

A Conceptual Framework for the Integration of IT Infrastructure Management, IT Service Management and IT Governance

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Abstract—The definition and use of standardized IT Management techniques and processes provide the basis for IT Service Management and IT Governance. With the establishment of de facto standard “Best Practice” reference and process models such as the IT Infrastructure Library (ITIL) or Control Objectives for IT and related Technologies (CobiT), an integrated management architecture for the provision of IT-Services built upon standards-based processes and tools becomes feasible. ITIL provides a structured and widely adopted approach to IT Service Management and its processes. ITIL can further be aligned with related standards such as ISO 20000 to manifest IT Service Management practice or CobiT to support IT Governance. However IT Management processes must be developed to align with the existing IT infrastructure and operation and must be modeled around frameworks such as ITIL. This paper illustrates the key IT Management requirements and reviews the current state of the art. A case study highlights the contribution of reference models and management related tools for organizations and presents an integrated management architecture.

Keywords— IT Management, IT Service Management, ITIL.

I. INTRODUCTION

“An IT service [according to ITILv3] is a service provided to one or more customers by an IT service provider. An IT service is based on the use of IT and supports the customer’s business processes. An IT service is made up from a combination of people, processes and technology and should be defined in a Service Level Agreement.” (Iqbal et al, 2007)

IT Services have existed ever since the adoption of IT Systems. However there has been rather limited progress in the standardization of processes for the delivery of IT Services (Chesbrough and Spohrer, 2006;). However, giving the rising costs of IT and the importance of IT in today’s corporations the need for IT Alignment (i.e. the alignment or correspondence between the business goals and the IT requirements), IT Compliance (e.g. Sarbanes Oxley) or the management of IT Services becomes evident (Johannsen & Goeken, 2006; Masak, 2006).

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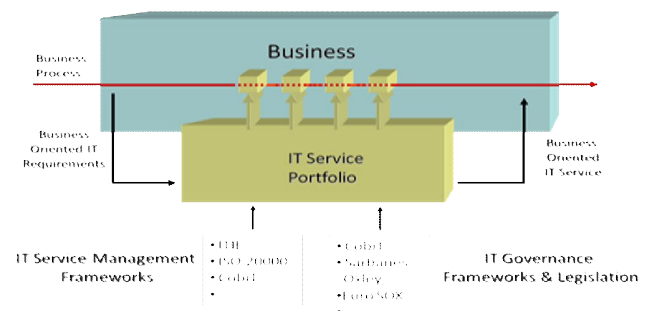


Fig. 1 IT-Service

A number of general key requirements exist that are further complemented by organization specific needs (Bartolini & Salle, 2006, Iqbal et. Al, 2007; Schwartz et al 2007, Zhen & Xin-Yu, 2007):

- Align IT and business strategy;
- Reduce Total Cost of Ownership (TCO) and increase Return On Investment (ROI);
- Comply with Corporate- and IT-Governance regulation (e.g. Sarbanes Oxley 404, Euro-SOX);
- Provide required IT services and standardize IT operations;
- Increase IT Customer satisfaction and productivity.

The paper provides a comprehensive overview of the requirements for integrated IT management and presents the adoption of different reference frameworks and techniques when addressing the key issues for an organization. Section II outlines IT Management requirements and frameworks. It isolates the different IT Management areas and identifies the most relevant corresponding IT Management reference models (ITIL and CobiT) that provide the context of the research. Section III analyses the various IT Management Stakeholders and related research. Section IV discusses the results of a case study. It presents an integrated management architecture and provides recommendations for the provision of management services. Section V gives a conclusion and discusses future work.

II. IT MANAGEMENT REQUIREMENTS & FRAMEWORKS

It is very challenging to fully and precisely establish and evaluate the business impact of IT services (Masak, 2006).

One explanation can be found in the various layers of the IT infrastructure (Server, Client, Operating Systems, networks etc...) that are typically “owned” and managed by different departments of an organization and that there is a rather limited view across the entire IT model of an organization.

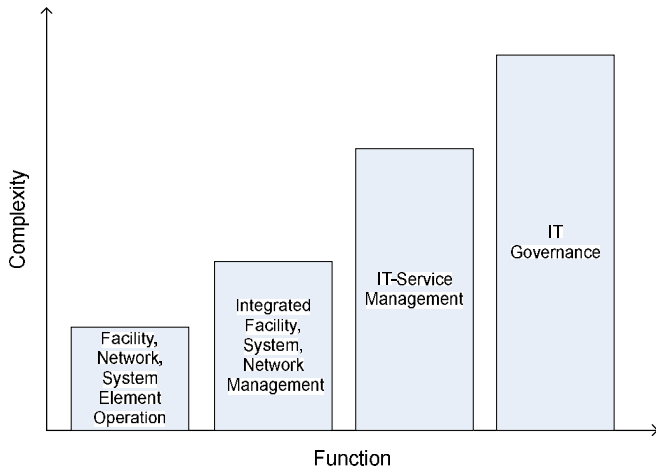


Fig. 2 IT Management Areas

According to ITILv3 “*IT Service Management is the management of all processes that co-operate to ensure the quality of live IT Services, according to the levels of service agreed with the customer*” (Iqbal et al, 2007). Given the fact that the introduction of IT Service Management activities can be regarded as an added overhead to an operational organization, the costs of modeling IT systems, resources, and processes must be kept at a minimum. However meaningful decision support and service improvement will ultimately optimize IT operations and reduce costs (Johannsen & Goeken, 2006; Masak, 2006). One approach is to identify the metrics collected at IT level that impact upon the business level and base the realization of IT Management processes on “Best Practise” process models (Bartolini et al, 2006).

The process approach According to Mackenzie is “basically to employ processes and their frameworks to describe, explain, predict, and alter behavior” (MacKenzie, 2000: 110). The parts of a process framework according to MacKenzie are (i) the set of considerations, (ii) the network defining the linkages between all pairs of considerations and (ii) the set of outcomes or consequences of the process. The process based approach facilitates the understanding and the generation of patterns for IT Service Management in a dynamic business environment.

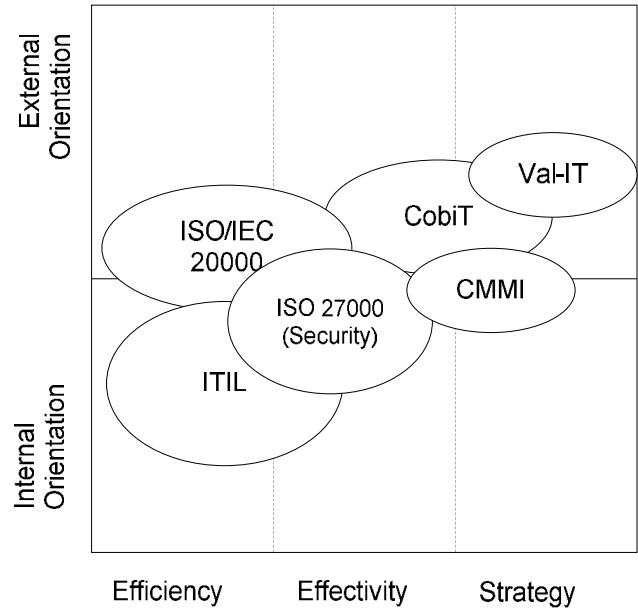


Fig. 3 IT Management Reference Models (Johannsen & Goeken, 2007)

A number of different frameworks for IT Management have been proposed and established in industry practice in recent years (Johannsen & Goeken, 2007). The Information Technology Infrastructure Library (ITIL) is a set of concepts and policies for managing information technology (IT) infrastructure, development and operations. ITIL has originally been developed by United Kingdom's government's Central Computer and Telecommunications Agency (CCTA) project and later by the UK Office of Government Commerce (OGC). ITIL is published in a series of books, the most recent major additions are the 5 books that cover the ITL Version 3 lifecycle model that were published in 2007. Each of the books covers an IT management topic. ITIL provides a description of a number of important IT ‘Best Practices’ with process definitions, role descriptions and realisation guidelines that can be tailored to any IT organization to improve efficiency of the IT-Service provision. Neither organisations themselves nor an IT management system can be certified as “ITIL-compliant” (only individual may seek an ITIL certification). However an organization that has based the provisioning of IT-Services on ITIL is able to seek compliance and achieve certification under the international IT Service Management standard ISO/IEC 20000. Both ISO 20000 and its predecessor BS 15000 build upon established IT Service Management ‘Best Practice’ contained within the ITIL framework. However it can further be applied to earlier IT Service Management frameworks originating in industry such as IBM IT Process Model or Microsoft Operations Framework (that were themselves largely based on ITIL) (Häusler et al, 2008) (Microsoft2008). IT Governance on the other hand is a subset of Corporate Governance focused on IT Compliance, IT Alignment and IT Strategy (Johannsen & Goeken, 2007). Control Objectives for Information and related Technology (CobiT) originates from the Information Systems Audit and Control Association (ISACA) and was subsequently adopted by the IT Governance Institute (ITGI) as a best practices framework for IT

Governance. CobiT provides corporate managers, external auditors and IT users with a set of relevant processes, measures and indicators to facilitate the adoption of appropriate IT governance and control in an organisation (e.g. when seeking compliance with Sarbanes Oxley or Euro SOX related IT Compliance requirements).

ITIL primarily addresses IT efficiency that relates to the effective operation of IT (e.g. measured by a comparison of production with cost as in time and money). On the other hand, CobiT is primarily addressing efficiency and strategy of IT in the context of an organization. Effectivity relates to producing a decided, decisive, or desired effect. Strategy relates to the strategic planning and adaptation (e.g. of structure or behavior) that serves the core function of IT to contribute to desired business outcomes.

TABLE 1
TRADITIONAL IT VERSUS MODERN IT

Traditional IT		Modern IT (ITSM Processes)
Technology focused	matures to	Process focused
„Fire-Fighting“	matures to	Preventive
Reactive	matures to	Proactive
User	matures to	Customer
Centralised or Distributed Ad Hoc In-House Support	matures to	Centralised / Outsourced Support
Isolated IT Siloes	matures to	Holistic IT Architecture
Ad Hoc Processes	matures to	Repeatable, Measurable
Unstructured Processes	matures to	Formal Best-Practise Processes
IT Perspective	matures to	Business Perspective
Functional Orientation	matures to	Business Orientation
IT Goals	matures to	Business Goals

The main idea behind Integrated Network and System Management (INSM), that forms the basis for IT Service Management and IT Governance, is to provide management services that cover the different layers of the service model for networked IT architectures. Although INSM development and operation has received considerable attention in research and industry, it is an area that is currently not well addressed by standards, implementations and design guidelines (Lewis, 2003; Pras, 2007). However it has received increased attention over the last few years, partly caused by the arising management challenges and the funding opportunities from new research led initiatives (e.g. the FP7 programme in Europe). In the area of Network Management, the IETF management related standards (e.g. SNMPv1-SNMPv3, NETCONF) focus primarily on TCP/IP related management provision, the TMN family of standards focusing primarily on telecommunications networks (Pavlou, 2007). System management is commonly encountered on an application specific basis given that related methodologies and approaches for the management of distributed services are still at the development stage (e.g. license and performance monitoring).

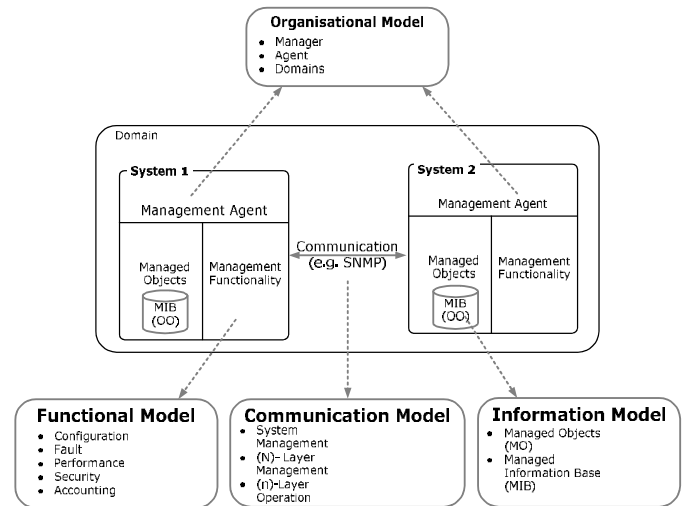


Fig. 4 Functional, Communication and Information Model

Current research and developments aim to further provide guidance on how Management Systems can be planned and developed within their architectural frameworks and how to integrate different Functional, Communication and Information models (Pras, 2007). A novel management system should further combine this with an appropriate planning and operation strategy for the provision of IT Services and IT-Alignment (Masak, 2006). However the heterogeneity of today’s communication infrastructures and services in which Management must be performed means that a common and accepted architecture for the provision of Integrated Network and System Management is currently not available (Lewis, 2003; Pavlou, 2007).

The integration of Network and System Management and of the various management technologies and applications is an issue that has not been resolved satisfactorily (Lewis, 2003; Pavlou, 2007, Pras, 2007). The integration of management services is becoming increasingly critical because of new services and resources in networked systems and because of the diversity of management architectures. One challenge is at which level integration should take place (e.g. at the management tool level), what should be integrated (e.g. user interface, events or data) and what the integration interface should look like. Integration is an extremely important issue. Until now, only partial solutions based on the Management Platform approach such as HP OpenView have been available. The Management Platform acts as a management middleware between the networked resources and services and the specialised management applications. The lack of integration of management services for existing IT infrastructures results in higher costs and personnel requirements. It is not only a system or technology oriented problem but also an organisational problem.

III. IT MANAGEMENT STAKEHOLDER AND RELATED RESEARCH

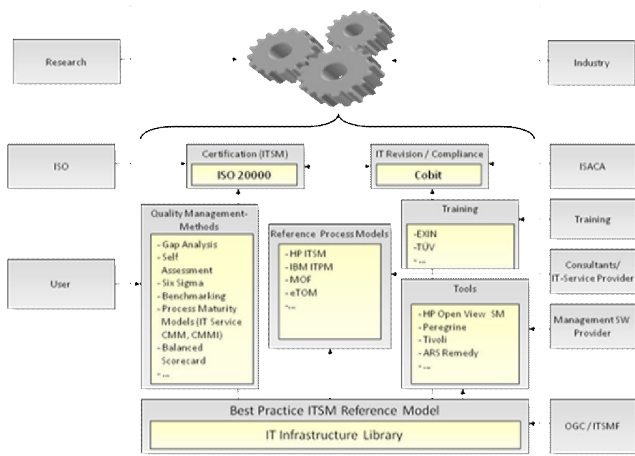


Fig. 5 IT Management Stakeholder

The area of ITSM and ITIL have received significant attention in industry and academia in recent years. However little scholarly work exists on this topic. Chesbrough and Spohrer (2006) indicate that "...in services there is no academic community of scholars that shares a common mission to understand the roots of this arena of economic activity, or how to advance it. Granted, services subfields are emerging in separate, siloed academic areas such as management, engineering, and computer science schools, but precious few attempts to integrate them have been undertaken... Through developing common terminology and methods that increase our insight into the services domain, we can reconnect universities to the dominant economic activities of the larger society that supports them." Reasons for this are the relative newness of widespread interest in areas such as IT Service Management (even though ITIL and other Best Practice Frameworks have been around for the last 2 decades) or the perceived focus on industrial, productive IT operations of existing technologies rather than the development of new technologies.

Another interesting area of research is the requirements specific adoption and configuration of IT Service Management and IT Governance Models. Goeken and Alter (2008) refer to this strategy as "situational method engineering" to provide methodological support for model adoption and configuration as models such as CobiT or ITIL are rarely implemented in their entirety.

According to the Gartner Hype Cycles for Higher Education for the years 2006-2008, CobiT has remained in the first phase of the Hype Cycle (i.e. the "technology trigger" or breakthrough, the product launch or other event that generates significant press and interest). On the other hand ITIL remained at the "Peak of Inflated Expectations" (i.e. the next phase, when a frenzy of publicity typically generates over-enthusiasm and unrealistic expectations; there may be some

successful applications of a technology or concepts, but there are typically more failures).

TABLE II
ITSM / INCIDENT MANAGEMENT IN HIGHER EDUCATION (SEE ALSO (WILD, 2008) AND (HANNEMACHER, 2008))

	Eidgenössische Technische Hochschule Zürich (Switzerland)	Freie Universität Berlin (Germany)	Katholieke Universiteit Leuven (Belgium)	Universität Basel (Switzerland)
General				
Number Staff /Students	8.000 / 12.000	? / 35.000	8.100 / 30.000	5.000 / 9.750
Number Calls/Year(2005)	18.000	Unknown	10.000	Unknown
First Level				
Opening Times	8-18 (Mo-Fr)	8-20 (Mo-Fr) 8-14 (Sa)	9-18 (Mo-Sa)	9-11:30/14-16:30 (Mo-Fr)
Single Point of Contact	No	No	No (planned)	No
Support Channels	Telephone, E-Mail, Counter	Telephone, E-Mail, Berater bei PC-Pools	Telephone, E-Mail, Counter, IT Support	Telephone, E-Mail
Students as Help Desk Staff	Discontinued	Yes	Yes	No HD
2nd/3rd-Level				
Direct Access to 2nd/3rd-Level	Yes (gewünscht)	Yes	Yes	Yes
Organisation				
Fixer Incident owner	No	Helpdesk	No	No
Adoption Ticket-System	Entire central IT	Part of central IT	Part of central IT	No Ticket System
Qualitätsmanagement / Kundenzufriedenheit				
Formalised QM Process	Yes	No	No	No
Review / Analysis Tickets	Initial	Initial	Initial	Kein TS
Monitoring of Support-Availability	No	No	No	No
Tools				
Ticket-System	Yes (ITIL Certified)	Yes (multiple Ticket-Request Tracker)	Yes (OTRS)	No
Solution Database	Yes	Yes	Yes	Unknown
Configuration Mgmt DB	No	No	No	No

Wild (2008), Wan (2008) and Hannemacher (2008) further point out that IT Management (e.g. based on ITIL) is gaining momentum not only in industry but also in Higher Education and can improve the delivery, planning and control of IT services. However they further suggest, that the implicit complexity (e.g. regarding organisational change) remains a key issue that must be addressed in ongoing implementations and that key processes and functions (e.g. Incident Management or Service Desk) are the primary focus (see also

Table).

IV. INTEGRATED MANAGEMENT CASE STUDY

The case study at the University of Applied Sciences Furtwangen further illustrates the adaptation of „Best Practice“ Frameworks and illustrates the challenges and opportunities for holistic IT Management.

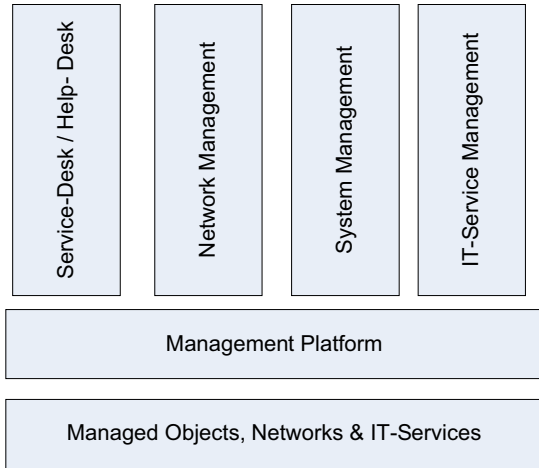


Fig. 6 Integration of Management Tools & Processes

A number of tools and processes are currently in place for Integrated Facility, Network and System Management. To facilitate the provision of structured and repeatable processes, the various tools can be integrated (e.g. based on HP BTO Service Management and Network Management Product Centers as illustrated in Fig. 7). The core IT operational processes can be modeled and implemented by this architecture based on ITILv3 recommendation.

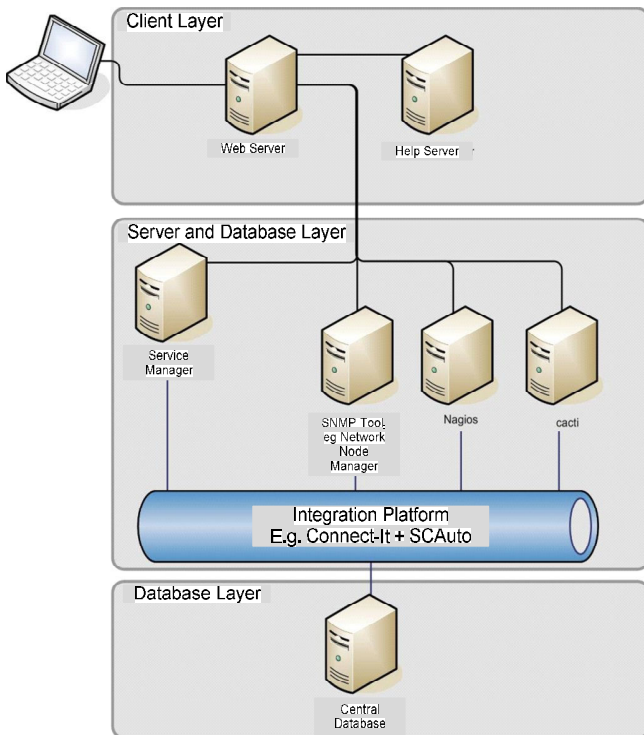


Fig. 7 Management Layers

The introduction of standardised IT process activities based on ITIL is seen as the fundamental underlying activity for the provision of IT Services and provides the basis for IT

Governance related activities (e.g. IT Alignment). This is particularly crucial to clarify and structure the planning, introduction and delivery of IT Services in a distributed and historically grown IT organization (e.g. centralized IT Services versus Faculty based IT Services). Hence the introduction and usage of IT Service Management with Service Level Agreements (SLAs) and Key Performance Indicators (KPIs) is crucial for achieving success in IT Service support and delivery.

Following an analysis of the current situation with the key stakeholders, the following ITILv3 processes and functions were identified for the 1st phase of the ITSM rollout (see also Fig. 8):

- Service Strategy: Service Portfolio Management;
- Service Design: Service Catalogue Management, Service Level Management, Availability Management, Security Management;
- Service Transition: Configuration Management;
- Service Operation: Incident Management, Service Desk, Problem Management.

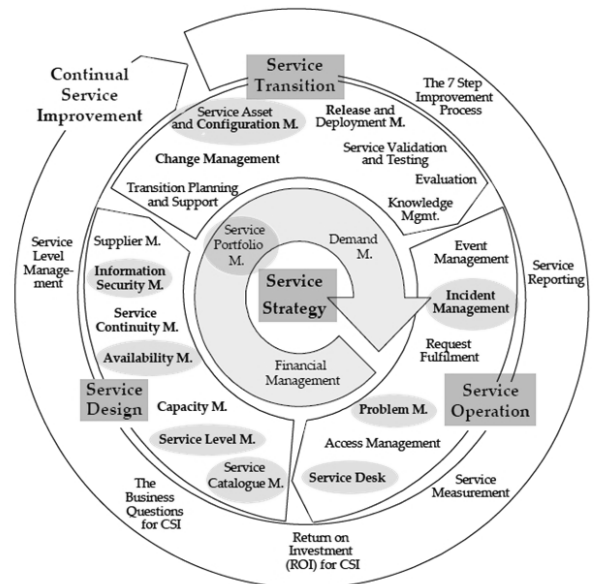


Fig. 8 ITILv3 Processes for Campus Solution

Among those processes, the Service Desk has been identified as a key function. The Service Desk plays a central role in the realization of integrated IT Management as defined by ITIL. The Service Desk provides a Single Point of Contact (SPOC) for the interaction with users of IT services to satisfy both customer (i.e. the entity paying for the usage of IT services) and IT provider (i.e. the entity providing the IT Services) objectives. Furthermore the Incident Management process has been identified as the crucial ITIL process to facilitate communication between the IT user and the IT provider that is represented through the Help Desk.

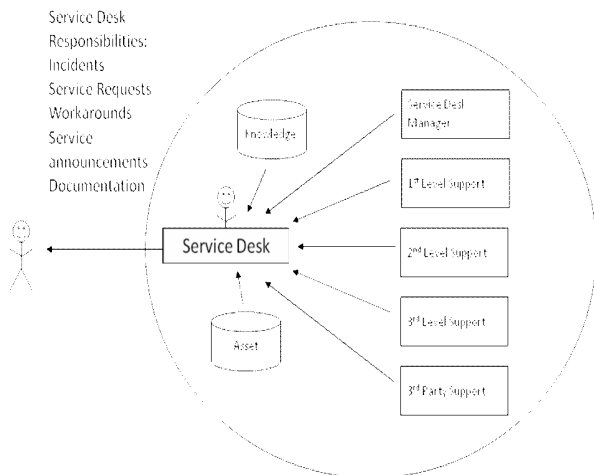


Fig. 9 ITIL conform Service Desk

Although ITIL contains basic process and role description for the ITSM processes such as Incident Management, it must be adapted to the concrete IT organization. Thus the theoretical framework must be adapted to the organizational complexity and the different stakeholders as illustrated in Fig. 10.

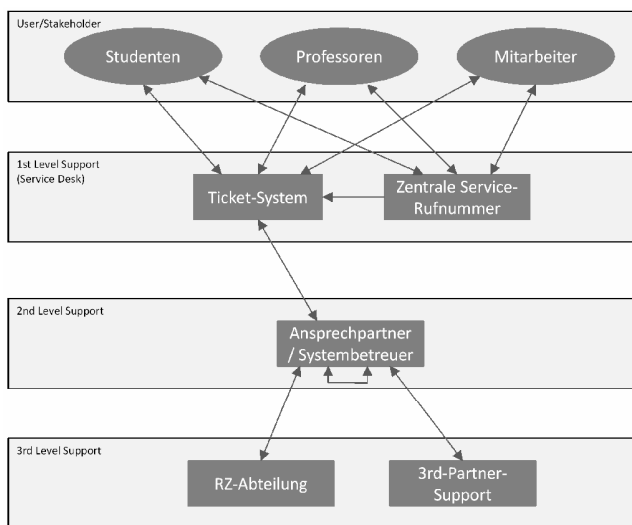


Fig. 10 ITIL conform Support Hierarchy

The investigation further highlights the need to align the IT Infrastructure and Service Management with IT Governance. CobiT provides a widely used framework for IT Governance and defines the IT Control Objectives. These objectives (e.g. Control Objectives for Availability and Capacity Management) can then be mapped to ITIL processes to define a standardized and structured realization of core governance activities.

V. CONCLUSION

The growing complexity and dependency on IT together with growing pressures on IT budgets dictate the use of industry and research best practices to support internal and external IT Service providers to manage their IT as a business.

However, “Best Practice” Reference Models such as ITIL or CobiT require careful analysis and adaptation when used in a real-world context.

Based on the IT Management theory and the realities of organizations, this paper proposed an integrated management architecture. Further management tool adoption and integration together with the introduction of related, “Best-Practice” processes will further support IT Management to facilitate IT Service Management and IT Governance.

Future work will further consider additions to the proposed IT Management model and recommendations that reflect the IT evolution to accommodate additional recommendations, processes and tools provided by industry and research.

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