if services run stable for a long time period. Actions must be taken to continuously ensure high awareness of the business for any risks.

Ad 5)

ITSM is not an end in itself; in fact ITSM bases on the business-IT-alignment cycle and shall be recognized as a paradigm which sustainably enables IT organizations to provide value to their customers or the business in the form of services. Thereby it is vital to understand what a service is and how a service differs from a product. The intangibility of a service makes it impossible to assess its quality before consumption. Furthermore services are created by processes which do not have homogenous input factors such as material but heterogeneous input factors such as capability, knowledge, material, people and further more. Simultaneous production and consumption as well as perishability should also be kept in mind. The consumer of a service is always involved to its production. If a service is not consumed immediately after its production it will vanish. For this reason it is not possible to keep a service in stock.

ITIL should not be seen as a miracle cure to implement ITSM. In fact it is a set of best-practice recommendations which provide a rude guideline to ITSP that consider to implement ITSM. The answers of chosen experts in chapter 4 showed frequent mistakes quite plainly. An important key finding of this paper is the fact that appro-

priate Service Level Management and Service Asset and Configuration Management processes are absolutely necessary for the implementation of further processes. An ITSP must understand the needs of the business from a qualitative and quantitative perspective and how to fulfill them appropriately. To fulfill these needs adequately an ITSP must know all components of its IT infrastructure including their relations. It is urgently recommended to define an appropriate scope prior to the implementation of further processes. This scope should address the most critical services first to get quick wins. ITIL provides numberless possible measures and methods for an implementation of processes which should be scrutinized individually. It depends on the IT organization as well as its maturity stage which measures and methods are meaningful to implement. A pragmatic approach can be definitely helpful.

List of Abbreviations

A	Automatic failover
AM	Availability Management
a.m.	ante meridiem
BIA	Business Impact Analysis
BCM	Business Continuity Management
BSC	Balanced Scorecard
CAS	Client Access Server
CCTA	Central Computing and Telecommunications Agency
CFIA	Component Failure Impact Analysis
CI	Configuration Item
CM	Capacity Management
CMDB	Configuration Management Database
CMIS	Capacity Management Information System
CMM	Capability Maturity Model
CMMI	Capability Maturity Model Integration
cp.	compare
CSF	Critical Success Factor
CSI	Continual Service Improvement
DM	Demand Management
e.g.	for example
F	False
FTA	Fault Tree Analysis
GB	Gigabyte
IT	Information Technology
IT-BSC	IT-Balanced Scorecard
ITIL	IT Infrastructure Library
ITSM	IT Service Management
ITSP	IT Service Provider
KPI	Key Performance Indicator
M	Manual failover
MB	Megabyte
MS	Mailbox Server
MTBF	Mean Time Between Failures
MTBSI	Mean Time Between Service Interruptions

MTRS	Mean Time to Restore Service
N.U.	Name Unknown
p.	page
PBA	Pattern of Business Activity
p.m.	post meridiem
pp.	pages
SACM	Service Asset and Configuration Management
SFA	Service Failure Analysis
SIP	Service Improvement Plan
SLA	Service Level Agreement
SLM	Service Level Management
SLR	Service Level Requirement
SPoF	Single Point of Failure
SPoFA	Single Point of Failure Analysis
T	True
TB	Terabyte
TCO	Total Cost of Ownership
UASIT	ITSP of the UASWN
UASWN	University of Applied Sciences Wiener Neustadt
X	Single Point of Failure

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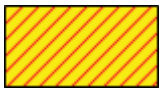
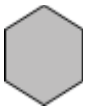
AND gate

Conditional event



Event (yellow background means a Manual Failover; red background means a Single Point of Failure)

House event (yellow background means a Manual Failover; red background means a Single Point of Failure)



Inhibit gate

OR gate

Appendices

Tables

Components		Service				Risk	
Component group	Component	E-library	E-Mail	Time registration	Web presence	Likelihood	Impact
Clients	terminal1			X		E	A
	terminal2			X		E	A
Hypervisors	xen1	M	M	M	M	E	C
	xen10	M	M	M	M	E	C
	xen2	M	M	M	M	E	C
	xen4	M	M	M	M	E	C
	xen6	M	M	M	M	E	C
Networks	bt1-2	M	M	M	M	E	B
	bt2-1			X		E	B
	bt3-8			X		E	B
	fire1	A	A	A	A	D	D
	fire2	A	A	A	A	D	D
	giga2			X		E	B
	giga3	M	M	M	M	E	B
	giga4	M	M	M	M	E	B
	MCS	M	M	M	M	E	B
Servers	cmsdb				X	D	B
	euleneu	X				E	C
	han	X				E	B
	hpux	A	A	A	A	D	C
	isgus			X		E	C
	johanna	A	A	A	A	E	B
	manu	A	A	A	A	D	C
	operator	A	A	A	A	E	B
	philipp				X	D	C
	reverse	X		X		E	C
	sebastian	A	A	A	A	E	B
	steffi				X	D	C
	verena2		A			D	B
	verena3		A			D	B
	verena7		X			D	B
	verena8		X			D	B
	webopac	X				D	C
Single Points of Failure		**6**	**2**	**8**	**3**		

Table 9: Extended Component Failure Impact Analysis with Risk Assessment on Configuration Item level

Figures

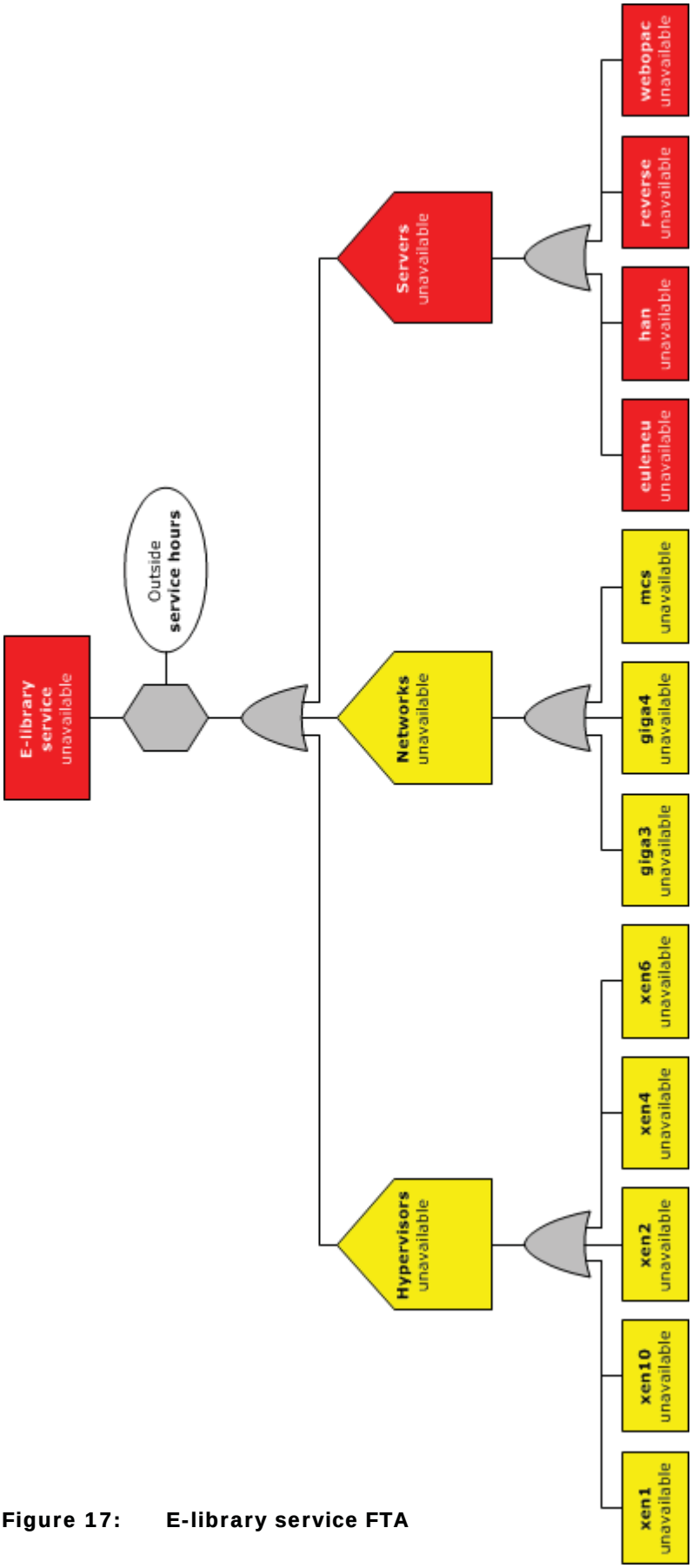


Figure 17: E-library service FTA

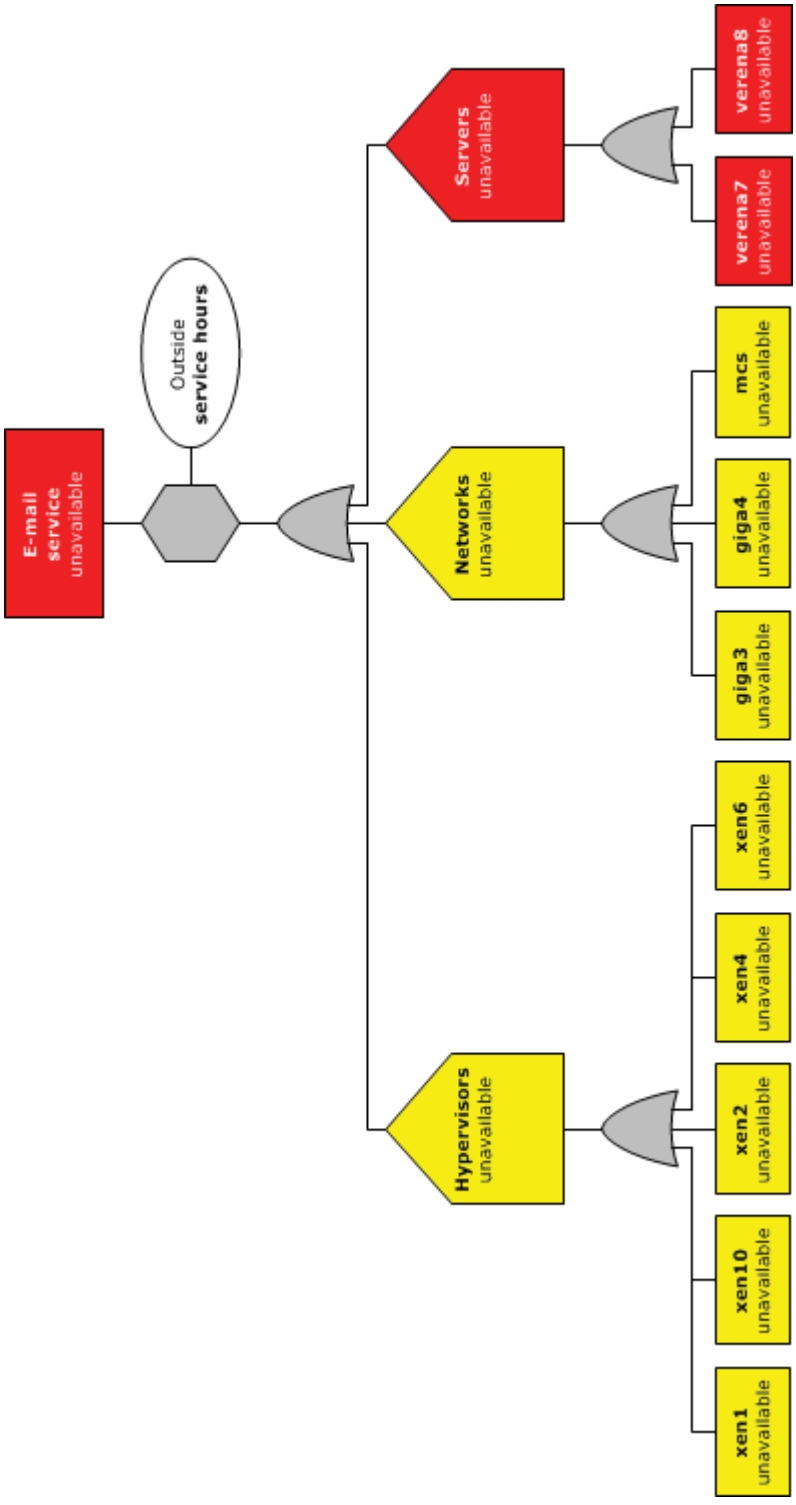


Figure 18: E-mail service FTA

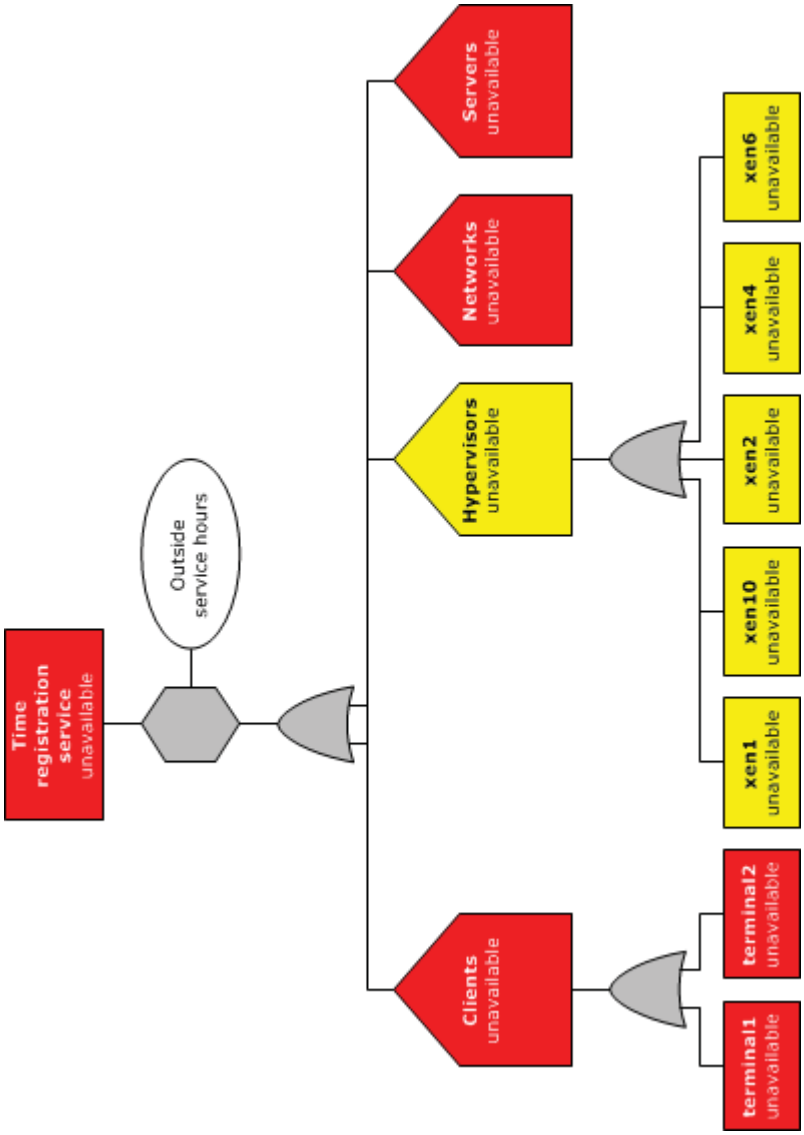


Figure 19: Time registration service FTA 1 / 2

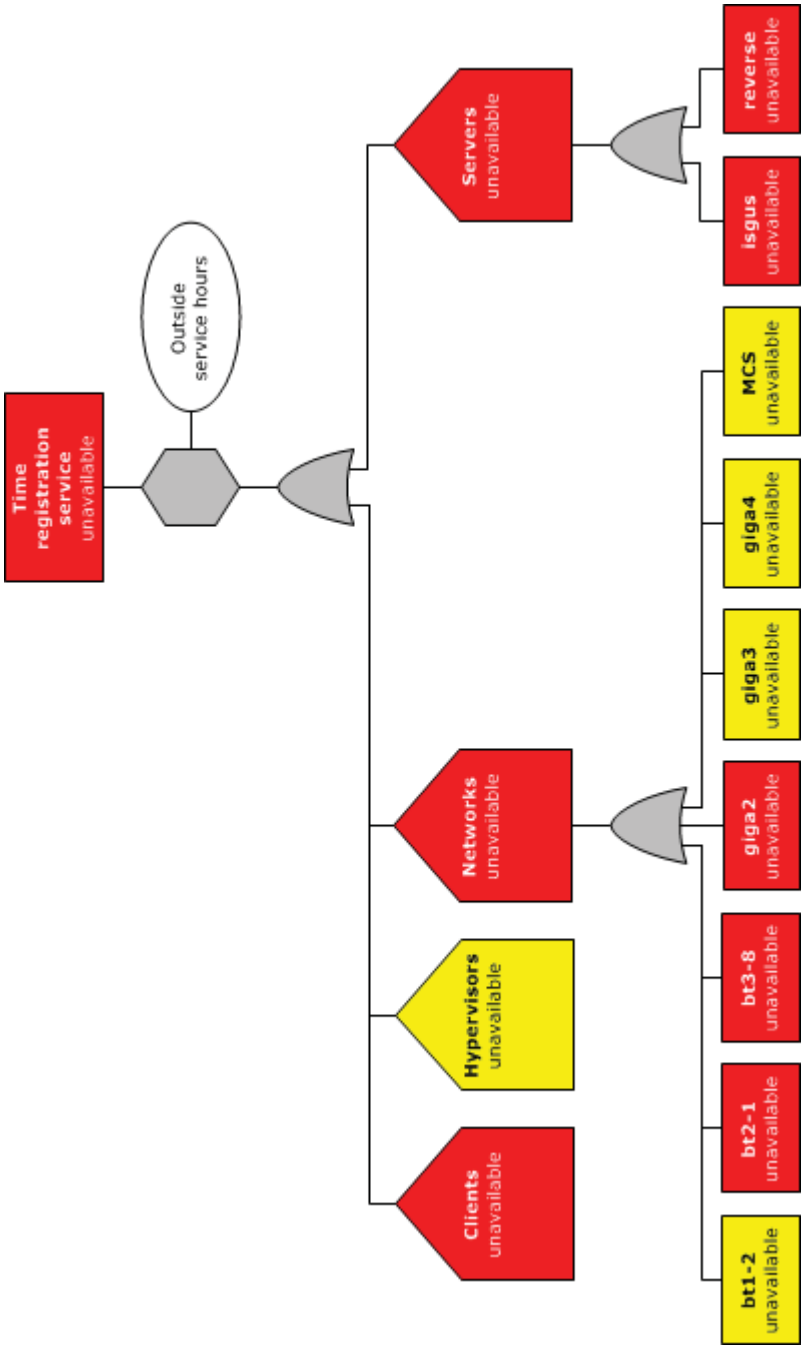


Figure 20: Time registration service FTA 2 / 2

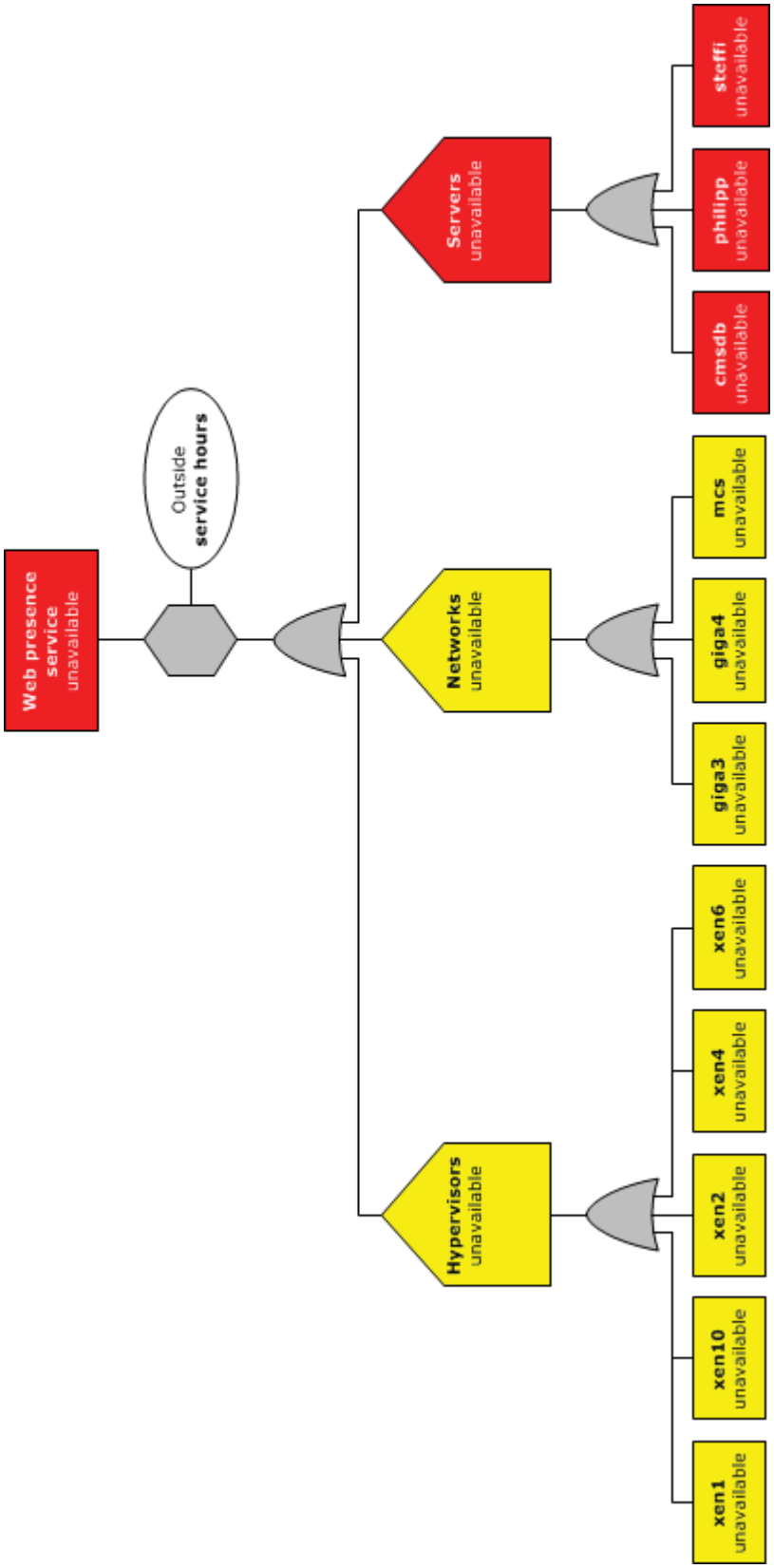


Figure 21: Web presence service FTA

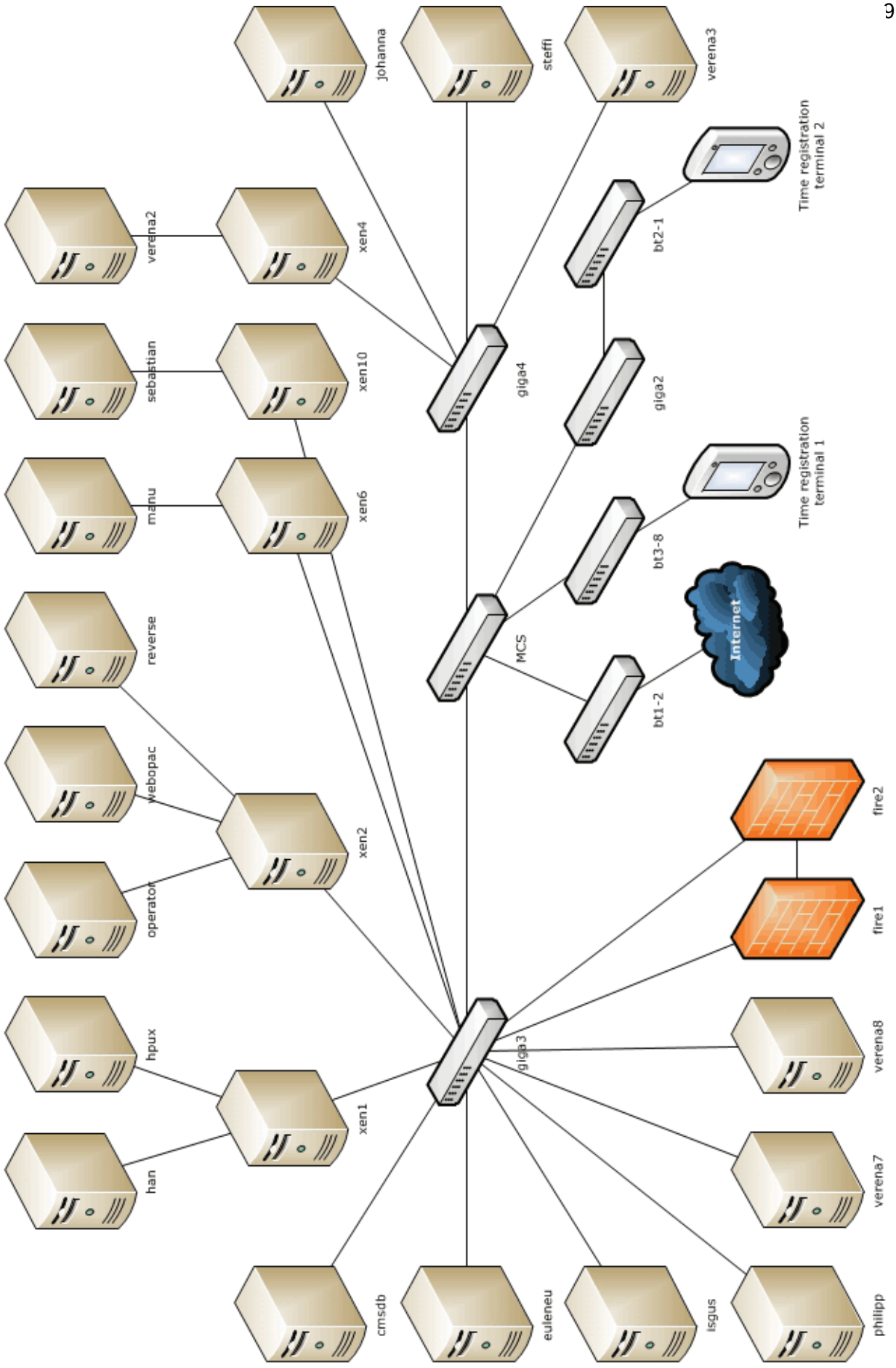


Figure 22: Component interdependences

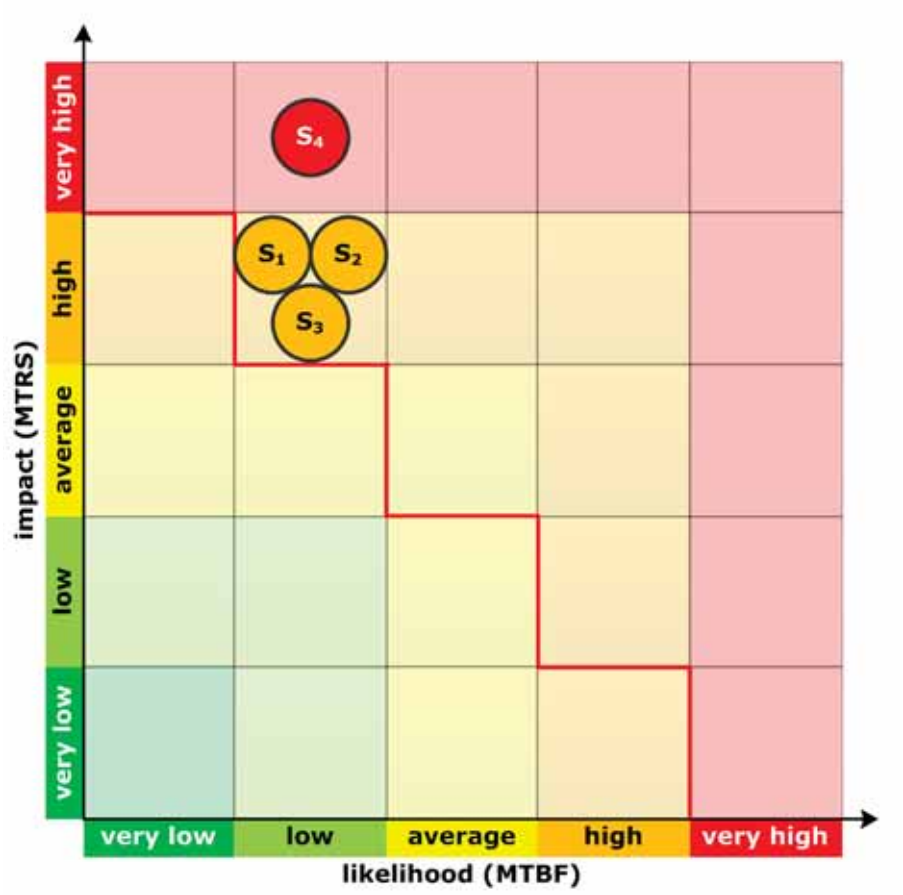


Figure 23: Risk matrix[33]

All services exceed the risk acceptance line due to a high risk of some networking CI which influence the overall risk of the services. The overall risk of services would fall below the risk acceptance line by decreasing the risk of these networking CI.

Service	Availability (%)												
	Target	As-is											
		January	February	March	April	May	June	July	August	September	October	November	December
E-library	99,00	99,94	99,74	99,96	99,88								
E-mail	99,00	99,93	99,74	99,96	99,88								
Time registration	99,00	99,94	99,74	99,96	99,88								
Web presence	99,00	99,94	99,74	99,96	99,88								

Target reached
Target threatened
Target failed

Figure 24: Availability Management dashboard

[33] For lack of space the services were abbreviated as follows: S_1 = e-library service, S_2 = e-mail service, S_3 = time registration service, S_4 = web presence service.

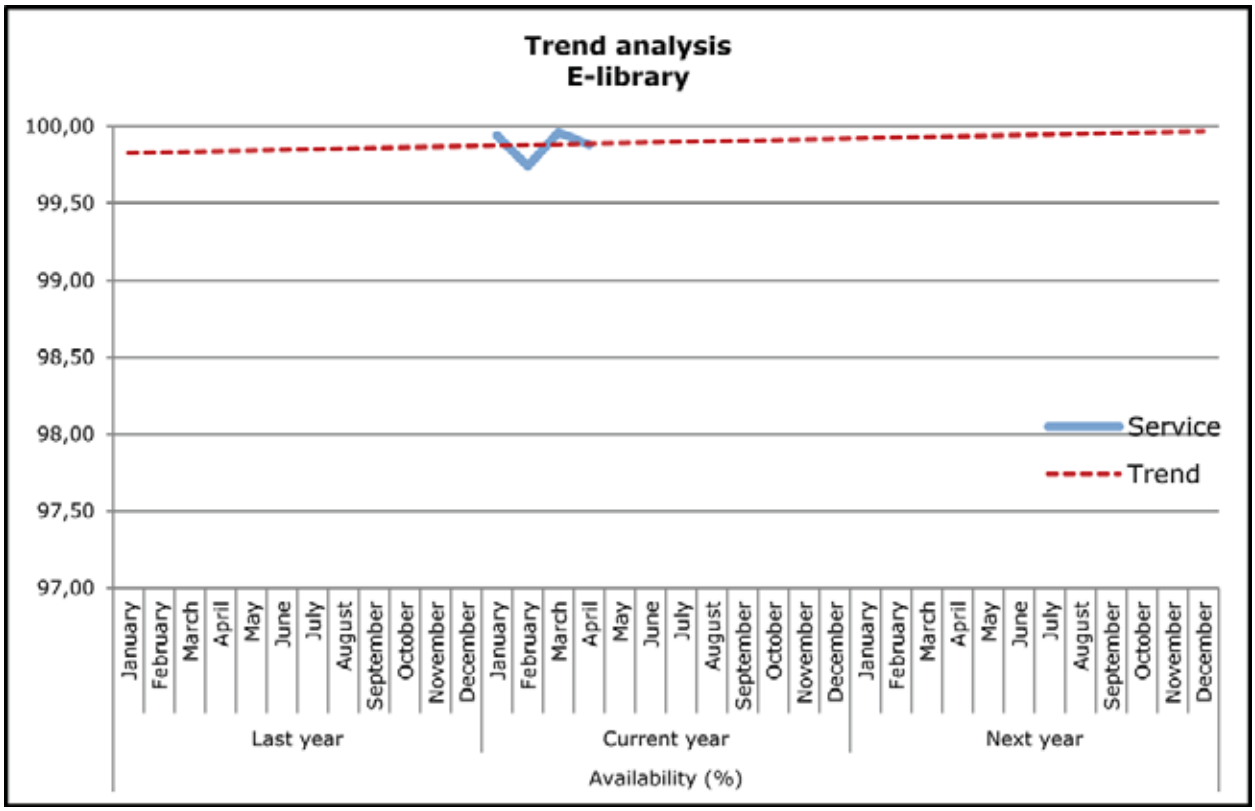


Figure 25: E-library service trend analysis

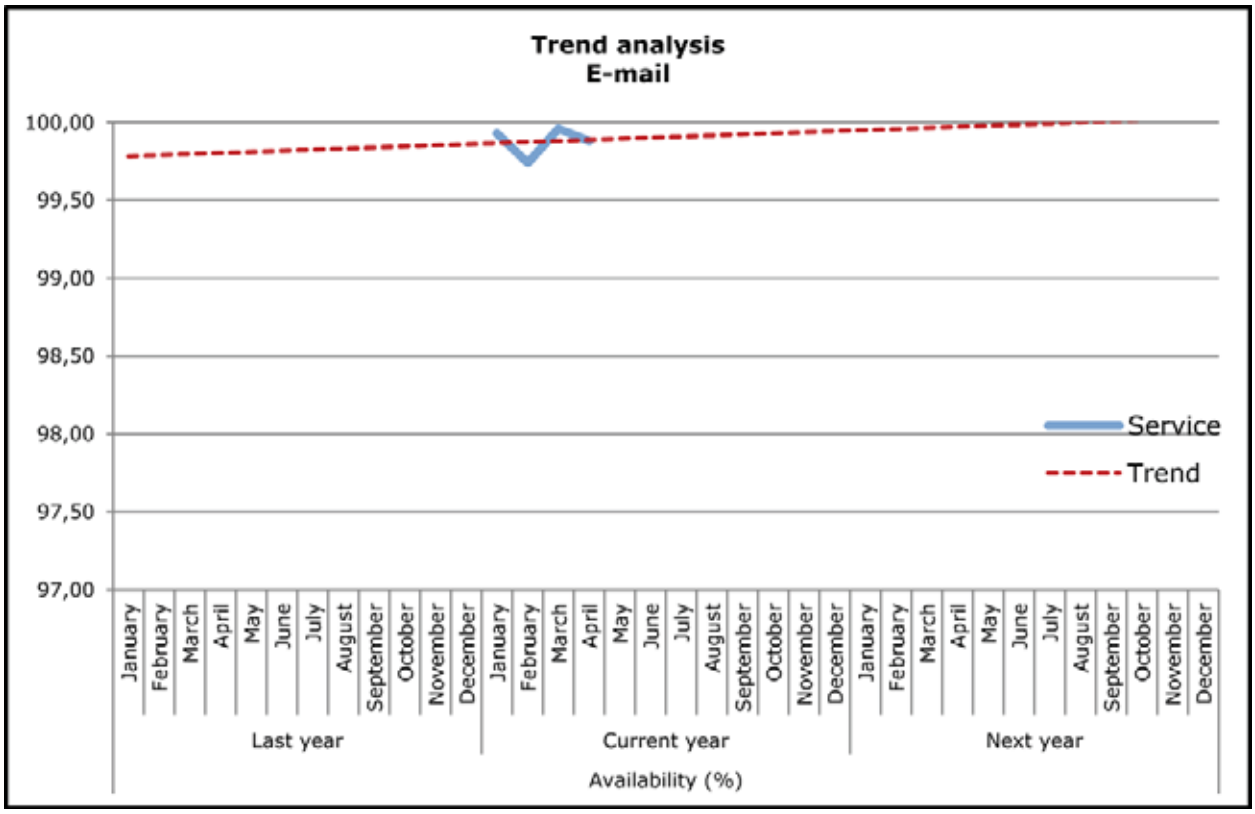


Figure 26: E-mail service trend analysis

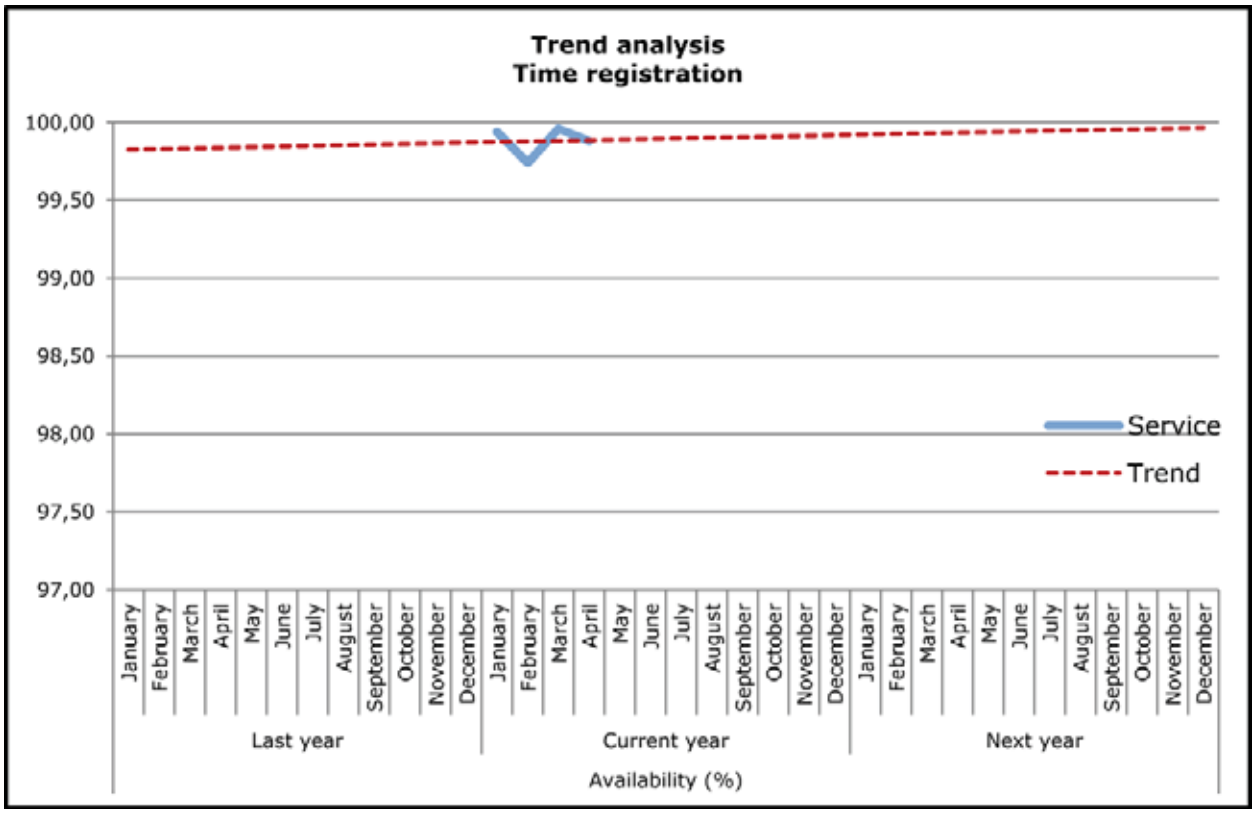


Figure 27: Time registration service trend analysis

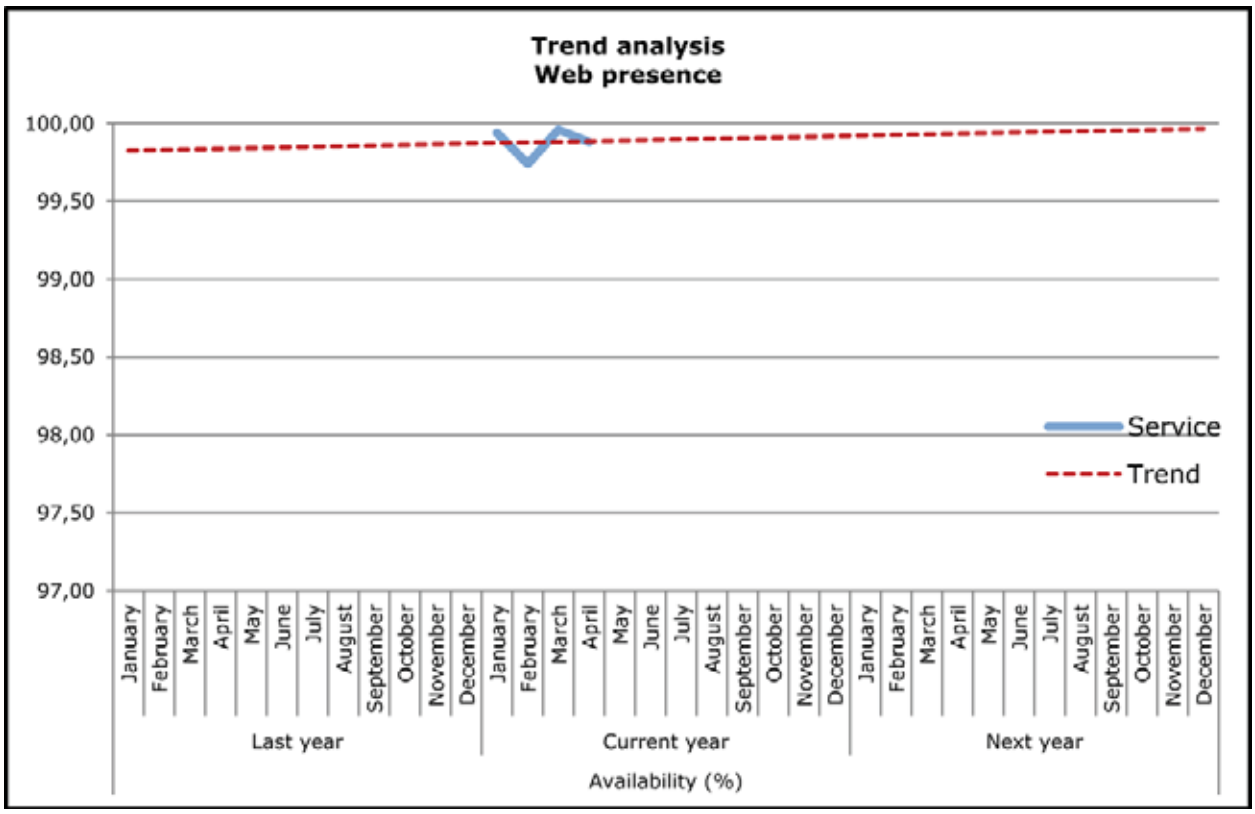


Figure 28: Web presence service trend analysis

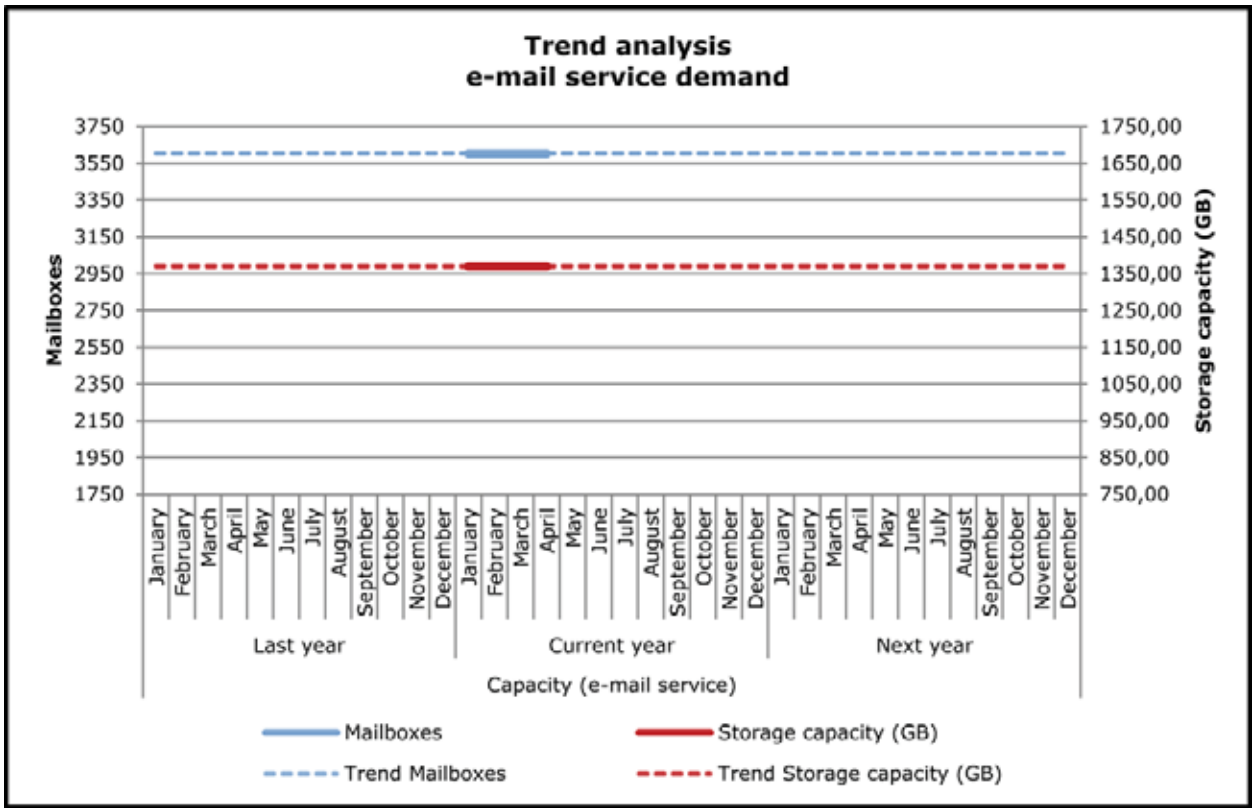


Figure 29: E-mail service demand trend analysis

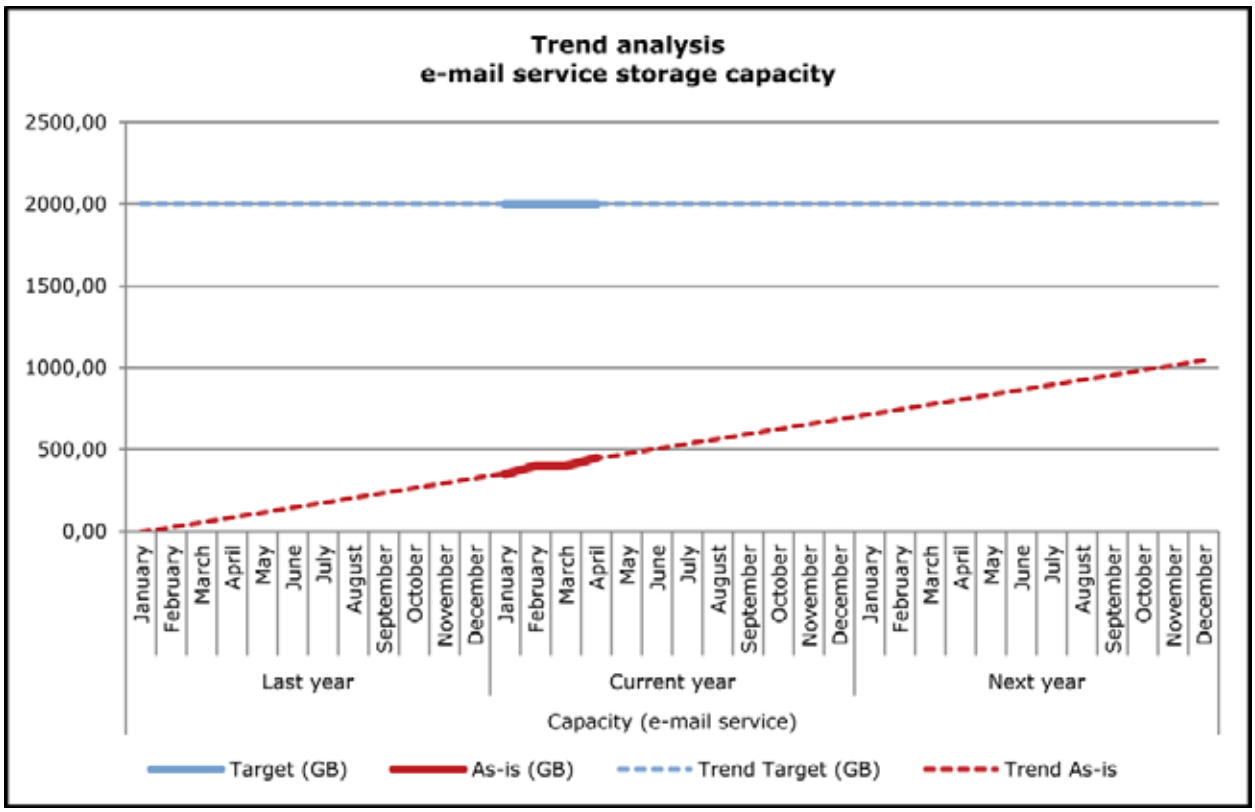
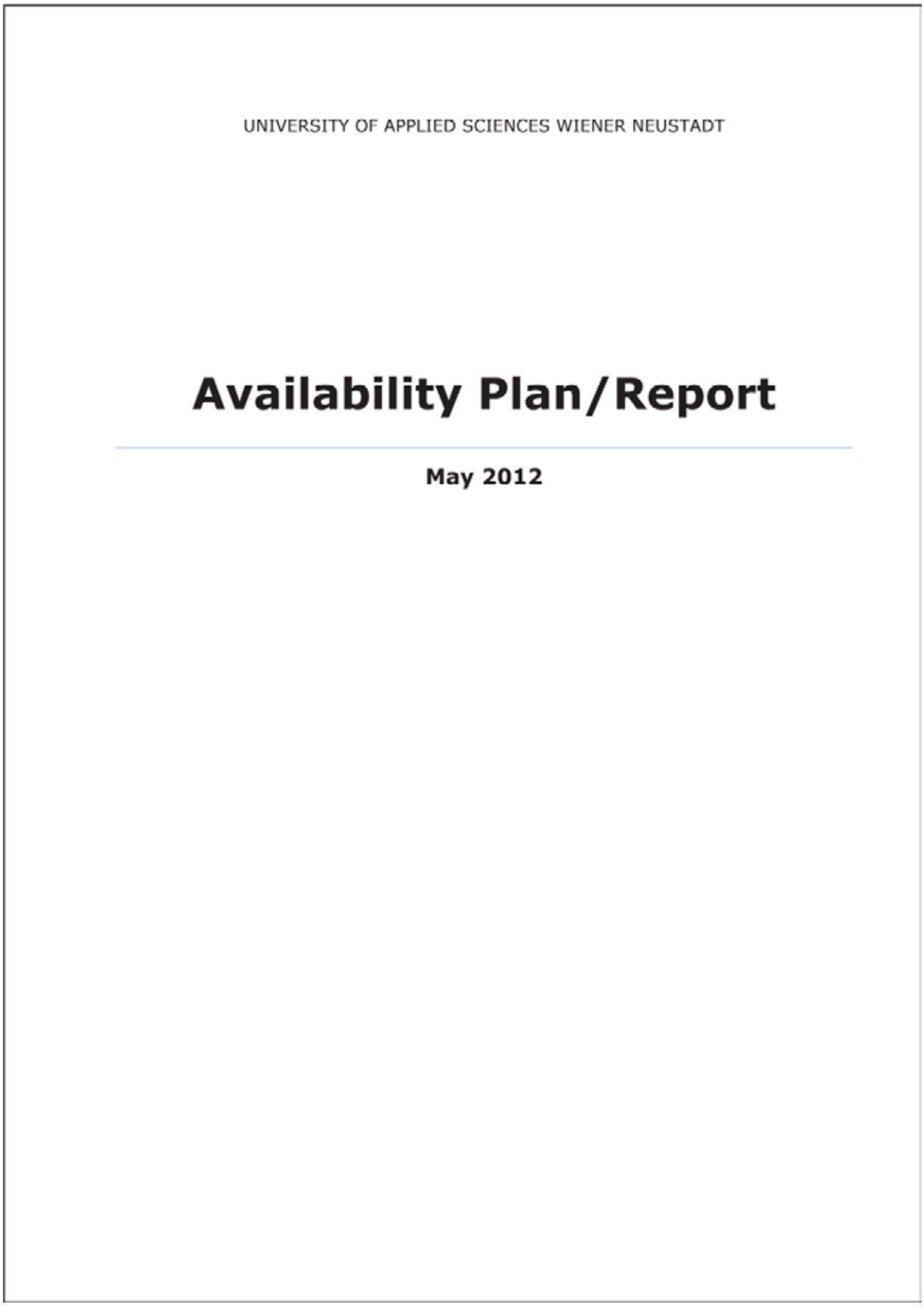


Figure 30: E-mail service storage capacity trend analysis



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Availability Plan/Report

May 2012

Figure 31: Availability Plan/Report, p. 1

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Figure 32: Availability Plan / Report, p. 2

1 Dashboard

1.1 Service availability

Service	Target	Availability (%)											
		As-is											
		January	February	March	April	May	June	July	August	September	October	November	December
E-library	99,00	99,94	99,74	99,96	99,88								
E-mail	99,00	99,93	99,74	99,96	99,88								
Time registration	99,00	99,94	99,74	99,96	99,88								
Web presence	99,00	99,94	99,74	99,96	99,88								

Target reached
Target threatened
Target failed

1.2 Service risk analysis

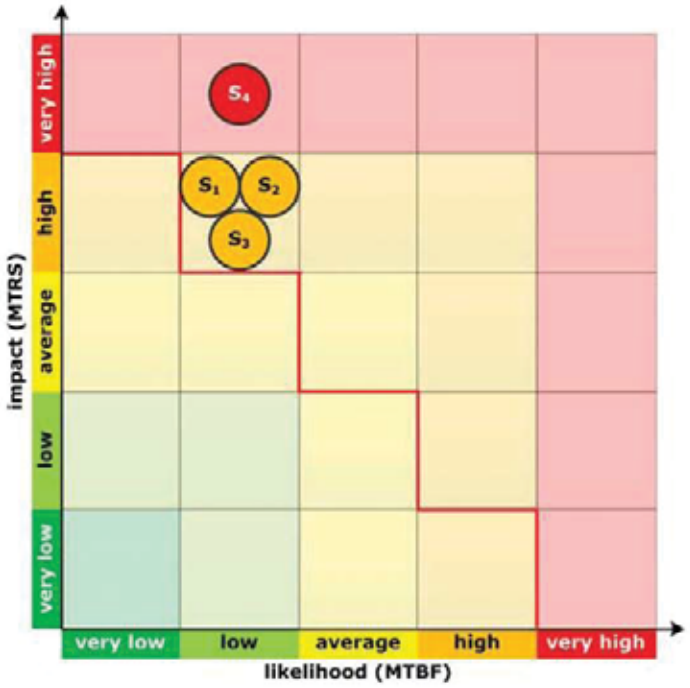


Figure 33: Availability Plan / Report, p. 3

2 Trend analysis

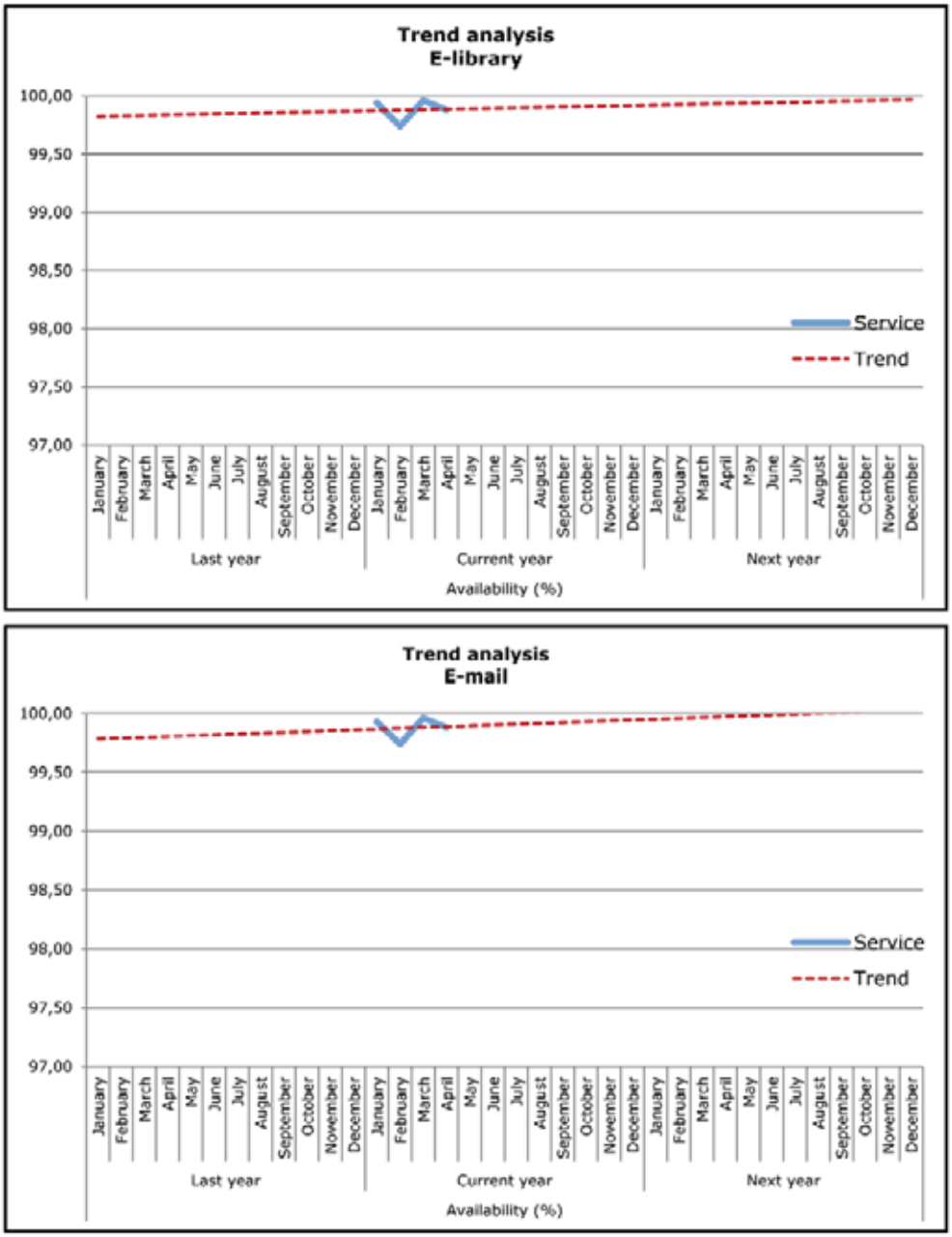


Figure 34: Availability Plan / Report, p. 4

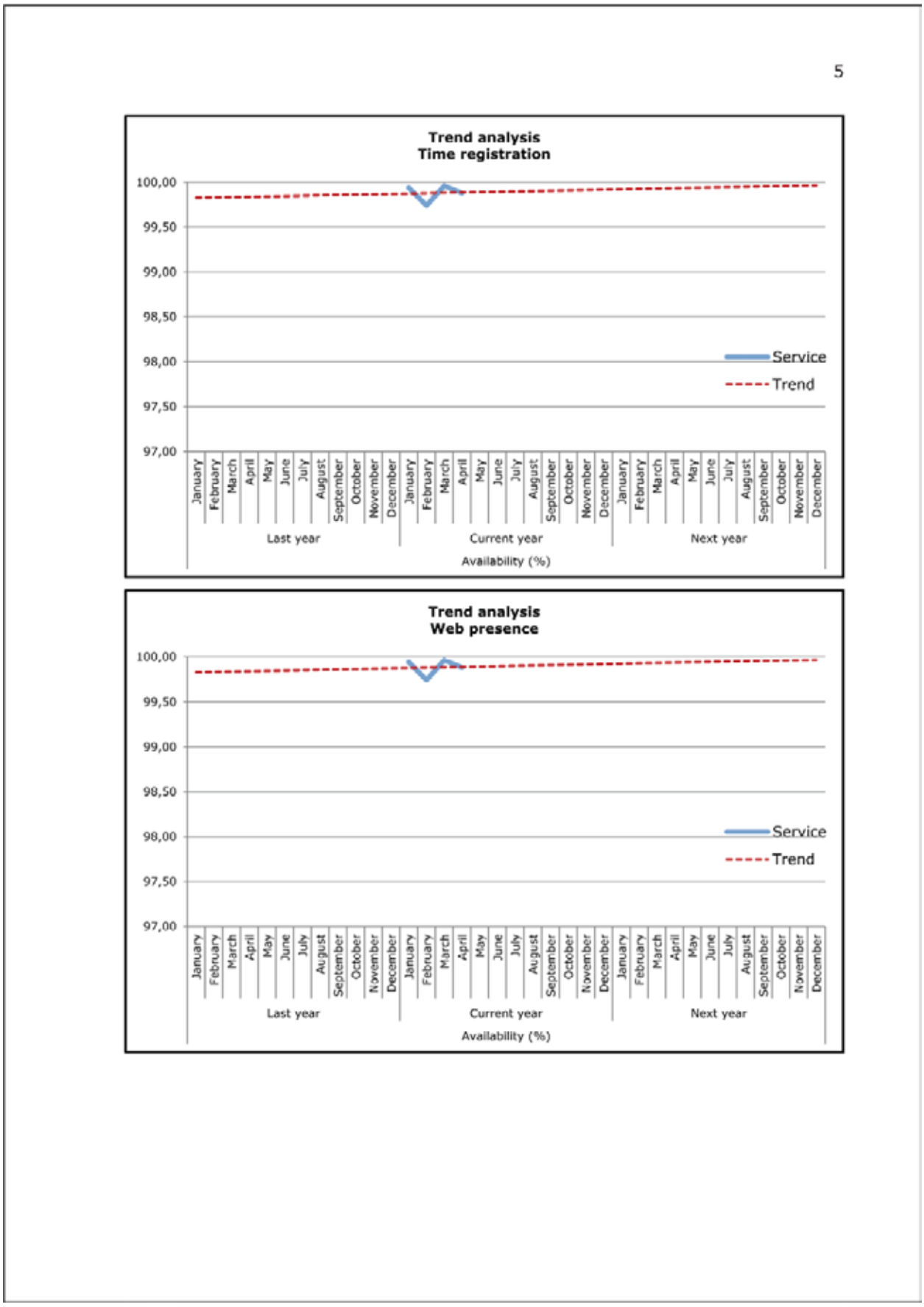


Figure 35: Availability Plan / Report, p. 5

3 Threats

3.1 Past and actual threats

3.1.1 Events

Identification number	Type	Description of event	Affected services and/or configuration items
Example	Exam-ple	Example	Example

3.1.2 Incidents

KPI Number of occurred incidents in April: **0**

Percentage change to March: **+/- 0%**

Identification number	Type	Symptomes	Countermeasures	Affected services and/or configuration items
Example	Exam-ple	Example	Example	Example

3.1.3 Problems

KPI Number of resolved problems in April: **0**

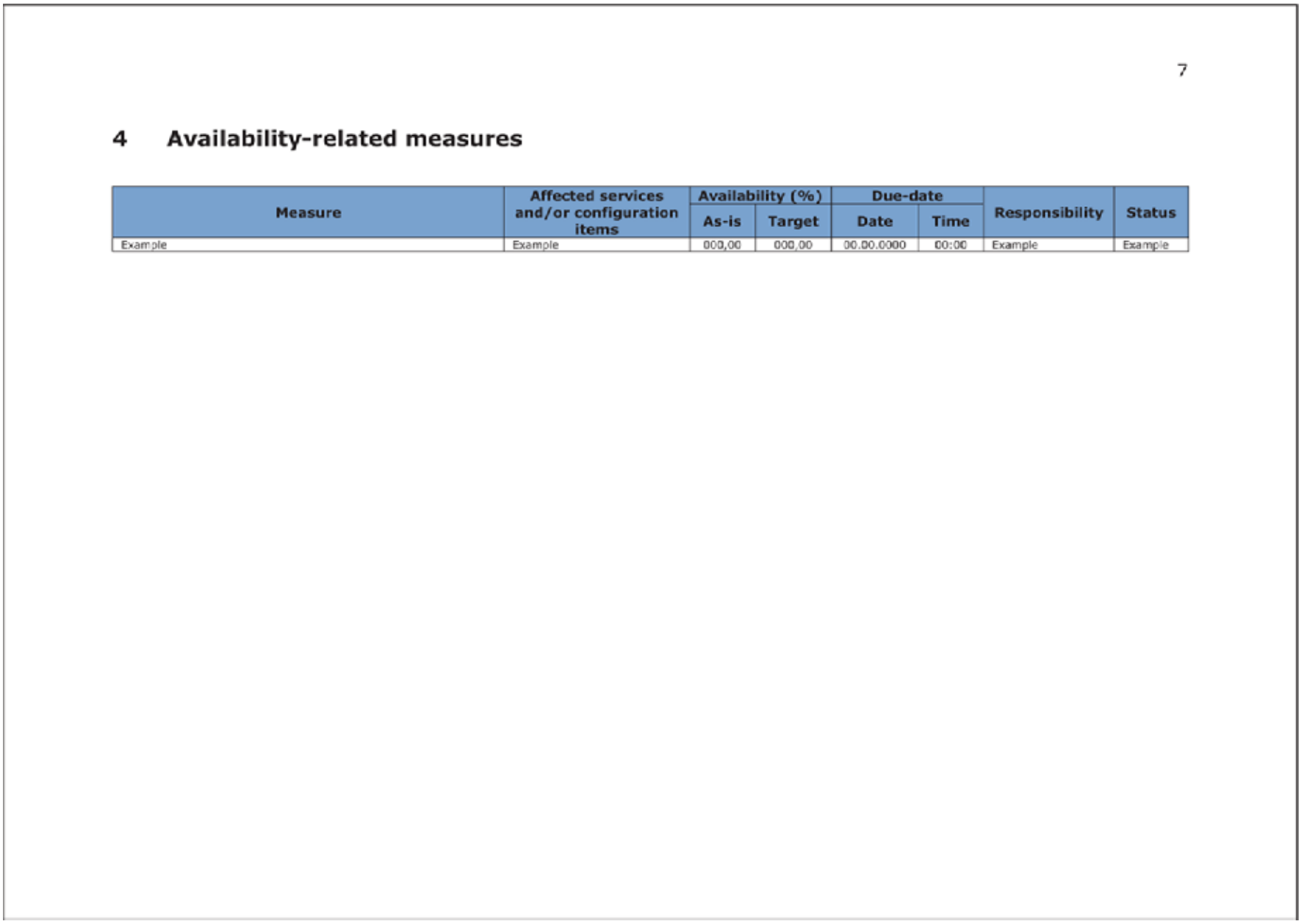
Percentage change to March: **+/- 0%**

Identification number	Type	Related incidents	Reasons	Countermeasures
Example	Exam-ple	Example	Example	Example

3.2 Future threats

Affected services and/or configuration items	Period		Assumptions
	Dates	Times	
Example	00.00.0000 – 00.00.0000	00:00 – 00:00	Example

Figure 36: Availability Plan / Report, p. 6

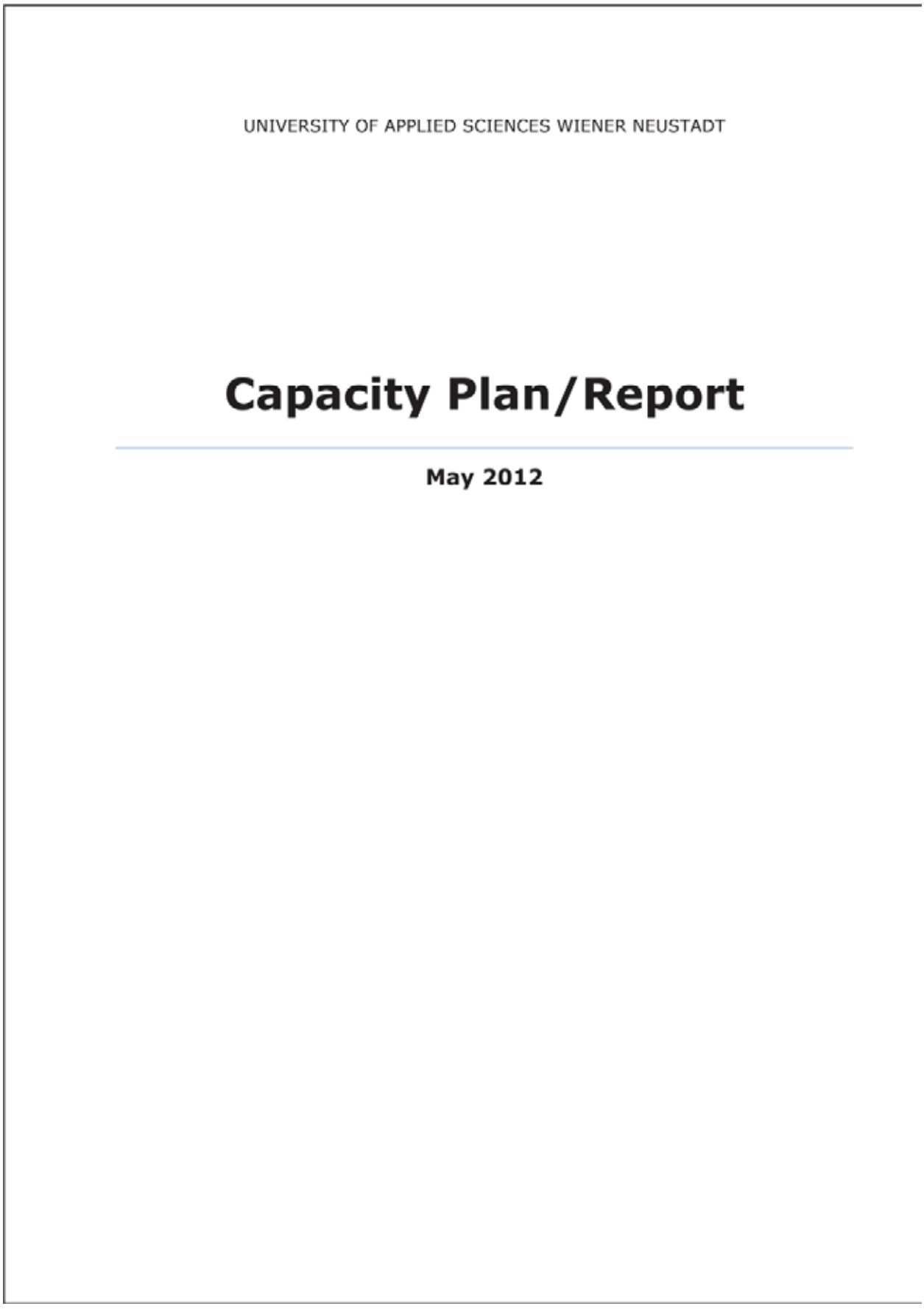


7

4 Availability-related measures

Measure	Affected services and/or configuration items	Availability (%)		Due-date		Responsibility	Status
		As-is	Target	Date	Time		
Example	Example	000,00	000,00	00.00.0000	00:00	Example	Example

Figure 37: Availability Plan/Report, p. 7



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Capacity Plan/Report

May 2012

Figure 38: Capacity Plan/Report, p. 1

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Figure 39: Capacity Plan / Report, p. 2

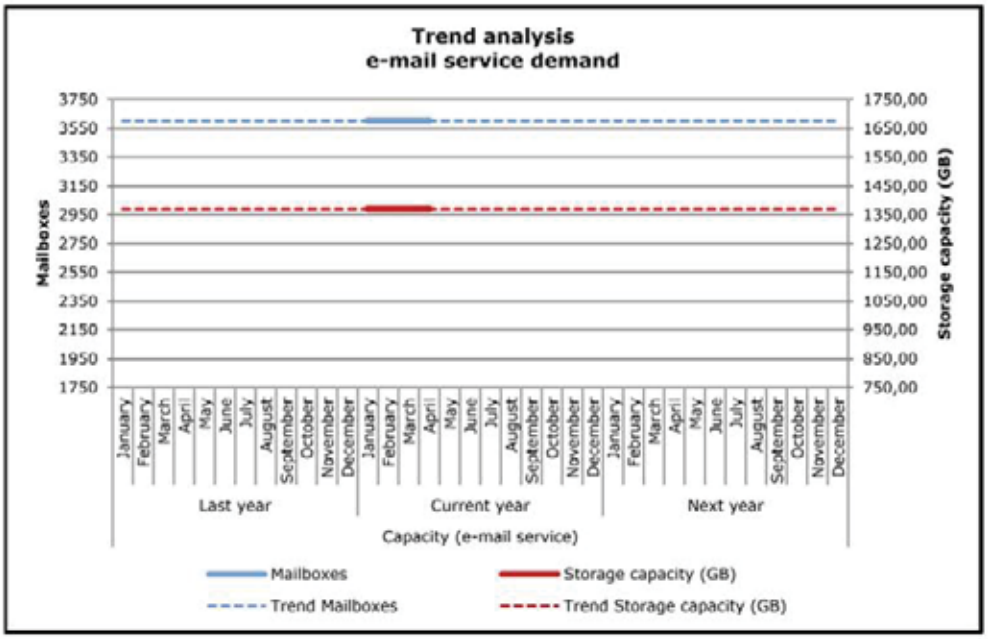
1 Dashboard

Sub-process/ indicator	Capacity (e-mail service)												
	Type	January	February	March	April	May	June	July	August	September	October	November	December
Business CM													
Mailboxes of salaried individuals	Demand	263	263	263	263								
Mailboxes of external referees	Demand	820	820	820	820								
Mailboxes of students	Demand	2.520	2.520	2.520	2.520								
Service SM													
Storage capacity (TB)	Demand	1,37	1,37	1,37	1,37								
	Target	2,00	2,00	2,00	2,00								
	As-is	0,30	0,40	0,40	0,50								
Component CM													
Storage capacity (TB) on verena7	Target	1,00	1,00	1,00	1,00								
	As-is	1,00	1,00	1,00	1,00								
Storage capacity (TB) on verena8	Target	1,00	1,00	1,00	1,00								
	As-is	1,00	1,00	1,00	1,00								

Demand/target reached
Demand/target threatened
Demand/target failed

Figure 40: Capacity Plan / Report, p. 3

2 Trend analysis



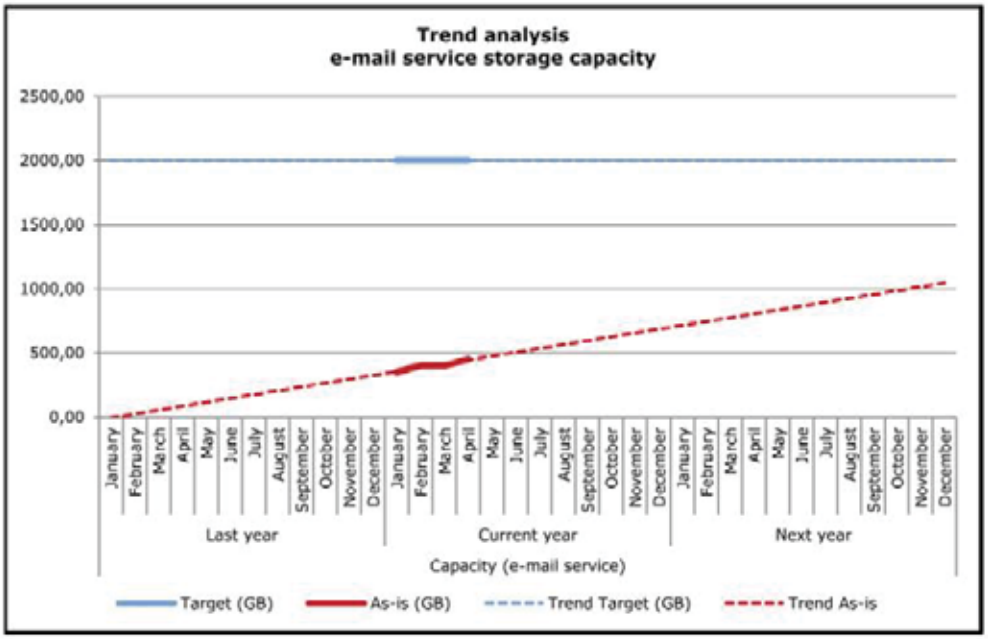


Figure 41: Capacity Plan / Report, p. 4

3 Threats

3.1 Past and actual threats

3.1.1 Events

Identification number	Type	Description of event	Affected services and/or configuration items
Example	Exam-ple	Example	Example

3.1.2 Incidents

KPI Number of occurred incidents in April: **0**

Percentage change to March: **+/- 0%**

Identification number	Type	Symptomes	Countermeasures	Affected services and/or configuration items
Example	Exam-ple	Example	Example	Example

3.1.3 Problems

KPI Number of resolved problems in April: **0**

Percentage change to March: **+/- 0%**

Identification number	Type	Related incidents	Reasons	Countermeasures
Example	Exam-ple	Example	Example	Example

3.2 Future threats

Affected services and/or configuration items	Period		Assumptions
	Dates	Times	
Example	00.00.0000 – 00.00.0000	00:00 – 00:00	Example

Figure 42: Capacity Plan / Report, p. 5

4 Capacity-related measures

Measure	Affected services and/or configuration items	Availability (%)		Due-date		Responsibility	Status
		As-is	Target	Date	Time		
Example	Example	000,00	000,00	00.00.0000	00:00	Example	Example

Figure 43: Capacity Plan/Report, p. 6

Glossary

Anonymous: Global operating group of people with national branches which protest against plans and actions of worldwide governments constraining privacy-related issues by attacks in cyberspace.

Benchmark: Approach to compare oneself to others regarding a certain purpose by using different methods.

Business: Purpose of a certain organization.

Customer: User in an organization.

External IT Service Provider: Legally independent IT organization providing services to at least one organization.

Function: Decided spot within an (IT) organization executing specific tasks.

Internal IT Service Provider: Legally dependent IT organization which provides services to only one unit within an organization.

IT organization: Organization with a specialization on IT and the intention to provide services to one or more organizations; external or internal IT Service Provider or IT shared service provider.

IT shared service provider: (Usually) legal dependent IT organization which provides services to at least two units within an organization.

Organization: Any private or public corporation with profit or nonprofit intentions.

Process: Structured set of specific tasks with a defined input and output.

Service Catalogue: Detailed catalog of all currently offered services to a certain customer.

Wiki: Electronic encyclopedia with a specific purpose.

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